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TECHNICAL ANNEX

MULTIANNUAL PROGRAMME
OF THE JOINT RESEARCH CENTRE
1980 - 1983

(presented by the Commission to the Council)

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A. NUCLEAR SAFETY AND THE FUEL CYCLE

A.1. REACTOR SAFETY

A.1. Reactor Safety

The expanding electrical energy needs in the Community can be met in the greater part only by an increase in the number of nuclear power plants. This, together with the increased sensibility of the public feeling towards the safety aspects of nuclear power installations, and its reflection on the licensing process, has been the most general motivation for a continuous increase of the Reactor Safety R&D activity in the JRC during this period. The present programme involves activities in the field of Light Water Reactors (LWR) and Liquid Metal Cooled Fast Breeders (LMFBR) Safety.

The major accident to be considered in a Light Water Reactor is a severe loss of coolant due to the rupture of the primary circuit and the consequent blowdown. Questions to be answered in this area are: What degradation of cooling does the core have to tolerate and what is the consequent behaviour of the cladding temperature? Does the emergency core cooling system (ECCS) provide sufficient compensatory cooling or does the ECCS water fail to enter the core? How does the rupture size and position and the response of the primary circuit affect the answer to these questions? In the case of imaginary ECCS failure and wide-spread core melting, what would be the behaviour of the core melt?

The Ispra contribution to this problem is centered around two main features: the Super-Sara Project and the Loop Blowdown Project (LOBI). The Super-Sara project is an in-pile experiment based on special facilities built in the ESSOR reactor by the Italian government and put at the free disposal of the Community. The Lobi project is an out-of-pile experiment based on an important test facility built by the JRC in the frame of a Euratom-BMFT contract. These two outstanding experiments are backed up by theoretical studies in the field of blowdown codes and general reliability assessments. A small effort will be devoted to the ATWS (Anticipated Transient Without Scram) towards the end of the four years plan.

In LMFBR Safety one important area is the study of the hypothetical event of the compaction of the core - or part of it - which might lead to an increase of reactivity above the prompt critical state, the initiation of an uncontrollable nuclear excursion and the generation of an explosive energy release. Initiating events for such a core disruptive accident might be:

Fault conditions in a subassembly, Loss of Flow (LOF) or Transient Overpower (TOP) without scram. The chain of events to be investigated includes: the loss of heat transfer in subassemblies leading to fuel pin rupture, the wide-spread subassembly damage and fuel melting with consequent fuel coolant interaction, the fuel compaction and prompt critical excursion, the explosive loading of the reactor vessel, the post accident heat removal and the control of molten core debris.

For Fast Breeder Reactors, the JRC is concentrating on the response of structures in incidental conditions and on the behaviour of the core in melt-down occurrences. A major contribution to these problems is the so-called Pahr (Post Accident Heat Removal) experiment which would be performed in an out-of-pile installation at Ispra, while

the in-pile aspects would be investigated by Sandia (USA) under a co-operation arrangement. In parallel, a limited effort will be devoted in the first phase to the definition of a large European in-pile experiment, the subsequent realization of which will be the subject of a specific decision during the course of the programme. This decision will be taken only on the basis of a favourable opinion of the relevant Advisory Committee for Programme Management and of the General Advisory Committee. These opinions should be available before the end of 1981. Theoretical studies will cover mainly the EAC code (European Accident Code) sponsored by the "Safety Working Group of the European Fast Reactor Coordinating Committee".

LWR LOCA STUDIES WITH LOBI

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : LOBI

1. Description

The LOBI project has been running since 1974 in the framework of an R&D contract between the CEC and the BMFT-Bonn. The integral system LOCA studies with the LOBI facility are aiming at the experimental investigation of the thermohydraulic behaviour of a PWR primary cooling system during the high pressure or blowdown period of a hypothetical LOCA caused by a tube rupture within the primary cooling system.

Besides the LOBI project in Europe, there are three similar projects running in the world: Semiscale and LOFT in the USA and ROSA in Japan.

With respect to size in terms of the scaling down factor from a real PWR, LOBI (712) ranges between the Semiscale (2000) and the LOFT (50), with 5.5 MW heating power input to a 64 heater rod bundle.

The distinguishing features of LOBI are two active loops designed placing great emphasis on simulation requirements, and a more comprehensive and systematic measurement instrumentation system.

2. Activities

During the next pluriannual programme the main experimental test programme will be performed, subdivided into three parts: A1, A2 and B. The programme parts A1 and A2 (BMFT programme) are concerned with the investigation of the influence of break size and location, pumps operation conditions, initial power, power input time function, strength of primary heat sink, downcomer resistance and volume, ECC (emergency core cooling) water injection location and quantity.

The programme part B (Community programme) is aiming at the investigation of the influence of the geometrical shape and the elevation of individual system components on the blowdown.

3. External collaborations

Belgium : Tractionel
Denmark : RISO
France : CEA, CEN-Grenoble, Framatome
Germany : GRS, KWU
G.B. : UKAEA-SRD, UKAEA-Harwell, NII
Italy : CNEN, CISE
USA : USNRC, EG & G - Idaho Inc.
Canada : Westinghouse Canada Ltd. (WCL), Atomic Energy of Canada Ltd. (AECL)

4. Planning

	1980	1981	1982	1983
LOBI project	1	2	3	
	4	5		

- 1 Continuation and completion of tests according to experimental programme A 1 (German test matrix, results exclusively available to the BMFT-Bonn)
- 2 Start of tests according to experimental programme A 2 (German test matrix including Community proposals, results available to Community)
- 3 Start of tests according to experimental programme B (Community test matrix, results available to Community)
- 4 Mounting of NMR (Nuclear magnetic resonance) apparatus into LOBI test facility, performance of test measurements
- 5 Mass flow measurements with NMR (Nuclear magnetic resonance) apparatus and evaluations

SUPER SARA TEST PROGRAM

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : Super - SARA

1. Description

The Super- SARA program is an in-pile experiment intended to establish data on rod to rod interactions in fuel rod clusters which may potentially cause the propagation of clad ballooning and rupture in LWR during LOCA and give rise to coherent obstructions to emergency reflooding, and to assess codes which model these interactions.

The experimental loop will accomodate bundles of significantly larger scale (number of rods and length) than PBF (at Idaho) and PHEBUS (at Cadarache) and should allow for a basic interpretation of the rod bundle behaviour which is not foreseen in LOFT (at Idaho).

2. Activities

The large cluster test will be executed in a once-through in pile section of the ESSOR reactor, with 2 m long 36 rod capacity.

The essential features of the facility are:

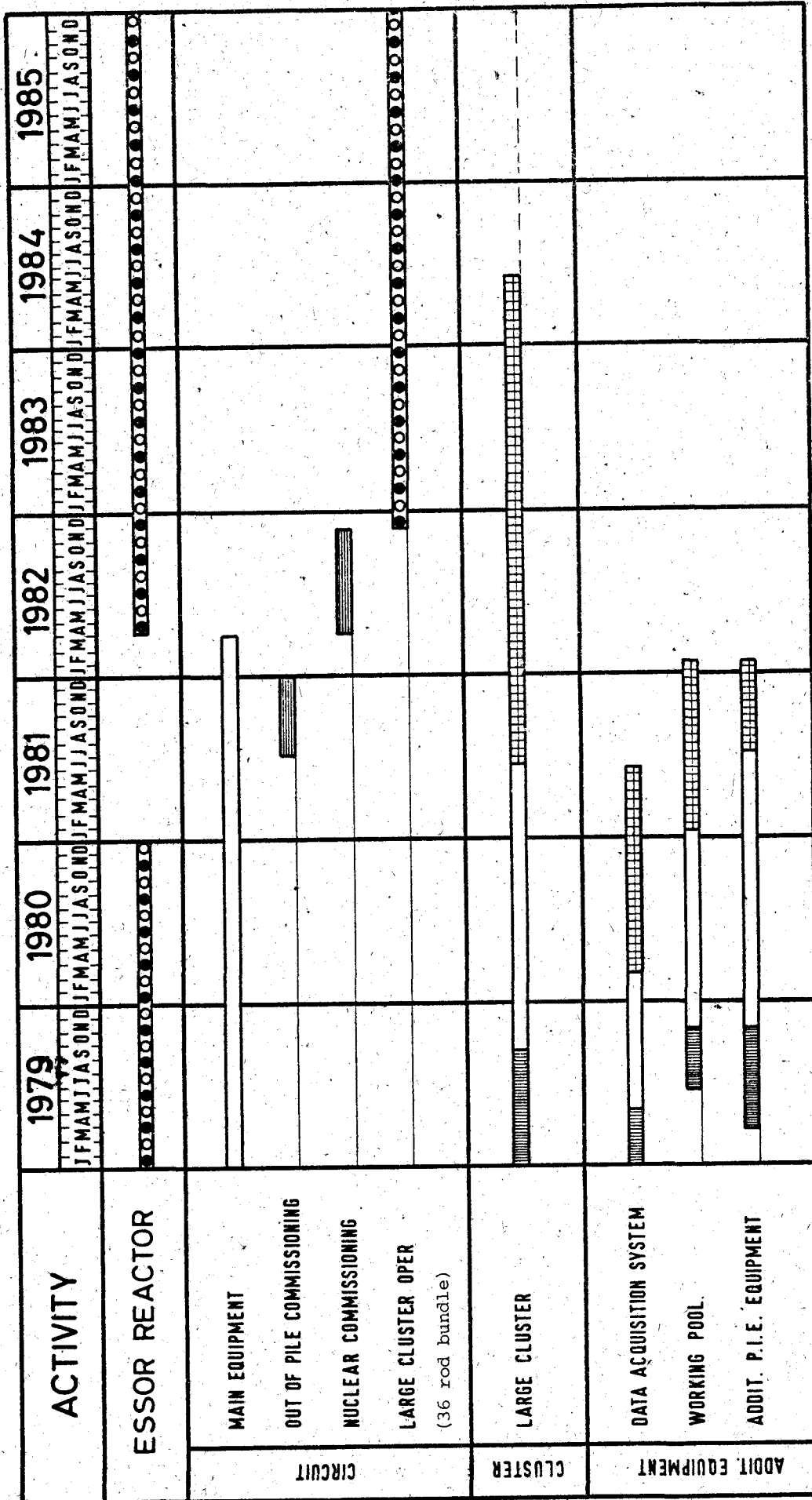
- the simulation of complete LOCA (Blowdown, Refill, Reflood) with wide variability and good control of thermohydraulics history
- the possibility to verify desired LOCA histories in parallel, electrically heated twin bundle.

LOCA tests with 36 rod bundle, employing 17x17 type PWR rods, will be performed starting from end 1982.



3. External collaborations



- US-NRC should provide half of the instrumented test section and supply important technical assistance. It is envisaged that also JAERI and EPRI should contribute financially and supply some technical assistance.
- Active participation of European nuclear industries will be sought.

SUPER SARA - PROGRAMME



 DESIGN
 PROCUREMENT
 MANUFACTURE

 COMMISSION
 OPERATION

 INSTALLATION
 TESTING ASSEMBLY

LWR PRIMARY CIRCUIT INTEGRITY

Area : Nuclear Safety and Fuel Cycle
 Programme : Reactor Safety
 Project : LWR Primary Circuit Integrity

1. Description

The objective of this project is the improvement of the early failure detection of LWR's pressure vessels by improving non destructive testing procedures. Models for the continuous evaluation of structural integrity deterioration are elaborated. A better knowledge of defect distribution, defect detection probability and defect behaviour will allow to improve probabilistic models for the estimation of the reliability of one particular vessel during reactor life, as well as to improve the inspection quality control and in service inspection of reactor vessels.

2. Subprojects*a) Performances of NDT*

The aim of the projects is the characterization of ultrasonic equipments and materials under test, and the analysis of the specification to be imposed for testing procedures. The verification of the performances will require the participation to Round Robin Tests such as the PISC programme. The performance of new techniques like acoustic emission and ultrasonic spectrum and phase analyses will be evaluated.

b) Loads and structural response

One goal is to improve knowledge on the variability of loading. To assess the power plant loading history it is foreseen to supplement the classical probabilistic approach with all information obtained by the operational records of some power plants.

As a second goal, particular attention will be given to the evaluation and experimental verification of residual stresses in welds. Stress distribution in defective zones is necessary for reliability evaluation.

c) Model development and data

The aim is to implement an adaptive model suitable for assessing the reliability of one single pressure vessel and piping system. This model will elaborate data on defects, loading history and material properties of a PV and piping system, together with data coming from in service inspection, for the continuous evaluation of the reliability of the structure.

3. External collaborations

France : CEA, Framatome, EDF, LNE, ECAN, ECN, CETIM, Creusot
 U.K. : UKAEA, CEGB, WI, SRD
 F.R.G. : IZFP, BAM, GRS, KWU, MPA, Mannesmann, KWO, Univ. of Munich,
 Univ. of Stuttgart
 Italy : ENEL, CNEN, CNR, CISE, BREDA, Univ. of Milano
 Belgium : VINCOTTE, COCKERILL
 Denmark : DWI, RISO
 Netherlands : RTD, NERATOM, Univ. of Delft, Rotterdam Nuclear BV
 Finland : VTT
 Spain : Technatom
 Sweden : ERC (Studsvik)
 USA : NBS, USNRC
 International: IIW, ISO, OECD-NEA (CSNI)

4. Planning

Sub-projects	1980	1981	1982	1983
Performance of NDT	1	2	3	4
Loads and structural response		5		
Model development and data		6	7	8

- 1 Results of PISC are available. Definition of/or participation to future round Robbin tests on recommendation of CSNI
- 2 Redefinition of small scale vessel experiments and definition of precise samples for circulation to some specialized laboratory
- 3 Results of ASME XI (procedure analysis)
- 4 Results on samples circulation for new NDT testing
- 5 Input to project C
- 6 Availability of collected data. Reliability of NDT could already result, as first evaluation of PISC and by characterization of ultrasonic equipments. Small scale vessel testing gives available results
- 7 First results from projects a & b available.
- 8 Use of results of study contracts
- 9 Model extended to nozzles and pipings available

LMFBR SUBASSEMBLY THERMOHYDRAULICS

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : LMFBR Subassembly Thermohydraulics

1. Description

The objective of this project is the physical and mathematical modelling of thermohydraulic events occurring in subassemblies of LMFBR's in the LOF (loss of coolant flow) and TOP (transient overpower) accidental situations, as well as of the behaviour of subassemblies with failures under steady conditions.

2. Subprojects

a) Code development and validation

This subproject is related to the development and validation of the subchannel computer code THARC for transient thermohydraulic rod bundle analysis for LOF and TOP type situations and of the VELASCO-3D computer code for the steady state thermohydraulic analysis of subassemblies with specific failures.

Experiments carried out with bundles using water as a circulating fluid, serve as experimental support for the above.

b) Sodium boiling studies

The development of computational tools requires the knowledge of sodium boiling characteristics. The main objective is the comparison of boiling characteristics in grid and wire spaced bundles. A supplementary aim is the performance of thermal noise studies in these bundles. This project is the extension of the experiments under way for single channels to bundle geometries (12 electrically heated rods of 8 mm diameter and 500 mm length) with emphasis on two phase pressure drop, dryout mechanism and radial two-phase phenomena. In the analysis use is made of the tools developed under subproject a).

3. External collaborations

A general exchange of information exists with CENG-Grenoble, CEN-Mol, CNEN-Casaccia, ECN Petten, GfK Karlsruhe, UKAEA-Risley, UKAEA-Winfrith. Specific tasks related to development and application of THARC for bundle pump run down experiments and for LOF analysis are carried out in close collaboration with GfK-Karlsruhe, CENG-Grenoble, EdF Paris. A close collaboration exists with CENG-Grenoble with regard to construction of the electrically heated rod assembly for the 12-rod bundle experiment.

The thermal noise investigation in grid and wire spaced bundles will be done in collaboration with the CEA-Centre of Cadarache who will prepare the hardware for the measurements and perform the data analysis.

4. Planning

Sub-projects	1980	1981	1982	1983
Code development and validation	1	2 - 3	4	5 - 6
Sodium boiling studies	7	8	9	9 - 11 - 12

- 1 Modelling of single phase flow redistribution effects in THARC
- 2 Modelling of transient two-phase flow in THARC
- 3 Work on single phase version VELASCO-3D
- 4 Work on boiling version of VELASCO-3D for undisturbed geometries
- 5 Modelling of boiling in VELASCO-3D for subassemblies with faults
- 6 Modelling of melting and relocation of fuel rod materials in THARC
- 7 Boiling experiments in grid spaced bundles.
- 8 Analysis of experiments with grid spaced bundle
- 9 Temperature noise measurements
- 10 Construction of wire spaced bundle
- 11 Boiling experiments in wire spaced bundle
- 12 Analysis of experiments in wire spaced bundle

LMFBR MECHANICAL TESTS

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : LMFBR Mechanical Tests

1. Description

In order to satisfy the need of design rules which take into account the real behaviour of the structural material (LMFBR reactors) the following activities are proposed:

- Study of creep-fatigue interaction and the effect of irradiation on austenitic stainless steel (AISI 316L and AISI 304L);
- Derivation of damage laws by means of which the time dependent damage accumulation in the structure can be calculated;
- Characterization of tensile and fracture toughness properties of materials to be used in the low-cycle fatigue conditions.

2. Subprojects

a) *Constitutive equations*

The aim of the project is to perform creep fatigue tests (strain controlled) under different conditions (temperature, push-pull parameters, geometry of the sample, unnotched specimens) and to develop constitutive equations which describe the macroscopic behaviour of the material from a purely phenomenological point of view, by deterministic evaluation data. The final aim is the introduction of the damage laws experimentally determined in constitutive equations.

b) *Fracture toughness of irradiated stainless steel*

The irradiation programme concerns the evaluation of the degradation of mechanical properties, essentially the fracture toughness characteristics of the stainless steel material when subjected to conditions inherent to LMFBR operation as far as irradiation fluences, temperature levels are concerned.

3. External collaborations

- Politecnico Milano - Istituto Meccanica e Costruzioni macchine
 - CEGB - Research Laboratories - Berkeley
 - UKAEA - Risley Laboratories -
 - CEA (Département Etude Mécaniques et Thermiques) -
 - CNEN - Bologna
 - Welding Institute - London
 - European Group on Fracture
 - F.R.C.C. Working Group Codes and Standards, Activity Group 2 and 3
 - CEA (Cadarache Centre) (irradiation problems)
 - C.S.N.I.
- } EPFM round robin problems

4. Planning

Sub-projects	1980	1981	1982	1983
Constitutive equations	1	2	3	4
Fracture toughness of irradiated stainless steels	1	5	6	7

- 1 Selection and procurement of materials (AISI 316L, AISI 304L)
- 2 Beginning of the creep fatigue interaction tests and the metallurgical characterization
- 3 Results concerning 1st estimation of constitutive laws
- 4 Results concerning 2nd estimation of constructive laws (including damage)
- 5 Beginning of irradiation experiments
- 6 Testing of irradiated specimen
- 7 Result of code development

EUROPEAN ACCIDENT CODE (EAC)

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : EAC

1. Description

Following the advice of the Fast Reactor Coordinating Committee, the JRC has developed during the 1977-1980 program a pilot version of a modular EAC incorporating computer programs (modules) describing the various scenarios of postulated accidents in LMFBR's. The modules are originated at different laboratories including JRC.

Comparative calculations were performed by JRC, representatives of the three national European LMFBR projects, and the US NRC, in order to make comparisons between the various models and various accident scenarios.

It is proposed a continuation and extension of the present programme in order to arrive at a flexible numerical tool which can be extended easily to include new physical phenomena in various scenarios of LMFBR's accidents.

2. Activities

It is proposed:

- 1) the description, maintenance and dissemination of the EAC to provide the member states continuously with an updated version of the code, by preparing a detailed "how to use" manual and by training potential users;
- 2) the assessment of new modules and their implementation into EAC;
- 3) the comparative analysis on bench mark problems such as TOP and LOF.

3. External collaborations

Close collaboration with the three national LMFBR projects through the WAC Group which is one of the subgroups of the Fast Reactor Safety Working Group (FRSWG).

4. Planning

Activities	1980	1981	1982	1983
EAC	1	2	2	2

- 1 Distribution of first version of EAC
- 2 Distribution of updated versions

POST ACCIDENT HEAT REMOVAL

Area : Nuclear safety and fuel cycle
Programme : Reactor safety
Project : PAHR

1. Description

It is intended to describe the transients of particulate bed formation, cooling and possible remelting and also the transients of molten pool formation and its interaction with core catcher structures. For both studies a materials research program is performed in parallel.

2. Subprojects

a) *Particulate bed cooling and its transition to a molten pool*

Theoretical analysis and some basic experiments on particulate bed cooling and its transition to a molten pool.

b) *In pile particulate bed tests*

See separate sheets.

c) *Molten pool cooling and related structures problems*

Development of the CONDIF code for the analysis of LMFBR's core catchers (turbulent regime, thermal interaction of the pool with melting support structures, natural convection in the presence of non-miscible fluids).

In parallel with the code development experiments will be performed (appearance and stability of crusts).

d) *Multipurpose out-of-pile facility*

The validation of molten pool models is planned to be performed in a large fuel melting facility capable to treat 100 Kg of UO_2 . The installation will also be used to perform tests in which the melt is released from the oven in clean conditions and enters in test sections to study problems of freezing, plate erosion, transient thermomechanical loads on catchers as well as problems of FCI i.e. large mass fragmentation, particulate formation and settlement, violent fuel coolant interactions.

e) *Materials properties research*

Materials thermophysical properties will be measured for core melts e.g. viscosity, thermal diffusivity, surface tension, density, etc. Studies on materials compatibility and distribution of fission products will be continued.

3. External collaborations

JRC activities are fully complementary to national ones. Experience shows that in almost all countries efficient collaboration could be established (KfK, UKAEA, CENG, CEN, Mol, are good examples).

PLANNING

sub project	Topic	1980	1981	1982	1983
Particulate bed cooling	1 Extension model for asymptotic particle bed behaviour	_____			
	2 Extension one dimensional transient particle bed model	_____			
	3 Particle bed sodium boiling exp. (contract)	_____			
	4 Parameter- and sensitivity studies	_____			
	5 Development of two dimensional model for transient particle bed behaviour		_____		
Molten pool cooling	6 Code development	_____			
	7 Model development	_____			
	8 Laboratory scale tests	_____			
	9 Assessment of catcher geometries	_____			
Multipurpose out of pile facility	10 Acceptance test 100 Kg facility	_____			
	11 Thermos tests		_____		
	12 FRAGOR tests		_____		
	13 Blokker tests			_____	
	14 Molten-pool tests			_____	
Materials properties research	15 Thermophysical properties	_____			
	16 Compatibility studies	_____			
	17 Distribution of fission products	_____			

IN PILE PAHR

Area : Nuclear safety and fuel cycle
Programme : Reactor safety
Project : In pile PAHR

1. Description

The objective of this action is to participate in performing in-pile particulate bed tests at SANDIA Laboratories. These tests are being performed in the ACRR reactor where power density levels of up to 4 percent of the nominal value can be generated in a particulate bed of about 8 cm diameter.

In these tests the validity of models and codes describing the thermal behaviour of a particulate bed will be investigated.

In addition, a project for further experiments to be executed in a Community reactor will be defined in a first phase, using the results of a feasibility study, which will be completed in 1979 and implemented by experimental activities (materials sorting, instrumentation, etc.). This will allow the precise definition of a case for the experiment, which will be submitted to the relevant Advisory Committee on Programme Management and to the General Advisory Committee. The decision to carry out the second phase, subject to favourable opinions, should be taken at the end of 1981. The tests will be designed to be complementary to the SANDIA-D series of experiments.

2. Activities

The attached table shows the parameter matrix of 19 experiments of the SANDIA programme, three of them have already been performed.

JRC will participate in performing those experiments and also participate in preshot and post-experiment theoretical studies.

An efficient consultant and results dissemination systems will be set up. The first phase of the European programme consists in designing the in-pile capsule in all its details and performing some out-of-pile back-up experiments. The second phase will take account of the results obtained during the SANDIA tests.

3. External collaborations

All ECC member countries have expressed strong interest in participating in this programme and will efficiently collaborate.

4. Planning

Topic

SANDIA : two tests per year of the programme outlined in the table.

European project : Execution of study in 1980 and 1981
 End 1981 decision on execution of the programme

Table 1 : In-pile debris bed experiment parameter matrix

ACRR (DECAY POWER > 4 Percent)

UO ₂ bed loading	Pre-upgrade power 100μ-1000μ particles	Added bed temps. UT's, 100μ- 1000μ particles	Extended dryout (crucible)	UO ₂ Fines added to 100μ- 1000μ particles	Settled bed	Steel particles & UO ₂ fines added to 100μ- 1000μ particles	Contaminated sodium	Molten UO ₂ into liq. Na-settled bed
300 Kg/m ²	D-1				D-8	D-11		D-16
450 Kg/m ²		D-4		D-7 D-14	D-9		D-14	D-18 Add steel
600 Kg/m ²	D-2		D-5		D-6	D-12	(D-15)	D-17
750 Kg/m ²			D-13	(D-10)	D-13			D-19
900 Kg/m ²	D-3							

FUEL COOLANT INTERACTION (FCI)

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : FCI

1. Description

In the present program experimental and theoretical investigations showed that two modes of fuel contact might release large mechanical energy (thermal detonation). The program proposed is aimed at a detailed analysis of this phenomena.

2. Subprojects

a) Research on fuel water stratification

It is proposed to perform theoretical and experimental investigations of the stability of "film boiling" in liquid-liquid systems. Even an empirical based criterion for the onset of instability in a melt-coolant stratified liquid-liquid system, would be of great significance in relation to the necessary initial conditions for large scale energetic events.

b) Basic research on fuel fragmentation by pressure waves

The essential condition for the thermal detonation seems to be the "coarse mix". It is proposed to investigate whether such a mixture can be produced in the free-contacting mode before the interactions start. The fragmentation process will be investigated in the FRAGOR test facility varying the triggering pressure waves in various types of material mixtures at mono and two-phase conditions.

c) FCI-code development

The research work on code development will be focussed on models and codes for LWR's and LMFBR's. Emphasis will be given to the propagation of FCI from a local starting point to a large scale event.

d) Feasibility and relevance study for large out-of-pile simulation experiments

It is suggested to perform a feasibility study for an out of pile large scale simulation experiment to be implemented through an international cooperation.

3. External collaborations

Collaboration is planned to be continued with Universities (T.U. Stuttgart and T.H. Aachen) and research institutions (Grenoble, Karlsruhe and UKAEA).

4. Planning

Sub-project		1980	1981	1982	1983
1	A	_____			
	B	_____			
2	C	_____			
	D	_____			
	E		-----		
	F	_____			
	G		-----		
3	H	_____			
	I	_____			
	J	_____			
4	K	-----			

- A Experiments on stability of stratified liquid-liquid layers
- B Theoretical analysis of stratified layers
- C Contracts
- D & E Experimental studies on fragmentation
- F Modelling of FRAGOR experiment
- G Experiments FRAGOR
- H Code, development describing mild interactions in LMFBR's
- I FCI model and code development for LWR's
- J Comparison of models with experiments and calculations for real case
- K Participation on international collaboration on large scale FCI simulation experiments

CONTAINMENT LOADING AND RESPONSE

Area : Nuclear Safety and Fuel Cycle
Programme : Reactor Safety
Project : CONT

1. Description

The long term goal of this project is to describe all the phenomena involved in containment loading from CDA's with an accuracy which is considered acceptable and balanced. The proposal is designed to complete the present containment and subassembly code development and validation program and to start activities in those research areas where understanding is inadequate.

2. Subprojects

a) 2-D structures loading and response code development and validation

Basic aim is to improve the fidelity of structural and hydrodynamic modelling in the SEURBNUK and EURDYN computer codes developed at JRC, and to validate code predictions by COVA (containment code validation) and COVAS (subassembly code validation) tests.

b) Study of Multifluid, Multiphase Hydrodynamics related to CDA's

The problem is the determination of the mechanical energy release which gives rise to the loading of reactor structures. It is proposed to set up a well coordinated European collaboration to make use of the experience already acquired in the U.S. where the code SIMMER is under active development.

c) Three-D Structure Loading and Response Studies

The activities foreseen are an improvement of the three-dimensional structural analysis capabilities of the existing EURDYN-03 code and development of a 3-D hydrodynamic code.

d) Materials properties research

COVA activities have shown that improvements are needed in the treatment of material and geometric non linearities. Plasticity expressions should be replaced by constitutive laws in which strain rate effects are accounted for and validated by experiments. The change of material properties by radiation induced embrittlement by weldings, by creep and fatigue will be investigated.

A large facility capable to exert loads of up to 3 MN is being built for tests on large specimens made of steel and concrete. Fracture mechanics concepts for brittle and ductile materials will also be included in these studies.

3. External Collaborations

The COVA and COVAS activities have found large consensus in all EEC member countries. An increasing number of analysis from various research institutes and from licensing authorities contribute to validate containment codes using experimental data produced at Ispra, Foulness and Winfrith.

It is expected that this efficient collaboration will continue in the future. Cooperation with the US NRC is considered.

PLANNING

sub project	Topic	1980	1981	1982	1983
2a	a) Improvement of 2-D structural analysis	_____			
	b) Improvement of 2-D hydrodynamic capabilities	_____			
	c) Dynamic plastic buckling			_____	
	d) Continuation of Δp tests	_____			
	e) Execution of structural tests	_____			
2b	a) Select and construct basic hydrodynamic formulation & code	_____			
	b) Calculate simple test cases	_____			
	c) Develop graphics	_____			
	d) Identify and model significant physical processes	_____			
	e) Test models numerically	_____			
	f) Experimental investigation of exchange processes		_____		
	g) Sensitivity studies		_____		
2c	a) Develop 3-D hydrodynamic model	_____			
	b) Interface fluid external structures dev.			_____	
	c) Interface fluid internal structures dev.			_____	
	d) Development of 3-D structural code and related exper.	_____			
	e) Experiments in rigid and flexible models		_____		
2d	a) Tests for COVA analysis	_____			
	b) Tests on specimens of austenitic stainless steels and nimonic alloy irradiated up to 10 d.p.a. in HFR	_____			
	c) Biaxial test on small specimens	_____			
	d) Monoaxial tests on large specimens	_____			
	e) Biaxial tests on large specimens			_____	
	f) Start of tests on materials irradiated up to 30 d.p.a. in HFR				_____
	g) Monoaxial dynamic tests on sub-assembly internals	_____			
	h) Biaxial dynamic tests on subassembly internals			_____	
	i) Monoaxial dynamic tests on plain, reinforced and prestressed concrete		_____		
	k) Biaxial dynamic tests on plain, reinforced and prestressed concrete				_____
	m) Dynamic tests on reinforcing bars and prestressing cables			_____	
	n) Preparation of tests on simple concrete models				_____
	o) Brittle fracture theory and tests	_____			
	p) Elastic plastic dynamic fracture mechanics theory and tests	_____			

RELIABILITY AND RISK EVALUATION

Area : Nuclear Safety and Fuel Cycle
 Programme : Reactor Safety
 Project : Reliability and Risk Evaluation

1. Description

The main problem that the implementation of a probabilistic risk assessment is facing in the representativeness and exhaustiveness of the analysis.

This proposal is intended to exploit as much as possible the information available either on past reactor history or/and on experimental research results in order to validate the risk analysis methodologies.

The inherent differences between LMFBR and LWR risk assessment have been catered for in the proposed activities: whereas for LMFBR attention is focused to the investigation at single physical phenomena taking place during the accident and to the understanding of the accident progression itself, in the case of LWR the activities have been focused on the confirmation of the probability of occurrence of the more risk relevant accident paths through retrospective analysis at plant operation.

2. Subprojects

a) LMFBR Risk assessment

The aim of the proposed activity will be:

- the description of the accident progression (few particular event trees will be taken as a kind of pilot exercise)
- the development and application of few methodologies for the treatment of continuous event responses typical of LMFBR (absence of safety system intervention)
- the analysis of single physical phenomena as approach to the previous item which implies the improvement of R.S.M. techniques.

b) LWR Risk assessment

The LWR Risk assessment project will inevitably be of confirmatory nature and it is articulated in two main actions.

- Study of initiating events and safety function failure, focused on the confirmation of the probability of occurrences of the more severe accidents through the study of nuclear plant power operational records (KWO, Fessenheim, Biblis power plants)
- Consequence analysis of major accidents such as ATWS and LOCA analyzed from the probability point of view, will study the spectrum of consequences.

3. External collaboration

- National research centres and regulatory bodies (CEA, UKAEA, GRS, CNEN, NII)
- Utilities (ENEL, EDF, CEGB, RWE etc.)
- Manufacturers (KWU, Framatome, etc.)
- Outside community organizations (NRC, IEEE, NPROS, EPRI, ASEATOM)

4. Planning

Sub-projects	1980	1981	1982	1983
LMFBR Risk assessment	1	2	3	4
LWR Risk assessment	5	9	6	7 8 10

Event tree construction and development

- 1 Screening of accident description and set up of reference pilot event trees on a reference design
- 2 Set up of preliminary methodology for event tree analysis
- 3 Preliminary analysis of pilot event trees by simple models
- 4 Analysis of pilot event trees by improved methods

Initiating events and system failure retrospective analysis

- 5 KWO power plant
- 6 Fessenheim power plant
- 7 Biblis power plant

Consequence analysis of major accident

- 8 Analysis completed for LOCA and ATWS

RSM and sensitivity analysis technique development

- 9 Set up of handbook for sensitivity analysis
- 10 Set up of RSM handbook

SUMMARY TABLE

PROGRAMME : A.1 REACTOR SAFETY

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. LOBI	1393	507	1732	3632	50
2. SUPER-SARA	2195	6991	3737	12923	75
3. LWR primary circuit integrity	382	-	382	764	20
4. LMFBR subassembly thermohydraulics	408	336	128	872	22
5. LMFBR mechanical tests	255	-	179	434	8
6. EAC	51	-	139	190	8
7. PAHR	767	1449	443	2659	38
8. PAHR in-pile	2434	3665	[6709]	[12808]	8
9. FCI	253	-	253	506	5
10. CONT	511	491	380	1382	36
11. Reliability & risk assessment	102	-	408	510	17
TOTAL	8751	13439	14490	36680	287 *
1980	1592	2881	2607	7080	
1981	1565	2473	2207	6245	
1982	3322	3959	4077	11358	
1983	2272	4126	5599	11997	

* Research staff of 207 were allocated to the corresponding programme in the period 1977-1980.

** The figures between brackets represent a provisional sum to be used only after favourable opinions from the relevant Committees.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"REACTOR SAFETY"

ADVICE OF THE ACPM REACTOR SAFETY ON THE
REACTOR SAFETY PROGRAMME PROPOSAL 1980-1983.

In order to comply with the draft request of the GAC, dated 16 November 1978, which has been transmitted through the Director General with letter dated 22 November 1978, the ACPM Reactor Safety met on 12-13 December 1978 and on 30-31 January 1979. Additional relevant information has been provided by the Director for prospective studies in his letter dated 6 December 1978.

The Committee has formulated its opinion in the following sections :

- section i : Introductory considerations
- section ii : Assessment of interest
- section iii : Remaining comments

Section i : Introductory considerations

1. The general approach of this Committee with respect to the 1980-1983 JRC programme is to endeavour to define a coherent Reactor Safety Research programme which, through the diversity and flexibility of its associated projects, represents as a whole a satisfactory use of the capabilities of the JRC for Community needs.
2. In this context, the ACPM Reactor Safety devoted during the meetings of December and January, its attention first to the recognition and confirmation of such Community needs for each of the eleven initial project modules, as proposed and presented by Ispra.
The results of this activity are given in Section ii which for reasons of convenience has been divided into :
 - Part a : Proposals for LWR research
 - Part b : Proposals for FBR research
 - Part c : Proposals of interest for both reactor types.
3. The technical/scientific recommendations of its ad hoc working groups have been available to this Committee for most of the project proposals, with the exception of SARA (module 4). This proposal was however considered by a group of experts convened by the JRC specifically for this purpose.
4. The ACPM supports the main objective of the Ispra Safety Research programme to contribute to an improved understanding and quantification of existing safety margins of commercial LWRs and to a further optimization of LWR and LMFBR reactor safety technology. The Ispra Safety Research programme, because of its limited resources, can obviously only provide partial answers to relevant safety questions in a few selected areas.

The Ispra contributions can, however, gain specific importance by careful coordination with the Indirect Action of the Commission on one hand, and national programmes of Community members on the other hand. The ACPM feels that the proposed topics within the Safety Research programme, with the indicated priorities, are properly chosen in this context, and recommends to proceed in this direction when further experimental and analytical details of the projects have to be defined. Past experience has shown that the joint contributions from experts from member states to project definition with ad hoc working groups can have, beyond the improvement of the efficiency of the projects, a strong integrating effect on safety activities within the Community. Since the world-wide cooperation in the nuclear safety field is quite active, the Ispra programme should also continue to take into account safety research work outside Europe.

Section ii : Part a : Proposals for LWR research

(modules 1, 4, 5, 10)

Module 1 : LWR loss of coolant accidents

LOBI (part a is funded by Germany,
part b is Community funded).

The objective of the project is to investigate the PWR loop influence on hydraulic phenomena within the primary coolant system and especially on core heat transfer during blowdown and to provide experimental results for the assessment of relevant best estimate codes.

The project has been discussed within the present pluri-annual programme in detail by the ACPM Reactor Safety and its ad hoc working group on the LOBI programme part b. That has given substantial guidance to the proposal of the Commission.

The Committee confirms the strong interest it has expressed earlier in the project and asks Ispra to make available the manpower necessary for the optimal execution of the experiments and of the analysis of the results.

Module 4 : Investigation of PWR fuel rod cluster behaviour
in simulated LOCA histories in the ESSOR reactor
(SUPER SARA)

The ultimate mission is to establish data on rod to rod interactions which might occur in fuel bundles during a LOCA and to assess codes which model rod to rod interaction. The safety issue addressed is pin failure propagation and/or coherent obstruction to emergency core cooling.

The Committee believes that there is not at the present time sufficient hard information available to be sure that this is in fact a real problem. They do however recognize that the characteristics of SUPER SARA would be more representative than other experiments in this area, and this is demonstrated by the interest shown by American and Japanese organizations.

The Committee notes that for the SUPER SARA programme the major part of a possible return on investment will come after the period covered by the next multiannual programme. The Committee points out the risk that the benefits of this work may decrease as the result of other work which will produce results during this period. In view of this, the Committee doubts whether the eventual return on investment will be adequate and will confirm the scientific justification for such a large undertaking.

The Committee is also concerned at the possibility that the SUPER SARA proposal will consume all of the current flexibility of the JRC Reactor Safety programme.

A particular concern is the additional burden that would be imposed on instrumentation specialists who are urgently needed for the successful execution of other projects.

Based upon available evidence, the Committee, with the exception of Italy, expresses a cautious low degree of interest in the execution of the SUPER SARA proposal.

Although the proposal is assigned low priority in comparison with other JRC projects, the interest of the Committee could be increased by sufficient additional financial support from other countries.

The Italian delegation thinks that the SUPER SARA project is complementary to the LOFT programme now in progress in the USA and may be of considerable help to the licensing authorities for the evaluation of the safety margins existing in the present regulatory process of nuclear power plants.

Module 5 : Experiments on transients related to LWRs

The Committee, with the assistance of its ad hoc working group, supports the effort required for the proposed feasibility study.

The Committee recommends that there should be a continuing contact and guidance of this project by the ad hoc working group, in considering a possible experimental programme on transients in LWRs.

Module 10 : LWR primary circuit integrity

Sub-project 1 - Performances of NDT

Characterization of ultrasonic equipment, characterization of the material under test, analysis of the imposed procedure, initiation of new round robin tests.

Sub-project 2 - Loads and structural response

The study of residual stress, of loads and their probabilities, the associated stress distributions and relevant material properties, in order to predict the behaviour of defects.

Sub-project 3 - Model development and data

Aims at the implementation of an adaptive model suitable for assessing the reliability of a reactor pressure vessel and piping system.

The Committee, in accordance with the recommendations of the ad hoc working group, attribute considerable interest to the project as a whole. A reservation regarding project 3 is that no large staff should be involved, as the Committee assume that in view of the general interest expressed, substantial collaboration with on-going national programmes may be expected.

Section ii : Part b : Proposals for LMFBR research

(modules 3, 6, 7, 8, 9)

Module 3 : Post accident heat removal (PAHR)

Sub-project 1 - Particulate bed cooling and its transition to a molten pool, theoretical analysis and basic experiments.

Sub-project 2 - In-pile particulate bed tests, and preparatory work.

Sub-project 3 - Molten pool behaviour, growth and interaction with structural material.

Sub-project 4 - Multipurpose out-of-pile facility for melting 100 kg of UO_2 .

Sub-project 5 - Material studies.

The Committee has been informed by Ispra that the coexistence of this module and project module 2 (FCI) has been foreseen. On the basis of this information, the Committee expresses considerable interest in the proposed project. It endorses the general aim and direction with the following comments :

- a) Concerning sub-project 2, based on the latest information presented, the Committee endorses the need for, and the general aims and direction of, the proposals with the following qualifications :
 - the feasibility study for a European in-pile experiment should be completed. We would expect that the outstanding technical questions will be resolved successfully and we have some confidence that the in-pile experiments can begin during this multiannual programme. We therefore recommend that the required funds be made available.
 - the limited in-pile PAHR proposal involving collaboration with Sandia is regarded as an integral part of the overall task. The proposed European in-pile work is complementary to the American work.
- b) Imperative to the execution of sub-projects 2 and 4 is the successful development of diagnostic instrumentation.
- c) Ispra should, when project approval is granted, proceed along the lines suggested by the relevant expert working group.

Module 6 : Whole core accident (WAC)

Sub-project 1 - Maintenance, description and dissemination of the European accident code (EAC).

Sub-project 2 - Assessment, adaptation and implementation in EAC of new modules.

Sub-project 3 - Comparative analyses.

This project is a logical extension of ongoing work with a long term aim.

The approach is modular and deterministic.

The Committee, encouraged by the positive results of the LOF- and TOP-comparative analyses for a common benchmark problem, approves with considerable interest the proposed continuation of work. The Committee is of the opinion that the critical staff of 8 man/years must be maintained.

Module 7 : LMFBR subassembly thermohydraulics

Sub-project 1 - Code development and validation.

Sub-project 1 is the logical continuation of the development of the computer code THARC and VELASCO 3d, already started in the present programme.

THARC is a transient sub-channel code which includes A.O. boiling incoherence effects. The safety issue addressed is voiding and reactivity effects.

VELASCO aims at 3d stationary flow and temperature fields in rod bundles with structural anomalies. The safety issue addressed is failure propagation in subassemblies.

The Committee expresses considerable interest in code development work enabling the extrapolation of results of boiling experiments in bundles to subassembly and core voiding processes. Code development should aim with priority at the analyses of bundle experiments in Ispra and in national laboratories. The Committee recommends that further close cooperation with ongoing relevant national programmes will be sought.

Sub-project 2 - Sodium boiling studies

An ongoing project which is entering in the experimental phase. The Committee confirms the considerable interest earlier expressed and recommends that the test programme be executed according to plan.

Module 8 : LMFBR mechanical testing and constitutive laws

Sub-project 1 - Constitutive equations.

Sub-project 2 - Fracture toughness of irradiated stainless steels.

The Committee recognizes the need for further activities in the field of LMFBR structural materials. Due to the restricted manpower associated with this project, we support the project suitably modified with the work concentrated on important topics for which the practical application of the results must be assured. Continuous collaboration and consultation with the respective expert working group is strongly recommended.

Module 9 : Containment loading and response

Sub-project 1 - Multifluid, multiphase hydrodynamics related to CDAS.

Sub-project 2 - 3d structure loading and response.

Sub-project 3 - Assessment of COVA and COVAS results and new activities in the field of 2d structure loading and response.

Sub-project 4 - Implementation of fracture mechanics in dynamic structure response.

Sub-project 5 - Material properties research.

The general long-term aim is to describe with sufficient accuracy all relevant phenomena involved in containment loading as a consequence of postulated core disruptive accidents.

Investigations were started years ago with a purely experimental approach. A shift to a more substantial theoretical approach and the development of numerical tools can be discerned in the presented proposal.

Sub-project 1 - It is agreed that some work should be done in this area. It is suggested that a review of existing codes and of physical models should be done before this task is undertaken.

Support is given for the implementation of an existing code rather than the development of a new European code.

Sub-project 2 - There is little support for the coupling of 3d hydrodynamic and structural codes. Priorities are in favour of the completion of the 2d code capabilities and on 3d structural code development.

The work on this project should only be started after work on sub-project 3 has been terminated and after having singled out in an experimental and theoretical study the main problem areas which have to be investigated.

Sub-project 3 - Here the priority is above all in the COVA and COVAS problem areas which were not sufficiently covered in the actual programme and to a somewhat less extent in the improvement of structural analysis capabilities. Low priority is given to the application of statistical techniques to containment codes, and to buckling phenomena.

Sub-project 4 - Substantial interest exists if the work could be limited to medium term goals with due regard to the relevant steady state activities in module 8. There is a preference for studies related to subassembly wrappers.

Sub-project 5 - Research on material properties is considered to be of substantial interest because of its value for all code development and verification studies.

The Committee approves the extension of this study to damaged materials.

The question regarding the preference for study of concrete structures or steel components should be further examined.

In summary the Committee expresses real interest in the project as a whole, and considerable interest in sub-project 3.

Section ii : Part c : Proposals for both LWR/FBR research

(modules 2, 11)

Module 2 : Fuel coolant interaction

Sub-project 1 - Research on fuel water stratification.

Sub-project 2 - Experimental and theoretical studies to validate violent interaction models.

Sub-project 3 - FCI code development.

Sub-project 4 - Study for large out-of-pile simulation experiments.

Although the understanding of FCI has increased largely during the last years, the question of its real role in the safety case still remains open.

The Committee confirms its real interest in the aims and direction of the proposed continuation of work and places sub-projects 2 and 3 at a higher priority than sub-projects 1 and 4.

Module 11 : Reliability and risk assessment

Sub-projects 1 and 2 - LMFBR and LWR reliability and risk assessment.

The Committee supports this work and recommends that the aims of sub-projects 1 and 2 should be to develop the advanced methodologies of risk assessment using the LWR and LMFBR as examples of the application of the methodology.

The ACMP stresses, in particular, the importance of the application of existing advanced methods of past LWR reactor operating experience and expects essential input from this to future code development.

Implementation of the methodology to LMFBRs will depend upon availability of manpower.

Specific reference should be made in this work to the analysis of the in-vessel accident behaviour.

Sub-project 3 - Reliability.

The reliability data bank is considered to be very desirable. This view is tempered only by some doubts concerning the difficulties of implementation of the project. The decision to proceed is therefore subject to the successful completion of the feasibility study. We are hopeful that these difficulties will be overcome. However, if they prove too great for implementation at the proposed level, it would nevertheless be useful to initiate this project with less ambitious goals. Close collaboration with member states is a necessary prerequisite for a successful outcome to the project. The Committee recommends that this module should be continuously monitored by the relevant ad hoc specialist group.

Section iii : Remaining comments

The Committee, referring to its yearly advice to the Council, notes that the manpower situation has not been a very relaxed one since the start of the current multiannual programme. The Committee recommends that any granted extension of project objectives beyond the already compressed capacity of the current programme should be accompanied by the allocation of appropriate resources.

Several more detailed suggestions and viewpoints resulted from the discussions of the JRC proposals in the ad hoc working groups and in the ACPM. The Committee recommends that such suggestions and viewpoints will be taken into account by Ispra when the proper scenario has been selected. The Committee will ask the ad hoc working groups to identify remaining controversial points and to propose a practical technical answer to this Committee.

Proposed Options

If a decision has to be taken, given the available options, the Committee supports option 1 (without SUPER SARA) in preference to option 2 (with SUPER SARA). The Committee would like to point out, however, that the results of its discussion on the different modules would indicate that a review, by the JRC of the options, might produce an option more in line with the Committee's views.

The French delegation has the following specific comments to join to Section iii : remaining comments :

" We agree on the main lines of option 1, except on some points.
We do not agree on option 2, which includes the SUPER SARA project".

The Italian delegation has the following specific comments to join to Section iii : remaining comments :

" The Italian delegation coherent with its position of giving its preference to the action which is of maximum interest for the convalidation of codes and models used in the licensing processes, states its preference for option 2, which includes SUPER SARA".

A.2. PLUTONIUM FUELS AND ACTINIDE RESEARCH

A.2. Plutonium Fuels and Actinide Research

The main orientations of this programme remain fairly constant, since the corresponding work is in the nature of medium-term basic research. It is therefore merely a question of continuity pursued in consultation with the Community's experts.

The part relating to plutonium fuels is broken down into two projects

- the project on utilization limits of plutonium fuels will continue to be concentrated on the study of fast reactor fuel behaviour and, more particularly, advanced fuels. During the new programme, the project will advance from the study of normal operating conditions to that of transient conditions, with the emphasis on the determination of the basic mechanisms of fuel behaviour. The measurement of the vapour tensions of selected nuclear fuels at very high temperature will be continued;
- the second project relates to the study of the safety of the actinide cycle. The intention is to continue experimental and theoretical studies on the formation of actinides in the reactor, on the safe handling of advanced plutonium fuels, including the problem of aerosol formation (risk of fire and contamination), and on some problems raised by the conversion of mixed carbides or nitrides into oxides under controlled conditions;
- the part relating to actinide research forms the third project. The research as such will relate to theoretical and experimental work on crystalline chemistry (preparation and characterization of samples) and on the study of the solid state physical properties which should make possible the establishment and confirmation of a general theory of bonding in solid actinides. This long-term basic research activity will develop in the new programme a component directed towards applications such as, if possible, the use of intermetallic actinide phases as catalyzers and the possibility of producing Californium neutron sources of very special forms.

OPERATION LIMITS OF PLUTONIUM
FUELS

Area : Nuclear Safety and
Fuel Cycle
Programme : Pu-Fuels and Actinide
Research
Project : Operation Limits of
Pu-Fuels

1. Description

This project aims at elucidating and quantitatively describing the consequences of defined normal and off normal operating conditions on some selected fuels.

Research will concern oxides and advanced fuels (mainly carbides). The current swelling investigations will be concluded and fundamental studies on in-pile fission gas diffusion and re-solution in carbides and oxides under steady state and transient conditions will be undertaken; selected power/temperature transient in- and out-of-pile experiments on oxides will contribute to the physical analysis of the fuel response under transients. Vapour pressure determination and PVT data collection by means of laser pulse technique and high-pressure and -temperature autoclave will be continued on FBR fuels, on some fission products and on Na coolant. The possibility of measuring thermophysical properties of molten nuclear material, not obtainable by classical means, should be investigated.

2. Sub-project

- a) Swelling of Advanced Fuels
- b) Oxide Fuel Transients
- c) Equation of State of Nuclear Materials

3. External collaboration

Risø Danish National Laboratories

CEA - Fontenay-aux-Roses

CNRS - Orléans

Kernforschungszentrum Karlsruhe, FR-2

University of Milan, Dept. of Electrochemistry

University of Rome

UKAEA - Harwell

CEGB - Berkeley

4. Planning

Sub-project	1980		1981		1982		1983	
Swelling of Advanced Fuels			1	2		3		4
Oxide Fuel Transients			5		6	7		8
					9			10
Equation of State	11	12	13	14		15		16
Monograph				17				

- 1 Model for interaction between swelling and porosity calibrated with experiments
- 2 Fast flux irradiation programme concluded. P.I.E. on irradiation DN2-bis performed and evaluated with code TPROF. This code will possibly have been coupled with a pellet mechanical code.
- 3 First comparison between micro-kinetics in oxides and carbides. (Interaction between gas atoms bubbles and lattice defects and re-resolution effects, fission gas diffusion coefficient)
- 4 Repartition of fission gas between single gas atoms, clusters, and bubbles. Conditions for bubble migration established
- 5 Transient irradiation testing begins
- 6 Transient testing in cell begins
- 7 First transient fuel behaviour model prepared
- 8 Fuel structure catalogue complete
- 9 First results on correlation of fuel structural changes with transient conditions
- 10 Experiments on volatile fission product microkinetics evaluated
- 11 Vapour pressure of UC up to 6000 K; critical point data of UC (Significant Structure Theory)
- 12 PVT data of Na (Autoclave Technique) up to critical temperature
- 13 Basic evaporation mechanism; gas dynamics theories extended to multiatomic species
- 14 Vapour pressure of (U,Pu)C up to 6000 K
- 15 Vapour pressure of UO₂ up to critical temperature
- 16 PVT data of the main fission products
- 17 Monograph on advanced fuels in print

ACTINIDE CYCLE SAFETY

Area : Nuclear Safety and Fuel Cycle
Programme : Pu-Fuels and Actinide Research
Project : Actinide Cycle Safety

1. Description

This project aims at answering some crucial questions arising from the impact of transuranium elements (mainly of Pu) on the safety of the nuclear fuel cycle. Measurements of actinide formation will be continued by the analysis of irradiated special fuel capsules containing significant amounts of higher actinides. Dust and aerosol formation during fuel fabrication processes, their accidental release and the environmental consequences will be studied; production routes for Pu ceramic fuels which facilitate safe handling and remote (re)fabrication will be investigated. Potential and limits of various reprocessing methods (oxidations) for Pu mixed carbides, as head-end processing will be demonstrated by realistic experiments.

2. Sub-project

- a) Formation of Actinides (FACT)
- b) Safe Handling of Pu Fuel (SHAPE)
- c) Aspects of the Head-end Processing of Carbide Fuel (RECARB)

3. External collaboration

CEA - Cadarache
Kernforschungszentrum Karlsruhe
European Safeguards Research and Development Association (ESARDA)

4. Planning

Sub-project	1980	1981	1982	1983	
FACT	1	2		3	
SHAPE		4	5	6	7
RECARB	8	9	10	11	

- 1 Fabrication of actinide irradiation capsule (pin). Irradiation start.
- 2 Final evaluation of the Isotope Correlation Experiments. Formation of transplutonium elements
- 3 Integral cross sections in characterized fast spectra
- 4 Measurements of dose rates and preliminary measurements of aerosols during 1
- 5 Aerodynamics of aerosols
- 6 Comparison of different fabrication processes and their single steps. Dose rates and aerosol measurements
- 7 Evaluation of contaminated smoke research, deposited aerosols
- 8 Assessment and comparison of different oxidation media and direct dissolution, unirradiated fuels
- 9 Same as 8, irradiated fuels
- 10 Laboratory demonstration of selected head-end procedures
- 11 Proposal for head-end procedure and start on tests with irradiated fuel pin

ACTINIDE RESEARCH

Area : Nuclear Safety and Fuel Cycle

Programme : Pu-Fuels and Actinide Research

Project : Actinide Research

1. Description

This project aims essentially at investigating and understanding the chemical bond in solid actinides with emphasis on intermetallic and single binary compounds of the least known elements in the first half of the series, especially Pa, Np, Am and Cm. Large effort is devoted to the preparation and characterisation of pure samples, often single crystals, which are used for the determination of physical and chemical properties. Experimental solid state physical investigations (crystal and electronic structure, thermodynamics, etc.) are supported and oriented by theoretical models. Application of this knowledge is planned: thus, the catalytic action of actinide intermetallic phases will be studied; likewise the possibilities for new applications of californium sources will be explored.

2. Sub-project

- a) Crystal Chemistry
- b) Solid State Studies
- c) Applied Actinide Research

3. External collaboration

University of Liège, Dept. of Chemistry
 Danish Atomic Energy Commission, Risø
 CEN - Grenoble
 CEN - Strasbourg
 Institut Laue-Langevin, Grenoble
 KFA - Jülich, Festkörperforschung
 Kernforschungszentrum Karlsruhe, FR-2
 University of Parma, Depts. of Chemistry and Physics
 University of Milan, Dept. of Electrochemistry
 AERE - Harwell, Chemistry Division

4. Planning

Sub-project	1980	1981	1982	1983
Crystal chemistry	1	2	3 4	5
Solid State Studies	6	7 8	9	
Applied Actinide Research	10			11
Monograph		12	13	

- 1 Set-up of methods of preparation and characterisation of actinide chalcogenides (possibly pnictides) in different forms
- 2 Preparation of neptunium chalcogenides (possibly pnictides) for physical measurements
- 3 Preparation of protactinium chalcogenides (possibly pnictides) for physical measurements
- 4 Preparation of intermetallic compounds of thorium, neptunium
- 5 Preparation of americium chalcogenides (possibly pnictides) for physical measurements
- 6 High pressure X-ray diffraction of actinide compounds started
- 7 Self-consistent band structure calculations for NaCl structured compounds, dioxides, possibly hydrides of actinides (interpretational tool for physical measurements)
- 8 Energy dependent photoemission (UPS) of plutonium and transplutonium oxides; studies on metals, Lave's phases ($AnAl_2$), NaCl-structured compounds of actinides
- 9 Neutron diffraction studies of neptunium chalcogenides (possibly pnictides)
- 10 Study of thorium metal surface in the presence of adsorbates
- 11 Chemical and physical catalytic studies on light actinide metals and intermetallics
- 12 Completion of monograph on actinides
- 13 Publication of monograph on actinides

SUMMARY TABLE

PROGRAMME : A.2. PLUTONIUM FUELS AND ACTINIDE RESEARCH

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Utilization limits of plutonium fuels	2537	1053	1829	5419	46
2. Safety of the actinide cycle	2052	132	336	2520	39
3. Actinide research	1531	306	126	1963	32
TOTAL	6120	1491	2291	9902	117 *
1980	1401	583	735	2719	
1981	1496	507	878	2881	
1982	1611	262	511	2384	
1983	1612	139	167	1918	

* Research staff of 117 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"PLUTONIUM FUELS AND ACTINIDE RESEARCH"

O P I N I O N

The Committee, during its meetings in Karlsruhe on November 27 - 28, 1978 and February 6 - 7, 1979, has considered the draft programme proposal "Plutonium Fuels and Actinide Research" for the period 1980-83 (TU O2/79). On request of the General Advisory Committee the following opinion has been formulated.

1. The Committee agrees to the general conception

- that promising lines of research of the current programme should be continued,
- that a reasonable balance should exist between the three projects constituting the programme, viz., "Operation Limits of Plutonium Fuels", "Safe Actinide Cycle" and "Actinide Research" and that at least the same potential as in 1977-80 should be available,
- that the broad cooperation with external organizations is continued.

2. As to the sub-projects :

A) Within Project 1 "Operation Limits of Plutonium Fuels"

- The competence achieved in the field of mixed carbides should be maintained, although the swelling project should be phased out around the middle of the programme period. Fundamental studies on fission gas behaviour in carbides should run concurrently with similar investigations on oxides.
- In order to develop physical models for fuel response to power and temperature transients, carefully prepared theoretical and experimental work should be undertaken. Experiments in oxides (at first) should take into account irradiation possibilities as for example the HFR as well as the experience in the field of direct electrical heating experiments available at the Transuranium Institute and be complementary to existing similar activities.

- The corrosion investigation (multiannual programme 1977-80) should be concluded in 1979. A limited activity, restricted to carburization of well-defined clad material, should be considered within the potential allotted to project 1.
- The "Equation of State" activity should continue as before. In addition to the central objectives of vapour pressure determination of laser heated nuclear materials, high-pressure autoclave investigation of alkali metals and the prediction of critical point data, the possibility of determining thermo-physical properties of molten nuclear material, not measurable by classical means, should be investigated.

B) Within Project 2 "Safe Actinide Cycle"

- The basic nuclear and radiochemical activity FACT ("Formation of Actinides") should continue as proposed.
- Within the sub-project "Safe Handling of Plutonium Compounds" (SHAPE), the aerosol research should be increased as proposed. It should draw from the experience existing in the field in general.
- In the context of the carbide competence, head-end procedures for carbide treatment (RECARB) have to be pursued and demonstrated on a laboratory scale with full regard to safety aspects for both dry and wet oxidation procedures.

C) The third Project "Actinide Research" is recognized for its central role within the Community. The basic character of the investigations should be maintained; in addition, a limited study is recommended in the field of heterogenous reactions, for instance catalysis, utilising the knowledge of electronic structure of actinides which has been accumulated in crystal chemistry and solid state studies.

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A.3. SAFETY OF NUCLEAR MATERIALS

A.3. Safety of Nuclear Materials

The nuclear fuel cycle industry give rise to a large inventory of radioactive waste which must be conditioned and disposed of safely. Due to the long half-life of alpha-emitters (actinides) contained in the waste, safety must be assured for time periods extending to over 100,000 years.

The JRC activity on radioactive waste management was initiated in 1973 and reoriented in 1977. These activities are closely related and complementary to the Indirect Action programme in the same field. It is now proposed:

- to conclude in the early part of the programme the studies on chemical separation of actinides from high activity waste and their nuclear transmutation
- and to concentrate efforts on risk evaluation of radioactive waste management, with considerable reorientation of present activities.

The programme is organized into four projects :

Risk evaluation. Unlike current studies, which are limited to disposal in geologic formations, they will extend to the consideration of the hazards arising from the management of waste over the entire fuel cycle. A baseline waste management strategy and different variants will be analyzed and compared in terms of risk/benefit.

Protective barriers against radionuclide migration will study the value of natural and man-made barriers which assure the confinement of radionuclides within the geosphere. It will include the study of the stability of various types of waste conditioning and the continuation of experiments on the interaction of radionuclides with geological media.

The work on actinide separation from high activity wastes will be concluded with the development of criteria for the assessment of a project for a pilot plant. The experimental activity will be carried forward to the problems raised by medium and low-activity wastes in the current fuel cycle operation for the minimization of alpha-contaminated waste.

The application of non-destructive radiometric methods to the monitoring and control of actinides will be continued in the actinide monitoring project.

This programme foresees the use of the hot cells for experiments of more direct application at industrial level. Further, for the decommissioning of the Ispra I reactor, the Director-General, following the opinion of the General Advisory Committee, reserves the possibility of examining this decommissioning with reference to safety requirements and in the light of the actions in this field which will be carried out within the corresponding indirect action.

RISK EVALUATION

Area : Nuclear safety and fuel cycle
 Programme : Safety of nuclear materials
 Project : Risk evaluation

1. Description

In order to obtain a fully operational fuel cycle industry in the European Community, it is of special importance that a final choice be done on the various options proposed for the conditioning, interim storage and ultimate disposal of the various types of wastes.

The objective of this project is to contribute to the solution of the problem

- by developing proper risk analysis methodologies
- by studying what are the dominant risk sources in a complete waste management system (from U-mine to waste repository) assumed as a baseline case
- by identifying and evaluating in terms of cost/benefit several modifications or alternatives to the baseline waste management strategy.

The work will be carried out in close co-operation with the Radioprotection indirect action programme (DG XII).

2. Subprojects*a) Development of risk evaluation methods*

- Probabilistic methods of analysis; the sophistication of the models should be balanced with the uncertainty of the input data
- Simplified methods for comparative evaluation between different options.

*b) Definition and risk evaluation for the baseline waste management strategy**c) Evaluation of modified options*

- Termination of activities on risk/benefit studies of nuclear transmutation of actinides
- Evaluation of alternative management of actinides separated from HAW
- A modified back-end of the cycle tending to minimize the waste arising of the fuel cycle
- Waste disposal into the sea bed

3. External collaborations

Risk analysis of geologic disposal is carried out on a Belgian experimental site (Boom clay formation) in close cooperation with the national Institutes. A cooperation with the laboratories of the indirect action Radioactive Waste Management and Storage (DG XII) is already under way through a working group on risk analysis of geologic disposal of which JRC keeps the secretariat. A cooperation between the Commission and the USA Department of Energy on waste management studies is presently being discussed (both direct and indirect actions). Through DG XII cooperative actions are periodically established with NEA and IAEA.

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4. Planning

Sub-projects	1980	1981	1982	1983
Development of risk evaluation methods				
Evaluation of the baseline waste management strategy	1	2	3	
Evaluation of modified options		4	5	6

- 1 Definition of baseline waste management strategy (BWMS)
- 2 Completion of collection of information related to the BWMS
- 3 Completion of a first evaluation of the BWMS
- 4 Termination of the activities on nuclear transmutation of actinides
- 5 Preliminary definition of flow sheets of other modified options; choice of first priority flow sheets
- 6 Completion of the evaluation of the first priority flow sheet (evaluations should be done basically at the pace of one per year)

PROTECTIVE BARRIERS

Area : Nuclear Safety and Fuel Cycle
Programme : Safety of nuclear materials
Project : Protective Barriers

1. Description

In the concept of a multiple protective barrier against migration to the biosphere of the radioactive waste, disposed in a geological formation, an important role is played by the conditioning of the waste and the capability of retention of radionuclides by the surrounding geological media.

The work, proposed in this project, will produce data concerning the stability of the conditioned waste and the interaction of radionuclides with geological media: these data, required as input for mathematical models are essential for the risk evaluation of geological disposal (see project Risk Evaluation).

This work is a continuation of the activity presently in progress, in co-operation with the corresponding indirect action programme.

2. Subprojects

a) Long-term stability of conditioned waste

This subproject involves:

- Studies on radiation damage and long-term leaching of vitrified waste; in particular solid state physics experiments tending to identify the mechanisms of the radiation damage.
- Development of models and experimental tests on the long-term leaching of various materials to be used for the conditioning of medium and low level waste: concrete, bitumen, thermosetting and thermoplastic resins.

b) Interaction of radionuclides with geological media

This subproject involves:

- Assessment of the physico-chemical form of radionuclides leached-out from conditioned waste
- Study of the retardation of their migration towards the biosphere induced by their interaction with geological media.
- Assessment of the effectiveness of special materials surrounding the disposed waste, to act as artificial barrier against the radionuclides migration.

3. External collaborations

For the subproject a) collaboration will be continued with the laboratories of the indirect action Radioactive Waste Management and Storage (D.G. XII) in the framework of the sheet 5: Properties of substances suitable for high level waste solidification. In this sheet the following laboratories are involved: Marcoule, Harwell, Hahn Meitner Institute, Karlsruhe, Mol. For the subproject b) collaboration will be continued with the laboratories of the indirect action Radioactive Waste Management and Storage (D.G. XII) in the framework of the sheet 7: Long term storage and disposal in geological formations, in particular with the CEN, Mol, on the disposal of radioactive waste in clay formations.

4. Planning

Sub-projects	1980	1981	1982	1983
Long-term stability of conditioned waste		1	2	
Interaction of radionuclides with geological media		3		4

- 1 Termination of the activities on simulated vitrified waste
- 2 Termination of a first set of experiments on low-level conditioned waste
- 3 Termination of the column experiments on interaction of actinides with geological media at low pressure
- 4 Termination of column experiments at high lithostatic pressure

ACTINIDE SEPARATION

Area : Nuclear Safety and Fuel Cycle
Programme : Safety of nuclear materials
Project : Actinide Separation

1. Description

The reduction of the potential long term hazard of radioactive wastes generated by the nuclear fuel cycle has been the objective of the main R and D programmes initiated during the last five years.

To this purpose experimental efforts were devoted by such programmes to investigate the feasibility of actinide separation from wastes.

In the framework of the 1977-1980 programme the feasibility of the chemical separation of actinides from high activity wastes (HAW) was studied at the JRC.

The separation of actinides from HAW was considered as the first stage of an advanced waste management strategy based on continuous recycling of actinides within the fuel cycle.

During the programme 1980-1983 the activity on the chemical separation of actinides from HAW will be completed.

The work will be extended to the separation of actinides from other waste streams from fuel reprocessing, not in view of transmutation of separated actinides but more generally as an optimization of waste management practices.

2. Subprojects

a) Actinide separation from HAW

Three alternative HAW partitioning processes (i.e. OXAL, TBP and HDEHP processes) have been developed at tracer level and are being verified at fully active laboratory scale. The experimental studies and engineering evaluations on the three processes will be completed during 1980.

b) Actinide separation from other reprocessing wastes

The experimental activities will be concentrated on the separation of actinides from:

- cladding hulls
- medium activity liquid waste (highly salted and organic solutions)
- residues from spent fuel dissolutions

Priorities among the various waste streams will be indicated by the Risk Evaluation project.

3. External collaborations

- In the framework of the activity of NEA of OECD on radioactive waste management a leading role has been assigned to the CEC in the field of the chemical separation and nuclear transmutation of actinides.
- A collaboration has been established with CEA - Fontenay-aux-Roses for the HAW partitioning.
- The studies for the separation of actinides from other reprocessing wastes have to be strictly coordinated with studies conducted on related subjects in the framework of the indirect action Radioactive Waste Management and Storage (DG XII).

4. Planning

Sub-projects	1980	1981	1982	1983
Actinide separation from HAW		1		
Actinide separation from other reprocessing wastes		2		3

- 1 Completion of experimental and engineering studies on HAW
- 2 Starting of experimental studies on other Purex wastes (MAW, cladding hulls, residues)
- 3 Termination of first set of experimental activities

ACTINIDE MONITORING

Area : Nuclear Safety and Fuel Cycle
 Programme : Safety of nuclear materials
 Project : Actinide Monitoring

1. Description

The proposed activity is mainly directed to solve problems of Pu monitoring in radioactive waste. The plutonium monitoring in radioactive waste is required for the accountability of plutonium and for the control of nuclear security and radiological safety during the handling and storage of plutonium-bearing wastes.

The plutonium monitoring in radioactive waste requires the development of non-destructive radiometric techniques, based on neutron and gamma measurements.

The present proposal is a continuation of the activities currently in progress at the JRC in close collaboration with national laboratories.

2. Subprojects

a) Interpretational models:

- review of the state of art in the interpretation of radiometric alpha-waste measurements
- edition of technical guides for analysis of alpha-waste monitoring systems.

b) Reference monitors:

- development of reference monitors for alpha-waste streams
- calibration services for routine monitors

c) Integral experiments in nuclear plants:

- evaluation of error statistics
- determination of systematic errors of in-plant monitoring systems

3. External collaborations

Collaboration is particularly important for the execution of integral experiments at the plant level. Such a collaboration was established with the Dounreay Nuclear Power Development Establishment (DNPDE) of UKAEA in the present programme 1977 - 1980.

Collaborative programmes with KFK, Karlsruhe, CEN, Mol and CNEN, Casaccia, are in preparation.

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4. Planning

Sub-projects	1980	1981	1982	1983
Interpretational models		1		
Reference monitors		2		
Integral experiments		3		

- 1 Edition of a revised technical guide on monitoring Pu contaminated solid waste streams
- 2 Advisory laboratory for assessment and calibration services; related to the monitoring of Pu contaminated solids, operational
- 3 Termination of the integral experiment on monitoring of Pu contaminated solid waste at the DNPDE, Dounreay

SUMMARY TABLE

PROGRAMME : A.3. SAFETY OF NUCLEAR MATERIALS

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Risk evaluation	26	-	151	177	14
2. Protective barriers	255	289	127	671	12
3. Actinide separation	445	562	217	1224	15
4. Actinide monitoring	332	212	165	709	11
TOTAL	1058	1063	660	2781	52 *
1980	238	292	176	706	
1981	266	371	161	798	
1982	284	275	169	728	
1983	270	125	154	549	

* Research staff of 62 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT
"MANAGEMENT AND STORAGE OF RADIOACTIVE WASTE"

O P I N I O N

on the JRC proposals for the new programme 1980-1983

In view of the preparation of the pluriannual programme 1980-1983 of the JRC, the General Advisory Committee, during the meeting of November 15-16, 1978, invited all the Advisory Committees for Programme Management to emit an advice on the JRC programme proposals under their competences.

The ACPM Management and Storage of Radioactive Waste has examined, during the meeting held in Brussels on February 1-2, 1979, the JRC proposals for the programme Safety of Nuclear Materials 1980-1983.

The JRC proposals present two options with the following staff numbers (research=staff) :

<u>Projects</u>	<u>Option 1</u>	<u>Option 2</u>
1. Risk Evaluation	14	14
2. Protective Barriers	12	12
3. Actinide Separation	21	15
4. Actinide Monitoring	11	11
5. Reactor Decommissioning	22	-
	<u> </u>	<u> </u>
TOTAL :	<u>80</u>	<u>52</u>

The specific credits proposed for Option 1 and Option 2 are 5.88 and 2.78 MEUA respectively.

The opinion of the ACPM on the JRC proposal is the following :

- The ACPM has expressed its complete agreement on the projects
 1. Risk Evaluation
 2. Protective Barriers
 3. Actinide Separation
 4. Actinide Monitoring

which are of major importance in the field of radioactive waste management and can give an important contribution in the solution of waste management problems in the European Community. These projects are the continuation of present activities on which the ACPM has already expressed its complete agreement.

- For the project Risk Evaluation, the Committee supports the intention of the JRC to continue the application of risk evaluation models on specific sites and to enlarge this activity in order to evaluate comparative risks of alternative waste management strategies.
- For the project Protective Barriers, the Committee considers very important that the techniques set up during the present programme can be exploited in order to get all the possible benefits for the previous activity.

The results of the studies on the Protective Barriers are essential in the assessment of the safety of the geological disposal.

- For the project Actinide Separation, the Committee appreciates the intention of the JRC to apply the competences and apparatus set up for the separation of the actinides from high activity waste (HAW) to problems of actinide separation from other types of wastes with the objective of a reduction of the alpha contaminated wastes.

The Committee considers that the conversion of the existing hot cells system into an experimental test facility for waste management studies, foreseen in Option 1, will permit to obtain results which are more directly applicable to an industrial scale and recommends this operation.

- For the project Reactor Decommissioning, the Committee has taken note of the opinions expressed by the expert group convened by the JRC to discuss the programme proposal (see attached document).

The Committee considers that these studies would be of interest to demonstrate methods and techniques for dismantling research reactors; however the Committee considers that the extrapolation to the dismantling of power stations would be difficult. The Committee expressed doubts on the priority of this action from the point of view of waste management.

- The Committee recommends for the staff of projects 1 to 4 the level considered in Option 1 (58 research-staff) with an appropriate budget to match the objectives of the proposed programme.

EXPERT MEETING ON THE DECOMMISSIONING OF THE ISPRA 1 REACTOR

ISPRA, DECEMBER 14-15, 1978

SUMMARY OF THE DISCUSSION

The expert group met at the J.R.C. Ispra on 14-15 December 1978 to discuss the J.R.C. outline proposals for decommissioning Ispra 1 reactor as a test case as part of a Community direct action programme in the four year period starting in 1980.

The group agreed that such a project, especially if carried through to completion so that the site could be released for unrestricted use or reuse, could make a valuable practical contribution to knowledge of decommissioning.

The following specific comments were made by the experts on various research activities proposed by J.R.C. :

1. The study would be limited in its application to power reactors but would provide an opportunity to demonstrate methodology and techniques which would be of particular interest in relation to the large number of research reactors within the Community and the adequacy of national licensing procedures.
2. A neutron induced activity inventory should be calculated and compared with measured specific activities to confirm the calculational method. This inventory should form the basis of calculated dose rates for specific operations which should be confirmed by measure made during decommissioning so that the method could be applied more confidently to other reactors.
3. A study of decontamination techniques could be useful and may be extended to include their application to commercial light water reactors.
4. During decommissioning work the relationships between mRem exposure of personnel and the arising of radioactive waste from the decommissioning process should be established to form the basis of a study relating to the cost effectiveness of this class of work. In this context it should be noted that the amount of waste to be stored will be governed by the specific activity limits permitted for unrestricted release. The specification of these activity limits, the possibility of achieving them and finally to measure residual activity, should receive particular consideration allied to this topic. The possible reuse of plant and equipment which cannot be decontaminated to the unrestricted release criteria, within nuclear sites should be evaluated.

5. It was pointed out that in evaluating the operation, its application to other research reactors should not be overlooked, bearing in mind that a considerable number of research reactors will be withdrawn from service possibly in the near future.
6. The most economic techniques should be employed in the dismantling of the Ispra 1 reactor. Extensive tests on alternative dismantling techniques should only be carried out if the possibility of their extrapolation to power reactors can be justified.
7. Some doubts were expressed on the acceptability of burning graphite and releasing C14 as CO2 to the atmosphere as a method of disposal and it was suggested that other methods could be examined including the possibilities of isotopic separation.

A.4. FISSILE MATERIALS CONTROL AND MANAGEMENT

A.4. Fissile Materials Control and Management

The responsibilities of Euratom Safeguards, the strengthening of the rules governing international safeguards for fissile materials, prospects for cooperation with the IAEA, the technical discussions in progress within INFCE and the needs of operators are all reasons for a considerable intensification of the JRC's research activity in the field of fissile materials safeguards and management. The aim of this research is to develop and optimize the use of the various safeguards techniques in the main types of nuclear facilities. This optimization will lead to greater effectiveness, simplicity and rapidity, and hence to a limitation of the cost of the methods applied.

These techniques and methods are also often used by the plant operators for fuel management purposes.

The programme is structured according to the techniques considered, as applied to each category of facility : fuel conversion and fabrication, irradiated fuel reprocessing, reactors and storage facilities.

In detail, the acquisition of accountancy data and the evaluation of the material balance concerns problems arising in the compilation, processing and analysis of the data supplied by operators or arising from verification activities.

The development of measurement methods and instrumentation is concerned with destructive and non-destructive analysis methods; methods for the evaluation of data on the isotopic composition of irradiated fuel, which are necessary for the verification of results, detection of errors and correction of calculation methods, are also developed.

The third project will study supplementary safeguards techniques, consisting of containment and surveillance. The work will apply to the development of seals and their industrial application, remote identification equipment and study of optical and ultrasonic monitoring methods.

The experience and the know-how accumulated in the various technical projects will be used in the last synthesis project which relates to the study of safeguards systems for the nuclear fuel cycle; the aim of these studies is to carry out optimizations in the application of the various techniques in view of cost-effective safeguards.

In close conjunction with the objectives of the Euratom Safeguards Directorate, and partly as a support to the activities of the IAEA to harmonize inspection efforts, this programme will be coordinated with the research organizations of the Member States and the nuclear plant Operators.

MATERIALS ACCOUNTANCY DATA ACQUISITION AND MATERIAL BALANCE EVALUATION

Area : Nuclear safety and fuel cycle
Programme : Fissile Materials Control and Managem.
Project : Materials accountancy data; acquisition and
material balance evaluation

1. Description

The objectives of this project are:

- To supply operators with guidelines for the adaptation of the information on measurements systems uses in plants, in order to help them comply with safeguards accounting needs.
- To design information recording systems and software for the calculation of plant material balances and appropriate statistical indices.
- To undertake research on statistical methods for the analysis and interpretation of material balance calculations.
- To study the problems of developing computerized real-time material accountancy systems.
- To provide continuing technical support to the Safeguards Authorities for the implementation of new techniques in materials accountancy.

2. Subprojects

a) Statistical methods for nuclear materials accountability

This subproject is aimed

- at developing and implementing statistical techniques to detect small losses occurring continuously throughout a series of balance periods
- at examining the way in which the limits of measurement efforts on material balances is affected by plant measurement practices.

Validation of statistical models for the measurement of error propagation will also be included.

b) Development of real-time nuclear material accountability

Under this activity a pilot experiment in real-time accountability will be undertaken.

The experiment will involve implementing a real-time accountability system in an uranium fuel element fabrication plant, taking into account safeguards criteria.

3. External collaborations

- ESARDA partners
- Plant operators: Nukem, RBV and others under discussion
- US laboratories: (LASL, Exxon) under discussion
- IAEA under discussion

4. Planning

Sub-projects	1980	1981	1982	1983
a)	1 _____			
	2 _____	_____		
	3 _____			
b)	4 _____			
	5 _____	_____		
	6 _____		_____	

- 1 Cumulative MUF evaluation on one fabrication plant
- 2 MUF sensitivity analysis for a Pu facility
- 3 Statistical model validation
- 4 Definition of specification for real time experiment
- 5 Acquisition of hardware and test
- 6 In plant experiment

MEASUREMENT METHODS AND INSTRUMENTATION AND FUEL ISOTOPIC
COMPOSITION DATA
EVALUATION METHODS

Area : Nuclear Safety and Fuel Cycle
Programme: Fissile Materials Control
and Management
Project : Measurements Methods and
Instrumentation and Fuel
Isotopic Composition Data
Evaluation Methods

1. Description

The purpose of this project is:

- To develop or improve the fissile material measurement techniques in analytical laboratories and for application under plant conditions
- To adapt the assay methods to the fast-growing fuel cycle and to perform feasibility studies for the assay of fissile materials in alternative fuel cycles
- To prepare the technical data and expertise required to reach an agreement and consensus within Europe on the use of measurements methods and reference materials
- To assist the Safeguards Directorate of DG XVII in the general aspects of the use of measurements methods for their verification activities
- To develop complementary methods for the evaluation of the measured isotopic composition data in irradiated fuels.

2. Subprojects

a) *Destructive analysis (DA)*

It is proposed

- To make reprocessing plant studies (isotope dilution techniques for volume calibration of reprocessing accountancy tank during operation; independent certification measurement methods of fissile isotope concentration and mass)
- To test a mobile mass spectrometer for the analysis of liquid waste samples and the laboratory equipment for input analysis
- To perform various analytical activities (application of Minor Isotopes Safeguards techniques; studies to minimize Pu sample size (resin bead) ; preparing and certifying reference materials and having these available for continuous supply; participating in measurement quality assurance programmes; reviewing the analytical measurement methods applied by plant operators in view of the harmonisation of procedures).

b) *Non Destructive Analysis (NDA)*

The purpose of this subproject is to develop NDA methods to be applied to new facilities for bulk quantities of U and/or Pu, of Pu produced in LWR's at high burn up level, in scrap and wastes and in spent fuel elements.

- To promote actions for the definition and procurement of reference materials to be used for NDA.
- To develop interactive microprocessor based measurement instruments and establish procedures for a NDA data evaluation.
To make available to external users both test and calibration facilities of NDA equipment and training possibilities.

c) Isotopic Correlation Techniques (ICT)

This technique is a useful complementary method for evaluating the correctness of experimental results of fuel isotopic composition measurements.

Activities proposed include:

- Participation in experiments of applications of ICT to fuel reprocessing campaigns
- Management of a data bank of spent fuel isotopic composition and its use for theoretical studies
- Development of an on-line mass spectrometer at the off-gas system of the reprocessing plant.

3. External collaborations

- ESARDA partners
- IAEA
- US Laboratories (LASL, NBS, NBL, ANL)
- Plant operators (e.g. Nukem, Belgonucléaire, FBFC, WAK, EUREX)

4. Planning

sub-projects	1980	1981	1982	1983
a)	1 _____			
	2 _____		_____	
	3 _____	_____		
b)	4 _____			
	5 _____		_____	
	6 _____			
	7 _____			
	8 _____	_____		
	9 _____			
	10 _____			
c)	11 _____			
	12 _____			
	13 _____	_____		

- 1 Mobile mass spectrometer development and test
- 2 Application on waste and input samples
- 3 Critical review of DA methods on major bulk facilities
- 4 Spent fuel element measurements
- 5 Implementation of waste and scraps measurements
- 6 Pu isotope measurements
- 7 Procurement of reference material
- 8 Availability of NDA test facilities for external users
- 9 Development of microprocessor measurement systems
- 10 NDA data evaluation team study
- 11 Evaluation of application of ICT in specific reprocessing campaigns
- 12 Collection of data and theoretical studies
- 13 On line fission gas measurements

CONTAINMENT AND SURVEILLANCE TECHNIQUES

Area : Nuclear Safety and Fuel Cycle
Programme : Fissile Materials Control
and Management
Project : Containment and Surveillance
Techniques

1. Description

The purpose of this project is:

- To continue the application, the design and prototype testing of ultrasonic seals under laboratory and plant conditions and improve the electronic equipment for remote identification, continuous interrogation and safe data transmission
- To study the practical application of other identification and sealing techniques developed elsewhere
- To investigate optical and ultrasonic surveillance techniques and their field of application.

2. Subprojects

a) Application of the ultrasonic identification and sealing techniques

A detailed analysis will be carried out on: fuel bundle structure or storage arrangement; design of seals and definition of the identification procedure; design of handling equipment for seal installation and identification, and identification and definition of the working conditions.

b) Study of other identification and sealing techniques

In order to investigate the field of application of identification and sealing techniques which have been developed in the USA and FRG (electronic and fiber optic seals), it is intended to study their operation procedures and tamper-resistance in field conditions.

c) Improvement of electronic equipment

The identification equipment, developed at JRC, will be completed along the following lines: ultrasonic surveillance without seals, using special transducers; remote control and identification; automation of the procedures for data acquisition.

d) Ultrasonic surveillance

Compared with normal optical surveillance (camera or TV), ultrasonic surveillance appears to be less intrusive and is insensitive to light conditions. Adoption of specially designed transducers, together with the JRC identification equipment could provide an efficient surveillance system. It is intended to apply this technique under field conditions.

3. External collaborations

- ESARDA partners
- NUKEM- Hanau (industrialisation of the equipment-manufacture of seals)
- Operators for fuel fabrication (EXXON, CERCA, NUKEM, KWU, BBR, FBFC)
- Reactor operators
- US Laboratories: BNL, Sandia - under discussion -
- AECL (Canada) collaboration agreement (CANDU)

4. Planning

Sub-projects	1980	1981	1982	1983
a)	1			
b)	2			
c)	3			
d)	4			
	5			

- 1 Specific application of ultrasonic seals
- 2 Comparison of different types of identification technique in 2 or 3 typical cases
- 3 Improvement of JRC electronic identification equipment
- 4 Study ultrasonic surveillance
- 5 Several applications in plants

SAFEGUARDS SYSTEM STUDIES IN THE NUCLEAR FUEL CYCLE

Area : Nuclear Safety and Fuel Cycle
Programme : Fissile Materials Control
and Management
Project : Safeguards System Studies in
the Nuclear Fuel Cycle

1. Description

The purpose of this project is:

- To provide the Commission Services with the technical expertise for the evaluation of the continuously changing safeguards parameters
- To support the Safeguards Authorities in the planification of the safeguards effort to match it to the future developments of nuclear power industry and to the changes of the fuel cycle
- To provide technical assistance to constructors and safeguards authorities in the validation of new plant designs
- To provide for the other projects of this programme indications on the sensitivity of the various parts of the fuel cycle to diversion and on the effectiveness of the proposed technical solutions in counteracting the relevant risks

2. Subprojects

a) An analysis of the *currently applied safeguards* measures in the various types of facilities of the nuclear fuel cycle and the elaboration of improvements. The results will serve as a basis for establishing reference manuals for safeguarding such facilities.

b) A contribution to *advanced safeguards*: The expected increase of the LWR capacity in the European Community, the automation in future nuclear fuel processing and the implementation of large-scale reprocessing will require advanced safeguards in order to meet the international safeguard criteria, which are becoming more and more stringent.

c) The safeguards system, developed for different plant categories have to be integrated in order to evaluate the safeguards effectiveness of the overall fuel cycle. This evaluation will be performed using different fuel cycle models.

3. External collaborations

- ESARDA partners
- Plant operators: BN, Nukem, and others to be decided
- Plant designers
- US laboratories: LASL, under discussion
- IAEA: under discussion

4. Planning

Sub-projects	1980	1981	1982	1983
a)	1	_____		
b)	2	_____		
c)	3	_____		
	4	_____		

- 1 Establishment of three reference manuals
- 2 Advanced safeguard study on specific new plant types
- 3 Preparation of European fuel cycle model
- 4 Study of overall safeguards effectiveness

SUMMARY TABLE

PROGRAMME : A.4. FISSILE MATERIALS CONTROL AND MANAGEMENT

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Materials accountancy data	60	200	274	534	5
2. Measurement methods	1047	294	176	1517	32
3. Containment and surveillance	102	222	47	37	12
4. Safeguard systems	-	-	255	255	11
TOTAL	1209	716	752	2677	60*
1980	256	210	227	693	
1981	278	308	190	776	
1982	327	170	175	672	
1983	348	28	160	536	

* Research staff of 40 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"FISSILE MATERIAL CONTROL"

O P I N I O N

The ACPM in its session of the 15/16th of February has examined the proposal of the pluriannual programme 1980-1983 of the J.R.C. in the field of Safeguards and Fissile Material Management. This programme proposal represents essentially a continuation of the existing programme : nevertheless some changes of trends were recognized which take into account the suggestions of this Committee.

Those trends are :

- the increase in the Containment and Surveillance activities,
- the increase of emphasis put on System Analysis Studies as a means of guidance of the technical projects,
- the strengthening of the cooperation with the plant operators.

The Committee expressed its general agreement on the proposed programme and the increase of the overall effort in staff and budget.

The Committee felt that the programme as laid out could not be completed in full with the available resources and that suitable priorities would have to be established and reviewed. Even if such priorities are established a possible increase in appropriately qualified staff may be necessary.

The Committee gave advice on each of the single projects.

With regards to the project :

- "Materials Accountancy Data Acquisition and Material Balance Evaluation", the Committee accepted the proposal presented by the Commission but, in order to obtain earlier results, that for the real time accountability subproject the initial study should be based on systems already existing.
- "Measurement Methods and Instrumentation and Fuel Isotopic Composition Data Evaluation Methods". The Committee accepted the proposal but recommended careful selection of the topics to be studied in the subproject Destructive Analyses. It also recommended particular care over possible duplication with the project Nuclear Reference Materials and Nuclear Reference Techniques in the Nuclear Measurement Programme.
- "Containment and Surveillance Techniques". The Committee recommended to increase the proposed manpower for this project and suggested that other subjects be considered as well such as :
 - verification and containment integrity
 - monitoring of movements of fissile materials
 - optical surveillance
- "Safeguards System Studies in the Nuclear Fuel Cycle".
The project was accepted by the Committee with the following comments :
 - the reference manuals should be regarded as an aid to develop safeguards methodologies and their preparation should be accelerated,
 - particular attention should be paid to assess the benefits of the application of containment and surveillance measures to supplement the fundamental accounting measures,
 - great care should be taken to strike the balance of the effort on the studies on existing and future plants,
 - attention should not be confined to the elaboration of existing techniques.

Considering the limitation in manpower and budget allocated to the Safeguard and Fissile Material Management programme, the Committee recommended to strengthen as much as possible the collaboration with other organizations and operators, in order to address the most important problems.

Finally, the Committee members insisted that as much flexibility as possible be given in future adjustments of the specific aims of the study and the allocation of the resources of personnel and budget, within the limits of the programme decision that may be adopted.

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B. FUTURE FORMS OF ENERGY

B.1. SOLAR ENERGY

B.1. Solar Energy

This programme has two main objectives :

- to pursue research in certain specific areas, and
- to operate with maximum efficiency the test facilities which give a concrete significance to the central role of the JRC and to its function as provider of public services.

The proposed programme is structured into four projects :

- European Solar Test Installation : ESTI

The effort will bear on completing the indoor and outdoor installation and on making available to all users and manufacturers the facilities offered by the ESTI Project. The first facilities will become operational at the end of 1979. The specific testing activities will be carried out in conjunction with support activities dealing with the identification of degradation processes, the development of test methods, and the definition, with the collaboration of national expert groups, of "state of the art" procedures for the qualification of solar components.

With reference to the objectives of the present programme, it is planned to enlarge this installation to cover outdoor tests and light concentrators, as well as the testing of low power photovoltaic systems.

- Use of solar energy in habitat and low-temperature applications

These studies will follow the lines of the present programme. They deal with the study and modelling of integrated systems for heating and cooling and the evaluation of certain components (heat pumps, etc.). In the studies on low energy building design, the latent heat of transformation of various chemical compounds will be studied in order to solve the problem of long period storage of heat. As far as the low-temperature applications are concerned, unsophisticated technological processes and devices will be studied in relation to agriculture, e.g. methane and methanol production.

These studies will be completed by techno-economic assessments and will be closely linked to the corresponding indirect action as it is the case at present.

- Solar power plant materials :

The proposed activities aim at the improvement of solar power plant performances in relation to their efficiencies and the reliability of components and materials. This effort would be implemented through appropriate contributions in the field of materials, complemented by evaluations of advanced concepts. Special attention will be given to the European Community 1 MWe power plant which is presently under construction in Sicily under the indirect action programme (DG XII).

- Photoelectrochemical and photochemical conversion

The objective of these orientation studies is the exploration of advanced techniques for the conversion of solar energy into electrical or chemical energy. The various approaches which will be followed are the direct conversion in liquid-semiconductor junction solar cells and photochemical water splitting using photosynthetic and micellar systems.

In the frame of this programme, ad hoc contributions of the JRC have to be envisaged in the field of technical assistance to those Developing Countries linked to the European Community by agreements covering scientific and technical aspects.

EUROPEAN SOLAR TEST INSTALLATION

Area : New energies
Programme : Solar energy
Project : ESTI

1. Description

Construction and operation of indoor and outdoor facilities for the test of photothermal and photovoltaic converters with the purpose to obtain reliable values for their expected performance and service life. The goal of this activity is to provide manufacturers and potential solar system users with a powerful tool for the quality assessment of solar energy conversion equipment.

2. Subprojects

a) Performance measurements

It is proposed to construct the collimated light simulator LS2 and to perform conversion efficiency measurements using LS1 and LS2 according to CEC recommended test methods. Correlation and calibration experiments will be done on outdoor test field TF1 which is already existing. The LS2 light simulator will provide a collimated light intensity of up to 1 KW/m^2 within a test volume of $2 \times 3 \times 3 \text{ m}^3$.

b) Photovoltaic systems using concentrators

The viability of concentrating photovoltaics is a problem which has to be studied on the system level. The proposed activity includes: selection of a typical application, construction of the concentrating photovoltaics system in close collaboration with industry, setting-up of another system without concentration for the direct comparison under identical conditions, and finally measurements of all relevant parameters on a continuous basis.

c) Qualification and endurance tests

Abbreviated and/or accelerated ageing experiments using the indoor test facilities AT1 (corrosive atmosphere) and AT2 (UV-irradiation). Design, construction and operation of additional facilities AT3 and AT4 is foreseen. AT3 and AT4 will allow to perform qualification tests like thermal shocks (heavy rain), thermal cycling (freezing and defreezing), static over-pressure (hail stones), rain tests (resistance to wind driven rain), positive live loads (resistance to snow and wind) and ageing tests like exposure to salt moisture, dust, wind and wind driven sand or biological attack.

The long term goal of accelerated ageing tests is the definition of generally accepted standard test procedures which should allow to obtain reliable estimates of the expected service life of solar energy conversion subassemblies or systems.

The proposed activity includes the setting up and operation of the outdoor test field TF2 which will comprise several loops for the determination of the instantaneous thermal efficiency, 10 installations for long duration endurance tests and a series of installations for concentrated sunlight exposure (concentration factor up to 10). In addition, it is foreseen to install a laboratory for the calibration of instruments.

d) Information service

JRC will participate in the establishment of a European Solar Information Service, due to be operated by one of the member states.

3. External collaborations

For thermal collectors a collaboration programme exists within the frame of the I.A. programme (1) of DG XII (participation of 19 European laboratories). In the working group for photovoltaic conversion representatives of LCIE, RTC, CNES, RAE, DFVLR and ESTEC are participating.

For the Solar Information Service, collaboration is considered with the University of Perpignan, various national centers for scientific and technical information, DG XII (indirect action solar energy) and DG XIII (CIDST); as well as with the US DOE (Golden Information Center).

4. Planning

Sub projects	1980	1981	1982	1983
Performance measurements	1	3	4	
Qualification and endurance tests	2	3 5 6	4 7	8
Photovoltaic systems using concentrators	9	10	11	12
Information service	13	14	15	

- 1 Start operation of collimated light simulator LS2
- 2 Start operation of AT3 and AT4
- 3 Start full operation
- 4 Start consulting and diagnostic work
- 5 Installation of test field TF2
- 6 Start routine testing for instantaneous efficiency
- 7 Development of methodology and test procedures
- 8 Start routine testing for endurance and reliability
- 9 System defined
- 10 Site prepared
- 11 Systems delivered
- 12 Regular operation
- 13 First test of the data base software (definition and preparation in 1979)
- 14 Data acquisition and networking
- 15 Pilot operation

(1) Indirect action.

SOLAR ENERGY FOR HABITAT AND LOW TEMPERATURE APPLICATIONS

Area : New Energies
Programme : Solar Energy
Project : HABITAT

1. Description

The project proposal for "habitat" is concerned mainly with the development of solar systems which will insure a year round utilisation of the solar collectors either by the combination of solar heating with solar cooling or by the adjunction of seasonable storage in order to improve the economics of such system. The proposal deals also with the use of solar heat for certain industrial or agricultural processes for which temperatures in the range of 100 – 150°C are needed (concentrating collectors with tracking devices).

2. Subprojects

a) *Seasonal energy storage using sensible heat*

The activity consists of the realisation and monitoring of ground storage in soils and rocks fed by vertical heating tubes; aquifers. A mathematical model will be set up and validated for the determination of the transient period, the yearly performance and the optimum geometry.

b) *Thermochemical storage at low temperature*

The purpose of this activity is the selection and study of chemical latent heat storage systems for the development of special systems to practical application. Special attention will be given to reactions with temperatures between 45 and 70°C (hot water production) 100 – 150°C (industrial application) near 20°C (to be incorporated in building materials). It is planned to select and characterize chemical reactions at low temperature to study their behaviour and to optimize the complete energy storage system.

c) *Combined heating and cooling solar systems - Integration with passive systems*

The activity will include the setting up of a solar system using combined heating and cooling. The utilization of heat pumps, lithium-bromide absorption machine and Rankine machines is foreseen. The study should demonstrate the feasibility of using collectors with low concentration ratio. Furthermore, the integration of active systems with passive systems using Trombe walls and structural accumulator will be studied. The determination of a methodology for the monitoring and modelling of such systems is an essential part of the project.

d) *Development of solar heat sources for industrial and agricultural processes*

The activity consists in: the setting up of a solar system to produce industrial heat up to 150°C (concentrating collectors) to investigate all related technological problems, the monitoring and the determination of performance. The operation of this solar heat source with an industrial processor (methanol production).

e) *Economic-technical evaluation of solar systems for habitat*

Evaluation of the solar energy cost, influence of climatic conditions, evaluation of hybrid systems, definition of basic reference building types.

3. External collaborations

All organizations involved in the Indirect Action.

4. Planning

Sub-projects	1980	1981	1982	1983
a	1	2	3	
b	4	5	6	
c	7	8		
d		9	10	

- a Seasonal Energy Storage using sensible heat
 - 1 Operation of a ground storage using heating tubes in transient state
 - 2 Operation in pseudo-steady state conditions
 - 3 Study of an aquifer storage system
- b Thermochemical Storage at low temperature
 - 4 Exploitation of laboratory results
 - 5 Setting up of a small scale pilot plant
 - 6 Design of a large scale pilot plant
- c Combined Heating and Cooling Solar Systems - Integration with passive systems
 - 7 Setting up of a combined heating and cooling system with lithium-bromide machine
 - 8 Setting up of a combined system using a Rankine machine
- d Development of Solar Heat Sources for Industrial and Agricultural Processes
 - 9 Setting up of a collectors array for the production of industrial heat at 120°C
 - 10 Coupling with a distillation system (methanol)

SOLAR POWER PLANTS : MATERIALS

Area : New energies
Programme : Solar energy
Project : Solar power plants

1. Description

The project aims to contribute to the improvement on the potential and cost effectiveness of helio-electric power-tower plants through appropriate contributions in the field of materials and concept evaluations.

Attention will be given to the EC 1 MW solar power plant to be built by the Consortium ANSALDO-ENEL-CETHEL in the frame of the current EC solar energy programme of the Indirect Action.

2. Subprojects

a) *Materials*

- Analysis of the materials behaviour under radiation: corrosion investigation, receiver blackening, burn-out, intercomparison of different mirror materials, behaviour of surface treatment, reliability studies
- Development of materials for operation in vacuum (selective surfaces for the use at 300°C long term and 500°C short term)
- Development of materials with spectral selective properties for operation in air receivers up to 600°C.

b) *Advanced concepts evaluation*

Thermodynamic and technico-economic evaluations of different cycles (open and closed gas cycles, mixed cycles).

3. External collaborations

The work on the EC power plant will be executed in collaboration with the Consortium or with the power plant operator.

The work on materials is desirably to be executed in collaboration with industry like Philips, MAN, FIAT, SNAM.

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4. Planning

Sub-projects	1980	1981	1982	1983
a) Materials	1	2	3	
b) Advanced concepts	4		5	

- 1 Continuation of work under way (last from year's programme)
- 2 Evaluation of the first results
- 3 Advanced medium T receiver equipped with absorber material ready
- 4 Start investigation
- 5 Specific investigation on a concept

PHOTOELECTROCHEMICAL AND PHOTOCHEMICAL CONVERSION

Area : New energies
Programme : Solar energy
Project : PPC

1. Description

The goal of this activity is the research of low cost direct conversion techniques, based on photo-electrochemical and photochemical methods. These methods allow the direct conversion of solar energy, not only into electric, but also into chemical energy and offer therefore the potential advantage to match also the storage problem which is a major problem of solar energy utilisation.

2. Subproject

Direct conversion by semiconductor liquid junction solar cells

This activity is centered around the field of electrode materials research. For semiconductor liquid junction cells a much larger class of semiconductors is at disposal because also materials can be used of which only one carrier type exists, regardless of its single crystal growth properties.

The investigations will concern: the low cost preparation of semiconductor electrodes (chemical vapour deposition, plasma spraying, oxidation, sputtering), the photoelectrochemical investigations to reveal whether and in which kind of cell the electrode can be utilized, and the experimental test in solar cells. The design and construction of a storage cell is envisaged.

Other processes for photodissociation of water into hydrogen and oxygen, by natural systems (photosynthesis) or artificial systems (as for instance unicellar systems) should be considered for a first approach as possible future methods.

The activity will be limited to an exploratory preliminary study.

3. External collaborations

A close collaboration exists with:

- Philips Forschungslaboratorium Hamburg
- Ecole Central de Lyon, Laboratoire de Chimie, Ecully
- The Royal Institution, Davy. Faraday Laboratory, London
- Division de Biologie CEN de Saclay
- Laboratorio di Fisiologia delle Piante, Università di Milano

4. Planning

Sub-projects	1980	1981	1982	1983
Subproject a)	1	2	3	
Subproject b)	4	5		6

- 1 Preparation and characterization of semiconductor electrodes
- 2 Experimental test in solar cells
- 3 Construction and testing of a storage cell
- 4 Preparation of samples; construction of optical equipment
- 5 Beginning of measurements under light irradiation
- 6 Construction of a test facility

SUMMARY TABLE

PROGRAMME : B.1, SOLAR ENERGY

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. ESTI	831	1613	369	2813	29
2. Habitat	488	973	178	1639	21
3. Solar Power Plants	231	189	98	518	7
4. PPC	179	158	74	411	6
TOTAL	1729	2933	719	5381	63 *
1980	350	1225	192	1767	
1981	420	891	198	1509	
1982	459	511	183	1153	
1983	500	306	146	952	

* Research staff of 33 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"SOLAR ENERGY"

OPINION OF THE ACPM SOLAR ENERGY - ISPRA 12.2.1979

The ACPM Solar Energy met at Ispra on the 12th of February 1979, in order to examine proposals for the Pluriannual Programme presented by the Commission for the Direct Action. This Programme has been elaborated on the basis of recommendations made by a Group of Experts nominated by the Commission at the ACPM's proposal.

The Committee, after having examined the technical content, gave an opinion on each of the projects contained in the proposal and made general comments.

The JRC Programme comprises two types of activity that correspond to the following two categories :

- "methodology services" (evaluation and performance measurements)
- research.

With regard to these "methodology services", the characteristics and principal aims can be indicated in the following way :

- a) definition, verification and development of methods for measuring the performance of the system components.
- b) comparison and harmonization of test methods developed in the Community Countries.
- c) technical evaluation of Commission activities in the field of Solar Energy.
- d) consultation service available to users.

Projects having the "methodology services" as a principal aim are ESTI and HABITAT.

The ESTI project (European Solar Test Installation) envisages a development which well corresponds to the objectives defined since the launching of the project. The increase in personnel is required due to the putting into service and the operation of the first facilities. The proposed activities are carried out in close liaison with the "Indirect Action" and constitute a support to the latter especially in the photovoltaic programme.

It is probably in this field of photovoltaics that a certain research activity as part of ESTI should be maintained, as is always necessary in such service work.

The HABITAT project was concentrated in the past on the standardization of measurements of components, in strict liaison with the "Indirect Action". In the new proposal the principal effort will be dedicated to the study of systems within the general area of low temperature applications.

The Committee approves this orientation and underlines the importance of co-ordination at the Community level. Its opinion is that this project's personnel must be significantly increased. The Committee equally recommends that alongside the "methodology services", which remain a priority, a research activity guaranteeing the vitality and competence of the group be maintained. Bearing in mind the number of subjects proposed, it appears necessary to establish priorities at the start of the programme.

With regard to the more specific research activities, two projects are proposed : materials at high temperature for solar power plants and research on photoelectrochemical and photochemical conversion. The sum total of the effort for these two projects represents a small part of the whole programme which the Committee considers it reasonable to increase, on condition that the activities are well integrated in one of the "Indirect Action" projects.

In conclusion, the Committee declares its satisfaction with the proposal presented by the JRC and approves it as a whole. The balance between the activities, "methodology services" and research, seems correct, especially in the division of the manpower in the proposal of about 3 to 1. The Committee wishes the potential expertise within the JRC to be also used for the evaluation of the studies made on the Commission's account; in particular the JRC should make syntheses and intercomparisons of this work. Further, a contribution by the JRC to the measurement studies on the Solar Power Plant at Catania is recommended. The Committee concludes that the personnel proposed for the execution of this programme is perhaps not sufficient and should be increased progressively from 60 to 70 persons during the course of the programme.

B.2. HYDROGEN PRODUCTION, ENERGY STORAGE AND TRANSPORT

B.2. Hydrogen Production, Energy Storage and Transport

With the evolution of the overall energy scene and following the progress of the specific work at Ispra on the thermochemical method for hydrogen production, the original motivations for the research on hydrogen have evolved towards considering it more specifically as means for transport and storage of energy;

Energy storage and transport is becoming increasingly important, especially if an increased use of renewable energies is assumed. Because of their location or because of their intermittent character, the cost-effectiveness of these energies is closely linked with the development of economic storage or transport systems.

The experience acquired at the JRC in the "Hydrogen" Programme provides a solid basis for the development of new techniques (or for the verification of known but unproven techniques) for the storage and transport of energy, especially by physico-chemical processes.

In this view, the present activities on hydrogen, which will still be important at the beginning of the programme, will progressively decrease in favour of a new activity on energy storage and transport, which will become the essential part of the programme at the end of the four-year period.

The activities of the programme are subdivided in three projects, each one having a different evolution of their importance in the time.

The first project is the thermochemical production of hydrogen : in the first two years of the programme the experimental realizations carried out in the present programme will be terminated. The objective is to verify the technological feasibility and the competitiveness of the thermochemical hydrogen production route on an industrial scale. The closed circuit, composed of glass, will be used to study control problems and the possible production of by-products during extended operation; the technological circuit, whose parts are being constructed during the present programme, will be used to evaluate operation parameters and to test materials. After the final step for the production of hydrogen (closing the circuit) has been selected, a final report describing a pilot plant will be produced. Consequently, during the third year of the programme, the technical and economic studies on thermochemical hydrogen production will be terminated. This timetable is compatible with our contractual commitments in the framework of the International Energy Agency.

The second project deals with advanced studies for energy carriers. The problem of storing and transporting energy can be solved in different ways, according to the situation and the system; an activity of more exploratory and basic nature is useful for defining and evaluating various ways to transport and store energy. The project will have two main orientations :

- evaluation and verification of advanced hydrogen production concepts. The expertise acquired during the preceding programmes will be applied to the evaluation of new possibilities for diversifying heat sources (e.g. solar energy); activities will also be directed towards new production schemes, in particular for advanced electrolysis, in close collaboration with the planned indirect action.

This activity will allow for a continuous updating of the comparative techniques for techno-economic evaluations of the different methods for producing hydrogen from water.

- exploratory studies and experimental verification of new techniques for the storage and transport of energy; research centred on chemical vectors, suitable for a range of temperature, electrochemical storage, etc.

The third project is study of systems : evaluation and testing of systems for collection-conversion-transmission-storage-utilization of energy under different conditions. Comparison of available data, techno-economic assessments, collection of experimental data, safety assessment. This project is subdivided into two parts :

- (i) techno-economic assessments, with collection of available data, comparisons, definition of the most suitable vectors in different cases, etc.
- (ii) design and construction of a "European Test Laboratory" for testing components and systems (conversion-transport-storage of energy), and the definition of measurements necessary to determine their performance and lifetime and to ensure their safety and reliability. This activity will be prepared in a first phase in direct connection with part (i).

The first tests will then be made on systems which are considered to be particularly promising from an economic point of view and in terms of efficiency, notably the combination solar energy - electrolysis - hydrogen storage, the coupling electricity - advanced batteries and the coupling primary heat source - chemical reactions storage.

THERMOCHEMICAL HYDROGEN PRODUCTION

Area : New Energies
 Programme : Hydrogen Production,
 Storage and Transport
 of Energy
 Project : Thermochemical Hydrogen
 Production

1. Description

The experimental studies and the techno-economic evaluations made in the present program on a number of thermochemical processes led to the selection of two processes as, at present, the more promising ones. One of these cycles, Mark 13, has been realized on a laboratory scale with glass equipment in an integrated closed circuit with a hydrogen production capacity of 100 lt/hr. To reach a valuable conclusion, it is proposed to check the chemical and technological feasibility of such processes through the operation of suitable circuits. A report will be prepared which will give a complete picture of the characteristics of these processes and a comparison with other methods of hydrogen production.

2. Subprojects

a) *Exploitation of complete circuits*

(i) Conclusion of the exploitation of the glass circuit

The operation during longer periods of time (weeks) of the glass circuit already built during the previous pluriannual programme, will provide data on the control system, as the short period fluctuations can be hidden by the inherent inertia of the circuit, on the capability of recovering all the chemical products and on the possible formation of by-products.

(ii) Construction and operation of a technological circuit

The technological circuit, of at least 10 fold size, built with metallic materials and working under pressure, will provide elements for a check of the heat recovery system, a control of the behaviour of materials in real conditions and an estimation of the thermal efficiency.

(iii) Complementary activities directly connected with the circuits: corrosion tests, development of electrochemical cells, study of catalysts

b) *Techno-economic evaluations*

With the already developed OPTIMO computer programme, implemented with the equipment cost data, evaluations will be made of the hydrogen production cost. Results from the technological circuit supplemented by other results from single process units will be used for these evaluations.

3. External collaborations

Agreement with KFA (Jülich) - RWTH (Aachen) - CEA (Saclay). "Implementing agreement" in the frame of the I.E.A. activities (with JRC Ispra as "operating agent"). Engineering companies making design on share expenses basis and industrial companies involved in the Indirect Action.

4. Planning

Activities	1980	1981	1982	1983
Thermochemical Hydrogen Production	A	_____		
	B	_____		
	C	_____		
	D	_____	_____	
	E	_____	_____	
	F	_____	_____	
	G	_____	_____	
	H			_____

- A Completion of circuit construction
- B Commissioning and preliminary tests
- C Electrolytic cells development
- D Experimentation with the completed circuit
- E Complementary activities
- F Evaluations
- G Glass circuit experimental activities
- H Preparation of status report

ADVANCED STUDIES FOR ENERGY CARRIERS

Area : New energies
Programme : Hydrogen Production, Storage and Transport of Energy
Project : Advanced Studies for Energy Carriers

1. Description

Aim of the activity is the exploration on energy carriers suitable for various conditions, particularly on those having high capability for storage and transport of energy. Items to be studied are:

- (i) the possibility of thermochemical hydrogen production using heat from a solar concentrator, for evaluating the feasibility
- (ii) some topics of the advanced water electrolysis concepts, i.e. in the field of the Solid Polymer Electrolysis (SPE) technology and of the high-temperature water vapour electrolysis
- (iii) exploratory studies on systems able to generate energy in chemical form and suitable for a range of temperature: from the low end intended as process heat e.g. for industrial processes, up to the level of temperature compatible with the generation of high pressure steam, e.g. for power generation

2. Subprojects

a) *Thermochemical hydrogen production - solar heat*

It is intended here to identify the required characteristics of these processes taking into account the specific properties of the solar source: the highest temperature achievable in solar concentrators and the periodic discontinuity. The evaluation of the whole system is the primary objective, with eventually experimental tests on high temperature chemistry of promising reactions.

b) *Water electrolysis*

Main items will be defined in close connection with the activities in progress in the frame of the indirect actions.

Examples of the activities are the following:

- (i) to make work on the preparation of electrocatalysts suitable for acidic electrolysis and on the deposition of these products on the SPE membrane
- (ii) for the high temperature water vapour electrolysis: exploratory work is foreseen in the field of cathodic electrocatalysts and on the compatibility of these products with the solid electrolyte. Work can also be done on the new technique of an electrolyte formed by a molten oxide contained in a porous, flexible matrix.

c) *Chemical and electrochemical systems*

The study will start with an exploratory analysis of various reversible chemical reactions collecting existing information and also extending the research to possible new areas and new technologies.

Experimental tests will be necessary for measuring the reaction rates in the operating conditions, the importance of hysteresis effects, the evolution of a system after a large number of cycles; the assembling and testing of some typical systems is a natural follow-up.

Another field of research is on the electrochemical storage. Electrical energy can be stored in the form of chemical energy, as it is done usually in lead batteries. Other systems working as electrolyte and fuel cells, that is with the chemical energetic species stored out of the electrochemical converter, may be more suitable and less expensive. An explorative research is thus foreseen on this kind of secondary batteries.

3. External collaborations

The research centre of Odeillo, for the solar heat source.

For the electrolytic hydrogen research collaboration is foreseen with companies actually working in that field in the framework of the indirect action: hydrogen production.

Organizations involved in the Indirect Action, for chemical storage, and industrial companies (Lurgi, P.U.K. for reversible reactions, De Nora for electrochemistry, etc.)

4. Planning

Sub-projects	1980	1981	1982	1983
Thermochemical cycles - Solar heat	A	B	C	D
Water electrolysis	E	F	G H	I
Chemical systems	L M N	O	P	Q

- A Definition of criteria and identification of suitable reactions and cycles
- B Experimental tests for the very high temperature reactions
- C Tests with solar concentrators
- D Technical assessment
- E Preparation and tests on electrodes plated on SPE
- F Preparation of stable high temperature electrolyte and cathodic electrocatalyst
- G Assembly and tests of complete cells - SPE
- H Results on chemical-mechanical stability of components for H.T. electrolysis
- I Assembly and test of H.T. cells
- L Exploration of suitable systems
- M First techno-economic assessments
- N Determination of physical and chemical properties
- O Design of experimental facilities
- P Verification of selected chemical reactions
- Q Comparison of various systems

STUDY OF SYSTEMS

Area : New Energies
Programme : Hydrogen Production, Storage
and Transport of Energy
Project : Study of Systems

1. Description

In connection with the exploitation and the rational use of new energy sources, new technical systems for energy conditioning (conversion, upgrading, storage, transportation) have been developed and are still under development. These systems can be divided into two broad classes: systems for energy collection (e.g. solar panels, solar cells, etc.), systems for coupling production and use needs (main items of these systems are for instance: sensible heat or chemical storage equipments, heat pumps for energy upgrading, heat pipes and "chemical pipes" for energy transport, electrolytic and fuel cells for chemical-electrical conversion, chemical reactors for heat-chemical energy conversion, etc.)

The optimization of the "coupling system" is a complex techno-economical problem which depends on many parameters (size, discontinuity, distance, quality, etc.) linked both to the sources and to the end users.

The project concerns:

- The modelling and the techno-economic assessments of various technical systems corresponding to different situations (energy source - end user)
- The assembling and testing of some typical systems for conversion storage and transport
- The preliminary design of a laboratory for testing "small scale energy system conditioning units"

2. Subprojects

a) *Techno-economic assessments*

Definition of systems of energy production, conversion units, storage methods for various conditions. The various solutions will be studied and assessed, with the aim of individuating the more suitable and economic ones for each condition, in order to match variations of energy availability with variations of energy demand. These assessments will be the basis for selection and the continuous theoretical support to the experimental realizations.

b) *Design and first tests of a European experimental facility*

The aim is to have a facility composed of energy production, conversion and storage units, adapted to various conditions and available to European organizations and companies for definition of test procedures.

The first experimental loops will be defined and designed in accordance with the results of the technico-economic evaluations of sub-project a) and the construction of modular units will be undertaken. An example would be a system consisting of solar cells for the collection of primary energy (or an suitable source simulator), electrolytic cells, hydrogen storage and/or a system consisting of a heat source and reversible chemical reaction. This centralised laboratory would consist essentially of programmable input (source) and output (user) simulators with the facility for modular combination of the various units to be tested.

3. External collaborations

Industrial companies involved in the study and the development of conversion units, working in the frame of the Indirect Action.

4. Planning

Sub-projects	1980	1981	1982	1983
a) Techno-economic assessment	1	2	3	
b) Design and first tests of experimental facility		4	5	6 7

- 1 Start collection of data
- 2 Definition and comparison of first systems
- 3 Verification of data and implementation of comparisons
- 4 Start design of main elements of test facility
- 5 Start construction of a first loop
- 6 Operation and results of the first loop
- 7 Definition of the complete facility

SUMMARY TABLE

PROGRAMME : B.2. HYDROGEN PRODUCTION, ENERGY STORAGE AND TRANSPORT

Project	Specific Appropriations			Total	Research staff
	Operating expendit.	Investments	Contracts		
1. Thermochemical production of hydrogen	316	366	280	962	15
2. Advanced studies on energy carriers	204	174	96	474	10
3. Systems studies	276	357	184	817	15
TOTAL	796	897	560	2253	40*
1980	198	350	222	770	
1981	234	136	247	617	
1982	183	105	91	379	
1983	181	306		487	

* Research staff of 50 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"PRODUCTION AND UTILIZATION OF HYDROGEN"

O P I N I O N

The ACPM met on the 1st and 2nd of February, 1979 in order to examine proposals for the Pluriannual Programme communicated by the Commission. Following a suggestion of the ACPM, this programme has been elaborated on the basis of recommendations made by a "Group of Experts" nominated by the Commission on the ACPM's proposal.

The proposal for the "1980-1983 programme" envisages significant modification with respect to the preceding Pluriannual Programme. The Committee expressed its agreement upon this new trend and gave advice on each of the principal objectives.

However, the Committee members insisted that as much flexibility as possible be given them in the orientation of the specific aims of the study and the allocation of the resources of personnel and budget, within the limits of the Programme decision that may be adopted.

With regard to the first project, Thermo-chemical Production of Hydrogen, the Committee accepted the programme proposal presented by the Commission, but :

- a) to modify it so that the programme may be revised at the end of 1981;
- b) before that date, an in-depth technical-economic study be carried out, by a European engineering company when sufficient technological input data are known, in particular, the results of laboratory experiments in progress and envisaged.

Regarding the second project "Advanced Studies on Energy Vectors" the advice of the Committee was to concentrate the studies on :

- a) thermochemistry with solar energy, confined to a preliminary assessment of the system;
- b) water electrolysis, in particular studies related to SPE;
- c) chemical and electrochemical systems, providing for an intermediate decision stage.

On the other hand, the Committee wished that very close collaboration would be maintained with those responsible for the Indirect Action in these same fields, in order to assure coherence in the realization of these programmes.

With regard to the third project "Study of Systems", the Committee endorsed the proposal to initiate work on the storage of energy. The Committee agreed on point a). However, on point b) they considered that further elaboration was necessary before an opinion could be expressed on the content of the programme beyond 1981 and on the resources (manpower) needed for it.

In particular, the Committee could not yet judge the extent of the need for a test facility.

B.3. THERMONÚCLEAR FUSION TECHNOLOGY

B.3. Thermonuclear Fusion Technology

The activities carried out by the JRC are closely correlated with the research and training programme of the European Atomic Energy Community in the field of controlled thermonuclear fusion.

The main guidelines of the JRC's work are oriented towards deepening and broadening conceptual and materials studies, starting orientative research on tritium and blanket technology, and organizing an irradiation programme in the broader framework of international co-operation in the field of materials behaviour under irradiation. Special emphasis must be put on safety problems and protection of the operators and of the population at large, in close co-operation with the Radioprotection indirect action programme.

The first project deals with conceptual design studies on fusion reactors, with the aim of contributing to the design of post-JET machines which will lead to future power reactors. Safety problems and techno-economic assessments will receive special attention.

The second project deals with orientation studies on blanket technology. Work will aim at obtaining nuclear data and setting up benchmark experiments for the shielding materials; the problems of lithium-compounds corrosion and tritium recovery will be investigated.

The third project deals with the study of structural materials to develop and validate the specifications for materials to be used for each first wall concept, and to study the evolution of their physical and mechanical properties under irradiation (neutrons, charged particles, electrons). Priority will be given to steels to be used in post-JET machines. Exploratory studies on targets for intense neutron sources are foreseen.

The orientative research on advanced materials is the subject of the fourth project : development of protective coatings for the first wall, research on composite materials and their use as structural elements, behaviour of insulating materials under irradiation.

The operation of the cyclotron is the fifth project. Four irradiation cells will be built and equipped, the experiments will be checked and the data collected using automatic systems.

An exploratory work will begin to identify and assess the main features of a European Tritium Laboratory for the main stream fuel cycle, in the frame of the actions of tritium envisaged in the European Fusion Programme. This work will involve the evaluation of various processes and the analysis of components and assembly techniques from the point of view of tritium containment under normal and accidental conditions (project 6).

CONCEPTUAL DESIGN AND SYSTEM STUDIES

Area : New Energies
Programme : Fusion Technology
Project : Conceptual Design & System Studies

1. Description

The aims of this project are:

- To contribute in the definition and conceptual design of the Tokamak type reactor experiments to be built after JET
- To perform sensitivity studies and technical-economical evaluations to support the definition of the long term goals of the European Fusion Programme.
- To develop proper methodologies for the assessment of safety and environmental impact of tritium burning reactors.

2. Subprojects

a) Conceptual design studies of Experimental Reactors

The objective of this activity will be the assessment of the major components of an experimental reactor intended to prove reliable D-T operation. This requires the set-up and implementation of models for life time evaluation of structural materials, blanket and shield design, reactor layout and maintenance. The acquisition of calculational models for plasma balance, fuelling and exhaust, electromagnetic field, energy storage is also foreseen.

b) Sensitivity studies and technical economical evaluations

It is intended to perform sensitivity analyses according to the requirements coming from the long term planning on fusion and european energy scenarios.

c) Safety and environmental problems

Two activities are foreseen:

- Risk assessment (Accident identification, accident evaluation and analysis)
- Tritium Toxicity Mechanism (in collaboration with DG XIII)

3. External collaborations

A tight collaboration is foreseen with the groups dealing with conceptual design studies in Europe (CNEN - Frascati, University of Naples, IPP Garching, Fontenay aux Roses, Culham, etc.)

The possibility of creating an international design team around the JRC nucleus at Ispra will be considered.

4. Planning

Sub-projects	1980	1981	1982	1983
Experimental reactor studies	1	2		
System studies		3		
Safety and tritium	4	5		

- 1 Start conceptual design of experimental reactor
- 2 Start engineering design of experimental reactor
- 3 Set up of the modular code
- 4 Initiating events identification and analysis
- 5 Accident propagation analysis by event tree methodology

BLANKET TECHNOLOGY

Area : New Energies
Programme : Fusion Technology
Project : Blanket Technology

1. Description

The design of the blanket of a fusion reactors requires the acquisition of knowledge in the field of tritium production, energy deposition, radiation shielding, heat extraction and stress analysis, tritium recovery, compatibility, radiation damage.

The objective of this project is to perform basic theoretical and experimental investigation, based on the blanket designs underway in the present program, to enable by the end of the program to start the construction of an out of pile facility to test the blanket units of the post-Jet machines. Close co-operation with the corresponding project of the Nuclear Measurements programme of the Central Bureau for Nuclear Measurements at Geel will be assured in carrying out the activities necessary concerning the acquisition of nuclear data.

2. Subprojects

a) Nucleonics

Acquisition of nuclear data in the range 1-14 MeV for Kerma factors, activation and atom displacements. Utilization of the cyclotron MC 40 (to be installed at Ispra) for the measurement of (n, charged particle) integral cross sections of steel and steel components in the energy range 10-14 MeV. Integral experiments of neutron and gamma attenuation in Titanium Hydride, Boron Carbide etc. to be performed in the EURACOS facility and by Ispra's Van de Graaf.

b) Lithium processing studies

The following items will be investigated:

- gas formation due to helium production and survey of possible gas venting systems
- analysis of outstanding problems related to tritium recovery by molten salts

c) Corrosion studies

Extension of present studies on compatibility of AISI 316 and 304 in presence of Lithium with a known partial pressure of Hydrogen, to the study of halogen impurities due to the molten salt extraction system and extension of the study to dynamic conditions in a small laboratory loop. In a second stage stress corrosion tests are envisaged.

3. External collaborations

A collaboration is foreseen for the nucleonics with ECN- Petten and the University of Birmingham (UK) and for thermomechanical problems with ATOM- Studsvik.

Contacts will also be undertaken with KFA- Jülich for lithium-lead investigations.

An agreement for collaboration with DOE (USA) on blanket experiments is foreseen (Wisconsin Univ., ANL, GA).

Continuous contacts will be maintained with the European laboratories (CEN - Mol) and industries for the corrosion experiments.

4. Planning

Sub-projects	1980	1981	1982	1983
Nucleonics	2	1 3		
Lithium processing	4			
Corrosion	5	6		7

- 1 Nucleonics experiments on cyclotron
- 2 Start 14 Mev radiation shielding experiments on the Van de Graaf
- 3 Start EURACOS experiments on Titanium Hydrides
- 4 Beginning of experiments on gas evolution in the blanket
- 5 Construction of *corrosion* loop
- 6 Start operation of the corrosion loop
- 7 Start construction of the loop for stress corrosion tests

CONVENTIONAL STRUCTURE MATERIALS

Area : New Energies
Programme : Fusion Technology
Project : Conventional Structure
Materials

1. Description

This proposal is a continuation of the present program aiming to select and characterize candidate materials for the endurance limits of first wall of a fusion reactor.

An answer on the stability limits of the austenitic steels under fusion reactor conditions and first informations on fatigue and irradiation effects is the main objective of this programme.

The materials investigated are austenitic stainless steels containing manganese instead of nickel, at the long run titanium alloys might be considered.

14 Mev neutron damage effects data will be obtained by simulation techniques (2 Mev electron accelerator, High Voltage Electron Microscope (HVEM), light ion Ispra cyclotron, HFR- Petten).

2. Subprojects

a) Metallurgical stability

Study of phase stability of austenitic stainless steel (in which Ni is partly substituted by Mn) with and without irradiation, below 600°C, is the major item of this subproject. Investigations are foreseen by using electrical resistivity, Vickers hardness, light and electron microscope). Irradiation will be simulated by 2 Mev electrons (Van de Graaf), 1 Mev electrons (HVEM) protons and α irradiations.

b) Tensile properties

The knowledge of tensile properties will be used not only for the design of technological structures but also as a mean to follow the formation of defect structure.

A great part of the irradiations will be executed in the cyclotron by protons and He⁺ which implies developing miniaturization of tensile tests for specimen to be irradiated.

c) Creep measurements

Measurement of creep properties of first wall materials in the range 400 ÷ 600°C (radiation induced creep in the cyclotron and in pile creep experiments in HFR Petten)

d) Measurement of fatigue and crack growth

A post-JET machine will work in a pulsed mode and the materials will consequently be subjected to fatigue. The contemporary action of fatigue damage and radiation damage in a power reactor has never been studied and it will be a problem of major concern for materials scientists in fusion technology. It is mandatory to extend the study to the behaviour of cracks for an exact determination of lifetimes under fatigue or creep conditions.

The foreseen activities include on-line measurements in the cyclotron by developing simple measurements for fatigue, creep-fatigue interaction, fatigue crack growth and creep crack growth.

e) Basic studies on advanced neutron targets.

The purpose of this proposal is the investigation of advanced targets for the production of intense fields of highly energetic (~ 14 Mev) neutrons (D-Li neutron booster and D-T gas target.)

A limited activity is foreseen mainly in the frame of the IEA.

3. External collaborations

- Antwerpen Univ., KFA, CISE Milan, MPI Stuttgart, AERE Harwell, ECN Petten, Clarendon Lab. Oxford Univ., Rutherford Laboratory.
- LASL, BNL, ORNL, Handford E.D.L. in USA.

4. Planning

Sub-projects	1980	1981	1982	1983
Metallurgical stability	1	2		3
Tensile properties	4	5		6
Creep and fatigue	4	5		6

- 1 Screening tests on phase stability of austenitic steels
- 2 Kinetics of phase transition
- 3 Study of irradiation induced defect structure
- 4 Preparation of on line tests
- 5 On line tests, in pile tests
- 6 Post irradiation tests

ADVANCED MATERIALS

Area : New Energies
Programme : Fusion Technology
Project : Advanced Materials

1. Description

This activity is tightly linked to the activities of conceptual design and design of the post-JET experiments, and is meant to indicate interesting new solutions for problems which seem to be rather difficult to be solved by conventional engineering methods. This project is the continuation of the present one and should furnish experimental data on materials up to now studied theoretically.

2. Subprojects

a) Application of composite materials

The aim is to prove feasibility of fibre-reinforced materials for the copper windings in the magnet and for the central support unit.

The envisaged activities in the field of copper windings include the manufacturing and working aspects of the conductor carried out in collaboration with industrial laboratories, the mechanical testing of sections of the conductor, electrical resistivity measurements as a function of strain, and the study of the plastic behaviour of copper-tungsten composition.

The structural application of fiber reinforced plastics for the central coil support of a Tokamak will require the extension of feasibility studies and the development of heavy sections fabrication techniques.

Characterization at cryogenic temperatures on virgin and irradiated specimens is foreseen.

b) Protective deposit for the first wall of thermonuclear machines and reactors

It is proposed to perform in collaboration with IPP Garching the following tests on a series of candidate coating materials (W, Mo, Ti, Al, B, etc. and their carbides, nitrides and silicides).

- deposition of candidate materials on austenitic steels
- sputtering tests on the deposits produced by different techniques

c) Ceramics for fusion reactors

Candidates ceramic materials for fusion reactor applications (Al_2O_3 , Si_3N_4 , BeO, YAG, MgO, glasses and glass ceramic) will be characterized and irradiated by X and gamma rays, high energy electrons, light and heavy ions. Amorphization, compaction, swelling and mechanical stresses induced at extreme damage densities will be studied and correlated to basic irradiation behaviour. Measurements of the electrical properties of these materials are also foreseen.

3. External collaborations

Collaboration is envisaged with :

- IPP Garching for sputtering experiments.
- AERE - Harwell for irradiations
- MASPEC-CNR - Italy for preparation of ceramics
- University of Genova - Italy for metal - ceramics interface effects
- European Industries (IRD, Newcastle, Montedison, Napoli, etc.)

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4. Planning

Sub-projects	1980	1981	1982	1983
Composite materials	1	2		3
Coatings	4			3
Ceramics	5		6	

- 1 Preparation of specimens
- 2 Mechanical tests
- 3 Evaluation of results
- 4 Preparation of coatings - Sputtering experiments at Garching
- 5 Optical measurements
- 6 Conductivity measurements

CYCLOTRON OPERATION

Area : New Energies
Programme : Fusion Technology
Project : Cyclotron Operation

1. Description

The MC-40 cyclotron, presently under construction by Scanditronix, should be installed at JRC-Ispra during the first half of 1980. The cyclotron is going to be dedicated to the simulation of the radiation damage in materials of a thermonuclear fusion reactor by energetic light ion irradiation (p, d and He ions).

2. Activities

During the present pluriannual program only three beam lines will be equipped with the magnetic lenses, beam viewer, beam profile monitor and vacuum system, up to the irradiation areas.

The set-up of other beam lines has to be included in the multiannual program 1980-1983.

At the end of the project the following facilities should be available:

- Irradiation chamber for post-irradiation testing and structural investigations
- Chamber for creep testing during irradiation
- Irradiation facility for on-line resistivity measurements
- Chamber for fatigue testing
- Facility for measurement of dielectric losses and electrical conductivity in insulating materials
- Irradiation chamber for gas implantation.

3. External collaborations

- K.F.A. Jülich, for cyclotron irradiation experiments
- Hahn-Meitner Institut, Berlin, for computer control of cyclotron operation.

4. Planning

Activities	1980	1981	1982	1983
Cyclotron operation	1 4	2 5 6	3	7

- 1 Installation of cyclotron with three beam lines (July 1980)
- 2 Preliminary operation of cyclotron terminated at end March 1981
- 3 Installation of additional beam lines and computer control of cyclotron operation
- 4 Design and construction of irradiation facilities
- 5 Installation of irradiation chamber for post irradiation analysis
- 6 Installation of computer control of irradiation facilities
- 7 Installation of on-line electrical resistivity, of the gas implantation irradiation chamber, and of the facility for insulators materials

EUROPEAN TRITIUM LABORATORY Area : New energies
 Programme : Fusion technology
 Project : European Tritium Laboratory

1. Description

As stated in the proposal of the "European Programme in the field of Controlled Thermo-nuclear Fusion" (1979-1983), presented to the Council of Ministers (COM/78/616 final), a European Tritium Laboratory is needed to demonstrate the capability of safe and reliable handling of important amounts of tritium in a Post-JET device.

One of the main tasks of this laboratory will be the examination and qualification, from safety and licensing points of view, of the main components and systems related to the tritium handling. The experience and capabilities of the JRC-Ispra in safety problems and heavy water reactors operation qualifies it for a contribution to the realisation of such a European tritium laboratory.

2. Activities

It is proposed to carry-on exploratory work in order to identify the problems related to a facility mainly intended for safety assessment and qualification of components and systems. This work will include the analysis and some experimental testing of units of commercially available components, systems and assembling techniques in the field of tritium handling and confinement, and its control, taking into account also materials behaviour, such as embrittlement and permeation phenomena or efficiencies and stand-times of catalysts for hydrogen gas purification from impurities such as C (H, D, T)₄ and N (H, D, T)₃.

3. External collaborations

Tight collaboration with the laboratories and industries dealing with tritium handling, development of components and optimisation of processes (CEA, KfK - Jülich, etc.)

Connection with design people of post-JET machines

Early contacts with Institutions and Authorities responsible for Safety and Health Physics (in particular the italian DISP-CNEN).

4. Planning

Activities	1980	1981	1982	1983
European tritium laboratory	1			
	2			

1 Analysis of technology

2 Preliminary design

SUMMARY TABLEPROGRAMME : B.3. THERMONUCLEAR FUSION TECHNOLOGY

Project	Specific Appropriations			Total	Research staff
	Operating expendit.	Invest- ments	Contracts		
1. Conceptual design studies on fusion reactor	204	-	176	380	15
2. Blanket technology studies	255	384	102	741	10
3. Studies on structural materials	511	-722	-619	1852	18
4. Studies on advanced materials	255	210	153	618	5
5. Operation of the cyclotron	323	830	-	1153	10
6. Tritium testing laboratory	102	142	-	244	5
TOTAL	1650	2288	1050	4988	63*
1980	350	1610	233	2193	
1981	409	495	334	1238	
1982	433	183	288	904	
1983	458	-	195	653	

* Research staff of 30 were allocated to the corresponding programme in the period 1977-1980.

OPINION OF THE CCF
ON THE DRAFT PROPOSAL FOR A FOUR-YEAR PROGRAMME 1980-1983
OF THE JRC
ON THERMONUCLEAR FUSION TECHNOLOGY

1. The CCF has examined the draft proposal for a research programme (1980-83) of the JRC on thermonuclear fusion technology.
2. On fusion reactor studies, the CCF approves the proposed programme with the following comments :
 - conceptual studies, inclusive of participation in the post JET definition work, are important and could be reinforced,
 - these studies should include an evaluation of the potential of hybrids for the European Communities.This opinion is not shared by the NL and UK delegations.
3. On materials sorting and development, the CCF agrees with the substances of the JRC proposals, and insists on the priority to be given to the utilization of the cyclotron, whose successful operation could contribute to prepare Ispra for future work using new installations such as an Intense Neutron Source.
4. On the question of tritium, the majority of the delegations expressed their support to the minimum proposal put forward by the JRC, i.e. the immediate launching of exploratory studies to prepare a further assessment, to be made in due time in common with the Associations, on the possible setting up of a European Tritium Laboratory.
The French delegation proposes to limit these studies within the framework of conceptual studies.

B.4. HIGH TEMPERATURE MATERIALS

B.4. High Temperature Materials

This programme, which was started relatively recently, is intended to promote within the Community the development of the high-temperature materials required for future energy technologies.

This programme consists of three projects

- the first project concerns the High-temperature materials information centre. This project will be centred on the supply of information and the development of close contacts with national and industrial energy programmes making use of high-temperature materials. This activity should promote co-operation between the various research organizations in this field;
- the title of the second project is Materials and engineering studies. It is the result of a concentration of the broader research areas of the present programme on materials used in some energy technologies such as coal conversion, the petrochemical industry, nuclear process heat and solar energy conversion. The studies carried out will be centred on mechanical behaviour in corrosive atmospheres at high temperature, with the aim of improving the life-time predictions of structures working in such conditions. The work will include studies on corrosion, creep, creep-fatigue interaction, behaviour of coatings, deflection tests, etc. under such experimental conditions that the correlation between laboratory results and industrial practice can be established;
- the third project deals with a High-temperature materials data bank. The need for such a bank has been evaluated in a recent study carried out by an engineering consultancy firm. The objective of this project is to set up a data bank containing evaluated data on mechanical properties and corrosion resistance of alloys used in conversion plants.

The results of a first study on the possible orientations for the project for a large test facility as well as the small manpower available for it have resulted in this project being restricted to an activity in the information centre (project 1) in the next multiannual programme.

HIGH TEMPERATURE MATERIALS
INFORMATION CENTRE

Theme : Future Forms of Energy
Programme : High Temperature Materials
Project : HTM Information Centre

1. Description

The objectives of the project are the

- provision of information service functions to the European HTM community
- encouragement of co-operation.

The following fields will be covered :

- energy conversion e.g. coal gasification, nuclear process heat, solar energy, thermonuclear fusion, etc.
- energy conservation in conventional high temperature technologies e.g. petro-chemistry.

The goal of the project is to provide the HTM programme with a "soft-ware" tool for achieving above mentioned objectives.

It will build upon the experience gained during the 77/80 programme period with the Meeting Point projects.

The objectives will be achieved through a set of processes leading to the following results:

Processes	Results
a) Information exchange	: <u>Conferences, colloquia</u>
b) Information collection	: <u>Surveys, inquiries</u>
c) Information dissemination	: <u>White Book, bulletins, Newsletter, proceedings</u>
d) Information transfer	: <u>Training courses/seminars</u>
e) Information storage	: <u>Inventory of on-going research</u>
f) Animation	: <u>Workshops on candidate areas for European co-operation.</u>

2. External collaboration

- a) Users, producers and research as well as standards organisations active in the field.
- b) Learned societies in member states (metals, corrosion, etc.)

3. Timing

Sub-project	1980	1981	1982	1983
Information Exchange	1	3	2	3
Information Collection		4		
Information Dissemination	6	5 6	6	5 6
Information Transfer	7	7	7	7
Information Storage			8	

- 1 European conference in co-operation with European Corrosion Federation
- 2 International conference on HT Alloys
- 3 Colloquia on specific HTM R & D problem areas
- 4 Enquiry on on-going research in HTM field (questionnaire)
- 5 Edition of up-dated White Book
- 6 Publication of bulletins in regular intervals
- 7 Implementation of training scheme: 3 courses and seminars per year
- 8 Implementation of permanent inventory on on-going research (obtained through 4)

MATERIALS AND ENGINEERING
STUDIES

Theme : Future Forms of Energy
Programme : High Temperature Materials
Project : Materials & Engineering
Studies

1. Description

The work aims to provide a materials understanding which enables improved assessments to be made of the lifetime of structures operating in the corrosive environments associated with high temperature processes and energy conversion systems of future importance, including coal conversion, petrochemical, nuclear process heat, high temperature reactor, solar power and nuclear fusion. Contact will be maintained with the other JRC projects requiring HTM information.

To satisfy these aims, the project will be concerned with aspects of corrosion, creep and creep/fatigue interaction. To enable this, materials science based information to be transposed into an engineering context some multiaxial tests will be performed.

The industrial applications involve reaction vessels, pipes etc. and are likely to have gas turbines associated. The materials will therefore include representative Fe, Ni and Co base alloys with appropriate coatings. The industrial operating environments are characterized by the presence of carbon, oxygen, sulphur compounds and may have other complexities. Temperatures range 600 to 1000°C. The systematic work will simulate these conditions.

2. Sub-projects

a) Corrosion and Protection Studies

Study of the kinetics of corrosion on base material, coatings and weldments will provide corrosion information suitable for extrapolation to industrial components.

b) Creep and Fatigue Studies

Studies of the deformation mode and fracture mechanism of selected alloys and weldments under static and cyclic uniaxial and multiaxial creep conditions will assist life time evaluation.

3. External collaboration

Collaboration with users and producers of high temperature alloys, safety authorities etc. in the relevant fields.

4. Timing

Sub-project	1980	1981	1982	1983
Corrosion and Protection	1	2	3	4
Creep and Fatigue	5 6	7 8	9 10	11

- 1 Corrosion results in carburising, oxidising, sulphidising atmospheres on first group of materials (Alloy 800H, 25/35/(Nb,W) Hastelloy X, IN739, HS188)
- 2 Erosion test results on selected materials and coatings in carburising, oxidising, sulphidising atmospheres
- 3 Corrosion and erosion test results on selected materials and coatings in more complex gas atmosphere
- 4 Information on corrosion and protection mechanisms for lifetime estimation
- 5 Creep test results in carburising, oxidising, sulphidising atmosphere for a selected material
- 6 Plain tube creep tests (pressure, end and thermal loads, temperature, inert environment). Construction of environmental rigs for complex loads
- 7 Results obtained on LCF tests in carburising/oxidising atmosphere
- 8 Creep tests on welded tubes, conditions as (6) and plain tube tests on environmental rigs
- 9 Creep and fatigue results in more complex atmosphere
- 10 Creep tests on welded tubes with environmental simulation
- 11 Information on creep and fatigue mechanisms for lifetime estimation together with preliminary conclusions on complex stress behaviour

HIGH TEMPERATURE MATERIALS
DATA BANK

Theme : Future Forms of Energy
Programme : High Temperature Materials
Project : High Temperature Materials
Data Bank

1. Description

The objective of this project is the implementation of a data bank. The target is focused on evaluated materials data related to mechanical and corrosive properties of alloys which are used in energy conversion plants (complementary to HTM programme R & D projects candidate materials: Alloy 800 group and 25 % Cr, 35 % Ni + Nb or W).

The goal for the operational data bank is the provision of

- an instrument for the identification of areas where research in data generation warrants stimulation, and
- service function to users.

A two step approach will be followed:

Step a) Preliminary demonstration phase:

- Identification of data sources
- Initiation of data collection and formatting action
- Publication of a demonstration output (hand book)
- Testing user's reaction and user sensibilisation
- Design of implementation phase (assistance JRC Ispra)
- Establishment of data evaluation functions

Step b) Implementation phase:

- Utilisation of JRC Ispra, depart. A, facilities and assistance (soft-ware (ADABAS) and hard-ware) for data input, storage and retrieval function
- System testing
- Demonstration of system operation
- Operation

2. External collaboration

Users, producers and research organizations involved in the field.

3. Timing

Sub-projects	1980	1981	1982	1983
Preliminary demonstration period	1, 2	4		
Implementation data bank		5		
(experimental operation)		1 2 3	6 7	8

- 1 Data collection
- 2 Data formatting
- 3 Data bank design
- 4 Demonstration handbook
- 5 Evaluation process
- 6 Implementation
- 7 Demonstration: data bank operation
- 8 Continuous operation

SUMMARY TABLE

PROGRAMME : B.4. HIGH TEMPERATURE MATERIALS

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Information centre	153	-	164	317	5
2. Materials & engineering studies	966	867	140	1973	30
3. Data bank	341	-	536	877	3
TOTAL	1460	867	840	3167	38*
1980	305	350	251	906	
1981	346	247	259	852	
1982	392	131	216	739	
1983	417	139	114	670	

* Research staff of 35 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT
"HIGH TEMPERATURE MATERIALS"

STATEMENT

The Advisory Committee for Programme Management "High Temperature Materials" met on February 8th/9th, 1979, under the chairmanship of Mr. K. Halpin to examine on the request of the General Advisory Committee, the Commission's proposal for Theme B.4. "High Temperature Materials" of the Joint Research Centre's 1980-1983 multi-annual research programme.

The Committee declared itself satisfied with the scope and scale of the proposed High Temperature Materials programme, taking into account the limited staff and budget available.

The Committee underlines the importance of problems in high temperature materials technology. In this respect, several members would support proposals to increase the programme to include other fields.

Furthermore, the Committee welcomes the degree of collaboration and integration so far achieved between the programme and Community industries and projects. It looks forward to a continuation and if possible, enhancement of this cooperation, leading to a more precise definition of specific aims and priorities as the programme develops.

Within the context of this programme, the Committee believes efforts applied to materials for thermonuclear fusion to be untimely.

Regarding a large component test facility, the Committee notes that with the resources available, construction is not proposed. However, it agrees that the matter of large scale test facilities be further reviewed in the course of the new programme.

The Committee agreed in principle to the proposals for the HTM Information Centre. The title of "information storage" should be replaced by "inventory of research programmes".

The Committee agrees to the proposal for Material and Engineering Studies and supports the intention to continue work leading to the understanding of material behaviour in conditions common to a number of applications and would welcome increased links with relevant engineering projects and aspects within the Community. It is understood that the work at present undertaken in connection with Cost 50 round II will continue until the conclusion of the present agreement.

The Committee entirely agrees with the proposal for the High Temperature Materials Data Bank and welcomes its initial concentration on a small number of materials.

The Committee is encouraged, when preparing its opinion, by the progress being made in the present programme.

C. STUDY AND PROTECTION OF THE ENVIRONMENT

C.1. PROTECTION OF THE ENVIRONMENT

C.1. Protection of the Environment

This programme is essentially a continuation of the current programme, which is further concentrated and includes a new emphasis on industrial chemical substances. This emphasis is justified by the worldwide concern about environmental chemicals, and by regulation of their use. All the activities of this programme are dedicated to supporting the Commission's services in establishing "criteria documents", the programme itself being prepared and executed in close co-operation with the indirect action programme in the same field.

In the area of chemicals there are five projects :

- ECDIN (Environmental Chemicals Data and Information Network) dealing with the collection and computer storage of environmentally relevant data on industrial chemicals, predominantly organics, in the categories of nomenclature, manufacture, use, fate, effects and legislation. ECDIN started as a pilot project in 1973. It is intended to make it the "information backbone" for the practical implementation of a number of directives and regulations of the Community.
It is proposed :
 - a) to make ECDIN progressively operational, giving priority to the needs of the Commission, as for instance to the directive of 4 May 1976 on the discharge of dangerous substances into water and to the (draft) modification of the 6th amendment of the 1967 directive on classification of dangerous substances.
 - b) to give priority access to users within the Community in the period 1980-83.
 - c) to build up the network of ECDIN partners for continuous input, filling-up and updating of data.
 - d) to give access to ECDIN mainly through EURONET.
 - e) to carry out research essentially on prioritization of chemical testing , structure activity relationship and linking of distributed data bases. Such a data bank is not only an information system, but also allows for the identification of research areas and for setting priorities in research.
- Exposure to chemicals : this proposal deals with the fate (pathway degradation) and concentrations of individual chemicals to which man and environment are exposed. Exposure data are the basis of risk analyses. Calculations of degradation constants will be converted into exposure through models (work mostly to be done by contract). Cases of real exposure will be measured in the framework of the subproject Indoor Pollution. Qualitative and quantitative determination of indoor pollutants will be made in private

homes, schools, department stores, and possibly occupational environments. If justified by analytical results a test chamber to isolate sources would be constructed.

The laboratories of Organic Chemistry in the Petten Establishment have specialized in the preparation of standard reference materials and in reference analytical methods for organic chemical substances. These activities, which should continue essentially along the same lines together with research on toxic organics which may migrate from polymeric packaging materials into foodstuffs, will be carried out in the subproject Chemical Products Organics.

Finally, within the "Action Programme on Safety and Health at Work" decided by the Council on 29 June 1978, the Commission (Directorate-General for Employment and Social Affairs) is considering the possibility of proposing to the ACPM specific research actions which the JRC would carry out.

- Air quality : this project represents essentially the present activity of "Particle Formation". It deals with gases and particles, which result from the reactions between nitrogen oxides, ozone and hydrocarbons (of both anthropogenic and biogenic origin), under the influence of ultraviolet radiation.
- Water quality : this project deals with the analysis of organic micropollutants in water with emphasis on coupling of liquid chromatography and mass spectrometry, and with some bioindicators for water pollutants
- Heavy metals pollution, exposure and health effects : the levels of exposure to heavy metals in specific situations will be evaluated and the metabolism and the biochemical effects of these metals together with the extrapolation of experiments on animals to man will be studied. The special situations envisaged are the production of energy, the incineration of municipal waste, the domestic environment and possibly the use of fertilizers.

In addition to these activities a project in the field of power ecology will be executed:

- Environmental impact of power plants ; this project is restricted to the measurement and description of nitrogen oxides and sulfur dioxide concentrations in the vicinity of conventional power plants, using available remote and in situ measurement techniques. This activity will be carried out in collaboration with the corresponding Indirect Action programme.

4. Planning

Sub-projects	1980	1981	1982	1983
a.	_____			
b.	_____			
c.	_____			
d.	_____			
e.	1	_____		
	2	_____		
f.	_____			

1 Commission Services

2 Public Services

INDOOR POLLUTION

Area : Study and protection of the environment
Programme : Environmental Protection
Project : Exposure to Chemicals
Subproject: Indoor Pollution

1. Description

Indoor air pollution in residential, administrative and public buildings (e.g. schools) as well as in traffic vehicles and its effects on man have been only occasionally studied so far, though it would appear easier to study a close environment as compared to an open environment.

Two research lines are proposed:

- a) Inventory of indoor pollution sources (heaters, paints, dishes and glasses, chemical products for cleaning)
- b) Analysis of pollutants and characterization of pollutants sources

2. Subprojects

- a) Inventory of pollution sources in connection with the program proposals ECDIN and Heavy Metals Pollution / Exposure and Health Effects
- b) Measuring campaigns in order to
 - establish indoor pollution levels in the above mentioned environments
 - check whether typical pollution patterns exist
 - identify "new chemicals" of environmental concern
 - to get hints on important indoor pollution sources
- c) Construction of a test chamber for indoor pollution sources
- d) Characterization of indoor pollution and establishment of concentration laws as a function of identified conditions (materials, air changes)

3. External collaborations

Collaboration with interested laboratories within the Community is envisaged. First contacts with TNO, Delft have been established

4. Planning

Sub-projects	1980	1981	1982	1983
a				
b				
c				
d				

CHEMICAL PRODUCTS – ORGANICS

Area : Study and Protection of the Environment
Programme : Environmental Protection
Project : Exposure to Chemicals
Subproject: Chemical Products, Organics

1. Description

The efficient control of air, water and domestic pollution by organic chemicals rests on two essential requirements: the existence of analytical methods of sufficient sensitivity and precision and the availability of reference materials of suitable purity to calibrate methods and apparatus. Fields of special interest are the control of carcinogenic materials (polyaromatic hydrocarbons and their derivatives, polychlorinated hydrocarbons and other potentially toxic chemicals) in the environment (air, water) and the determination of toxic organic products (plastic additives) which may enter foodstuffs from polymeric packaging materials. Some work is to be carried out on radiochemical characterization of polymers, too. In the first case the organic chemicals which are to be controlled effectively have to be made available in sufficient quantities and purity grades to allow their identification and quantitation in environmental samples.

In the area of domestic pollution, the development of reliable methods of analysis and measurement is a first requirement, followed by the provision of suitable calibration and reference materials.

The experimental work is to be complemented by a scientific information group.

2. Subprojects

a) Analytical methods and calibration materials

- carcinogenic materials (polyaromatic and polychlorinated hydrocarbons and derivatives)
- polymeric materials (antioxidants, plasticisers, dyestuffs, radiation chemistry of polymers)

b) Scientific information office

- to carry out surveys and evaluate future needs in this field
- to organize working parties, conferences and courses on related subjects

3. External collaborations

Close and efficient collaboration with many expert (public service and research) laboratories in the EC on these subjects has been established and is to be continued.

Remark: some of these activities can be incorporated into theme
"Specific Support to sectoral activities of the Commission!"

4. Planning

Sub-projects	1980	1981	1982	1983
Carcinogenic and other toxic Materials	1	2	3	4
Scientific information office	5	6/7	5/7	6

- 1 Methylchrysenes/sulfur containing heterocycles
- 2 Antioxidants, plasticisers, polychlorinated biphenyls
- 3 6-ring polyaromatic hydrocarbons, dyestuffs
- 4 Nitrogen containing heterocycles, radiation characterization of polymers
- 5 Workshop
- 6 Scientific conference
- 7 Safety course

AIR QUALITY

Area : Study and Protection of the Environment
Programme : Environmental Protection
Project : Air Quality

1. Description

The project proposes a global study of the complex air pollution system: the combined effects of the primary natural and anthropogenic emissions and the analysis of the transformations which they undergo due to chemical and photochemical reactions. The knowledge of the physico-chemical behaviour of atmospheric pollutants (chemical products) is essential in order to establish "air quality criteria", which regard the relations between concentration and the associated adverse effects, and to develop a strategy for pollution control.

2. Subprojects

- a) Analysis of atmospheric pollutants (concentration, type, chemical composition)
- b) Chemical and photochemical reactions (in situ infrared spectroscopy with Fourier Transform for the measurements of organic nitrogenous and oxygenous compounds)
- c) Mutagenic Test (in order to evaluate the correlations between carcinogenic and mutagenic activity of certain pollutants selected by contracts to specialized laboratories)

3. External collaborations

Laboratories of the concerted action, organized by DG XII under the same heading (8 countries):

4. Planning

Sub-projects	1980	1981	1982	1983
a				
b				
c				

WATER QUALITY

Area : Study and Protection of the Environment
 Programme : Environmental Protection
 Project : Water Quality

1. Description

To establish water quality criteria then standards, analytical methods must be developed and the pollution effect on man, animals and plants must be studied. This project proposes three research directions:

- a) Improvement of analytical methods for identifying traces of organic compounds not detectable by means of the gas chromatography commonly used.
- b) Study of the chemical transformation and the fate of water pollutants.
- c) Development of global response bioindicator-systems able to give warning (sensitive to organic and mineral pollutants that may be identified by chemical methods)

2. Subprojects

- a) Identification of compounds that are difficult to detect (about 80%)
- b) Development of automatic methods for identifying and quantifying the overmentioned compounds (these methods will be based on analytical references: mass-spectra, retention index)
- c) Combination of methods of liquid chromatography at high pressure and mass-spectrometry to improve analytical methods
- d) Measurements of the pollutant toxicity on some bio-indicator-species in laboratory conditions
- e) Measurements of the pollutant toxicity in semi-natural conditions.

3. External collaborations

- M.B.A., Plymouth
- University of Parma
- FBAW, U.K.
- Institut für Wasser und Abfallwirtschaft, Karlsruhe.
- Participants to the Cost action 64 b.

4. Planning

Sub-projects	1980	1981	1982	1983
a	_____			
b	_____			
c		_____		
d			_____	
e			_____	

HEAVY METAL POLLUTION: Area : Study and protection of the environment
EXPOSURE AND HEALTH EFFECTS Programme : Environmental protection
Project : Heavy metal pollution
Exposure and health effects

1. Description

The technological development has raised new problems in the frame of heavy metals toxicology at traces level.

In order to establish environmental quality standards for heavy metals (HM), it is necessary to study by an integrated approach:

- The problems of HM emission from different pollution sources (fuels, propellents, burned wastes, food, land, fertilizers, etc.)
- The distribution and relevance HM pollutants in the environment, in relation to the natural HM content of the biosphere
- The HM exposure levels to individuals and populations, and the corresponding biochemical, physiological and pathological significance

The proposed activity, which is strictly coordinated with national activities at the Community level, deals essentially with two points:

- The study of dose-effect relationships for different HM, independently of the emission sources
- The study of specific exposure situations of high priority for the Community Action Programme on the environment

During the programme period the subproject ILE (1977-80 programme) will be continued.

2. Subprojects

- a) Study of health effects (metabolic behaviour, biochemical effects) by means of nuclear and radiochemical techniques, which are not commonly available to biochemical laboratories
 - Data collection and critical analysis
 - Laboratory experiments on small mammals
 - Biochemical experiments on human tissues
- b) Study of specific exposure situations, based on the critical pathways approach
 - Chemical analysis (neutron activation, spectrochemical techniques, X-ray fluorescence, mass spectroscopy)
 - Evolution models for HM in the biosphere

3. External collaborations

- All contractants engaged in the corresponding action of the Environment and Radioprotection indirect action programme
- All contractants of the Environment and Consumer Protection Service
- Several universities
- Electricity producers (B, UK, EIR)
- Several national laboratories (E.G., VGB-Essen, NCB-Middlesex)

4. Planning

Sub-projects	1980	1981	1982	1983
a				
b				

ENVIRONMENTAL IMPACT OF POWER PLANTS

Area : Study and Protection of the Environment
 Programme : Environmental Protection
 Project : Environmental Impact of Power Plants

1. Description

The increasing energy demand makes economically interesting low quality fossil fuels, in particular high sulphur coals. This fact requires a better knowledge on dispersion of pollutants released from electrothermal power plants into the atmosphere (particularly SO₂ and NO_x) This project consists to simulate and describe the dispersion of these pollutants in atmosphere in order to help the definition of air quality standards near power plants and to make easier the studies of the possible impact of even more powerful plants.

2. Subprojects

- a) Selection of typical power plants (geographical, meteorological, orographic, etc. criteria)
- b) Measurement of parameters interesting dispersion models (experiments in situ using Cospec, Teletec, Lidar, Tracers and long duration campaigns)
- c) Data processing and development models
- d) Evaluation of the "dispersion capacity" of the site

3. External collaborations

- National electric companies
- KFK, Karlsruhe
- University of Munich
- DFVLR, Garmisch
- CNR, Turin/Rome
- IFA Bologna

4. Planning

Sub-projects	1980	1981	1982	1983
a	_____	_____	_____	_____
b	_____	_____	_____	_____
c	_____	_____	_____	_____
d	_____	_____	_____	_____

SUMMARY TABLEPROGRAMME : C.1 PROTECTION OF THE ENVIRONMENT

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. ECDIN	63	125	2138	2316	25
2a Indoor pollution	125	128	64	317	7
2b Organic substances	268	211	25	504	8
3. Air quality	362	199	125	686	18
4. Water quality	125	52	-	187	10
5. Heavy metals pollution	311	62	60	433	15
6. Impact on the env. of power plants	122	-	61	183	7
TOTAL	1376	787	2473	4636	90 *
1980	401	244	654	1299	
1981	426	222	847	1495	
1982	368	209	590	1167	
1983	181	112	382	675	

* Research staff of 80 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"ENVIRONMENT AND RESOURCES"

OPINION OF THE ACPM "ENVIRONMENT AND RESOURCES"
ON THE PROGRAMME PROPOSAL "PROTECTION OF THE ENVIRONMENT" AND
"SEA PROTECTION"

(The latter is part of the programme "Remote Sensing").

1. The Advisory Committee approves the general outline and balance of the proposed programme. Nevertheless it formulates priorities for execution of the programme, and a few minor changes to the initial conditions which it considers would be easier to achieve in collaboration with the JRC if the decision of the Council of Ministers is framed in general enough terms.
The priorities and changes are detailed in the following.

2. ECDIN

The Committee generally recommends that ECDIN become operational as soon as possible on the basis of the document "Summary of the ECDIN Proposal" of 15.2.1979, giving priority to the support of existing directives and to the preparation of an inventory of existing industrial chemicals. During this programme period the network of member state nodal points should be established. The Committee considers that the resources detailed in the proposal are barely adequate for the purposes described.

This is especially evident in the contracts for data collection although contribution from direct and indirect actions are in balance. A substantial supplement to this funding should be sought from co-ordinated/concerted actions and by users, particularly in the Commission.

More research should be done concerning user groups before setting up an operational system to meet the requirements of the member states and other interested organizations.

3. The Committee welcomed the two proposals on "exposure" (Indoor Pollution at Ispra and Chemical Products - Organics at Petten).
They recognize the relevance of the Petten proposal to the Environment programme.
4. The introduction of mutagenic screening in the Air Quality project should be preceded by intense consultation with the Contact Group Mutagenicity.
Although accepting a reduction in the size of the project, the study of the Po Valley (anthropogenic/biogenic sources of pollution) should not be abandoned immediately.
5. The studies of eutrophication should not be abruptly stopped. The evaluation of ecotoxicological effects of chemicals in water should be done in the framework of the corresponding indirect and concerted actions.
6. Mention should be made of the intention to bring the ILE experiment to a useful conclusion in the programme period.
7. The Committee recommends that the action on Environmental Impact of power stations be pursued as described in the proposal with an early review of its services in validating mathematical models.
8. The Committee agrees to the JRC proposal "Sea Protection", committing 70% of the effort to hydrocarbon pollution (with not more than 1 or 2 test sites), 20% to support UNEP MED POL research activities and 10% to design a future (hydrocarbon) pollution monitoring network for the Mediterranean based on remote sensing techniques.

C.2. REMOTE SENSING FROM SPACE

C.2. Remote Sensing from Space

It is proposed that the activities be limited to two research projects only, along the lines of the present activities : one project in agriculture and one in environmental protection. In addition, the JRC will put its know-how and its equipment to use through promotion, assistance and education activities in these new techniques. Furthermore, ad hoc contributions of the JRC are envisaged in the field of technical assistance to those Developing Countries linked to the European Community by agreements covering scientific and technical aspects.

Agriculture

Taking into account the present experience at the JRC, it is proposed that remote sensing techniques be applied :

- to the construction of a regional forecast model for the grain harvest (in Europe);
- or to the construction of a regional forecast model for rice production in Western Africa;
- or to a study of land use in rural areas (in Europe), which could be linked to the first possibility.

A choice will have to be made between these applications, taking into account the interest shown by our partners and the limited resources available to the JRC. For the first two projects the research would bear on the feasibility of measuring bioclimatic parameters associated with the phases of the phenological calendar or the plants under examination, together with the validation of agrometeorological models developed in close collaboration with competent national research institutes. The third project consists of a comparison between the present use of the land and a utilization optimized on the basis of measured characteristics. This research would contribute to the establishment of optimum utilization maps of the rural areas.

The first project is related to agricultural policy (DG VI) in particular.

The second project fits into the general framework of development aid policy (DG VIII), and more specifically into the policy on the proposed financing by the European Development Fund of 40.000 hectares of rice fields in the Niger Bani area.

The third project would be an integral part of the research programme on land use and rural resources in the framework of the agricultural policy.

Protection of the Sea

This project consists of two parts :

- the first part is devoted to evaluating the considerable quantity of information supplied by the Numbus-G satellite between 1978 and 1980/81. The information collected by the CZCS (Coastal Zone Color Scanner) and used under the Eurasep project in the present programme will be retrospectively evaluated and in particular will enable studies on oceanographic optics (reflection and absorption at the surface and light fields under the water surface) and on atmospheric physics (fog zones) to be carried out;
- the second part consists of an overall study project on the Mediterranean Sea in cooperation with a large number of institutes in countries bordering it.
The JRC will provide :

- 1) a general framework for research in the form of working parties by research subject;
- 2) technical assistance notably in remote sensing and pollution sensing;
- 3) heavy equipment (aircraft fitted out for remote sensing or oceanographic ships chartered by the JRC) or specialized apparatus (buoys and mobile measuring units).

The research areas considered include : evaluation of marine pollution caused by atmospheric pollution, basic research and monitoring of heavy metals and chlorinated hydrocarbons, the transport of pollutants along the coast and the detection of hydrocarbon spill.

These activities are to be seen in the context of a large number of international agreements or protocols : the 1975 Barcelona Convention of which the Commission is a signatory, the UNEP's MED-POL programme and the Protocol on Cooperation in Combating Pollution in the Mediterranean. The Environment and Consumer Protection Service proposed to UNEP in November 1978 that the JRC participate in the Programme of Research and Continuous Monitoring of the Pollution in the Mediterranean Sea.

**AGRICULTURE
YIELD FORECASTING (WHEAT)**

Area : Study and protection of the environment
Programme : Remote sensing from space
Project : Agriculture - Yield forecasting (wheat)

1. Description

The early forecasting of yields has today assumed great importance for the farming economy. The refinement of remote sensing techniques allows us already to envisage the setting up of a system of cereal forecasting which is standardised, synoptical, fast and sufficiently precise. A methodology specially adapted to meet European requirements could be worked out on the basis of data acquired by the new sensors which will be available in 1981 with the second generation satellites (LANDSAT-D).

The project in question proposes the study of yield forecasting model of wheat characterised by a precision responding to the criteria 95 - 90 (95 percent during 90 percent years).

To achieve this, 3 axes of research are foreseen:

- a) determination of ecozones (zones in which the cultivation is run on the same lines)
- b) development of agrometeorological models
- c) establishment of a phenological calendar

2. Subprojects

- a) Establishment of a climatic regression model (calendar time scale)
- b) Establishment of a climatic regression model (mean phenological time scale within the considered ecozone)
- c) Establishment of a regression model (true phenological time scale)
- d) Attempt to establish a biostructural model (direct relationship-reflectance-biomass-yield)
- e) Availability of the methodology to users

3. External collaborations

- Several laboratories and institutes in the eight Member States already engaged in collaboration (AGRESTE and TELLUS Projects): agronomy institutes, hydrology and soil institutes
- International organisations: ESA, WMO, FAO
- NASA

4. Planning

Sub-projects	1980	1981	1982	1983
a, b				
c				
d				
e				

AGRICULTURE REGIONAL MODEL FOR RICE PRODUCTION (MALI)

Area : Study and protection of the environment
Programme : Remote sensing from space
Project : Agriculture - Regional model for rice production

1. Description

The forecasting of yields has today assumed great importance for the agricultural economy of developing countries (preparation of new cultivated zones, making better use of the resources of irrigation water, improvement of yields). Recourse to aerospatial remote sensing techniques is often necessary because of the ground organisation and its weaknesses and the difficulty of access.

The project in question proposes a study of a hydrological model of the Niger-Bani system in order to forecast the resources of water in the swamp areas of the inland delta before they are fed into the rice-fields, and the study of forecast models of yield of the rice harvest responding to the criteria 80/90 (80 percent during 90 percent years). The combination of the two models should allow an estimate of production in the prepared zone.

2. Subprojects

- a) Study of the hydrological model of the inland delta (physiographic characters, use of LANDSAT imagery, platforms for hydrological data collection)
- b) Establishment of a phenological calendar
- c) Development of a climatic regression model (true phenological time scale)
- d) Attempt to establish a biostructural model (relationship of direct reflectance biomass - yield)
- e) Establishment of a model for regional production

3. External collaborations

- Institute of research for tropical agriculture; Mali
- ORSTOM, Paris
- Association for Regional Development in Western Africa - Mopti (Mali)
- International organisations (ESA, WMO, FAO)
- NASA

4. Planning

Sub-projects	1980	1981	1982	1983
a	_____			
b	_____			
c		_____		
d			_____	
e		_____		

**AGRICULTURE
RURAL LAND USE**

Area : Study and Protection of the Environment
Programme : Remote Sensing from Space
Project : Agriculture - Rural Land Use

1. Description

The surface area of land under cultivation in Europe is decreasing as a result of the expansion of urbanisation, of communication networks, of industrialisation and the increase of pollution. In order to plan the best ways of utilising the land we must determine its physical capacity, both social and economic, and compare this with its actual usage.

Today, remote sensing techniques allow us to determine synoptically and almost in real-time a region which has to be planned.

The project in question envisages three stages of research:

- Determination of the actual land use
- Determination of factors linked to its potential use (soil moisture, type and structure of soil)
- Preparation of thematic maps combining the data acquired by remote sensing and those coming from other sources.

2. Subprojects

- a) Measurement and analysis of the spectral signatures of land situated in rural zones (based on systematic ground truthing).
- b) Processing of the data and recognition of patterns (based on the spectral contents, the shape and contours, the texture).
- c) Establishment of criteria for classifying land use (e.g. rules relative to less-favoured areas).

3. External collaborations

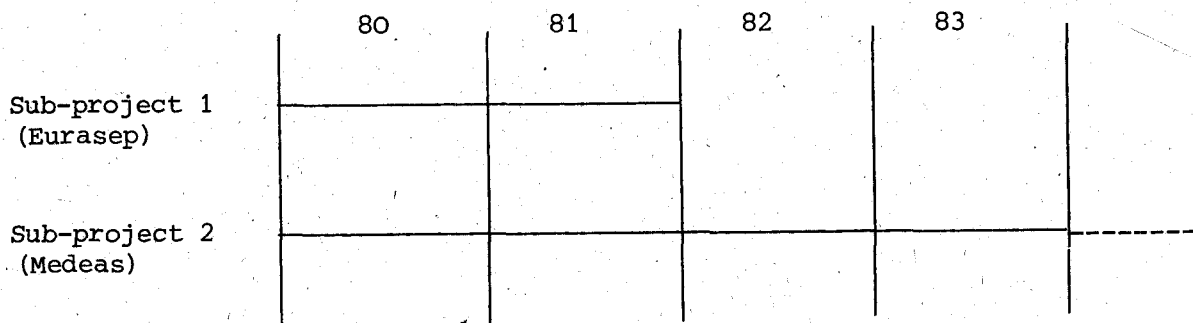
- All the indirect action contractors in "Agricultural Research" organized by the Directorate General for Agriculture
- International organisations: ESA, FAO, EARSeL/W.G.4.
- Various Community Institutes (e.g. Agricultural University Wageningen).

4. Planning

Sub-projects	1980	1981	1982	1983
a	_____			
b	_____			
c	_____			

- about 40 laboratories presently contributing in the EURASEP project.
- from 10 to 20 laboratories out of the 83 participating in the MED POL Programme of UNEP, representing 18 border-countries of the Mediterranean basin.
- the Regional Oil Combatting Centre of Malta (UNEP).
- the AIEA-Monaco Laboratory in charge of MED POL 11 (standardization of measurements).
- C.I.S.M. (Conférence Internationale pour l'Etude Scientifique de la Méditerranée).

4. Planning



SUMMARY TABLE

PROGRAMME : C.2. REMOTE SENSING FROM SPACE

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Agriculture	525	573	445	1543	32
2. Protection of the sea	497	765	255	1517	18
TOTAL	1022	1338	700	3060	50 *
1980	234	315	163	712	
1981	248	321	173	742	
1982	262	341	184	787	
1983	278	361	180	819	

* Research staff of 29 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT
"ENVIRONMENT AND RESOURCES"

Opinion of the ACPM for "Remote Sensing"

see Opinion of the ACPM "ENVIRONMENT AND RESOURCES"

D. NUCLEAR MEASUREMENTS

D.1. NUCLEAR MEASUREMENTS

D.1. Nuclear Measurements

This programme, which will be carried out primarily at the Central Bureau of Nuclear Measurements, Geel, is in conformity with the rôle assigned to it in the Treaty. The next programme activity will be centred on measurements of neutron constants and parameters, the determination of radionuclide characteristics, production of standards, isotopic analysis and the preparation of well defined samples. It is also proposed that the production and enrichment of certain actinide isotopes for the preparation of isotopic reference materials be studied; this will require the installation of a magnetic separator in the laboratory. Lastly, it is proposed to include in this programme the activities of the European Shielding Information Service (ESIS), which have hitherto been carried out within the data processing programme.

The programme consists of three main projects :

- The first project deals with nuclear data measurements, using the existing large accelerators. The study of "neutron data" (i.e. data on neutron induced reactions), will be oriented on actinides, structural materials for fission reactors, fission products, standards, and on fusion research technology. In parallel with this research activity, the laboratory equipment will be improved in order to be able to accomplish effectively its task.

The studies on "non-neutron nuclear data" will deal with the measurement and evaluation of data on radioactive decay (the accent being placed on actinides and fission products) and with atomic constants (notably for aspects presenting an interest in the biomedical field).

- The second project deals with nuclear reference materials and techniques.

The C.B.N.M. has always been active in the preparation of reference materials in the following three categories : "elementals" for the study of the physical and chemical properties, "isotopics" for measurements using mass spectrometers, and "radioisotopics" for the study of isotopic composition using emitted radiation. These reference materials are essential for the nuclear industry, and in particular for the analyses carried out in relation to safeguards. This activity will be continued in the next programme, in the co-operation with programmes A.4 Fissile Materials Control and Management and E.2 Support to Safeguards.

The study performed by C.B.N.M. has revealed the constant need of the nuclear industry for actinide reference materials. These reference materials are at present supplied by organisations outside the Community, which sometimes causes irregularities in the supply. For this reason it is proposed that an effort be made in this programme to arrive at a later stage at a relative independence of Europe in the procurement of such materials. The first phase of this project consists of buying and utilizing a medium-sized isotopic separator. The equipment will be utilized first for the experimental separation of stable isotopes, then quickly moving on to uranium isotopes and finally plutonium isotopes. This experimental programme will be completed by an economic study of the various options for producing and separating these isotopes in Europe.

- The third project concerns the "European Shielding Information Service" (ESIS). This activity is centred on the dissemination of knowledge in the field of radiation shielding. Data are gathered, analysed, validated and diffused, and contacts with specialist groups are promoted.

NUCLEAR DATA

Area : Nuclear Measurements
Programme : Nuclear Measurements
Project : Nuclear Data

1. Description

Provision of accurate data and development of improved measurement techniques required for fission and fusion reactors and their fuel cycles by

- determination of the characteristics of neutron interactions mainly with fissile and fertile material of fission and fusion reactors, with the products of such nuclear reactions, with structural, control-rod and coolant components, with shielding materials and those of dosimetric interest, with materials used as cross-section standards and those whose study improves theoretical understanding of these processes. Neutron sources are modernized linear and Van de Graaff accelerators and the neutron beam of the reactor BR-2 at SCK/CEN Mol.
- determination of radionuclide (e.g. actinides, fission products, elements of dosimetric, biomedical and environmental interest) decay characteristics by measurement and evaluation of decay scheme data like α -, β -, and γ -ray intensities, internal conversion coefficients, branching ratios and half-lives, of atomic constants related to X-rays, of Auger electron and Coster-Kronig transitions.

2. Sub-projects

- a) Neutron Nuclear Data
- b) Non-Neutron Nuclear Data

3. External collaboration

Participation in the work of international committees with nuclear data responsibilities, e.g. INDC (International Nuclear Data Committees of IAEA), NEANDS (Nuclear Energy Agency's Nuclear Data Committee). Regular contacts and/or common experiments with national laboratories in Belgium, France, Germany, Italy, United Kingdom.

4. Timing

Sub-projects	1980	1981	1982	1983
ND	1	2, 3	4	
NNND		5		

- 1 Simultaneous thermal and high energy neutron experiments using beam multiplexing system at the LINAC
- 2 Improved neutron energy resolution using post-accelerator buncher at the LINAC
- 3 Improved neutron energy resolution using post-accelerator buncher at the Van de Graaff
- 4 Automatic control of Van de Graaff accelerator
- 5 Installation of low-energy electron spectrometer

NUCLEAR REFERENCE MATERIALS
& NUCLEAR REFERENCE TECHNIQUES

Area : Nuclear Measurements
Programme : Nuclear Measurements
Project : Nuclear Reference Materials
& Nuclear Reference Techniques

1. Description

- Development of nuclear reference techniques for the characterization of elemental, isotopic and radioisotopic samples and the organization and preparation of characterized materials for, interlaboratory comparisons. Development of methods ensuring traceability of safeguard measurements to a common reference.
- Development and provision of special nuclear reference materials for analytical purposes primarily in the nuclear industry, for safeguards, for clinical, biomedical and environmental purposes by preparation and characterization of elemental, isotopic or radioisotopic samples (e.g. bulk samples, alloys, spikes, films, solutions) for major components, impurities and isotopic composition determinations.
- Assessment of the possibilities of preparation, chemical purification and electromagnetic isotopic enrichment of rare actinides.

2. Sub-projects

- a) Materials and Techniques
- b) Study of European Production of Enriched Actinide Isotopes

3. External collaboration

Regular cooperative work and other contacts with national laboratories and universities of the Community and USA, with DCS Luxembourg, with the US Safeguards Analytical Laboratories Evaluation (SALE) programme, with the IAEA, with ESARDA and other international bodies such as IRCM, BIPM, etc.

4. Planning

Sub-projects	1980		1981		1982	1983
Materials and Techniques	1	5 6	2	12 3	13	7
Study of European Production of Enriched Actinide Isotopes	8		9		10	11

- 1 Characterization of U metal and oxide
- 2 Characterization of Pu metal and oxide
- 3 Characterization of first mixed U/Pu oxide
- 4 First surface reference material (3MV VdG)
- 5 Completion of $MnSO_4$ measurement campaign
- 6 Completion of U_{308} ARM activity
- 7 Spark source mass spectrometer for isotope dilution analysis
- 8 Installation of mass separator
- 9 Experimental uranium isotope separation
- 10 Experimental plutonium isotope separation
- 11 Assessment of possibilities of enriched actinide production in Europe
- 12 Availability of Pu/V alloys for reactor neutron dosimetry
- 13 Availability of set of well-characterized plutonium isotopic reference materials

EUROPEAN SHIELDING INFORMATION SERVICE (ESIS)	Area Programme : Project :	Nuclear Measurements Nuclear Measurements European Shielding Information Service (ESIS)
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1. Description

Dissemination of competence in the field of radiation shielding by

- collecting, analyzing, evaluating and circulating pertinent information,
- promoting contacts and close cooperation between European shielding groups concerned with performance and analysis of shielding benchmark experiments.

2. Sub-projects

- a) Assessment of Shielding Design Data and Shielding Codes.
- b) Shielding Data Bank and Information Dissemination.

3. External collaboration

IKE (Stuttgart)
Univeristy of Hannover
UKAEA (Winfrith)
CNEN (Bologna, Casaccia)
CEA (Cadarache)
RSIC (Oak Ridge Nat. Lab.)
NEA Data Bank (Saclay)
IRK (Vienna)
NDS (IAEA)

4. Planning

Sub-projects	1980	1981	1982	1983
Assessment of Shielding Design Data and Shielding Codes	1	2		3

Shielding Data Bank and
Information Dissemination

- 1 Conclusion of the Euracos iron benchmark experiment and comparison with other iron benchmark experiments.
- 2 Editing of sensitivity code and a data-adjustment programme
- 3 Editing of updated library with a variance-covariance matrix.

SUMMARY TABLEPROGRAMME : D.1. NUCLEAR MEASUREMENTS

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
1. Nuclear data	1633	1420	204	3257	56
2. Nuclear reference materials and techniques	1403	1832	436	3671	52
3. European shielding information service (ESIS)	51	-	128	179	5
TOTAL	3087	3252	768	7107	113 *
1980	706	1329	227	2262	
1981	748	853	129	1730	
1982	792	904	314	2010	
1983	841	166	98	1105	

* Research staff of 170 were allocated to the corresponding programme in the period 1977-1980 and corresponded to the whole of the METRE programme (both nuclear and non-nuclear).

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT
MEASUREMENTS, STANDARDS AND REFERENCE TECHNIQUES (METRE) -
NUCLEAR

ADVICE OF THE ACPM-METRE NUCLEAR ACTIVITIES ON
THE PROGRAMME PROPOSALS FOR THE PROGRAMME
"NUCLEAR MEASUREMENTS" 1980 - 1983

During the meeting of February 5 and 6, 1979, the Advisory Committee on Programme Management (ACPM) of METRE Nuclear Activities examined the proposals for the 1980-1983 programme "Nuclear Measurements". The advice of the ACPM has mainly been based on the documents CCMGP-METRE Nucl. 55/78 and CCMGP-METRE Nucl. 45/78. A discussion was held on all proposed investment items costing more than 100 000 EUA (CCMGP-METRE Nucl. 58/78).

The ACPM was satisfied that the programme proposals take into account the changing needs of the Community and are in agreement with statutory tasks of CBNM, JRC Geel, as described in the Treaty of Rome.

The ACPM gave the following detailed advice :

1. NUCLEAR DATA

1.1. Neutron Data

The proposals were met with general agreement and as a whole seem well aligned to the requirements of the European Community. The ACPM strongly supported the proposals for shortening the pulse on both Linac and Van de Graaff, as it was felt that these would significantly improve the quality of measurements to be made. Apart from the continuation of measurements to satisfy requirements in the field of fission reactors, the CBNM should start the measurement of fusion data, selecting those appropriate to the expertise of the laboratory.

The ACPM recognises that the actinide measurements, a major and high priority component of the neutron data proposals, are dependent on non-community sources of supply of actinide targets of suitable mass and purity.

1.2. Non-Neutron Nuclear Data

The proposals met with the general approval of the ACPM. As in the past measurement and evaluation of decay schemes and atomic constants should be guided by the Non-Neutron Nuclear Data Request List (e.g. CCMGP-METRE Nucl. 54/78), should be closely related to the existing expertises of CBNM and advantage should be taken of the international coordination arranged by IAEA.

The purchase of a low energy electron spectrometer in 1981 is in principle supported. The ACPM, however, suggests that a survey be made of data needs in the radiobiomedical field to determine the experimental programme and the best type of instrument to purchase.

2. NUCLEAR REFERENCE MATERIALS AND TECHNIQUES

2.1. Material and Techniques.

A support was given to the main lines of the proposed activities in the field of reference materials, reference techniques and preparation of special nuclear samples. The ACPM particularly recommends the continuation and the extension of the work on the preparation and certification of EC actinide reference materials for applications in chemistry, physics and isotope analyses.

The proposals related to radioisotopic reference materials and techniques also met the general approval of the ACPM. For certified actinide reference materials it has been emphasized that user oriented expert groups should be established to define priorities. Competent

laboratories within the member-countries should be encouraged to participate in the work. With respect to biomedical and environmental reference materials the needs of the EC were recognised, but the programme should be chosen carefully, bearing in mind the existing work in national laboratories.

The field of non-actinide reference materials should be explored in relation to CBNM experience and taking into account current Community programmes and industrial needs.

The ACPM strongly recommends the examination of the implications of a proposed partial transfer of responsibility to the ACPM Fissile Materials Control. Such a transfer would imply, inter alia, serious problems in allocating staff to the corresponding activity and would lead to a decrease of flexibility with CBNM.

2.2. Study of EC Production of Enriched Actinide Isotopes

The crucial importance to European nuclear industry of highly enriched isotopic reference materials of the actinide elements was made evident in a study recently carried out on the recommendation of the ACPM by CBNM staff and national experts (CCMGP-METRE Nucl. 25/78).

The ACPM welcomed the proposal to study the production within the EC of actinides of high isotopic enrichment for actinide reference materials for Community use.

It considers CBNM an appropriate laboratory to perform this study because of its long experience in the preparation of actinide reference materials. The installation at CBNM of a medium output electromagnetic isotope separator is an essential part of this work. The primary aim of this experimental and theoretical study is to make an estimate of the technical requirements, manpower and cost for a production facility, and the recommen-

dation of possible locations. An important part of the study is the continual up-dating of the vital EC needs for such reference materials. The ACPM considers that this programme, at the level proposed, should have high priority in the overall programme at CBNM.

MAJOR INVESTMENTS

The list of major investments submitted by the direction of CBNM and divided into groups of descending priority order was as follows :

- I. Electromagnetic Separator
- II. Post-acceleration Buncher at Linac
Pulse Compressor at Van de Graaff
X-Ray Fluorescence Spectrometer
- III. Spark SOurce Mass Spectrometer
Low Energy Electron Spectrometer
Beam Transport on 3.7 MV Van de Graaff
Tandem Mass Spectrometer
- IV. Beam Multiplexing System at Linac
Automation of Controls at Van de Graaff
Automation of Controls at Linac

The proposal for the UF_6 mass spectrometer was withdrawn because it is expected to be purchased in 1979.

The ACPM considered only technical aspects and gave a general endorsement to this sequence of groups with two changes, namely moving the Automation of Controls at Van de Graaff into Category III and doubting the validity of the Beam Transport proposal on the 3.7 MV Van de Graaff until it has been examined in greater depth. Reservations were also expressed on the proposal for the installation, at the present, of the Beam Multiplexing System at Linac.

REMARKS

In view of the investments in both hardware and expertise already existing at CBNM the ACPM noticed with concern that a new programme proposal had been made by JRC Ispra for neutron data measurements with its cyclotron. It was suggested that for the future all the JRC activities in the differential neutron data field should be brought to the attention of this ACPM.

During the discussion the French delegation remarked that the support to DG XVII (Safeguards) should not result in CBNM performing work that could just as well be done in the national laboratories. Under these circumstances this delegation asks to reduce this support to DG XVII and to send samples for analysis to the national laboratories whenever this is possible.

Documents cited :

- CCMGP-METRE Nucl. 25/78 : ACTINIDE REFERENCE MATERIALS, 23.2.1978
- CCMGP-METRE Nucl. 45/78 : NEXT PLURIENNIAL PROGRAMME FOR CBNM, 20.10.1978
- CCMGP-METRE Nucl. 54/78 : NON-NEUTRON NUCLEAR DATA REQUEST LIST, December 1978
- CCMGP-METRE Nucl. 55/78 : PROPOSALS FOR PROGRAMME OF CBNM 1980/1983, 18.12.1978
- CCMGP-METRE Nucl. 58/79 : PROGRAMME PROPOSALS 1980/1983, MAJOR INVESTMENTS, 27.1.1979

END OF THE ADVICE

E. SPECIFIC SUPPORT FOR THE COMMISSION'S SECTORAL ACTIVITIES

E.1. INFORMATICS

E.1. Informatics

These activities are concentrated on two areas of research with a well-defined central character and closely integrating the research with the service aspects. As such they constitute a good framework to host the management teams of the European informatics programmes (DG III).

The JRC is playing a specific role in international activities in teleinformatics, due to its participation in the COST 11 action, and its contribution to the European Informatics Network, forerunner of the EURONET system. The research will be centered on the two subjects of "network" (language, operation, protocol) and "data" (data-banks, standards, processing).

The aim of the second project is to integrate more closely the research and service activities in software evaluation and dissemination within EUROCOPI. The research will be oriented on programming techniques and software information transfer problems; the information service will also be improved.

TELEINFORMATICS

Area : Specific Support to the Sectoral
Activities of the Commission
Programme : Informatics
Project : Teleinformatics

1. Description

The general objective of this project is to contribute in the research efforts undertaken on European scale in order to activate the utilisation of computer networks, to enlarge the spectrum of the applications which can be supported by the public data networks and the speed up the process of standardization in the field of distributed data processing.

2. Subprojects

a) Coordinated Research

Following the fruitful experience of COST Action II (European Informatics Network) the JRC intends to continue its research efforts on those subjects which could involve a divergence of technical opinions.

The subjects envisaged are : high level protocols (remote job entry protocols, virtual terminal protocols, file management protocols), network implementation language, network operating systems (extension of packet switching network to resource switching network), distributed data bases (feasibility, implementation, maintenance and interrogation of a distributed data base).

The research effort will use existing public networks as its tool. But it will also be based on the experience gained of the internal network of the JRC Ispra, which is currently in the course of construction.

The research work, which should lead in a wider context to a higher level of teleinformatics standards, will be carried out as at present and in the past in collaboration with a wide range of European Organizations interested in the field.

It is hoped and intended that this can be organized within the Community-COST action on teleinformatics. The JRC is also ready to assume all technical secretariat functions in this field which could be required of it. Independently of this the JRC intends to organize its research in close collaboration with its national partners.

b) EURONET Services and Developments

The future developments of EURONET require extensive studies on interdisciplinary, multilingual, user-oriented access to data bases.

The foreseen activities are:

- Data Modelling for a high level data bank interrogation language
- Automatic document and query processing for information retrieval
- Reference and test center for higher-level protocols.

3. External collaborations

The envisaged research activities are meant to evolve as cooperative ventures on European Scale.

The CREST-COST action in teleinformatics and the Euronet project provide the scenario in which the appropriate relationships and engagements can be defined.

Actual external collaborations exist with

- University of Liège, Belgium
- Technical University of Denmark
- IRIA, France
- CREI and CNUCE, Italy
- GMD, FRG, NPL, U.K.

4. Planning

Sub-projects	1980	1981	1982	1983
Community-COST action				
Direct Participation:				
- high level protocols	1	2	3	
- network language	4		5	6
- network operating system	7		8	9
- distributed data bases	10	11		12
EURONET Services and developments				
- data bank interrogation language	13	14		15
- automatic docum. & query processing	16		17	18
- reference and test centre for HLP		19		19

- 1 Virtual terminal protocol expansion and test
- 2 File transfer protocol expansion and test
- 3 Remote job entry and text editor final
- 4 Definition of primitives and syntax
- 5 Prototype compiler
- 6 Prototype network interpreter
- 7 Resource naming and addressing
- 8 Resource scheduler
- 9 Prototype resource switching network
- 10 Data definition language
- 11 Transaction routing
- 12 Pilot implementation
- 13 Primitives for data description
- 14 Mapping on real data bases
- 15 Model for question answering
- 16 Indexing with automatic controlled vocabulary
- 17 Query processing
- 18 Relevant assessment with test data base
- 19 Periodical publications of debugging aids and protocol enhancement proposals

EUROPEAN COMPUTER PROGRAM INSTITUTE

Area : Specific Support to the
Sectoral Activities of the
Commission
Programme: Informatics
Project : EUROCOPI

1. Description

EUROCOPI promoted in 1976 the setting up of the European Association for Software Access and Information Transfer (EASIT), and served as aggregation nucleus and driving force, JRC is playing an important role in the armonization of EASIT activity with the Commission policy for data processing, promoting cooperation on a full European basis, by improving information service and program library techniques and providing applicable programming/documentation techniques for the development of portable and usable programs.

2. Subprojects

a) *Research activities*

The research done by EUROCOPI should be aimed at:

- giving an original contribution in the fields of technology transfer through computer programs and of program library techniques, by increasing portability and readability of programs through an analysis of advances in high level programming languages and programming techniques.
- transferring from the informatics research to the end users programming/documentation practices and techniques, through publications, seminars and courses.

b) *Program Library and Information Service*

The service activities consist of a program information and program distribution service. The program information service is intended to collect, organize and disseminate information on available computer programs for scientific/technical applications, by quality checking and computerization of program abstracts, data base maintenance including updating of the program classification and indexing scheme.

The program distribution service will ensure an organic and sistematized collection/distribution of programs produced by JRC or by other institutes in the areas of interest of JRC.

3. External collaborations

Close cooperation will be continued with organizations providing program library and program information services in support to European users as well as with research organizations which are active in the field of programming/documentation techniques and standards. EASIT working groups and joint projects will provide the framework for cooperation.

4. Planning

Sub-projects	1980			1981		1982		1983	
Research activities	1	2	3	3	4	3	5	3	
Program library and Information service	6			7					

- 1 Study of programming techniques and tools for portable software
- 2 Development of the EPOS Program Classification Scheme
- 3 Courses on Programming Techniques for portable software and for program documentation standards
- 4 Publication of guidelines for programmers
- 5 Publication of guidelines for program documentation
- 6 Program information service through EURONET
- 7 Full operation of specialized sectors of the Program Library

SUMMARY TABLEPROGRAMME : E.1. INFORMATICS

Project	Specific Appropriations			Total	Research staff
	Operating expendit.	Invest- ments	Contracts		
1. Teleinformatics	576	297	388	1261	11
2. EUROCOPI	63	-	317	380	15
TOTAL	639	297	705	1641	26 *
1980	140	99	218	457	
1981	142	87	153	382	
1982	164	111	223	498	
1983	193	-	111	304	

* Research staff of 37 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"INFORMATICS"

O P I N I O N

on the proposals for the future programme of the JRC

(Expressed at the 4th ACPM-Informatics Meeting, Ispra, January 25-26th, 1979).

With reference to the advice given by the General Advisory Committee at its 23rd meeting on November 15-16th at Petten, the ACPM-Informatics has been invited by the Director General of the JRC to give an opinion on some proposals for the future programme of the JRC.

The Committee has been informed about the following 4 proposals (so-called "modules") which are related to the current JRC programme on Informatics :

ESIS
EUROCOPI
Real Time Systems
Teleinformatics.

Detailed explanations were given to the Committee by the JRC staff about the technical content of the proposals, their place in the European and International context, the means needed for their execution and the planning of the work proposed.

During its 4th meeting on January 25th and 26th the Committee discussed the four proposals and arrived at the following conclusions for each of them.

ESIS

The Committee has given careful consideration to the proposals put to the General Advisory Committee regarding the future of ESIS, in which the manpower proposals are to cut the present level of effort on ESIS from 13 to 5. It notes that in these proposals some of the present shielding expertise is transferred to other programmes (such as Fusion Programme) in order to give shielding advice in these specific areas, and that it is proposed to discontinue experimental work with the Euracos Facility at Pavia.

The Committee strongly advises against the restructuring of the shielding activity in the proposed manner as, with the consequent fragmentation of the specialized effort, a cohesive and viable project, presently valued by Community members, would cease to exist.

The Committee's views are as follows :

1. The present ESIS activity is well balanced between experimental and theoretical work on topics which serve the Community needs in a specialized area.
2. The Euracos Shielding Facility has only relatively recently begun again to produce useful results having suffered a prolonged interruption due to its being moved from Ispra to Pavia. The team has acquired knowledge of the latest technology needed to make the measurements for the programme the Community requires. The Euracos Facility has a unique role to play as it offers a higher flux of a well defined spectrum for radiation penetration studies than can be obtained elsewhere.
3. The theoretical programme aimed at contributing to meeting the Community needs for shielding nuclear data provides for the analysis of these experiments together with those from other laboratories on a consistent basis; it includes the development of appropriate analytical techniques. Moreover, it includes the construction and on-going development of coupled neutron gamma data sets required for use throughout the Community.
4. ESIS provided a valued service in the testing and development of Computer Codes made available by individual countries to serve the needs of the Community in a highly specialized area. It has the ability to apply such validated codes to real problems arising from both fission and fusion reactor studies.
5. The information service activity provides for the dissemination of topical information in the Shielding area to Community members together with the organization of suitable training courses.

The Committee noting these points gives its formal advice that it unanimously opposes either the reduction or fragmentation of expertise at present embodied in ESIS and recommends that the activities of the present programme be continued as a cohesive whole into the next pluriannual programme.

The Committee recognizes the need to minimize the number of separate ACPMs, and the problems brought about in associating ESIS with the Informatics ACPM. However, the Informatics ACPM believes that it can conduct its affairs in such a manner that will allow it to continue to give advice in the specialized area of ESIS.

EUROCOPI

The Committee considers that EUROCOPI has so far provided a useful service as concerns both program distribution and information dissemination. This service should continue in the future with undiminished effectiveness. It is agreed that further expansion of the service should be channeled in those fields in which the JRC is active.

The Committee agrees that the future programme should include specific research activities connected with standard documentation and programming techniques, especially in connection with the needs of the service; however these activities should not detract from the effective operation of the EUROCOPI services.

The Committee believes that this programme should rely on about the same manpower (12 men year/year) as presently allocated (but not actually fully deployed).

REAL TIME SYSTEMS

The Committee agrees that the project concerns a subject which is of high priority in the field of Informatics, because of the evolution of technology and of the growing number and importance of applications (see also the CREST advice *).

The Committee believes that the scope of the JRC activities can justify the implementation of a viable programme on this subject, with a particular focus on reliability and availability of safety and control systems, intended in general for the operation of industrial processes and public utilities.

The Committee, however, is aware that the implementation of a viable programme on the above subject requires the availability of a well defined complement of manpower resources, divided equally between experts in software engineering and experts in modern electronic technologies.

As far as the number is concerned, the proposed number of 5 men year/year should be considered as a minimum to start, but it should double in about two years. As it is not clear whether the necessary expertise is available within the JRC, carrying out this project might require taking in new staff.

In addition the Committee thinks that the final definition of the objectives for this programme should be done with the contribution of other sectors of the JRC, and of the related ACPM (e.g. Reactor Safety).

Finally, the Committee feels that the project should be carried on with systematic contacts with other national and international organizations, which are working on the same subject, and that, for the eventual realization of specific equipment, should be relied on the more qualified firms, operating in Europe, in the field of electronic data processing.

TELEINFORMATICS

The proposal stands on two main bases :

- the contribution to the European actions in teleinformatics,
- the assistance to EURONET services and development.

The proposal supports outstanding initiatives at European level in the field of the development of teleinformatics and could assure to them a contribution of technical/scientific expertise by performing research work on selected key subjects, provide a coordination of similar contributions coming from national research institutes and provide an active forum for the exchange of information, standardization of procedures and support to users.

The Committee welcomes the inclusion of the Automatic Documentation project in this module. It recognizes the potential value of its application within EURONET and it expects that this will give useful aims to further development in this field.

The Committee feels that both the European initiatives mentioned above are important for the future of the European Teleinformatics and should be strongly supported. The Committee judges the JRC proposal good and useful for the purpose; the Committee considers that this proposal should have high priority among the JRC activities.

The resources to be allocated to this action as indicated by the JRC are considered reasonable, but in particular the manpower should certainly not be lower than the 11 men year/year indicated in the proposal.

E.2. SUPPORT TO SAFEGUARDS

E.2. Support to Safeguards

These activities consist of technical support to the Safeguards Directorate (DG XVII) in Luxemburg in the performance of the tasks assigned to it by the Euratom Treaty.

The JRC, as an independent European organization, already has the role of reference laboratory for analysing samples taken during safeguards inspections. These analyses are carried out in the Geel, Ispra and Karlsruhe laboratories.

This technical support also covers the adaptation and testing of measuring devices (or complete systems) at specific installations. Lastly, some activities covering the training of inspectors in the various safeguards techniques are also included.

SUMMARY TABLEPROGRAMME : E.2 SUPPORT TO SAFEGUARDS

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
TOTAL	918	560	51	1529	18*
1980	210	560	12	782	
1981	222	-	12	234	
1982	235	-	13	248	
1983	251	-	14	265	

* Research staff of 10 were allocated to the corresponding programme in the period 1977-1980.

E.3. SUPPORT TO THE COMMUNITY BUREAU OF REFERENCE

E.3. Support to the Community Bureau of Reference

The JRC contributes at present to the workings of the CBR Secretariat and to the running of different projects and specialist groups established by the CBR.

Though withdrawing from this programme, the JRC will nevertheless continue to their normal conclusion a certain number of coordination tasks which it has undertaken. This will take the form of the part-time participation of a certain number of experts from the Ispra, Petten and Geel Establishments in the activities of the CBR. This participation will be accompanied by a certain effort of the JRC's own research.

Ispra will further continue to assure in the earlier stages its technical assistance in results evaluation and statistical analysis.

SUPPORT TO THE COMMUNITY
BUREAU OF REFERENCE

Area : Specific Support to the
Commission's Sectoral Activities
Programme : Support to the Community Bureau
of Reference

1. Description

The JRC will continue to provide scientific and technical support for the indirect action programme of the Community Bureau of Reference. The support will take the form of organizing and co-ordinating specialist groups in areas that come within the competence of JRC teams involved in its programmes, and, in the earlier stages, assistance in the statistical processing of results.

2. Subprojects

These activities relate to a wide variety of fields - notably physics, analytical chemistry, mechanics and non-destructive testing - and include :

- the organization of groups of experts,
- the technical evaluation of results, and
- the preparation of summary reports.

Moreover, the statistical processing and evaluation of measurement results will continue to be handled at Ispra as far as required.

3. External collaboration

The contractors for the CBR Indirect Action programme.

SUMMARY TABLE

PROGRAMME : E.3 SUPPORT TO THE COMMUNITY BUREAU OF REFERENCE

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
TOTAL	262	-	109	371	17 *
1980	60	-	29	89	
1981	62	-	25	87	
1982	67	-	27	94	
1983	73	-	28	101	

* Research staff of 170 were allocated to the corresponding programme in the period 1977-1980 and corresponded to the whole of the METRE programme (both nuclear and non-nuclear)

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"REFERENCE MATERIALS AND METHODS" (CBR)

OPINION OF ACPM ON THE NON NUCLEAR METRE PROGRAMME
(DIRECT ACTION)

The ACPM wishes to draw the attention of the Commission on the economic importance of a programme of activities in the field of reference Materials & Methods, and the excellent results obtained in this field by the close collaboration of the JRC with the CBR.

It considers that a high priority should be given to the continuation of a European activity in RMs. It strongly recommends the continuation of support by JRC to CBR actions and also a suitable METRE programme.

It proposes that a part of the activities of the JRC, within the CBR framework, should become well identified permanent major functions.

If the Director General of the JRC intends to include a METRE non nuclear proposal in the future programme of the JRC according to the recommendation of ACPM, the Committee proposes to the Commission to define clearly the future role of JRC within the framework of CBR.

As immediate consequence of this recommendation a further option for the next JRC programme should be formulated for presentation to CCG.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"REFERENCE MATERIALS AND METHODS" (CBR)

OPINION OF ACPM ON THE INDIRECT ACTION -
REFERENCE MATERIALS AND METHODS AND APPLIED METROLOGY

Having received official information that approval of the indirect action programme has been delayed pending the decision on the non nuclear METRE direct action, the Committee strongly underlines the necessity of an immediate positive decision on the continuation of the indirect action programme which this Committee unanimously approved considering the intrinsic validity of its different parts.

The ACPM recalls the importance of continuing the indirect action on reference materials and methods (CBR) and to undertake collaborative work at Community level in the field of Applied Metrology.

Although the work in the field of reference materials has been the subject of collaboration between direct and indirect action, the indirect action could be continued if necessary independently, with success, but on a somewhat smaller basis and with some changes in the procedures.

The work on Applied Metrology is purely an indirect action.

E.4. TRAINING AND EDUCATION

E.4. Training and Education

The organization of the "Ispra Courses" will be continued. Since their start 60 courses or seminars have been held. Subjects covered are closely related to the activities of the Centre.

The teaching is undertaken by the Centre's scientific personnel and by invited lecturers. The contribution of the latter, who are always recognized experts in their fields, is an attractive feature of these courses.

During the years ahead the number of courses will be increased, and increased consideration will be given to the particular needs of countries associated to the Community by various co-operation agreements.

A particular effort will be devoted to the development of practical work.

TRAINING AND EDUCATION

Area : Specific Support to the Sectoral
Activities of the Commission
Programme : Training and Education

1. Description

This programme is aimed to contribute:

- to the dissemination of knowledge available in the JRC as a result of the research activities
- to satisfy the growing demand of continuing education for scientific and technical staff in Europe
- to improve exchange and ties between scientific workers in Europe in subjects in relation with the JRC Programme.

These objectives will be implemented through the organization in Ispra of courses and seminars of short duration (some days to some weeks) advertised on a public basis in european countries.

This activity will continue that one organized in the framework of the 1973-76 and the 1977-80 programmes.

An additional activity will be set up in favour of participants coming from the countries of the LOME Convention and from Associated Countries of the Mediterranean zone.

2. Subprojects

About 20 courses or seminars per year will be organized in the various disciplines dealt with in the general programme of the establishment: nuclear energy, new energies, environment, informatics, etc.

The subjects will be selected in order that a significant contribution to the lecturers from JRC scientific staff be feasible.

Emphasis will be placed on subjects where the position of JRC seems specially favourable.

3. External collaborations

The formula of organizing courses in cooperation with other organizations (e.g. universities, R & D organizations, scientific societies, professional organizations etc.) or under their formal sponsorship has proven its usefulness and will be used where feasible.

Moreover the integration of invited lecturers (~ 50% of the total) in the courses contributes also to cooperation with the organizations where they are coming from.

SUMMARY TABLE

PROGRAMME : E.4 TRAINING AND EDUCATION

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
TOTAL	544	-	-	544	9*
1980	52	-	-	52	
1981	155	-	-	155	
1982	164	-	-	164	
1983	173	-	-	173	

* Research staff of 5 were allocated to the corresponding programme in the period 1977-1980.

E.5. VALORIZATION OF RESEARCH RESULTS

E.5. Valorization of Research Results

According to the rules in force, persons and organizations of Member States have the right to obtain non-exclusive licenses on patents and know-how owned by the Community, where they are able to make effective use of the inventions resulting from the execution of research programmes.

This valorization programme is intended to facilitate the technology transfer of promising inventions by improving the information on the programmes and on the results obtained, and by providing technical support to licensees for bridging the gap between the research laboratory and successful exploitation of the inventions on the market.

This action is carried out in close co-operation with D.G. XIII.

VALORISATION OF RESEARCH RESULTS

Area : Specific Support to the Sectoral
Activities of the Commission
Programme : Valorisation of Research Results

1. Description

The project intends to make maximum use of the research activity of the JRC by transfer of immediate results (during the programme work of the JRC being in progress) to a variety of industries.

The technical and legal aspects of the technology transfer process by giving licenses on JRC patents and knowhow are dealt with by the Directorate General XIII - Direction A.

It seems important to set up a mechanism for supporting valorisation projects with specifically assigned persons and resources to overcome the difficulties due to the typical time gap (3 - 5 years) between the invention and the moment of opportunity for its valorisation. By this mechanism a more effective cooperation between DG XIII and JRC could be promoted.

A number of actions under the general heading "assistance" (listed under item 2) are therefore proposed, through which the JRC would provide a technical help to DG XIII and at the same time would demonstrate its growing interest towards valorisation of its own research.

2. Subprojects

a) Support to patent examination

Experimental work to support the claims and for the relation of patents should be provided by the inventor on request of DG XIII.

b) Further development of inventions

Assistance of the inventor (and his collaborators) by e.g. experimental work for to file additional provisional specifications, for an assessment of the commercial viability of the invention and for an eventual improvement of the accuracy and technical adequacy of the specifications.

c) Support to licensees

Bridging the gap between the research laboratory and the successful exploitation of the invention on the market, by means of ad hoc agreements with the licencees.

d) Valorization of the fall-out of research results

Measures are to be foreseen to ensure a continuous process of evaluation and monitoring for every project in order to examine the conditions under which its results could best be applied (support to adapted and appropriate technologies). As a consequence contribution to the development of prototypes, demonstration projects, research contracts, etc. are envisaged. Although consistent support is expected from the involved research programmes, a minimum amount of ready-to-use resources is needed.

e) General information

To improve public information on JRC activities and results it is foreseen to participate to topical fairs and exhibitions (2 – 3 times per annum), participate to exhibitions of general interest (1 time per annum), elaborate descriptive material (brochures, technical notes, newsletters) on JRC activities and results.

3. External collaborations

The patenting process involves continuous contacts with external patent agents and organisations, which are extremely numerous and distributed over all member countries. In the field of technology transfer valorisation agreements are usually established with relevant national organisations (some member states have one valorisation organisation, some have several and some have none).

4. Planning

According to the specific nature of this project, no time planning could be given. The essential character of these activities is to respond in a flexible way to the situation of requirement.

SUMMARY TABLEPROGRAMME : E.5 VALORIZATION OF RESEARCH RESULTS

Project	Specific Appropriations			Total	Research staff
	Operating expendit.	Invest- ments	Contracts		
TOTAL	306	-	204	510	4 *
1980	70	-	47	117	
1981	74	-	49	123	
1982	79	-	52	131	
1983	83	-	56	139	

* No equivalent programme in the period 1977-1980.

E.6. PROVISION OF SCIENTIFIC AND TECHNICAL SERVICES ON REQUEST

E.6. Provision of Scientific and Technical Services on Request

The activities which the JRC carries out on demand for the other services of the Commission fall into two categories :

- Technical evaluations which use systems analysis methods to study different problems in, for example, energy, transport, agriculture, regional development, and the environment, and which provide the technical elements for the appreciation of the desirability of various actions.
- Technical assistance which generally concerns the expertise and services on request which the JRC is able to provide in response to requirements expressed by the other services of the Commission by virtue of its teams, skills and installations.

This assistance involves in particular the technical management of projects deriving from the policies conducted by other Directorates-General. Such actions make a particular contribution to the co-ordination of programmes carried out simultaneously.

TECHNICAL EVALUATIONS

Area : Specific Support to the Sectoral
Activities of the Commission
Programme : Service on Request
Project : Technical Evaluations

1. Description

In order to function effectively, the Commission must be provided with general information concerning the development of our society together with the necessary tools for analysing it. The JRC shall act for the Commission as a continuous source of technical advice and take an active part in setting up and running an information network. Three outstandingly important aspects of the deployment of resources, which happen to fit particularly well with the competences of the JRC, should be emphasized:

Resources (e.g. model of regional development, studies on agricultural production patterns, raw material problems)

Energy (e.g. analysis of the energy system, evaluation of technological progress, studies on energy conservation)

Environment (e.g. collecting and updating information concerning ecological models, providing reasonable scenarios of the geographical distribution of pollutants emission)

The identification of these areas as most typical of the JRC's possible technical support to the Commission stems on the one side from past experience and on the other from the Commission's need for a continuous source of information best based on a lively interdisciplinary background.

The presentation of a consistent set of proposals does not mean that technical evaluations for the Commission are intended here as being carried out by a single team of people. A good deal of the activities upon request will be carried out by people engaged part-time or for limited periods, although it is hoped that their work will find links with a consistent set of continuous studies.

2. Subprojects

a) Resources

This chapter is dealing generally with constraints on development and more specifically with such general aspects of the life of the Community as regional economics, agriculture and deployment of raw materials.

If general studies have to be carried out concerning the development of resources in particular areas, then it is sensible to develop a methodology aimed at assessing the mutual interaction of various resource consuming activities. An effective support to the development of such a general background competence of the Commission might be useful.

As far as particular areas in which effective contributions can be given (e.g. Regional policies, Agriculture, Analysis of industrial activities, Raw materials: constraints, recycling), the activities of the JRC will be confined to a few subjects corresponding to the requests made by various G.D.'s.

b) Energy

This chapter concerns specifically the analysis of the European energy system and the evaluation of the possible penetration of various technologies.

As a tool for placing sectoral evaluations about technologies and energy consumption in a general perspective, the energy flow model LABYRINTH, which has been developed in the JRC, could be applied. The model has been already successfully used for many activities

carried out on request of GD XII and GD XVII. Tasks as Prospects for advanced technologies and energy carriers, Energy conservation and location problems are envisaged. The setting-up of an EC Data base is regarded to be helpful.

c) Environment and technology assessment

This chapter is covering some aspects of the impact of industrial development on our environment and our society. Technical support of various types, which can be classified in this category, has been requested in the past by various GD's. This proposal matches with the proposals a) and b). The activities in the future will be of a similar character as the ones of the past having dealt with: Support to indirect activities concerning ecological models, Investigations about particular sectors of industry, Siting problems and Transport problems.

3. External collaborations

For instance:

- Energy Technology Support Unit (ETSU), AERE Harwell
- Brookhaven National Laboratory, N.Y.
- Institut Economique et Juridique de l'Energie, Grenoble
- International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
- International Federation of Institutes for Advanced Studies (IFIAS), Stockholm
- Department of Energy, USA
- Kernforschungsanlage Jülich
- Kernreaktorzentrum Karlsruhe
- UKAEA Winfrith and Risley
- CEA Saclay
- Institute of Gas Technology, Chicago

4. Planning

According to the specific nature of this project, no time planning could be given. The essential character of these activities is to respond in a flexible way to the situation of requirement.

TECHNICAL ASSISTANCE

Area : Specific support to the sectoral activities of the Commission
Programme : Service on Request
Project : Technical Assistance

1. Description

An important and expanding activity of the JRC consists in providing the Commission with a technical and scientific assistance in analyses of technical problems required e.g. by the implementation of new regulations, in the evaluation of research proposals, development of technical annexes to collaboration contracts, technical management of contracts, comparisons and synthesis of results, preparation and animation of joint research venture, intercalibration campaigns, etc... These activities may involve a number of national laboratories also.

On the other hand, the requirements of independency and secrecy which often are needed for the execution of the work, can be satisfied in a laboratory operated by the Commission like the JRC.

The first two subprojects (a, b) listed below are already ongoing analyses in collaboration with DG V and DG III. Subprojects c - n represent examples of items which are appropriate to be treated.

Sub-projects o and p are examples of the assistance which has developed widely in recent years to the point where the JRC has been fully entrusted with the technical management responsibility (project leader) of various projects on behalf of the indirect actions of DG XIII in the same fields where the JRC is currently running a direct action such as reference materials, solar energy and hydrogen. Under consideration similar arrangements are with DG III, DG XVII, etc. within Action Plans or Demonstration Programmes.

2. Subprojects

Part I - Analysis and development of methods

- a) Heavy metals in blood: quality control, reference laboratory
- b) Fertilizers: study of analytical procedures
- c) Support to the Common Custom Tariffs: chemical analysis
- d) Dairy products and food stuffs: assessment of laboratory equipment and analysis techniques
- e) Release of toxic elements from domestic kitchenware: measurements as a function of temperature and time
- f) Analysis of atmospheric pollutants
- g) Measurements of physical atmospheric parameters
- h) Stable isotopes studies: studies of the soil-plant system, studies of animal nutrition and physiology, studies of plant biochemistry
- i) Adaptation of X-ray diffraction method to specific applications
- k) Improvement of analytical methods for water pollution problems
- l) Biodegradability of surfactants: research of control methods for EC Council directives
- m) Cosmetics: development of analytical methods and reference materials
- n) Fire behaviour of construction material

Part II - Technical Assistance to project management

- o) Secretariat and technical assistance to management of experts working groups
- p) Technical assistance to project management (project leader) on behalf of indirect actions.

3. External collaborations

In general the activities proposed (like the ones a to l) could be undertaken in common laboratories belonging to the member states. However, the listing of different laboratories can be prepared only when the choice of activities will be done.

For activities like the ones u and v the collaboration with external organizations and industrial firms will be a natural feature.

In particular the collaboration will involve international agencies like IEA, Paris; National Professional Organizations and national and private laboratories to which the contracts will be placed by the Commission GD's.

4. Planning

The planning will be established after the topics will be selected respectively will depend on the timing of the various actions and contracts.

SUMMARY TABLE

PROGRAMME : E.6 PROVISION OF SCIENTIFIC AND TECHNICAL SERVICES ON REQUEST

Project	Specific Appropriations				Research staff
	Operating expendit.	Invest- ments	Contracts	Total	
TOTAL	222	--	154	376	132*
1980	52	-	34	86	
1981	54	-	38	92	
1982	56	-	40	96	
1983	60	-	42	102	

* Research staff of 13 were allocated to the corresponding programme in the period 1977-1980.

F. OPERATION OF LARGE-SCALE INSTALLATIONS

F.1. OPERATION OF THE HFR PETTEN

F.1. Operation of the HFR Petten

The operation of the reactor will continue to the benefit of the research programmes of the participating Member States and for the JRC's own requirements. Outside clients will also be able to use the irradiation facilities on payment.

During the next programme the teams will continue the maintenance and upgrading of the reactor and the development and improvement of the irradiation equipment and apparatus to enable this installation to hold its place among the most important means of irradiation of the Community.

OPERATION OF THE HFR PETTEN

Area : Operation of large-scale installations
Programme : Operation of the HFR Petten

1. Description

Within the new programme the reactor operation will be pursued for the benefit of research projects of participating member states as well as for own JRC projects. Available irradiation space will then be used, against payment, by other clients and for radioisotope production. The 1980-1983 irradiations will be carried out in support of :

- light water reactor development, in particular transient fuel irradiations and experiments in the scope of reactor safety,
- fuel and structural material testing for high temperature reactor development,
- fast reactor fuel development; advanced fuel tests under stationary and transient conditions as well as vessel material irradiations
- fusion reactor structural materials development

The horizontal beam tubes, on the other hand, will be used for nuclear physics and solid state physics research.

Improvements of the pool side irradiation facilities are planned within the new programme. They will be introduced together with the replacement of the reactor vessel. Moreover, the construction of a new active working area is foreseen providing, among others, a remote encapsulation facility for pre-irradiated fuel pins.

2. External collaboration

With most Nuclear Research Centres within the Community,

3. Planning

Operation and utilization of HFR Petten are continuous tasks, following detailed time schedules which are up-dated periodically.

SUMMARY TABLEPROGRAMME : F.1 OPERATION OF THE HFR PETTEN

Project	Specific Appropriations			Total	Research staff
	Operating expendit.	Invest- ments	Contracts		
TOTAL	1326	-	713	2039	41 *
1980	303	-	163	466	
1981	321	-	173	494	
1982	341	-	183	524	
1983	361	-	194	555	

* Research staff of 41 were allocated to the corresponding programme in the period 1977-1980.

ADVISORY COMMITTEE ON PROGRAMME MANAGEMENT

"HIGH FLUX REACTOR"

S T A T E M E N T

1. During a special meeting on February 12, 1979, the Advisory Committee for Programme Management on "High Flux Reactors" has reviewed and discussed the proposals for the continuation of the HFR programme during 1980/83.
2. The discussion was based upon the following documents :
"Preparation of the JRC Programme 1980/83. Module : HFR Petten" of 22 January 1979, and Part. F.1. of document CCG 250/251, as well as on additional verbal information supplied by JRC Petten.
3. The Committee acknowledges the analysis made of the possible long-term utilization, covering the 1980/83 period and opening a perspective beyond 1983.
4. Concern is expressed about the insufficient number of programme research staff, leading to a restriction in reactor utilization and delays to irradiation programmes. The Committee recommends that an increase of the Research Staff from 41 to at least 46 is proposed to the Council.
5. The Committee draws attention to the risks to the programme should cost increases beyond average inflation of certain HFR expenses occur (e.g. fuel cycle costs, operation expenses).
6. The Committee endorses the approach of assuring the long-term availability and improvement of HFR Petten by making necessary investments, e.g. vessel replacement. In this connection the Committee regrets that the "active workshop" mentioned in the documents has had to be abandoned due to a lack of funds.

7. It confirms the present and future importance of HFR Petten for programmes of JRC and of Member States, and recommends the execution of the programme along the lines proposed in the above-mentioned documents.