COMMISSION OF THE EUROPEAN COMMUNITIES

COM(81) 551 final

Brussels, 1st October 1981

ARRANGEMENT BETWEEN THE UNITED STATES NUCLEAR REGULATORY COMMISSION (USNRC) AND THE COMMISSION OF THE EUROPEAN COMMUNITIES ON BEHALF OF THE EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM) ON IN-PILE LIGHT WATER REACTOR (LWR) LOSS OF COOLANT ACCIDENT (LOCA) SIMULATION

(Communication from the Commission to the Council)

COM 551

1.

SUBJECT : Communication to the Council concerning an Arrangement between the United States Nuclear Regulatory Commission (USNRC) and the Commission of the European Communities on behalf of the European Atomic Energy Community (EURATOM) on In-Pile Light Water Reactor (LWR) Loss of Coolant Accident (LOCA) Simulation.

---

1. The current 1980-1983 multiannual research programme of the Joint Research Centre (JRC), decided by the Council on 13 March, 1980 (1), includes the Super-SARA Project, to be conducted in the ESSOR reactor at the Ispra Establishment, as its single most significant contribution to LWR safety research. One of the main aims of this project is to investigate by simulation in the reactor (in-pile) the behaviour of reactor fuel in loss of coolant accident conditions.

   This area of LWR safety research is a major international priority, in particular following the Three Mile Island (TMI) incident in the United States on 28 March, 1979.

2. Throughout its discussions leading to the Decision on the current multiannual programme of the JRC, the Council stressed the importance of international cooperation in the Super-SARA project. It was informed at the time of its Decision that the Commission had entered into negotiations with the USNRC for a possible such cooperation, and that the USNRC contribution to the project, which would be in kind, had already been taken into account in the estimated cost of the project to the Community (2).

3. The Council was informed of the subsequent development of the Commission's negotiations with the USNRC during 1980 in the Commission's communication to the Council on the Execution of the First Phase (1980) of the Super-SARA Project (3). In reaching its Decision on the second phase of the project (1981-1983), the Council again noted that the value of the expected USNRC contribution in kind had been taken into account in the estimated cost of the project to the Community (4).

---

(1) O.J. n° 272 of 18 March, 1980, p.11
(2) Council document 5422/80 (ATO 31) of 4 March, 1980, p.3
(3) COM (80) 750 final of 27 November, 1980, p.40
(4) Council document 7107/81 (ATO 46) of 19 May, 1981, p.3

4. At the same time, the Advisory Committee on Programme Management "Reactor Safety" and the General Advisory Committee of the JRC were kept fully informed of the development of the Commission's negotiations with the USNRC.

5. These negotiations have now successfully arrived at the text of a draft agreement (in the form of an Arrangement) and annexes which is acceptable to both sides. In addition to regulating the use of information and patents between the two parties (article 5), its main features are :

- the USNRC will make available to EURATOM the relevant information related to the USPBF experiment (article 3). The Super-SARA Task Force, established by the Commission in June 1980 to give technical support to the Commission in the definition of the Super-SARA programme objectives and to ensure the linking of this project to other related experiments, identified the importance of the PBF experiment in this context and the need to ensure the complementary/confirmatory relationship between these two projects, in particular through the pooling of information (5);

- the USNRC defines the in kind contribution which it is to make to the project (annex 3) at an annual level which it estimates as roughly equivalent to a minimum of US $ (1981) 1.5 million, subject to continued annual US Congress funding for the project. This would represent a contribution of US $ 4.5 million for the years 1981-1983 under the current multiannual programme of the JRC or US $ 10.5 million over the 7 year period covered by the Arrangement. The estimated cost to the Community of the project (at May 1981 prices) in the period of the current multiannual programme of the JRC is 54.03 MioEcus, or 107.53 MioEcus for the 7 year period 1980-1986 (6).

- the Arrangement provides for the consultation of the US NRC in the execution of this cooperation.

6. The Arrangement gives concrete expression to the framework "Arrangement between the United States Nuclear Regulatory Commission and the European Atomic Energy Community in the field of Nuclear Safety Research" concluded on 19 March, 1979 . This provides inter alia, and subject to the conclusion of separate agreements between the parties, for the execution of joint programmes and cooperative research projects and for the exchange of information in defined areas of nuclear safety research conducted by the USNRC or EURATOM through the JRC, in this case Primary Coolant System Rupture Studies and Loss of Coolant Accident Studies and Analyses by the USNRC and In-Pile Simulation of LOCA by the JRC.

7. The implementation of this Arrangement will entail no additional expenditure for the JRC budget.

---

(5) COM (80) 750 final of 27 November, 1980, p.5
(6) Council document 7107/81 (ATO 46) of 19 May, 1981, p.2-3

8. The legal basis for the Arrangement is Article 101, (3.) of the EURATOM Treaty which specifies that agreements whose implementation does not require action by the Council and can be effected within the limits of the relevant budget shall be negotiated and concluded solely by the Commission.

9. The Commission now informs the Council of its intention to conclude an arrangement with the US NRC in conformity with the procedure envisaged by Article 101. (3.) of the EURATOM Treaty. The draft Arrangement and annexes are attached to this communication.

D R A F T

ARRANGEMENT BETWEEN

THE UNITED STATES NUCLEAR REGULATORY COMMISSION
(HEREAFTER CALLED USNRC)
AND
THE EUROPEAN ATOMIC ENERGY COMMUNITY
(HEREAFTER CALLED EURATOM)
REPRESENTED BY THE COMMISSION OF THE EUROPEAN COMMUNITIES
ON

IN-PILE LWR LOCA SIMULATION

The USNRC and EURATOM consider it will be mutually beneficial to cooperate in the field of reactor safety research.

As the USNRC and EURATOM have agreed in their bilateral general arrangement on cooperation in the field of nuclear safety research (hereafter called bilateral arrangement), signed in 1979, Art.II.5 of this bilateral arrangement foresees the possibility of cooperative research projects based on the facilities owned or operated by one of the parties;

As the multiannual programme 1980-1983 of the Joint Research Centre of the Commission of the European Communities contains an activity on reactor safety to which this cooperation will directly contribute;

As the ESSOR reactor, owned and operated by the Joint Research Centre, together with its Super-SARA circuit, have particular characteristics of interest for the LWR safety research;

As this safety research has complementary characteristics to the research work undertaken by the USNRC facilities;

The following technical cooperation will be undertaken.

./.

The contracting parties agreed as follows :

ART.1 - OBJECT

This arrangement covers the safety research area concerned with LWR fuel behaviour under loss-of-coolant accident conditions.

The USNRC participates to a Community research programme concerning the experiments in the Super-SARA circuit of the ESSOR reactor. This participation concerns the preparation of the programme, its execution and the evaluation of its results. The cooperation has a duration of 7 years, starting January 1, 1981, subject to the provisions of ART.VI of the bilateral arrangement, which reads : "It is understood that the ability of the Parties to carry out their obligations is subject to the availability of appropriated funds."

ART.2 - FORM OF COOPERATION

The cooperation will be executed as foreseen in ART.II of the bilateral arrangement and in particular in the following form :

1. The exchange of technical information in the form of reports, experimental data, computer codes, correspondence, newsletters and oral discussions.
2. The organization of relevant meetings.
3. Short visits by specialist teams or individuals to the facilities of the other Party.
4. Possible temporary assignment of personnel of one Party to the laboratory or facilities of the other Party, each such assignment to be considered on a case-by-case basis and be the subject of a separate attachment of staff agreement between the Parties.
5. The supply of equipment relevant to the execution of the research project.

./.

ART.3 - LIMITS OF COOPERATION

The cooperation will extend to the Super-SARA programme as defined in Annex I of this arrangement.

1. The USNRC will make available to EURATOM information in the relevant field of research pertinent to the timely, successful performance of tests in the currently proposed Super-SARA test programme, which it has the right to disclose either in its possession or available to it, in particular the relevant information related to the US PBF experiment.
2. EURATOM will make available to the USNRC the information relevant to the execution of the Super-SARA project.
3. Each Party will promptly transmit and call to the other Party's attention any information on its research results appearing to have significant safety implications.

ART.4 - EXECUTION OF COOPERATION

The general provisions of ART.IV of the bilateral arrangement apply.

"Each Party will designate as Administrator a senior representative "to coordinate its participation in the overall exchange. A review "meeting of the Administrators or their representatives will be "held at agreed-upon intervals to review the status of exchange "and cooperation established under this Arrangement, to recommend "revisions for improving and developing the cooperation, and to "discuss topics within the scope of the cooperation. The time, place "and agenda for such meetings shall be agreed upon in advance."

Specific provisions concerning the implementation of the scientific-technical content of the present cooperation are given in Annex II.

ART.5 - USE OF INFORMATION AND PATENTS

The provisions of ART.V and VII of the bilateral arrangement apply.

./.

-7-

"EXCHANGE AND USE OF INFORMATION

1. The Parties support the widest possible dissemination of information provided or exchanged under this Arrangement, subject to the need to protect proprietary information as may be exchanged hereunder, and to the provisions of ART.VII, PATENTS.

2. As used in this Arrangement, the following definitions apply :

   (i) The term "information" means scientific or technical data, results or methods of research and development, and any other information intended to be provided or exhanged under this Arrangement.

   (ii) The term "proprietary information" means information which contains trade secrets or other privileged or confidential commercial information, and may only include information which :

      (a) has been held in confidence by its owner; and

      (b) is of a type which is customarily held in confidence by its owner; and

      (c) has not been transmitted by the transmitting Party to other entities (including the receiving Party) except on the basis that it be held in confidence; and

      (d) is not otherwise available to the receiving Party from another source without restriction on its further dissemination.

3. The Party receiving proprietary information pursuant to this Arrangement shall respect the privileged nature thereof, provided such proprietary information is clearly marked with the appropriate legend of the transmitting Party and with the following (or substantially similar) restrictive legend :

"This document contains proprietary information furnished in confidence under an Arrangement date _____ between the United States Nuclear Regulatory Commission and EURATOM and shall not be disseminated outside these organizations, their consultants, contractors and licensees, and concerned departments and agencies of the Governments of the United States and of the member states of EURATOM without the prior approval of _____.

This notice shall be marked on any reproduction hereof, in whole or in part. These limitations shall automatically terminate when this information is disclosed by the owner without restriction.

./.

4. In regard to the dissemination and use of proprietary information received in confidence under this Arrangement, the Parties agree that :

(i) Such information may be disseminated by the receiving Party to persons within or employed by the receiving Party, and to :

(a) concerned government departments and government agencies in the country or member states of the receiving Party;

(b) prime or sub-contractors or consultants of the receiving Party located within the geographical limits of the receiving Party's country or member states, for use only within the framework of their contracts with the receiving Party in work relating to the subject matter of the proprietary information;

(c) organizations permitted or licensed by the receiving Party in the field of development, design, construction and operation of nuclear production or utilization facilities for use only within the terms of such permit or license;

(d) contractors of organizations identified in Item 4 (i)(c) above for use only within the scope of the permit or license granted to such organizations;

provided that any proprietary information so disseminated under sub-paragraphs (b), (c) and (d), above shall be pursuant to an agreement of confidentiality and shall be marked with a restrictive legend substantially identical to that appearing in paragraph 3 above.

(ii) With the prior written consent of the Party providing proprietary information under this Arrangement, the receiving Party may disseminate such proprietary information more widely than otherwise permitted in the foregoing subsection (i). The Parties shall cooperate with each other in developing procedures for requesting and obtaining approval for such wider dissemination and each Party will grant such approval to the extent permitted by its national policies, regulations and laws.

(iii) Each Party shall exercise its best efforts to ensure that proprietary information received by it under this Arrangement is controlled as provided herein. If one of the Parties becomes aware that it will be, or may reasonably be expected to become, unable to meet the non-dissemination provisions of this Article it shall immediately inform the other Party. The Parties shall

./.

thereafter consult to define an appropriate course of action.

(iv) Non-documentary proprietary information provided in seminars and other meetings organized under this Arrangement, or information arising from the attachments of staff, use of facilities or joint projects shall be treated by the Parties in accordance with the principles specified in this Article, provided, however, that the Party communicating such proprietary information places the recipient on notice as to the character of the information communicated.

(v) Nothing contained in this Arrangement shall preclude the use or dissemination of information received by a Party from the sources outside this Arrangement.

(vi) Information given by one Party to the other under this Arrangement shall be accurate to the best knowledge and belief of the Party giving it, but neither Party gives any warranty as to the accuracy of such information or shall have any responsibility for the consequences of any use to which such information may be put by the other Party or by any third party."

"PATENTS

1. As set forth in this Article, "Country" shall be taken to mean;
   (i) The United States of America for the USNRC Party;
   (ii) The Member States of EURATOM for the EURATOM Party.

2. With respect to any invention or discovery made or conceived in the course of or under this Arrangement;
   (i) If made or conceived by personnel of one Party (the Assigning Party) or its contractors while assigned to the other Party (Recipient Party) or its contractors;
      (a) The Recipient Party shall acquire all right, title, and interest in and to any such invention or discovery in its own Country and in third countries, subject to a non-exclusive, irrevocable, royalty-free license in all such countries to the Assigning Party, with the right to grant sub-licenses, under any such invention or discovery and any patent application, patent or other protection relating thereto, for use in the production or

./.

utilization of special nuclear material or atomic energy; and

(b) The Assigning Party shall acquire all right, title, and interest in and to any such invention or discovery in its own Country, subject to a non-exclusive, irrevocable, royalty-free license to the recipient party, with the right to grant sub-licenses under any such invention or discovery and any patent application, patent or other protection relating thereto for use in the production or utilization of special nuclear material or atomic enery.

(ii) If made or conceived by personnel other than the personnel referred to in paragraph (i) above, as a result of attendance at meetings or as a result of employing information which had been communicated under this Arrangement by one Party or its contractors to the other Party or its contractors, the Party of such personnel making the invention shall acquire all right, title, and interest in and to any such invention or discovery in all countries, subject to the grant to the other Party of a royalty-free non-exclusive, irrevocable license, with the right to grant sub-licenses, in and to any such invention or discovery and any patent application, patent or other protection relating thereto in all countries, for use in the production or utilization of special nuclear material or atomic energy.

(iii) With regard to other specific forms of co-operation, including loans or exchanges of materials, instruments and equipment for special joint research projects, the Parties shall provide for appropriate distribution of rights to inventions or discoveries resulting from such co-operation. In general, however, each Party should normally own the rights to such inventions or discoveries in its own Country with a royalty-free, non-exclusive, irrevocable license to the other Party, and the rights to such inventions or discoveries in other countries should be agreed by the Parties on an equitable basis.

3. Neither Party shall discriminate against citizens of the Country of the other Party with respect to granting any license or sub-license under any invention or discovery pursuant to paragraph 1 above.

./.

It is understood that the licensing policies and practices of each Party may be affected because of the rights of both Parties to grant licenses within a single jurisdiction. Accordingly, either Party may request, in regard to a single invention or discovery or class of inventions or discoveries, that the Parties consult in an effort to lessen or eliminate any detrimental effect that the parallel licensing authorities may have on the policies and practices of the Parties.

4. Neither Party will assume the responsibility to pay awards or compensation required to be paid to the nationals of the other Party according to the laws of the other Country."

ART.6 - COSTS

The USNRC will participate in-kind in the costs for the programme at an annual level roughly equivalent to 1,500,000 US 1981 dollars or more, subject to continued annual US congressional funding of programme support and maintenance of SST programme content and progress. This participation will be in the form of supply of test hardware, manpower and services as defined in Annex III.

ART.7 - FINAL PROVISIONS

1. This Arrangement shall enter into force from the date of conclusion thereof, and, subject to paragraph 2 of this Article, shall remain into force for a period of 7 years, unless previously extended by agreement between the Parties.

2. Either Party may withdraw from the present Arrangement after providing the other Party written notice 1 year prior to its intended date of withdrawal.

3. The Parties agree that all discussions, meetings, exchange of documents or other acts of cooperation between them and prior to the entry into force of this Arrangement which, if they had occurred subsequent to the entry into force of this Arrangement, would have been subject to this Arrangement, shall be subject to the terms hereof.

./.

FOR THE UNITED STATES
NUCLEAR REGULATORY COMMISSION

BY : _____

TITLE : _____

DATE : _____

FOR EURATOM
COMMISSION OF THE EUROPEAN COMMUNITIES

BY : _____

TITLE : _____

DATE : _____

ANNEX 1

OUTLINE OF THE SUPERSARA TEST PROGRAM (SSTP)

1. General

During 1980, a Task Force was established by the Joint Research Centre of the Commission of the European Communities to discuss and reach a consensus among the participants on the objectives, test matrix and technological difficulties of the SSTP. This consensus was reached in October 1980 and the program which emerged, designated as the "consensus SSTP", remains the foundation of all on-going work.

The first basic objective of the consensus SSTP is the attainment of data and a deeper generic understanding concerning those aspects of LWR fuel cluster behaviour which can lead to significant fuel damage, core blockage and coolability problems as a result of hypothetical accident situations of a low probability where normal safeguard systems are assumed to be partially or wholly in-operative.

In addition to such an understanding of the thermo-mechanical and thermohydraulics processes governing LWR fuel cluster damage and blockage, a second basic objective is the correlation of the transient fission product release (FPR) occuring during accident situations with the type and extent of the fuel damage provoked.

The consensus SSTP covers fuel cluster behaviour both for the transient conditions of the "large break" loss-of-

.../...

coolant-accident (LB-LOCA) and the transient conditions of other accident scenarios which under certain circumstances could lead to periods of partial core uncovery and higher clad temperatures and a potential for severe fuel damage (SFD). An important example of such a transient leading to SFD is provided by the Three Mile Island (TMI) accident.

It is understood that more emphasis should be placed on the SFD part of the program than on the LB-LOCA part. The reason for this is essentially that, while a considerable amount of work has been started or completed for the LB-LOCA, activities in the SFD field are relatively behind and require intensification.

2. LB-LOCA test program

The LB-LOCA part of the consensus SSTP has been established on the basis that is must be confirmatory with respect to the current out-of-pile LB-LOCA fuel behaviour programs such as REBEKA at the KfK Karlsruhe (which are able to scope well the governing parameters and require only limited in-pile checks to confirm the typicality of rod-simulators performance) and complementary with respect to the current in-pile LB-LOCA programs such as PBF at INEL-Idaho and PHEBUS at Cadarache, France (where the data available or expected should be backed up by in-pile tests which give something new).

The SUPERSARA loop is being fabricated with the design aim to simulate the entire LB-LOCA scenario, blowdown to reflood, by means of control actions on valves and cluster power. This capability will be exploited in order to meet the basic objectives stated above, which, for the LB-LOCA

.../...

take on the following particular form:

- Clad deformation characteristics, likely to be dominated by high strain-rate ballooning, influencing the degree of cluster blockage.
- Interactions caused by deformations which might influence the cluster blockage fraction.
- Rod cluster coolability and thermal response during reflooding.
- Dependence of FPR on the extent of cluster damage.

The consensus LB-LOCA test matrix which fits within the required confirmatory/complementary context is covered by the following tests:

- 4 Tests with 2m long PWR (type 17 x 17) clusters of 32 rods;
- 1 test with a 2m long BWR-type cluster (probably type 8 x 8 R);
- 2 unspecified tests to cover unforeseen requirements of high priority arising at a later stage.

3. Core uncovery and SFD test program

In contrast to the LB-LOCA part, the SFD part of the consensus SSTP seeks to generate a more comprehensive range of data. There is not currently the wide variety of activity for SFD as for the LB-LOCA field: the only other known comparable SFD program is that planned for the PBF at INEL - Idaho, starting in 1982. The PHEBUS program may also propose SFD tests, in which case these will also have to be considered. For the time being, the SSTP has to ensure a

.../...

good complementary/confirmatory relationship only with the PBF program.

Considering the basic objectives stated above and the large array of accident scenarios which may potentially lead to SFD, as occurred in the case of the TMI accident, the SUPERSARA loop has the design aim to simulate the essential common feature of all the SFD scenarios: cluster boildown and uncovery to provoke relevant transient of clad temperature in combination with relevant transients of system pressure, followed by re-submergence and quenching. This capability will be used to address the following particular SFD objectives.

A) Degree of cluster blockage and FPR due to clad deformation and rupture at the low strain-rates possible in "core uncovery" transients, especially considering the effects of clad oxidation on such deformation in the high α-high β range ($\sim$ 1100 - 1650K).

B) Degree of cluster blockage and FPR resulting from the formation of a rubble bed due to the widespread oxidation of the rods (up to $\sim$ 1900K), with or without prior ballooning and rupture, followed by rod fragmentation either by quenching (re-submergence) or system depressurisation.

C) Degree of cluster blockage and FPR resulting from the formation of a Zr/UO_2 liquid solution above $\sim$ 2070K (rod "candling") in the presence of widespread rod oxidation, with or without subsequent rubble bed provocation by quenching.

The consensus SFD test matrix which fits within the required complementary/confirmation relation with PBF, will be attained by means of the following tests:

.../...

- 3 tests with objective (A), all with 2m long PWR type clusters of 32 rods;
- 4 tests with objective (B), 3 with 2m long PWR type clusters of 32 rods, 1 with a 2m long BWR type cluster;
- 5 tests with objective (C), 4 with 2m long PWR type clusters of 32 rods, 1 with a 2m long BWR type cluster;
- 2 unspecified tests to permit the inclusion of unforeseen objectives which may later become of high priority.

TABLE 1: SSTP LARGE BREAK LOCA TEST MATRIX

TEST N°	INTENTIONS	CLUSTER TYPE	CLAD DEFORMATION CONDITIONS	FUEL	COMMENTS
LB - 1	INVESTIGATE CLAD DEFORMATION IN β PHASE IN "HEAT BEFORE LOAD" CONDITIONS	PWR (*)	HEAT-BEFORE-LOAD; DEFORMATION AT $\sim$ 1300K	FRESH PRECONDITIONED	COMPLEMENTARY TO PHEBUS, PBF, NRU
LB - 2	HIGH POTENTIAL FOR CLAD DEFORMATION (HIGH α); "HEAT BEFORE LOAD" CONDITIONS	PWR (*)	HEAT-BEFORE-LOAD; DEFORMATION AT $\sim$ 1070K	FRESH PRECONDITIONED	
LB - 3	AS TEST LB-2 BUT DEFORMATION IN "LOAD BEFORE HEAT" CONDITIONS	PWR (*)	LOAD-BEFORE-HEAT; DEFORMATION AT $\sim$ 1070K	FRESH PRECONDITIONED	CONFIRMS REBEKA, MRBTF
LB - 4	AS TEST LB-3 BUT INVESTIGATE EFFECT OF FUEL BURN-UP I.E. FUEL CRACKING, RELOCATION ETC.	PWR (*)	LOAD-BEFORE-HEAT; DEFORMATION AT $\sim$ 1070K	SOME IRRADIATED RODS	COMPLEMENTARY TO NRU
LB - 5	AS TEST LB-3 BUT CONFIRM EXTRAPOLATION OF PWR TEST RESULTS TO OTHER FUEL GEOMETRIES	BRW (**)	LOAD-BEFORE-HEAT; DEFORMATION AT $\sim$ 1070K	FRESH PRECONDITIONED	COMPLEMENTARY TO PHEBUS, PBF, NUR, REBEKA, MRBTF
LB - 6 LB - 7	2 UNSPECIFIED TESTS TO PERMIT TESTING OF REMEDIAL MEASURES OR ANY OTHER STUDY LATER ENTIRING HIGH PRIORITY				

(*) 17 x 17 TYPE GEOMETRY

(**) PROBABLY 8 x 8 TYPE GEOMETRY

TABLE 2: SSTP CORE UNCOVERY/SEVERE FUEL DAMAGE TEST MATRIX

TEST SERIES A: INVESTIGATION OF EXTENT OF CLUSTER BLOCKAGE AND FISSION PRODUCT RELEASE DUE TO CLAD DEFORMATION UNDER "SMALL AND MEDIUM BREAK" CONDITIONS COMPLEMENTARY TO PBF.

TEST N°	CLUSTER TYPE	INTENTION	TEST TERMINATION/FINAL CONDITIONS
SFD-A-1	PWR (*)	CLUSTER UNCOVERY TO TCLAD ~1080 - 1200K, THEN CLAD LOADING AND BALLOONING BY SLOW PRESSURE RAMP ΔP CLAD ~ 0.005 MPa/S	CLUSTER RE-SUBMERGED AFTER WIDESPREAD CLAD RUPTURE
SFD-A-2	PWR (*)	AS SFD-A-1 BUT WITH TCLAD ~1350K AND ΔP CLAD ADJESTED IN RANGE 0.005-0.05 MPa/S TO GET DESIRED OXIDATION DURING BALLOONING	CLUSTER RE-SUBMERGED AFTER WIDESPREAD CLAD RUPTURE
SFD-A-3	PWR (*)	AS SFD-A-2 BUT WITH TCLAD ~1650K	CLUSTER RE-SUBMERGED AFTER WIDESPREAD CLAD RUPTURE

* 17 x 17 TYPE GEOMETRY

TABLE 2 (CONT.): SSTP CORE UNCOVERY/SEVERE FUEL DAMAGE TEST MATRIX

TEST SERIES B: INVESTIGATION OF EXTENT OF CLUSTER BLOCKAGE AND FISSION RPODUCT RELEASE WITH NO MOLTEN COMPONENT DUE TO ROD FRAGMENTATION AND RUBBLE BED FORMATION; COMPLEMENTARY TO PBF

TEST N°	CLUSTER TYPE	INTENTION	TEST TERMINATION/FINAL CONDITIONS
SFD-B-1	PWR (*)	CLUSTER UNCOVERY TO TCLAD ~ 1900K AT A RATE ~ 0.3 K/s TO PROVOKE CLAD RUPTURE AT ~ 1100K FOLLOWED WIDESPREAD CLAD OXIDATION AND EMBRITTLEMENT. PSYS ~ 8MPa	SLOW COOL-DOWN TO AVOID ROD FRAGMENTATION AND RUBBLE BED
SFD-B-2	PWR (*)	AS SFD-B-1	FAST COOL-DOWN TO PROVOKE ROD FRAGMENTATION AND RUBBLE BED FORMATION
SFD-B-3	PWR (*)	AS SFD-B-1 BUT WITH CLAD RUPTURE OCCURING AT ~1650K	AS SFD-B-2
SFD-B-3	BWR (**)	CLUSTER UNCOVERY TO TCLAD ~ 1500K WITH NO RUPTURE (ΔPCLAD < 0); WIDESPREAD CLAD OXIDATION AT ~ 1500K; SLOW COOL-DOWN TO TCLAD ~ 600K. PSYS ~4MPa	PSYS DROPPED FROM 4 TO 1MPa TO PROVOKE CLAD SHATTERING FOR TCLAD ~600K. SLOW COOL-DOWN CONTINUED TO AVOID FURTHER ROD FRAGMENTATION

* 17 x 17 TYPE GEOMETRY

** PROBABLY 8 x 8 TYPE GEOMETRY

TABLE 2 (CONT.) SSTF CORE UNCOVERY/SEVERE FUEL DAMAGE TEST MATRIX

TEST SERIES C: INVESTIGATION OF EXTENT OF CLUSTER BLOCKAGE DUE TO FORMATION OF A MOLTEN SOLUTION OF UO_2 IN ZIRCALLOY (ROD"CANDLING"), POSSIBLY FOLLOWED BY QUENCH-INDUCED RUBBLE BED; PWR TESTS CONFIRMATORY TO PBF, BWR TEST COMPLEMENTARY

TEST N°	CLUSTER TYPE	INTENTION	TEST TERMINATION/FINAL CONDITIONS
SFD-C-1	PWR (*)	CLUSTER UNCOVERY TO TCLAD ~ 2300K AT A RATE ~ 4 K/s TO PROVOKE CLAD RUPTURE AT ~ 1100 K FOLLOWED BY CLAD OXIDATION, MELTING AND DISSOLUTION OF UO_2 (CANDLING) TO FORM FROZEN SLAG AT COOLER ELEVATIONS. PSYS ~ 8 MPa	SLOW COOL-DOWN TO AVOID RUBBLE BED DUE TO FRAGMENTATION OF RODS AND SLAG
SFD-C-2	PWR (*)	AS SFD-C-1	FAST COOL-DOWN TO PROVOKE RUBBLE BED DUE TO ROD AND SLAG FRAGMENTATION
SFD-C-3	PWR (*)	AS SFD-C-1 BUT WITH CLAD RUPTURE OCCURING AT ~ 1650 K	AS SFD-C-2
SFD-C-4	PWR (*)	AS SFD-C-1 BUT WITH FASTER UNCOVERY TO SIGNIFICANTLY EXCEED 4 K/s TCLAD RAMP TO INVESTIGATE MORE EXTENSIVE CLAD MELTING	AS SFD-C-2
SFD-C-5	BWR (**)	AS SFD-C-1 BUT WITH $\Delta P_{CLAD} \leq 0$ TO GET CLAD CREEP-DOWN INSTEAD OF RUPTURE. POTENTIAL FOR MORE CLAD MELTING AND ASSESSMENT OF BWR SUBASSEMBLY MELT-THROUGH	AS SFD-C-1

* 17 x 17 TYPE GEOMETRY
** PROBABLY 8 x 8 R TYPE GEOMETRY

TABLE 2 (CONT.): SSTP CORE UNCOVERY SEVERE FUEL DAMAGE TEST MATRIX

TEST SERIES D : UNSPECIFIED TESTS

TEST N°SFD-D-1 :) 2 UNSPECIFIED TESTS TO PERMIT STUDIES LATER ENTERING HIGH PRIORITY,
TEST N°SFD-D-2 :) CURRENTLY UNFORSEEN

11

ANNEX II

Bilateral Technical Implementation Committee

The contractiong Parties hereby set up a Bilateral Technical Implementation Committee to assure the execution of the co-operation provided for in this Arrangement.

Each Party will designate its members to this Bilateral Committee and may further designate a technical spokesman.

The Committee shall meet at least annually to review SST programme progress and the effectiveness of the cooperative programme effort. The output from these meetings will be used by the NRC as a part of its annual internal review of the SST programme progress and its continued applicability to current NRC programme objectives.

ANNEX III

The basic USNRC in-kind contribution shall be at an annual level roughly equivalent to 1,500,000 US 1981 dollars or more, (subject to continued annual US congressional funding of programme support and maintenance of SST programme content and progress) as defined in ART.6 of the Arrangement. The form of the US contribution, listed in order of priority, shall be :

1. NRC basic supply of 3 test trains including all precalculations, R&D, operational data, safety analyses, QA-QC results, in addition to the test train hardware and components for tests and schedules equivalent to or better than SFDA-1, SFDB-1 and SFDC-1 of the currently planned SST programme, subject to US cash flow limitations.
2. Long term assignments providing liaison with PNL to assist Ispra in :
2.1. harmonizing with US precalculations and test operational specifications;
2.2. harmonizing with US design and analysis of SFD-TT's;
2.3. assembly of SFD-TT's at Ispra;
2.4. SFD test feasibility and safety assessment;
2.5. co-ordination of PBF test experiment and results (e.g. shroud performance) into Super-SARA planning.
3. Short term assignments providing :
3.1. assistance with loop commissioning activities;
3.2. specification and development of special software for data acquisition system and programme monitoring system;
3.3. assistance in calibration and application of the transient thermo-hydraulic instrumentation;
3.4. assistance in design, testing and application of the transient rod system;
3.5. assistance in the fission product release (FPR) field, with a view to attaining optimal specifications for the Super-SARA FPR monitoring system in the light of US experience with similar equipment.
4. Supporting services in the US :
4.1. special analyses, defined and requested by Ispra and agreed to by NRC, to support;
4.2. back-up for item 2 above;
4.2.1. safety assessment;
4.2.2. test precalculations performed by Ispra.

./.

5. Supply of special components for remaining test trains :

5.1. advanced instrumentation, e.g. :

5.1.1. fused alloy high temperature sensors;

5.1.2. mixture level sensors;

5.1.3. 11 shrouds.

The annual NRC level of SSTP support effort for the several listed activities, is estimated as follows :

item 2 : one man per year for 5 years;

item 3 : eight man months per year for 3 years;

item 4 : seven man years.

The USNRC notes that at the minimum level of in-kind contribution of dlr. 1.5m/year there is high risk that delivery of the three test trains may not be timely. NRC budget projections do not allow for initial annual in-kind contributions of more than dlr. 1.5m thus, the priority schedule may need periodic examination and revision to reflect these limitations. The NRC notes further that total funding will probably not cover more than a small part of the item 5 priorities, e.g. the 11 shrouds in item 5.1.3. probably cannot be provided, either in a timely fashion or within the available annual NRC funding levels.