IMPLEMENTING ARRANGEMENT

CONCERNING IRRADIATION OF EIGHT PINS IN THE PHENIX REACTOR

under the

Agreement between

The Department of Energy of the United States of America

and

The Commissariat à l'Energie Atomique of France

For Cooperation in Advanced Nuclear Reactor Science and Technology

The Department of Energy of the United States of America (DOE) and the Commissariat à l'Energie Atomique of France (CEA), hereinafter referred to as the "Parties";

NOTING the Agreement between the Department of Energy of the United States of America and the Commissariat à l'Energie Atomique of France for Cooperation in Advanced Nuclear Reactor Science and Technology of September 18, 2000 (the "Agreement"), which includes advanced reactor materials irradiation development and testing as an area of cooperation between the Parties;

NOTING that the Parties have respectively developed research programs in the minor actinides transmutation domain, notably in the fuel sector, and that CEA is operating the PHENIX experimental reactor for this purpose;

NOTING that the Parties desire to perform an experimental irradiation project in the PHENIX experimental reactor, to test various types of fuel loaded with minor actinides under constant conditions and acquire data necessary to permit selection of the best-performing fuel prior to any qualification program;

NOTING that the Japan Atomic Energy Research Institute (JAERI), having cooperated in the past with DOE, and the European Commission's Institut des Transuraniens (ITU), having developed a similar research program, have expressed a desire to take part in the Parties' experimental irradiation project; and

NOTING the Parties' determination to collaborate on a "FUTURIX FTA" program concerning the irradiation of eight fuel elements in the PHENIX reactor;

HEREBY AGREE AS FOLLOWS:

ARTICLE 1 - DEFINITIONS

For purposes of this Implementing Arrangement, the following definitions shall apply:

COOPERATING ENTITIES: DOE, CEA, ITU, and JAERI.

DOMAIN: the transmutation of minor actinides (fuel element sector).

PROGRAM: the "FUTURIX FTA" program concerning the irradiation of eight fuel pins in the PHENIX experimental reactor as defined in the technical and financial appendix attached to this Implementing Arrangement as Appendix I and constituting an integral part hereof. The PROGRAM constitutes "joint research" within the meaning of section II-B-2 (C) of Annex I to the Agreement.

RESULTS: manufacturing data as well as analyses results pertaining to irradiated fuel pins and reference samples (not irradiated) arising from the PROGRAM, as well as data pertaining to the PHENIX experimental reactor required for RESULTS interpretation calculations.

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KNOWLEDGE: all know-how, data, specifications, software or any other type of information necessary to perform the PROGRAM belonging to a Party prior to execution of the PROGRAM. A list of KNOWLEDGE is set forth in Appendix II attached to this Implementing Arrangement and constituting an integral part hereof.

ARTICLE 2 - PURPOSE

2.1 The purpose of this Implementing Arrangement is:
- to set out the terms and conditions according to which the Parties will collaborate to perform the PROGRAM, and
- to set out the rules governing the assignment of RESULTS ownership and the conditions limiting usage of same.

2.2 This Implementing Arrangement is subject to and governed by the Agreement. In case of any inconsistency between this Implementing Arrangement and the Agreement, the terms of the Agreement shall prevail.

ARTICLE 3 - PROGRAM FINANCIAL AND IN-KIND CONTRIBUTIONS

3.1 Contributions by the Parties, subject to the availability of appropriated funds, are:

3.1.1 DOE contributions, after deduction of the monetary value (to be mutually agreed by the Parties) of in-kind material provided, shall consist of:

- contribution in cash covering 50% of the following costs:
  - manufacture and test/inspection of pins, with their extensions,
  - transportation of eight pins from ITU to PHENIX, and from PHENIX to the analysis laboratories,
  - procurement, assemblies, controls, disassemblies and post-irradiation analyses necessary for the capsule, drafting the files and drawings associated with the irradiation device and CEA/PHENIX facility safety/criticality analyses,
  - irradiations (irradiation monitoring and analysis file, neutrons).
- contribution in-kind relating to:
  - provision to ITU and CEA of a quantity of americium oxide necessary to manufacture pellets for irradiation and for the upstream R&D phase to perfect manufacturing,
  - manufacturing, transportation of pellets.

3.1.2 CEA contribution shall consist of

- contribution in cash covering 50% of the following costs:
  - manufacture and test/inspection of pins, with their extensions,
  - transportation of the 8 pins from ITU to PHENIX, and from PHENIX to the analysis laboratories,
  - procurement, assemblies, controls, disassemblies and post-irradiation analyses necessary for the capsule,

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- drafting the files and drawings associated with the irradiation device and CEA/PHENIX facility safety/criticality analyses,
- irradiations (irradiation monitoring and analysis file, neutrons).

- contribution in kind relating to:
  - purification of the quantity of americium oxide necessary to manufacture pellets for irradiation and for the upstream R&D phase to perfect manufacturing,
  - manufacturing and transportation of pellets.

3.2 Potential contribution from JAERI:
The Parties expect a contribution from JAERI of 10% of the total PROGRAM cost to be made in exchange for access to all nitride-related RESULTS from the PROGRAM. The Parties also expect JAERI to make available its nitride-related data. CEA shall be responsible for securing JAERI's contribution.
This JAERI contribution shall reduce the DOE and CEA contributions in equal part.

3.3 Contribution from ITU:
CEA shall be responsible for obtaining ITU's technical contribution and be responsible for ITU's access to the RESULTS.

3.4 The provisional PROGRAM schedule, including proposed contribution schedule, is described in detail in Appendix I.

ARTICLE 4 - FINANCIAL ACCOUNTING

4.1 The Parties estimate the total cost of the six-year PROGRAM will be 6,493,037 Euros

4.1.1 Subject to Article 3.2, DOE's contribution to the PROGRAM will be payable in U.S. dollars, in 6 annual installments, within 60 days after receipt of invoices issued by CEA. Each annual invoice will be sent to DOE on the anniversary date of signature of this Implementing Arrangement and will include U.S. dollar to Euro conversion charges, at the rate given by "Banque de France" on such anniversary date, payable by DOE.

4.1.2 DOE intends to make an initial payment of 500,000 Euros within 60 days of the date that this Implementing Arrangement enters into force. All subsequent payments are subject to adjustment in accordance with Article 3.2.

4.2 DOE will pay its contribution to the PROGRAM in accordance with applicable DOE financial disbursement procedures, directed to the following payee:

CEA/CADARACHE
UG/TD
Bât.130
13108 Saint Paul lez Durance Cedex, France

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Bank account :
BNP, 7 place Vendôme, 75001 Paris, France
Bank code: 30004 – branch office code: 00601 – account n°: 00021518978 – Clé RIB: 21

4.3 CEA shall maintain or cause to be maintained books of account, in accordance with generally accepted accounting practices, concerning PROGRAM contributions and expenditures. On an annual basis for the duration of the PROGRAM, CEA shall provide an annual financial report concerning the PROGRAM to the Steering Committee established under Article 5 of the Agreement.

4.4 At its sole cost, DOE shall have the right to audit the account maintained under Article 4.3 of this Implementing Arrangement. Not more than one such audit will be performed in any U.S. fiscal year.

ARTICLE 5 - MANAGEMENT

5.1 Tracking

5.1.1 Each Party will appoint a Contact who will be entrusted with management and continual tracking of the PROGRAM, including the exchanges of KNOWLEDGE. Each Contact will report to his/her management concerning the progress of the PROGRAM.

5.1.2 The Contacts will make an annual report on the progress of the PROGRAM to the Steering Committee established under Article 5 of the Agreement. If necessary to complete the PROGRAM, such financial report may include a recommendation for additional financial and/or in-kind contributions by the Parties or others.

5.2 Exchange of KNOWLEDGE

5.2.1 All KNOWLEDGE in the possession of the Parties necessary for the dimensioning of fuel pins, drafting of irradiation files (technical file and safety file), and interpretation of post-irradiation analysis results, will be exchanged in the form of referenced technical documents. CEA shall be responsible for obtaining ITU's and JAERI's KNOWLEDGE and providing it to DOE.

5.2.2 Technical documents will be circulated in the English language.

5.3 Circulation of RESULTS

5.3.1 Subject to the provisions of Article 3.2, all RESULTS pertaining to the manufacture of fuels, characterisation of fuels, measurements of fuel properties, dimensioning and design of the irradiation device, irradiation safety and technical studies, and the history of irradiation at post-irradiation analyses will be circulated among the COOPERATING ENTITIES in the form of technical reports.

5.3.2 A synthesis file covering the entire PROGRAM will be jointly drafted by the Parties upon completion of the PROGRAM.

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5.3.3 Technical meetings of specialists will be held as often as required in order to ensure monitoring and correct performance of the PROGRAM. The location of said meetings will be jointly agreed by the Contacts. All COOPERATING ENTITIES will be routinely invited. Minutes will be drafted for all meetings.

5.3.4 Reports and minutes will be drafted in the English language by the main actors. The latter are designated in Table 1 of Appendix I.

ARTICLE 6 - INTELLECTUAL PROPERTY

6.1 The protection and allocation of intellectual property arising under the activities conducted under this Implementing Arrangement shall be governed by Annex I to the Agreement.

6.2 A technology management plan within the meaning of section II.B. of Annex I to the Agreement is set forth in Appendix III attached to this Implementing Arrangement and constituting an integral part hereof.

ARTICLE 7 - LIABILITY

Without prejudice to Article 8 of the Agreement and in its capacity as the nuclear operator, CEA shall bear the financial consequences of its liability as provided for by the law and regulations of France concerning France's implementation of the Paris Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960, and its protocols.

ARTICLE 8 - SHUTDOWN OF THE PHENIX REACTOR

8.1 In the event a decision is made to shut down operation of the PHENIX reactor, CEA shall notify DOE of said decision as quickly as possible by registered letter.

8.2 In the event of the shutdown of the PHENIX reactor, the Parties shall consult as soon as possible on the distribution of KNOWLEDGE generated and to be generated by the PROGRAM, the disposition of material utilized in the PROGRAM, and the disposition of unspent financial contributions in the possession of CEA.

ARTICLE 9 - TERM, AMENDMENT AND TERMINATION

9.1 This Implementing Arrangement shall enter into force upon signature and shall remain in force for 6 years, so long as the Agreement remains in force. It may be amended or extended by written agreement of the Parties, so long as the Agreement remains in force..

9.2 In the event of budgetary restrictions, significant restructuring and/or reorientation of a Party's programs, or in the event that access to a Party's facilities is limited for any reason whatsoever, or if a Party's performance of its undertakings under this Implementing

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Arrangement is prevented, limited or hindered by any other circumstance, the Parties will meet as quickly as possible in order to jointly agree to a revision of the Implementing Arrangement or its prolongation in time (to permit continuation of the PROGRAM to completion), or the early termination of the Implementing Arrangement, under conditions that are fair to the Parties.

9.3 The provisions set out in Article 7 shall remain in effect notwithstanding the expiration or termination of this Implementing Arrangement.

9.4 Either Party may terminate this Implementing Arrangement by giving 6 months written notice to the other Party.

9.5 Any activities not completed upon expiration or termination of this Implementing Arrangement may be continued to completion under the terms of this Implementing Arrangement

DONE in duplicate both in the English and French languages. The English version prevails.

FOR THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA:

Date: August 24, 2004

Place: Paris, France

FOR THE COMMISSARIAT A L'ENERGIE ATOMIQUE OF FRANCE:

Date: 24-08-2004

Place:

APPENDIX I
TECHNICAL AND FINANCIAL APPENDIX

TECHNICAL APPENDIX:

Experimental grid

The irradiation experimental grid was commonly defined and approved by all PROGRAM participants (CEA/ITU and DOE) during the meeting of the "fuel and materials" workgroup (WG2) constituted in the framework of the CEA-DOE collaboration. Said grid comprises:

- 4 pins defined by Argonne National Laboratory (ANL) and Los Alamos National Laboratory (LANL) comprising:
  - 1 pin of Pu-Am-Zr metallic fuel bonded with sodium,
  - 1 pin of U-Pu-Np-Am-Zr metallic fuel bonded with sodium,
  - 1 pin of (Pu, Am, Zr)N nitride fuel bonded with sodium,
  - 1 pin of (U, Pu, Am, Np)N nitride fuel bonded with sodium.
- 2 pins defined by the ITU comprising:
  - 1 pin made of (Pu, Am, Zr)O_2 diluted in an inert metallic matrix (Mo^{92}) bonded with helium
  - 1 pin made of (Pu, Am)O_2 diluted in an inert metallic matrix (Mo^{92}) bonded with helium.
- 2 pins defined by the CEA:
  - 2 pins made of (Pu, Am)O_2 diluted in a ceramic matrix (MgO) differentiated in terms of their Pu and Am content and bonded with helium.

The 8 experimental pins will be mounted in a standard Phénix irradiation device (KCI capsule) containing 19 pins. Eleven other pins, defined outside the framework of this Implementing Arrangement, will complete the device.

The pins are designed in two sections: one active leaktight 1 meter section in which the fuel is found and an inactive or "extension" section 0.80 meters long, welded to the lower part of the active pin.
Irradiation is scheduled for the two last reactor cycles, that is, insertion into the reactor planned at the end of 2006 (for a Phénix restart in mid 2003).

Technical content

The technical content covers the manufacturing, irradiation and post-irradiation analyses results of the 8 experimental pins. It covers :

1. Supply by the DOE to all manufacturers with a quantity of americium oxide necessary to perform the manufacturing process development/perfection program, R&D on new fuels (property measurements), manufacturing and control of fuel pellets for the irradiation itself.

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2. Purification of the americium oxide by CEA both for its own requirements and those of ITU.
3. Manufacturing of fuel pellets: each participant will be responsible for the costs associated with the development of the pellet manufacturing process and manufacturing of its own fuel pellets in its laboratory(ies). Monitoring of manufacture by CEA is in accordance with point 8 below. Manufacturing results will be shared by all participants.
4. Transportation of pellets from CEA and DOE to ITU for cladding. This will be undertaken by the dispatching manufacturer.
5. The manufacturing of all pins by ITU, that is to say filling of pins with fuel, filling of pins with helium or sodium, welding of plugs and extensions, test/inspection of pins and all reports associated with said operations.
6. Procurement by CEA of all structures (pins, plugs, springs, head, base and body of the capsule, etc).
7. Manufacture of the capsule and irradiation device by CEA with the associated controls, including the positioning of the spacer wire on experimental pins.
8. Drafting of all contractual files under quality assurance (ISO 9001).
   - with respect to Phénix: presentation file, technical file, safety file, manufacturing report and deviation processing,
   - with respect to manufacturers: specifications and drawings.

   All the files and reports will be written by CEA, with the exception of the manufacturing reports which will be written by each manufacturer. In the context of file requirements, participants' KNOWLEDGE associated with their national programs will be exchanged.
9. Transportation of pins from ITU to the Phénix plant.
10. Irradiation in the Phénix reactor.
11. Transportation of irradiated pins from the Phénix plant to participants' post-irradiation analyses laboratories (CEA, DOE and ITU).
12. Results of post-irradiation analyses for all pins irradiated in participating laboratories. Analyses results will be shared by all participants.

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DISTRIBUTION OF TASKS

TABLE N°1: DISTRIBUTION OF THE WORKLEAD BETWEEN THE CO-OPERATING ENTITIES

Action	Actor
PELLETS	
Provision to CEA of americium oxide for ITU and CEA requirements (transportation included)	DOE
Purification of americium oxide for ITU and CEA requirements	CEA
Transportation of purified americium oxide for ITU requirements	CEA
Manufacture of metallic fuel pellets	DOE
Manufacture of nitritude fuel pellets	DOE
Manufacture of (U, Pu, Am)O2 fuel pellets	ITU
Manufacture of cermet oxide fuel pellets	ITU
Manufacture of cercer oxide fuel pellets	CEA
Transportation of DOE pellets to ITU	DOE
Transportation of CEA pellets to ITU	CEA
PINS	
Procurement of structures and delivery to ITU	CEA
Manufacturing and control of 8 pins	ITU
Welding and control of 8 extensions	ITU
Transportation of pins to the Phénix reactor	ITU
CAPSULE	
Procurement of structures	CEA
Manufacturing, Assembly and Controls	CEA
IRRADIATION FILE	
Presentation, technical, safety files, specifications and plans	CEA
Manufacturing, quality assurance and monitoring of suppliers	CEA
CEI/Phénix facility criticality and safety	CEA
IRRADIATION in PHENIX	
Analysis of irradiation files	CEA
Irradiation and irradiation monitoring	CEA
WASTE MANAGEMENT	
Management of DOE and ITU fuel wastes	DOE and ITU
Management of CEA fuel wastes	CEA

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KEY DATES

- Handing over of the technical file to Phénix : February 2005
- Acceptance testing of pellets : January 2006
- Insertion into reactor : November 2006
- Removal from reactor : November 2008
- Post-irradiation analyses from 2009

This schedule is dependent on Phénix operation and may be revised.

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FINANCIAL APPENDIX

Table No. 2 provides estimate of the PROGRAM cost, broken down by task and the distribution of costs between the Parties.

TABLE N°2:PROGRAMME COST ESTIMATE IN EUROS

TASKS	Amount	Investment amount	Distribution of costs
PELLETS			
Pellet manufacturing **Pellet transportation US to ITU and CEA to ITU**			**Outside the scope of the Agreement**
Provision of AmO_2 and shipment			**100% DOE**
AmO_2 purification (CEA-ITU)			**100% CEA**
PINS			
Manufacturing and controls (8 short pins)	**464 000**	**60 000**	**50% DOE 50% CEA**
Manufacturing and controls with extensions	**128 000**		**50% DOE 50% CEA**
Transportation ITU to PHENIX	**125 000**		**50% DOE 50% CEA**
CAPSULE			
Procurement	**1 000 000**		**50% DOE 50% CEA**
Assembly, controls, disassembly and post-irradiation analyses	**62 917**	**186 480**	**50% DOE 50% CEA**
FILES			
Presentation, technical, safety, specification and drawings	**1 501 093**		**50% DOE 50% CEA**
Manufacturing	**1 500 353**		**50% DOE 50% CEA**
CEI Phénix (safety and criticality)	**59 994**		**50% DOE 50% CEA**
IRRADIATION			
Irradiation monitoring and analysis file	**445 200**		**50% DOE 50% CEA**
Neutrons	**810 000**		**50% DOE 50% CEA**
Transportation to analysis laboratories	**150 000**		**50% DOE 50% CEA**

Total amounts	**6 246 557**	**246 480**
CEA contribution	**3 123 278,5**	**123 240**
DOE contribution	**3 123 278,5**	**123 240**

Overall estimated total: **6 493 037** **Euros**

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Table No. 3 provides the schedule for estimate of expenditure and distribution of expenditure between the Parties.

TABLE N°3 : ESTIMATE OF EXPENDITURE SCHEDULE IN EUROS

	2003	2004	2005	2006	2007	2008	Task amount	Undertaking
PINS:								
Manufacturing and controls with extensions (8 pins)	60 000,00	167 000,00	167 000,00	130 000,00			524 000,00	50% DOE 50% CEA
Controls and extensions		15 000,00	75 000,00	38 000,00			128 000,00	50% DOE 50% CEA
Pin transportation to Phénix				125 000,00			125 000,00	50% DOE 50% CEA
CAPSULE:								
Procurement	500 000,00	250 000,00	250 000,00				1 000 000,00	50% DOE 50% CEA
Manufacturing, assembly and controls		30 730,00	155 750,00	62 917,00			249 397,00	50% DOE 50% CEA
FILES:								
Presentation, safety and specifications	303 757,00	568 304,00	314 516,00	314 516,00			1 501 093,00	50% DOE 50% CEA
Manufacturing, quality assurance and supplier monitoring	483 000,00	572 250,00	222 551,50	222 551,50			1 500 353,00	50% DOE 50% CEA
Criticality and safety				59 994,00			59 994,00	50% DOE 50% CEA
PHENIX IRRADIATION:								
File analysis	69 400,00	198 900,00	39 250,00	73 450,00	64 200,00		445 200,00	50% DOE 50% CEA
Irradiation					405 000,00	405 000,00	810 000,00	50% DOE 50% CEA
Pin transportation						150 000,00	150 000,00	50% DOE 50% CEA
Total	**1 416 157,00**	**1 802 184,00**	**1 224 067,50**	**1 026 428,50**	**469 200,00**	**555 000,00**	**6 493 037,00**	

APPENDIX II
LIST OF KNOWLEDGE

KNOWLEDGE exchange pertains to:

1. Fuel and pin specifications and manufacturing procedures relevant to the fabrication of fuels for the FUTURIX-FTA experiment and including the R&D phase on fabrication process optimisation,
2. The characteristics and physico-chemical properties of new and irradiated FUTURIX-FTA fuels or simulants (fuels whose composition is close to that of FUTURIX-FTA fuels, the behavior of which may be likened to or extrapolated from that of FUTURIX-FTA fuels), required for the fuel modelling and design studies of the FUTURIX-FTA pins,
3. Laws and behavioral models concerning FUTURIX-FTA fuels or their simulants under irradiation in normal operation, incident and accident modes, required for the mandatory technical and safety files,
4. Post-irradiation examination performed on FUTURIX-FTA fuels or their simulants, interpretation of examination results, and fuel modelling performed with the codes developed by each participant.

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APPENDIX III
TECHNOLOGY MANAGEMENT PLAN

Ownership rights

Each Party shall remain the owner of KNOWLEDGE, whether patented or not, that it held prior to execution of the Implementing Arrangement.

RESULTS, other than inventions, arising from the PROGRAM shall be construed as owned by the Party creating the RESULTS. However, each Party may use or reproduce said RESULTS without the consent of the other Party. With respect to publication or disclosure of said RESULTS, except for manufacturing data, any such RESULTS delivered to one Party shall be subject to the unlimited right to publish or disclose such RESULTS for any purpose.

For inventions, i.e., subject matter that is or may be patentable, the Parties shall jointly agree to an equitable allocation of rights and responsibilities within a reasonable time from the time a Party becomes aware of the creation of an invention, taking into account the relative contributions of the Parties and other COOPERATING ENTITIES, and other factors deemed appropriate.

Usage of RESULTS

Each Party, and the other COOPERATING ENTITIES, will have the right to make use of RESULTS, patented or not, obtained within the framework of the PROGRAM for its own research requirements free of cost.

The industrial and commercial usage of RESULTS, patented or not, may be performed through transfer of license or licenses to third parties.

Licenses may be transferred by a Party or any third party designated by the latter. The licensee and main license terms and conditions should be established in consideration of market conditions and the joint interest of the Parties.

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