IMPLEMENTING AGREEMENT

between

THE UNITED STATES DEPARTMENT OF ENERGY

and

THE FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE

in the area of

RADIATION HARDENING OF REMOTE MAINTENANCE CONTROL

SYSTEM HARDWARE FOR APPLICATIONS TO HIGH RADIATION FIELDS

(RADIATION HARDENING AGREEMENT)

This Implementing Agreement to be called the "RADIATION HARDENING AGREEMENT" is made between the UNITED STATES DEPARTMENT OF ENERGY (hereinafter referred to as "DOE") and the COMMISSARIAT A L'ENERGIE ATOMIQUE OF FRANCE (hereinafter referred to as "CEA") hereinafter called the "Parties."

WHEREAS,

DOE and CEA under the Agreement in the Field of Remote Systems Technology of September 13, 1985, (hereinafter referred to as the "Remote Systems Technology Agreement" included for reference as Appendix I to this Implementing Agreement*) agreed to establish an equitable exchange of remote systems technology,

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*Letters of transmittal from Mr. Vaughan to Mr. Rapin of September 6, 1985, and of acknowledgement from Mr. Rapin to Mr. Vaughan of September 12, 1985, are included.

DOE and CEA have a mutual interest in designing and demonstrating the radiation hardening of control system hardware for remote maintenance systems,

CEA plans to install an MA-23 servomanipulator with an environmentally hardened control system in the Hulls Consolidation Cell (404) in the TOR Facility at Marcoule, France (hereinafter referred to as "TOR-404"),

DOE wishes to participate by providing particular components for the control system for testing in TOR-404,

DOE and CEA believe that joint collaboration in radiation hardening development and testing would be of significant benefit to both Parties.

IT IS AGREED AS FOLLOWS:

ARTICLE 1 - OBJECTIVE

1.1 The objective of cooperation under this Implementing Arrangement is to establish and to carry out a joint development and testing program (hereinafter referred to as the "Program") to investigate the performance of radiation-hardened control system hardware in the radiation environment of TOR-404.

1.2 This cooperation shall involve the exchange or loan of samples, materials and/or equipment under and as envisaged in Article 3.e. of the Remote Systems Technology Agreement.

ARTICLE 2 - PROGRAM

2.1 A joint Program designed to meet the objectives of this Implementing Agreement has been agreed between the Parties as described in Appendix II. It is recognized at the outset that this Program may be subject to changes as the work progresses. Any changes to the Program affecting cost, schedule, and broad objective shall require the prior agreement in writing of the Parties.

2.2 In summary, the Program envisages:

a. Development and radiation testing of individual components and subsystems of the overall system partly in the U.S. and partly in France.

b. Integration of the components and subsystems into operating systems to perform control functions needed for operating servomanipulator systems with peripherals.

c. Testing the operating servomanipulator system in typical radiation environments.

d. Sharing of all technology jointly developed and tested in this program.

e. Recording and exchange between the Parties of results arising from the Program as brief letter progress reports and topical reports.

ARTICLE 3 - PROVISION OF COMPONENTS AND SERVICES

3.1 To meet the requirements of the Program defined in the Appendix II, DOE shall, at its own expense:

a. Discuss and agree with CEA on a detailed experimental plan to carry out the Program.

b. Arrange and provide for the attachment and visits of staff of the Oak Ridge National Laboratory (ORNL) to CEA facilities where appropriate in accordance with paragraph 3.3 of this Implementing Agreement and Article 10 (Personnel Assignments) of the Remote Systems Technology Agreement.

c. Provide suitable office facilities for the CEA attached staff, if any, to ORNL to enable them to fulfill the agreed function of participation in the Program.

d. Loan equipment components or subsystems developed and tested by ORNL for the purposes of the Program.

e. Provide to CEA reports, general arrangement or layout drawings for replacement of equipment components, and sufficient details of the above equipment necessary for the implementation of the Program.

f. Arrange and provide for transport of the above equipment to an agreed point of entry into France.

3.2 To meet the requirements of the Program defined in Appendix II, the CEA shall at its own expense:

a. Discuss and agree with DOE on an experimental plan to carry out the Program.

b. Arrange and provide for visits and attachment of CEA staff to ORNL where appropriate in accordance with paragraph 3.3 of this Implementing Agreement and Article 10 (Personnel Assignments) of the Remote Systems Technology Agreement.

c. Provide suitable office facilities at Marcoule, France, for the ORNL attached staff, if any, to enable them to participate in the Program.

d. Provide to DOE reports, drawings, specifications, or similar material necessary for implementation of the Program.

e. Install the ORNL equipment in TOR-404.

f. Be responsible for the preparation of any documents necessary for securing approval for utilizing the equipment provided by DOE in the TOR-404.

g. Be responsible for safekeeping of the equipment and any necessary transport in France.

h. Implement the agreed program of testing in the TOR-404.

i. Be responsible for the recording of agreed data from the tests in 3.2(h) and make them available to DOE.

j. Arrange and provide for the return of the above equipment to DOE, unless agreed otherwise by DOE.

3.3 Each Party shall, at its own expense, have the right to observe the measurement performance at the other Party's facilities. This right may be exercised by short visits or by the attachment of staff in accordance with Article 3.c and 3.d of the Remote Systems Technology Agreement.

3.4 The Parties may each propose to analyze the results arising from the Program according to their own requirements at their own expense. However, each Party shall inform the other Party of its intentions in this respect so as to provide for the possibility of cooperation on appropriate aspects of the analysis if desired between the Parties.

3.5 Termination costs, if any, shall be borne by each Party for the portion of the Program that Party is obligated to perform.

3.6 Except where otherwise provided, all costs incurred from the performance of the Program shall be borne by the Party that incurs them.

3.7 Each Party shall be responsible for obtaining any documentation, customs clearance, or other procedures necessary to permit the import or export

of the remote maintenance control system hardware into or out of its own country. The control system hardware shall be considered to be scientific not having a commercial character. Each Party shall, therefore, endeavor to obtain all possible exemptions to costs associated with the export or import of this hardware.

ARTICLE 4 - GENERAL PROVISIONS

Articles 5 (Management), 6 (Information), 7 (Patents), 8 (Disclaimer), 9 (Liabilities), 10 (Personnel Assignment), 11 (Legal Provisions), and 12 (Financial Obligations) of the Remote Systems Technology Agreement are hereby incorporated by reference.

ARTICLE 5 - PATENTS

5.1 As provided for in Article 4.3 of the Remote Systems Technology Agreement, the following provisions covering patents that are specific to the particular activity of this Implementing Agreement are added to supplement Article 7 of the Remote Systems Technology Agreement.

a. The entire right, title, and interest in inventions or discoveries conceived or first actually reduced to practice in the course of this Implementing Agreement which relate to equipment or samples supplied by a Party shall be owned by that Party in all countries subject to a license to the other Party as set forth in 5.1.b, below.

b. The Party owning a patent or patent application covering any invention conceived or first actually reduced to practice in the course of this Implementing Arrangement shall, upon request of the other Party, grant to that Party, its Government, and nationals designated by it a nonexclusive, irrevocable, royalty-free license in such patent or patent application.

ARTICLE 6 - USE AND DISCLOSURE OF INFORMATION

6.1 Information developed under the scope of the Program shall be jointly owned by the Parties.

6.2 Each Party shall be entitled to make available information to its contractors or licensees or other national industrial firms for commercial and industrial purposes when incorporated in a marketable product in accordance with the terms of Article 6 of the Remote Systems Technology Agreement.

6.3 The Parties shall provide to each other sufficient information of the equipment and the TOR-404 facilities to enable each Party to fulfill its commitments under this Implementing Agreement including the requirements of Article 3.2(f) above.

6.4 The Parties shall produce an agreed schedule for testing and analysis and each Party shall promptly disclose to the other Party all information arising from the testing and analysis of results obtained under the Program.

6.5 The Parties may publish jointly or either Party may publish individually (after no less than 30 days' advance notice to the other Party) a series of reports, after joint consultation, of the tests and analyses of the results.

ARTICLE 7 - MANAGEMENT OF THE PROGRAM

7.1 The Program shall be managed pursuant to the terms of Article 5 (Management) of the Remote Systems Technology Agreement.

7.2 Each Principal Coordinator shall nominate one representative to be responsible for making and coordinating the arrangements for all transport of material or equipment required by the Program.

ARTICLE 8 - FACILITIES AND EQUIPMENT

8.1 In the event that equipment, other than that agreed in support of the radiation hardened remote maintenance control system hardware, is to be provided by one Party to the other Party for the purposes of implementing the Program, the loan or transfer of ownership of such equipment shall be the subject of a separate agreement.

8.2 Subject to Article 9 (Liabilities) of the Remote Systems Technology Agreement, each Party shall at all times be responsible for the operation of its own facilities and for any consequences arising from such operation. The Parties shall discuss any modifications to the Program which may be necessary for safety or operational reasons but each Party

shall retain the right to suspend operation of its facilities at any time for operational or safety reasons.

ARTICLE 9 - DELAYS

If, during the course of this Implementing Agreement, any event occurs which significantly delays the Program, the Parties shall discuss the action to be taken to achieve an equitable solution.

ARTICLE 10 - DURATION AND TERMINATION

10.1 This Implementing Agreement shall enter into force upon the later date of signature and, except as provided in Article 10.2 and 10.3, shall continue for 5 years.

10.2 This Implementing Agreement may be amended or extended at any time by mutual agreement of the Parties in writing.

10.3 This Implementing Agreement may be terminated at any time at the discretion of either Party upon 1 year's advance notification in writing by the Party seeking to terminate the Implementing Agreement. Such termination shall be without prejudice to the rights which may have accrued under this Implementing Agreement to either Party up to the date of such termination.

10.4 In the event of termination by either Party pursuant to Article 10.3 after completion of the Program, all information and results available up

to the time of such termination shall be exchanged by the Parties under the terms of the Implementing Agreement.

Done in duplicate in both the English and French languages, both texts being equally authentic.

FOR THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA

NAME David E. Bailey

DATE 7 Aug 1987

FOR THE COMMISSARIAT A L'ENERGIE
ATOMIQUE OF FRANCE

NAME [illegible]

DATE 15 September 1987

APPENDIX I

AGREEMENT

between

THE UNITED STATES DEPARTMENT OF ENERGY

and

THE FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE

in the field of

REMOTE SYSTEMS TECHNOLOGY

SEP 6 1985

Mr. Michel Rapin, Director
Institute of Technological Research
and Industrial Development
Commissariat a l'Energie Atomique
29-33 Rue de la Federation
F-75752 Paris
France

Dear Mr. Rapin:

It is with pleasure that I submit for your signature the Agreement between the United States Department of Energy (DOE) and the French Commissariat a l'Energie Atomique (CEA) in the field of Remote Systems Technology. I believe that the active exchange of technology in this area between our countries will advance the availability of economic, safe nuclear energy.

I wish to express my appreciation to Messrs. Jean Hulst and Yves-M. Le Niger for their efforts in bringing the Agreement to a successful conclusion. I also wish to express the deep sorrow felt in the United States at the loss of M. Jean Vertut, an able scientist and a good friend to many.

It is understood that the United States will transfer no sensitive nuclear technology, as defined by the Nuclear Nonproliferation Act of 1978, under the Agreement. We also understand that CEA agrees not to transfer to a third country any technology received from DOE under the Agreement without DOE and CEA joint discussion and approval.

We look forward to a mutually beneficial exchange in this area of technology.

Sincerely,

James W. Vaughan, Jr.

James W. Vaughan, Jr.
Acting Assistant Secretary
for Nuclear Energy

Enclosure

COMMISSARIAT A L'ÉNERGIE ATOMIQUE

31-33 RUE DE LA FEDERATION - PARIS (XV)

TELEPHONE 273-60-00

INSTITUT de RECHERCHE TECHNOLOGIQUE
et de DEVELOPPEMENT INDUSTRIEL

Le DIRECTEUR

ref. IRDI/Dir-85/1008

PARIS, LE September 12,1985

Mr. James Vaughan, Jr
Acting Assistant Secretary for
Nuclear Energy
Department of Energy
WASHINGTON DC 20585 USA

Dear Mr. Vaughan,

I thank you for your letter on September 6, 1985 in which you sent me for signature the Agreement between US.DOE and CEA in the field of Remote Systems Technology. I am convinced, as well, that a cooperative program of exchange in this area would be of mutual benefit and will contribute to safe and economic application of nuclear energy.

I have greatly appreciated the efforts done by Mr. Bailey in bringing the Agreement ready for signature.

With respect to the third paragraph of your letter I have noted our mutual understanding that any technical information received from DOE under this Agreement will not be transferred to a third country without DOE and CEA joint discussion and approval.

Looking forward to a mutually exchange in this area of Remote Systems Technology, I remain

Yours truly

M. RAPIN

WHEREAS

The UNITED STATES DEPARTMENT OF ENERGY (DOE) and the FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA), hereinafter referred to as the Parties, are both carrying out activities on remote systems technology and their applications to hostile environment and, in consideration of the high degree of compatibility between their respective programs in terms of current activities and future interest, DOE and CEA have a mutual interest in establishing cooperation in the field of remote systems technology.

DOE and CEA believe that a cooperative program of equitable sharing of their respective research and development data, technology and experience in remote systems technology would be of mutual benefit,

DOE and CEA recognize the contribution such research and development in remote systems technology can make to safe and economic application of nuclear energy,

DOE and CEA act in certain areas related to remote systems technology through their contractors, subsidiaries or associated industrial firms,

DOE and CEA recognize the need to establish procedures for the protection of Proprietary Information,

It is the understanding of each Party that certain information is provided in confidence to the other Party, and that the undue dissemination thereof would be prejudicial to the interests of each Party and to prospects for future collaboration between DOE and CEA,

IT IS AGREED AS FOLLOWS :

.../...

ARTICLE 1 - OBJECTIVES

1.1 The objective of this Agreement (to be called the Remote Systems Technology Agreement) shall be to establish the basis for cooperation between the Parties in the field of remote systems technology.

1.2 As a first step, this Agreement provides for an exchange of general information, including basic R & D results, between the Parties regarding the studies and research, development, demonstration and operational activities carried out by each Party in the technical areas listed below in Article 2.

Each Party shall provide sufficient information to enable the other Party to evaluate and assess the level and scope of knowledge acquired by the other in the technical areas listed in Article 2, so that the Parties are able to identify specific areas or topics which may lead to further and more extensive forms of cooperation in remote systems technology.

1.3 Such exchange of information will be governed by the provisions of Article 6 of this Agreement.

1.4 Cooperation between the Parties shall be on the basis of mutual benefit, equality and reciprocity.

ARTICLE 2 - AREAS OF COOPERATION

2.1 At the time of signing this Agreement, the following areas of cooperation have been identified :

I. Applications Feasibility

1. Signal and Power Transmission

2. Remote Viewing and Sensing

II. Remote Work Efficiency

3. Man-Machine Interface

4. Teleoperator-Task Environment Interface

III. Optimization and Refinement

5. Control Systems

6. Advanced Teleoperation

7. Electromechanical Systems

Detailed descriptions of these areas of cooperation under this Agreement are contained in the Appendix.

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2.2 The above list of areas of cooperation may be modified by mutual written agreement of the Parties.

ARTICLE 3 - CONTENT AND FORMS OF COOPERATION

Cooperation under this Agreement may include exchange of general and specific scientific and engineering information and R & D results and methods in remote systems technology by means of :

a. Exchange on a current basis of periodic, topical and letter reports.

b. Organization of, and participation in, seminars or other meetings on specific agreed topics in remote systems technology, within the areas of cooperation of Article 2.

c. Short visits by specialist teams or individuals to the experimental and operational remote systems technology facilities of the other Party, subject to the prior written agreement of the receiving Party.

d. Attachment of the staff of one Party, its contractors or subsidiaries or designees, to the remote systems technology facilities of the other Party, its contractors, subsidiaries or designees for participation in agreed research, development, design, analysis or other experimental activities, and on-going operations in the field of remote systems technology. Such attachment shall be in accordance with Article 10 of this Agreement.

e. Exchange or loan of samples, materials and/or equipment for testing.

f. Joint projects in which the Parties agree to share the work and/or costs.

g. Other specific forms of cooperation, in remote systems technology, not included above.

ARTICLE 4 - IMPLEMENTING AGREEMENTS

4.1 If it is decided to employ a form of cooperation given in paragraph 3 - e, f or g, then an Implementing Agreement between DOE and CEA or its designee shall be executed.

.../...

4.2 Moreover, if it is contemplated to exchange information that would include detailed design information such as drawings and specifications for full-scale components and industrial equipment and associated operational procedures and experience necessary to provide a working device then either Party may request that an Implementing Agreement between DOE and CEA or its designee shall be executed.

4.3 Each Implementing Agreement shall include all detailed provisions for carrying out that activity, and shall cover such matters as technical scope, total costs, cost-sharing between the Parties, project schedule, management of the cooperation, exchange of equipment, and provisions covering exchange of Proprietary Information, patents, and information disclosure specific to the particular activity. Activities under Implementing Agreements may involve, as appropriate, associated firms, or laboratories or designees of the Parties or their contractors or subsidiaries.

ARTICLE 5 - MANAGEMENT

5.1 To supervise the execution of this Agreement, each Party shall name a Principal Coordinator. The Principal Coordinators shall normally meet each year alternately in the United States and in France, or at such other times and places as agreed.

5.2 At their meetings, the Principal Coordinators shall evaluate the status of cooperation under this Agreement. This evaluation may include a review of each Party's remote systems technology program status and plans, a review of the past year's activities and accomplishments under this Agreement, a review of the activities planned for the coming year within each of the various areas of cooperation listed in Article 2, an assessment of the balances of exchanges under this Agreement within each of the areas of cooperation listed in Article 2, and a consideration of measures required to correct any imbalances. In addition, the Principal Coordinators shall consider new proposals for cooperation in accordance with Article 2 and 3 and submit such proposals to the Parties for consideration. If such new proposals are accepted by both Parties, this Agreement shall be amended accordingly. For additionnal areas of cooperation, the Appendix shall be revised accordingly.

5.3 Day-to-day management of the cooperation under this Agreement, and/or specific areas of cooperation under Implementing Agreements, if necessary, shall be carried out by Technical Coordinators designated by the Principal Coordinators. The Technical Coordinators shall agree on specific details of cooperation in the technical areas listed in Article 2, within policy guidelines

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established by the respective Principal Coordinators. Each Technical Coordinator shall be responsible for working contacts between the Parties in his respective area of cooperation. Technical Coordinators may, in turn, appoint correspondents for the purpose of day-to-day implementation of the exchange on specific topics or areas.

5.4 At periodic meetings, or by correspondence, as appropriate, Technical Coordinators of each Party shall together review the progress and balance of the cooperation and where appropriate, make recommendations on any necessary or desirable modifications taking into account information arising from the Agreement or elsewhere. Such recommendations shall be developed by the respective Technical Coordinators and agreed to by both. Technical Coordinators shall prepare reports to the Principal Coordinators for use by the Principal Coordinators at their meetings pursuant to 5.1. The reports shall include a summary of the year's activities and the agreed-to recommendations.

5.5 Implementing Agreements executed pursuant to Article 4 for the performance of cooperative activities shall include appropriate provisions for the management of such activities.

ARTICLE 6 - INFORMATION

6.1 Each Party shall provide to the other Party on a current and timely basis information as described in Article 3 in areas listed in Article 2 and the detailed descriptions thereof in the Appendix. The Parties agree that information provided, exchanged, generated or obtained under this Agreement may be given distribution as each Party chooses, except as noted in paragraphs 6.4, 6.5, Article 7, and as provided in Implementing Agreements, which means that a Party, its Government and its nationals have a right to freely use, translate, reproduce, publish and distribute such information for any and all purposes without any requirement of compensation whatsoever.

6.2 Although this Agreement does not commit either of the Parties to transmit to the other Party any information considered to be proprietary, the Parties recognize that transmission of such Proprietary Information might prove useful to their collaboration, in which case the provisions of Sections 6.4 through 6.6 of this Agreement shall apply.

6.3 Information exchanged under this Agreement may be in either French or English.

.../...

6.4 Definitions as used in this Article :

6.4.1 The term "information" means scientific or engineering data, results or methods of research and development, operational expertise, and any other information intended to be provided or exchanged under this Agreement.

6.4.2 For the purposes of this Agreement, "Proprietary Information" ("Informations Privilégiées" in French) shall mean information of a confidential nature as trade secrets, or commercial or financial information which is privileged or confidential, and may only include such information which :

a) has been held in confidence by its owner,

b) is of a type which is customarily held in confidence by its owner,

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.

6.5 Procedures

6.5.1 A Party receiving Proprietary Information, as defined in Section 6.4.2, pursuant to this Agreement shall respect the privileged nature thereof. Any document which contains Proprietary Information shall be clearly marked with the following (or substantially similar) restrictive legend :

"This document contains Proprietary Information furnished in confidence under an Agreement dated ---------- between the UNITED STATES DEPARTMENT OF ENERGY and the FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE and shall not be disseminated outside these organizations, their contractors, licensees and the concerned departments and agencies of the Governments of the U.S. and France without 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."

.../...

6.5.2 Proprietary Information, as defined in Section 6.4.2, received in confidence under this Agreement may be disseminated by the receiving Party to :

a) persons within or employed by the receiving Party, and other concerned Government departments and Government agencies in the country of the receiving Party, and

b) prime or subcontractors of the receiving Party located within the geographical limits of the receiving Party's nation, for use only within the framework of their contracts with the receiving Party in work relating to the areas of cooperation in Article 2,

c) organizations licensed by the receiving Party in the field of Remote Systems Technology for use only within the terms of such licenses ; and

d) organizations with which the receiving Party has contractual relationships and which are located in the receiving Party's nation for use only within the framework of their contracts with the receiving Party in work relating to the areas of cooperation in Article 2,

provided that any such Proprietary Information shall be disseminated on a need-to-know basis pursuant to an agreement of confidentiality and shall be marked with a restrictive legend substantially identical to that appearing in Section 6.5.1 above.

6.5.3 With the prior written consent of the Party providing Proprietary Information under this Agreement, the receiving Party may disseminate such Proprietary Information more widely than otherwise permitted in the foregoing Section 6.5.2. The Parties shall cooperate with each other in developing procedures for requesting and obtaining prior written consent for such wider dissemination, and each Party shall grant such approval to the extent permitted by its national policies, regulations, and laws.

6.6 Each Party shall exercise its best efforts to ensure that Proprietary Information received by it under this Agreement shall be 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.

6.7 Information arising from seminars and other meetings arranged under this Agreement shall be treated by the Parties according to the principles specified in this Article, provided, however, no Proprietary Information orally communicated shall be subject to the limited disclosure requirements of this Agreement unless the individual communicating such information places the recipient on notice as to the proprietary character of the information communicated on or before such communication.

.../...

6.8 Nothing contained in this Agreement shall preclude the use or dissemination of information received by a Party other than pursuant to this Agreement.

ARTICLE 7 - PATENTS

7.1 With respect to any invention or discovery conceived or first actually reduced to practice in the course of the cooperative activities undertaken by the Parties in implementing this Agreement :

7.1.1 If conceived or first actually reduced to practice by personnel of a Party (the Assigning Party) or its contractors while assigned to the other Party (the Recipient Party) or its contractors in connection with an assignment of scientists and other specialists.

7.1.1.1 The Recipient Party shall acquire all right, title and interest in and to such invention or discovery, and any patent application or patent that may result, in its own country and in third countries ; and

7.1.1.2 The Assigning Party shall acquire all right, title and interest in and to such invention, discovery, patent application or patent in its own country.

7.1.2 If conceived by or first actually reduced to practice by a Party or its contractors as a direct result of employing information which has been communicated to it under this Agreement by the other Party or its contractors, but not otherwise agreed to under a cooperative effort covered by paragraph 7.1.3.

7.1.2.1 The Party so conceiving or first actually reducing to practice such invention or discovery shall acquire all right, title and interest in and to such invention or discovery, and any patent application or patent that may result, in its own country and in third countries, and

7.1.2.2 The other Party shall acquire all right, title and interest in and to such invention, discovery, patent application or patent in its own country.

7.1.3 For other specific forms of cooperation as set forth in Articles 3.e, 3.f, and 3.g, or specific exchange of information under Article 4.2, the Parties shall provide for appropriate distribution of rights to inventions. In general, however, each Party should normally determine the rights to such inventions in its own country, and the rights to such inventions in other countries should be agreed by the Parties on an equitable basis.

.../...

7.1.4 Notwithstanding the allocation of rights covered under paragraphs 7.1.1 and 7.1.2, in any case where one Party first actually reduces to practice after the execution of this Agreement an Invention, either conceived by the other Party prior to execution of this Agreement or conceived not in the course of the cooperative activities undertaken by the Parties in implementing this Agreement, then the Parties shall provide for an appropriate distribution of rights, taking into account existing commitments with third parties ; provided, however, that each Party shall determine the rights to such invention in its own country.

7.2 The Party owning a patent covering any invention referred to in 7.1 above shall licence the patents to nationals and licensees of the other Party, upon request of the other Party, on nondiscriminatory terms and conditions under similar circumstances. At the time of such a request, the other Party will be informed of all licenses already granted under such patent.

7.3 Each Party shall take all necessary steps to provide the cooperation from its inventors required to carry out the provisions of this article. Each Party shall assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

7.4 It is understood that after the European Patent Conventions have come into force, either Party may request a modification of this Article for the purpose of according equivalent rights as provided in this Article under the European Patent Conventions.

ARTICLE 8 - DISCLAIMER

Information transmitted by one Party to the other Party under this Agreement shall be accurate to the best knowledge and belief of the transmitting Party, but the transmitting Party does not warrant the suitability of the information transmitted for any particular use or application by the receiving Party or by any third party.

ARTICLE 9 - LIABILITIES

9.1 The Parties shall use all reasonable skill and care in carrying out their duties under this Agreement in accordance with the laws and regulations of their respective countries.

9.2 Compensation for damages incurred under this Agreement shall be in accordance with the applicable laws of the respective country of the Party concerned.

.../...

9.3 The sending Party shall not be liable for damages of any nature, either direct or indirect, to property or personnel of the receiving Party or to any third party resulting from the use by the receiving Party of information provided under this Agreement.

ARTICLE 10 - PERSONNEL ASSIGNMENTS

10.1 Whenever an attachment of staff is contemplated under this Agreement each Party shall ensure that qualified staff are selected for attachment to the other Party.

10.2 Each such attachment of staff shall be the subject of a separate attachment agreement between the Parties.

10.3 Each Party shall be responsible for the salaries, insurance and allowances to be paid to its staff.

10.4 Each Party shall pay for the travel and living expenses of its staff while on attachment to the host Party unless otherwise agreed.

10.5 The host establishment shall arrange or do its best to arrange for comparable accommodations for the other Party's staff and their families on a mutually agreeable reciprocal basis.

10.6 Each Party shall provide all necessary assistance to the attached staff (and their families) of the other Party as regards administrative formalities.

10.7 The staff of each Party shall conform to the general and special rules of work and safety regulations in force at the host establishment.

ARTICLE 11 - LEGAL PROVISIONS

Each party's activities under this Agreement shall be in accordance with its national laws and regulations. All questions related to the Agreement shall be settled by the Parties by mutual agreement.

ARTICLE 12 - FINANCIAL OBLIGATIONS

Except when otherwise specifically agreed in writing, all costs resulting from cooperation under this Agreement shall be borne by the Party that incurs them. It is understood that the responsibilities of each Party to carry out its obligations under this Agreement are subject to the availability of appropriated funds.

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ARTICLE 13 - DURATION, AMENDMENT AND TERMINATION

13.1 This Agreement shall enter into force upon signature and, subject to Section 13.2, 13.3 and 13.4, shall continue for a three (3) year period.

13.2 This Agreement may be amended or extended by mutual written agreement of the Parties.

13.3 This Agreement may be terminated at any time at the discretion of either Party, upon six (6) months advance notification in writing by the Party seeking to terminate the Agreement. Such termination shall be without prejudice to the rights which may have accrued under this Agreement to either Party up to the date of such termination.

13.4 All joint efforts and experiments not completed at the expiration or termination of this Agreement may be continued until their completion under the terms of this Agreement.

Done in duplicate, in the English and French languages, each equally authentic, this 13th day of SEPTEMBER, 1985.

FOR THE DEPARTMENT OF ENERCY OF THE UNITED STATES OF AMERICA

James W Vaughan, Jr

NAME : James W. VAUGHAN, Jr.

TITLE : Acting Assistant Secretary for Nuclear Energy

FOR THE COMMISSARIAT A L'ENERGIE ATOMIQUE OF FRANCE

NAME : Michel RAPIN

TITLE : Directeur de l'Institut de Recherche Technologique et de Développement Industriel

George J Bradley

NAME : George J. BRADLEY

TITLE : Acting Assistant Secretary International Affairs and Energy Emergencies

APPENDIX

Detailed Description of Areas of Cooperation in Remote Systems Technology

Three broad areas of technical interest are listed in Article 2. The technical scope of these areas is described below.

I. Applications Feasibility

1. Signal and Power Transmission

As the sophistication of in-cell remote handling systems is increased, the number of data channels and electrical interconnections increases proportionately. To mitigate potentially severe remote cable handling requirements, advanced concepts for remote signal transmission must be developed to make servomanipulators and television vision reliable for large cells. Such systems involve megabaud-level bandwidth with multi-channel, bi-directional operation and error detection/correction. The two most promising technical directions presently under consideration include directed-optical laser infrared and electromagnetic (microwave) transmission. Major application issues include environmental sensitivity, facility integration, reliability, and remote maintainability. The U.S. has concentrated on the latter and France the former. An exchange of operating and analytical data will make it possible to compare the two techniques.

2. Remote Viewing and Sensing

The quality of remote viewing is known to be an important factor in manipulator operator performance. Display tradeoffs include line resolution, frame rates, gray scales, display size, color vs black and white, and steroscopic vs monocular. Techniques for camera aiming and lighting control aboard mobile maintenance systems are also very important. In addition to signal transmission, the survivability (which is the combination of operating life and remote maintainability) of remote systems, the radiation hardenability of video electronics and optics are essential.

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In addition to remote viewing, there are other methods to provide augmentative sensing which will enhance teleoperation. These include : auditory feedback (not stereo and monaural), proximity sensing in the near vicinity of handling equipment, integrated computer image sensing and processing object recognition and identification and end-effector contact sensing for tactile and touch feedback from the slave manipulators. As with other cell equipment utilizing solid-state technology and sensitive materials, radiation hardening is a key factor. Various data on several of these elements has been obtained in both countries and will be exchanged and compared.

II. Remote Work Efficiency

3. Man-Machine Interface

Recent work in both France and the United States has shown that the human factors engineering aspects of remote maintenance system design have a very significant influence upon work efficiency. Control room design parameters must be based upon proper human factors which combine anthropometry, teleoperation functions, and critical aspects of the work task environment. Displays and control sizing, layout, and allocation must be carefully selected to maximize telepresence. Comparison of work in this area done in both countries will be compared and assessed.

4. Teleoperator-Task Environment Interface

A new area of interest to both countries is systematic analysis and understanding of the basic relationships between work tasks and remote manipulation and handling equipment design. Effective methodologies for the characterization and evaluation of work tasks with respect to remote work performance and remote handling design tradeoffs would be a most desirable capability to have available. This type of analytical methodology would provide needed guidance in the specification/selection of handling geometrics (e.g., manipulator ranges of motion, etc..), effectors (e.g., grips, tooling, etc..). Work done to date in each country will be exchanged and compared.

III. Optimization and Refinement

5. Control Systems

Rapidly advancing electronics technology, particularly digital technology, is having major impact upon the realization of advanced force-reflecting servomanipulators. Design concepts utilizing the latest hardware and software technology available are essential to achieving

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future performance objectives. Expandible multiprocessor architectures which take the fullest advantage of high-speed local area networking are important in the implementation of fully integrated maintenance system control (e.g., manipulators, transporters, viewing, etc..). The software aspects of future distributed-digital control systems are as equally important. More efficient (memory and speed), realtime operating systems compatible with microprocessor-level hardware are needed to facilitate extensible high-level software languages.

6. Advanced Teleoperation

Computer supervisory control can be used to provide important new servomanipulator control aids to operators. Demonstrations (in France particularly) of automatic load weight suppression, automatic television camera tracking of end-effectors, and special geometrical processing have been completed. In geometrical processing, various forms of motion scaling and constraints have been implemented. Future work will address the coordination of the entire system at the man-machine interface in addition to the master controllers, which will include multi-system operation and obstacle avoidance.

Artificial intelligence is a popular emerging computer science intended to ultimately give computers (some of) the attributes of human intelligence necessary for decision making. Expert systems techniques are used to encode human technical expertise in software and have been successfully implemented in a wide range of application. The time is now right to begin to apply these new ideas to advanced teleoperation. Emphasis must be placed upon near-realtime operation in applications such as equipment failure diagnosis, work task planning, and obstacle avoidance.

7. Electromechanical Systems

Servomanipulator design represents one of the most complex kinematic design problems ever addressed in mechanical engineering. Even today most of the design process remains intuitive. Optimization of manipulator kinematics, including considerations of joint ranges of motion, redundant degrees of freedom, and ultimate load/dynamics capabilities, is an important development goal. Kinematic synthesis, in the ideal case, must consider the integrated motion capability of the entire handling system including the transporter, intermediate manipulator positioners, manipulators, and camera aiming.

The mechanical design, particularly in the actuators and power transmission, of servomanipulators is also complex because of the objectives of force-reflection operation. Ideally, servomanipulator designs attempt to optimize static friction, backdriveability, and inertia characteristics to provide good teleoperation characteristics. The increased use of gears and linkages to eliminate tendon drives (for reliability and maintainability) introduces greater backlash and friction nonlinearities and joint cross-coupling. The use of active force sensing to enhance bilateral force-reflection under these conditions is a new and exciting development area. Needless to say, many technical challenges remain in manipulator mechanical design.

APPENDIX II

THE UNITED STATES DEPARTMENT OF ENERGY (USDOE)
THE FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA)
RADIATION HARDENING AGREEMENT

TECHNICAL SCOPE

The USDOE and the French CEA will collaborate in the development and testing of Environmentally Hardened In-Cell Electronics Systems for the control of servomanipulators and related auxiliaries. The program will include:

a) The development and radiation testing of individual subsystems of the overall system to be done partially in the United States and partially in France,

b) Integration of these into operating systems to perform that control function in operating servomanipulator systems with peripherals,

c) Testing in typical nuclear radiation environments, and

d) Sharing all technology jointly developed and tested in the program.

1. Focus of the Collaboration:

The overall long-range plan, which will take 3 to 5 years to complete, will include development and implementation of the technology for providing environmentally (radiation and atmosphere) hardened remote handling control systems for complete servomanipulator systems (one or two arms, peripherals, cameras, and transporter). The program will follow two pathways:

1) An initial task focused on an ongoing CEA program, which presently includes an MA-23 servomanipulator system with a wall-mounted transporter that will be tested in the Hulls Consolidation Cell (404) in the TOR (TOR-404) facility at Marcoule, France, beginning in early 1990.

2) A longer-range effort utilizing the technology demonstrated in the initial task, to complete any additional technology development required, and to incorporate that technology into the electronic packages for the complete in-cell systems. For this second task, it is anticipated that these systems would be built:

   a. Complete in-cell package for the US/ORNL Advanced Integrated Maintenance System (AIMS), utilizing existing mechanical and control-room equipment.

   b. Complete in-cell package for a CEA servomanipulator prototype.

(Both of these are nonactive prototypes for functional testing.)

c. Complete in-cell system(s) to be tested eventually in a remote, radioactive facility. Specifics for this test are not yet envisioned and may not occur within the timeframe of the present agreement.

2. Elements of the Initial Effort Focused on TOR-404:

A major part of the technical tasks of developing and radiation testing all subsystems required for the whole program will be done in this initial part of the plan. Both CEA and ORNL have previously completed rad-hardening on some subsystems, leaving only a few major subsystems to be developed. Steps in the program will include:

a) Development

Completion of the development of the remaining rad-hardened subsystems by the end of calendar year 1987.

a.1. ORNL to develop D.C. power supplies.

a.2. ORNL to complete for use by CEA portions of its ongoing program in radio-frequency signal transmission as a potential option for signal transmission in place of the present choice, fiber-optics, for digital data and radio-frequency for video and audio.

CEA will provide, not later than March 15, 1987, specifications to be followed by ORNL for the execution of points a.1 and a.2.

Progress realized in the development of these subsystems by ORNL, as well as fabrication problems, will be evaluated during a visit to ORNL by CEA and its contractor representatives. This visit will be held in September 1987.

A nonhardened prototype of the radio-frequency transmission subsystem will be lent by ORNL to CEA for testing beginning not later than October 1987. ORNL representatives may participate in these tests.

a.3. CEA to develop the other subsystems:

(1) Fiber optics data transmission,
(2) Multiplexing system,
(3) Low power amplifiers,
(4) Video and audio wireless transmission

and do the design integration of all subsystems.

b) Fabrication

After specific design is done by CEA, fabrication of the TOR-404 system will be completed by early 1989 for functional testing in France.

b.1. ORNL to supply detailed designs of ORNL-developed subsystems and fabricate such subsystems as mutually agreed upon.

b.2. CEA to supply subsystems developed by CEA and fabricate the entire package.

c) Testing

Testing in TOR-404. The test and operational program in TOR-404 will be sent by CEA to DOE. U.S. representatives will be permitted to be present for the final tests.

All operational and test results obtained in this program will be available for ORNL.

d) General Support

In addition to the hardware development program, ORNL will be prepared to assist in:

d.1. Providing information and support to extent possible in purchasing radiation hardened commercial electronic components in the U.S. on an as-needed basis.

d.2. Internal technical reviews of the complete MA-23 TOR-404 system design, including review of the components and subsystem details.

3. Wider-Range Program:

While most of the effort of the first year or two will be devoted to the TOR-404 focused initial effort, elements of the wider-range program may be carried out by the end of the calendar year 1987, such as planning, identifying additional technology needs not being developed in the TOR-404 task, and assignment of work tasks between the countries as can be agreed to and as funds are available in each country.

A major assessment and replanning of the longer-range program should be made by the end of the second year of the collaboration so that an orderly effort can be carried out.

CEA-developed inductive-coupled power transmission is recognized as one of the important elements of a wider range program; France has agreed to assist there, having already provided most of the basic technology in prior meetings. Also important to both Parties are in-cell intelligence problems.