SPECIFIC MEMORANDUM OF AGREEMENT
BETWEEN
THE UNITED STATES DEPARTMENT OF ENERGY
AND THE
UNITED KINGDOM ATOMIC ENERGY AUTHORITY
IN THE AREA OF
MECHANICAL HEAD END SHEARING OF LMFBR FUEL ELEMENTS
(THE HEAD END SHEARING AGREEMENT)

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between

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and

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY

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MECHANICAL HEAD-END SHEARING OF LMFBR FUEL ELEMENTS

This Agreement to be called "THE HEAD-END SHEARING AGREEMENT" is made between the UNITED STATES DEPARTMENT OF ENERGY (hereinafter referred to as "DOE") and the UNITED KINGDOM ATOMIC ENERGY AUTHORITY (hereinafter referred to as "UKAEA") hereinafter called the "Parties."

WHEREAS

The Energy Research and Development Administration (ERDA) and UKAEA under the Liquid Metal Fast Breeder Reactors Agreement of 20 September 1976 (hereinafter referred to as "the LMFBR Agreement") agreed to continue close and long term cooperation in the field of LMFBR technology.

Pursuant to the Department of Energy Organization Act of 1977 ERDA was abolished and all functions transferred to and vested in DOE.

Both DOE and UKAEA have an interest in providing support to LMFBR reactor design and the associated Fuel Cycle by means of experimental and theoretical research and development.

Both DOE and UKAEA have an interest in providing close cooperation among designers, research and development personnel and safety assessment personnel. Both DOE and UKAEA have an interest in the handling of LMFBR irradiated sub-assemblies in the fuel dismantling route, and the development of mechanical shearing processes as a preliminary (head-end) stage in the reprocessing of LMFBR fuel assemblies as an alternative to pin pulling and pin cropping routes.

The DOE at Oak Ridge National Laboratory (ORNL) have a continuing programme, facilities and equipment for the development and analysis of head-end shearing operations.

The UKAEA have a plant for the reprocessing of LMFBR fuel from its Prototype Fast Reactor (PFR) at Dounreay in Scotland. In addition the UKAEA by virtue of their programme to develop a commercial LMFBR have a particular design of gridded fuel assembly which can be made available in a form containing no fissile or fertile nuclear materials.

DOE and UKAEA believe that a joint project for collaboration in the design and development of handling of irradiated LMFBR sub-assemblies in the fuel dismantling route including shearing UKAEA gridded fuel assemblies to an agreed programme would be of significant benefit to both parties.

IT IS AGREED AS FOLLOWS:

ARTICLE 1 - OBJECTIVE

1.1 The objective of cooperation under this Specific Memorandum of Agreement (SMA) is to establish and to carry out a joint experimental and analytical programme (hereinafter referred to as the "Programme") to investigate the performance of shearing of UKAEA gridded fuel assemblies, and to exchange information on the handling of irradiated LMFBR sub-assemblies in the fuel dismantling route.

1.2 This cooperation shall be a joint project under and as envisaged in the LMFBR Agreement.

ARTICLE 2 - PROGRAMME

2.1 A joint Programme designed to meet the objectives of this SMA has been agreed between the Parties and is given in Appendix 1. It is recognised at the outset that this Programme may be subject to changes as the work progresses. Any changes to the Programme shall require the prior agreement in writing of the Parties.

2.2 In summary, the Programme envisages:

a. The attachment of UKAEA staff to ORNL and of DOE staff to UKAEA for the purpose of participation in the Programme. The dates and duration of each attachment to be agreed between the Parties and each attachment to be the subject of a separate Attachment Agreement.

b. The supply by UKAEA of commercial LMFBR type gridded fuel assemblies in which a non-nuclear material (porcelain pellets) has been substituted for the nuclear component of the fuel pins or alternatively the supply of several sections of fuel assemblies which it is agreed by the Parties constitute an equivalent quantity of a fuel assembly for the purpose of the Programme.

c. Transport of the fuel assembly from UKAEA to ORNL.

d. Implementation of agreed Programme for shearing the fuel assembly.

e. Packaging and identification of all sheared specimens, samples and debris (hereinafter referred to as "samples") arising from the Programme and return of these materials to the UKAEA.

f. Recording and exchange between the Parties of agreed data analysis and results arising from the Programme.

g. Preparation and exchange between the parties of agreed reports during the Programme and preparation of a joint report at the end of the Programme.

2.3 There shall be no transfer, under this SMA, of special nuclear material or information under the Additional Agreement for Cooperation between the United States of America and the European Atomic Energy Community (EURATOM) concerning Peaceful Uses of Atomic Energy of June 11, 1960, as amended.

ARTICLE 3 - PROVISION OF COMPONENTS AND SERVICES

3.1 To meet the requirements of the Programme defined in Appendix 1 UKAEA shall at its own expense:

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

b. Arrange and provide for the attachment of UKAEA staff to DOE in accordance with paragraph 2.2 (a).

c. Provide suitable office facilities for the DOE attached staff to enable them to fulfil the agreed function of participation in the Programme.

d. Supply UKAEA fuel assemblies or parts of fuel assemblies in accordance with paragraph 2.2 (b).

e. Provide the details and drawings of the fuel assemblies or parts of fuel assemblies necessary for the implementation of the Programme.

f. Transport the fuel assemblies or parts of fuel assemblies to an agreed point of entry into the USA.

g. Transport the samples from an agreed point of departure in the USA to the UKAEA.

3.2 To meet the requirements of the Programme defined in Appendix 1 the DOE shall at its own expense:

a. Discuss and agree with UKAEA an experimental plan to carry out the Programme.

b. Arrange and provide for the attachment of DOE staff to UKAEA in accordance with paragraph 2.2 (a).

c. Provide suitable office facilities for the UKAEA attachment staff to enable them to fulfil the agreed function of participation in the Programme.

d. Design and procure the tooling (compactive gags and shear tools) agreed to be necessary for this Programme.

e. Be responsible for the preparation of any documents necessary for securing approval for testing subassemblies and fuel pins, provided by UKAEA, in its facilities.

f. Implement the agreed Programme of shear trials on the UKAEA fuel assembly.

g. Be responsible for the agreed analysis and recording of the results of the tests in 3.2 (e) and make them available to UKAEA.

h. Be responsible for the packaging and labelling of the samples resulting from the Programme and be responsible for transport to an agreed point of departure in the US.

3.3 Each Party shall at its own expense have the right to observe test activities and analytical work of the other Party. This right may be exercised by short term visits or by the attachment of staff subject to the prior agreement of the receiving Party on each occasion. Attachments of staff shall be the subject of separate attachment agreements in respect of each person. The Party proposing an attachment shall notify the receiving Party of the names of the persons proposed for attachment and shall provide such information respecting any of the said persons as may be required by the receiving Party. The receiving Party may either approve or reject any persons so proposed and may at any time during the continuance of this Agreement without stating any reason revoke any approval previously given.

3.4 DOE and UKAEA each propose to undertake analysis of the results arising from the Programme according to its own requirements using its own data and codes and at its 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. Each Party shall make available to the other Party the results of analyses, and the Parties shall cooperate in attempts to establish the reasons for any differences between results of the analyses.

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

3.6 Except where otherwise provided all costs incurred from the performance of the Programme shall be borne by the Party that incurs them and shall be subject to the availability of appropriated funds.

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 consignments of sub-assemblies, parts of sub-assemblies and samples into or out of its own country.

ARTICLE 4 - GENERAL PROVISIONS

Articles 6,7,8,9 and 11 of the LMFBR Agreement are hereby incorporated by reference.

ARTICLE 5 - USE AND DISCLOSURE OF INFORMATION

5.1 Information developed prior to or outside the scope of the Programme which is proprietary pursuant to Article 6 of the LMFBR Agreement shall be treated as prescribed therein.

5.2 Each Party may examine designs of fuel pins, fuel sub-assemblies, shipping flasks, test hardware and all procedures of the other Party excluding fabrication process specifications related thereto in sufficient detail to enable each Party to fulfill its commitments under this SMA including the requirements of Article 3.2 (e) above and to provide for the mutual approval of such designs and pro cedures.

5.3 Proprietary information, as defined in Article 6 of the LMFBR Agreement, disclosed or revealed by the results of the testing of each sub-assembly and analysis of the samples shall be owned by the Party which owns and provided the sub-assembly.

5.4 Each Party shall advise the other Party of the 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 Programme.

5.5 The Parties recognise that in certain cases information contained in the results of activities conducted during the Programme may disclose proprietary information as defined in Article 6 of the LMFBR Agreement. Such information shall be identified as soon as possible after it arises by the Party asserting that proprietary information may be disclosed and the other Party advised of that identification. Results which may lead to such disclosure shall be

considered to be proprietary information and shall be controlled as provided in Article 6 of the LMFBR Agreement. Either Party may provide to the other a non-exclusive list of those types of information arising under the Programme which may disclose proprietary information as defined in Article 6 of the LMFBR Agreement and which are to be treated as prescribed therein.

5.6 Each Party shall make available to the other Party information from other programmes of work agreed to be relevant to the Programme and may agree to exchange computer programmes to implement or support the Programme.

5.7 The Parties may publish, jointly or (after no less than 30 days' advance notice to the other Party) individually, a series of reports of the tests and of the analyses of the results. If notwithstanding one Party's objection to a proposed disclosure of such information, the other Party shall decide to publish such information, the disclosing Party shall, no less than 10 days prior to publication, provide the other Party with a written statement of its reasons for going forward with such publication.

ARTICLE 6 - MANAGEMENT OF THE PROJECT

6.1 Pursuant to the terms of Article 4 of the LMFBR Agreement the Joint DOE/UKAEA Coordinating Committee shall be responsible for review, evaluation, assessment and approval of the Programme to be implemented under this SMA.

6.2 One person shall be nominated by each Party for the purposes of day-to-day management of the Programme in the country of that Party.

6.3 Each Party shall nominate one or more representatives who at periodic meetings shall together review the progress of the Programme and consider and, where appropriate, make decisions on any necessary or desirable modifications to the Programme taking

into account information arising from the Programme and elsewhere, and shall report such decisions to the persons nominated for day-to-day management of the Programme for implementation and to the Joint Coordinating Committee.

6.4 Each Party shall nominate one representative to be responsible for coordinating the arrangements for all transport of material or equipment required by the Programme.

ARTICLE 7 - FACILITIES AND EQUIPMENT

7.1 In the event that equipment is to be provided by one Party to the other Party for the purposes of implementing the Programme, the loan or transfer of ownership of such equipment shall be the subject of a separate agreement.

7.2 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 Programme 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 8 - PATENTS

8.1 In accordance with paragraph 1.c. of Article 8 of the LMFBR Agreement, UKAEA shall acquire all right, title and interest in and to any inventions or discoveries made or conceived in the course of or under this Memorandum of Agreement, which are improvements to the fuel assemblies provided by UKAEA, in its own country and in third countries, subject to a non-exclusive, irrevocable, royalty-free license in all such countries to DOE, its Government, and its nationals designated by it. DOE shall acquire all right, title and interest in and to such improvements in its own country, subject to a non-exclusive, irrevocable, royalty-free license to UKAEA, its Government, and its nationals designated by it.

8.2 In accordance with paragraph 1.c. of Article 8 of the LMFBR Agreement, DOE shall acquire all right, title and interest in and to any inventions or discoveries made or conceived in the course of or under this Memorandum of Agreement, which are improvements to the shearing equipment provided by DOE, in its own country and in third countries, subject to a non-exclusive, irrevocable, royalty-free license in all such countries to UKAEA, its Government and its nationals designated by it. UKAEA shall acquire all right, title and interest in and to such improvements in its own country, subject to a non-exclusive, irrevocable, royalty-free license to DOE, its Government and its nationals designated by it.

8.3 With regard to other inventions or discoveries made or conceived in the course of or under this Memorandum of Agreement, the provisions of paragraphs 1.a. and 1.b. of Article 8 of the LMFBR Agreement shall apply.

8.4 With regard to all inventions or discoveries made or conceived in the course of or under this Memorandum of Agreement, the provisions of paragraph 3 of Article 8 of the LMFBR Agreement shall apply.

ARTICLE 9 - LIABILITIES

Compensation for damages incurred during the implementation of this SMA shall be in accordance with the applicable laws of the countries of the Parties.

ARTICLE 10 - DELAYS

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

ARTICLE 11 - DURATION AND TERMINATION

11.1 This SMA shall enter into force upon signature by both Parties and except as provided in Article 11.3 shall continue for five years.

11.2 This SMA may be amended or extended at any time by mutual agreement of the Parties in writing.

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

11.4 In the event of termination of this SMA, Article 6, 7 and 8 of the LMFBR Agreement incorporated by reference into this SMA shall survive its termination.

11.5 In the event of termination by either Party pursuant to Article 11.3 after completion of the shearing trials at ORNL all information and results which may be obtained by either Party from the examination of the samples or from subsequent studies using any or all of the samples shall be made available to the other Party under the terms of the SMA.

Done at Washington D.C. this 8th day of October 1980.

FOR THE UNITED STATES
DEPARTMENT OF ENERGY

NAME Joseph A. Yanarella

TITLE Director Nonproliferation

FOR THE UNITED KINGDOM
ATOMIC ENERGY AUTHORITY

NAME J.W. Harper

TITLE Senior Liaison Officer

APPENDIX 1

DESCRIPTION OF MASSIVE SHEAR PROGRAMME

1. General Introduction

1.1 The purpose of the Programme is to make a practical assessment of the relevance and suitability of massive shearing to dismantling a typical UK Commercial Demonstration Fast Reactor (CDFR) sub-assembly.

1.2 The information produced from this Programme will provide data as to whether massive shearing is practical for a CDFR style sub-assembly. It will also provide data on the type of product which will be used in the assessment and selection of the sub-assembly dismantling route and dissolver for a future UK CDFR Reprocessing Plant. If massive shearing is selected as the breakdown route, data from the Programme will be used to design equipment for inactive and active development.

1.3 Two simulated CDFR sub-assemblies, one with and one without a wrapper, will be sheared. These will be supplied by the Dounreay Nuclear Establishment (DNE) and will reflect the main design features of a typical UK CDFR style sub-assembly, ie 325 pins supported in honeycomb grids. The results from a wrapped and unwrapped sub-assembly will allow a better quantified discussion of the possible dismantling options. Following from this work it may be necessary to extend the Programme to shearing further UK sub-assemblies. This would be arranged under a separate or an extension to this Agreement following prior discussion between DOE and UKAEA.

1.4 Different types of tooling will be tested using the ORNL 250 ton Birdsboro shear. All shear equipment associated with the Programme will be provided by ORNL.

1.5 DOE will have access and right of use of data obtained from the shearing of the UK dummy sub-assemblies in accordance with the provisions of the LMFBR Agreement. It will add significantly to DOE's knowledge of shearing nuclear reactor fuel because of the different design features between UK and US Fast Reactor fuel elements.

1.6 One or two engineers will be attached to ORNL to assist in the design and development of sub-assembly shearing equipment which will include the implementation of this "massive shearing" programme; reciprocally ORNL will have a representative attached to the PFR Reprocessing Plant at DNE.

2. Objectives of the Massive Shearing Program

2.1 To assess the performance of ORNL tooling in shearing a simulated CDFR style gridded sub-assembly without wrapper.

2.2 To assess the performance of ORNL tooling in shearing a simulated CDFR style gridded sub-assembly with wrapper.

2.3 To investigate the influence of the tooling on pin end closure.

2.4 To assess the effectiveness of the tooling in shearing honeycomb grids.

2.5 To collect and characterize by size analysis the fines generated in shearing and relate to sub-assembly material conditions and tooling designs.

2.6 To measure the power requirements and forces generated during shearing of the UK sub-assemblies.

3. Experimental Procedure

3.1 The shearing trials will be carried out on two dummy sub-assemblies one with and one without a wrapper. These will be supplied by DNE. The unwrapped dummy sub-assembly will be 85 inches long and consist of 13, PE 16 honeycomb grids and 325 stainless steel pins. The wrapped dummy sub-assembly will be 50 inches long. It will comprise of PE 16 wrapper, 10 stainless steel honeycomb grids, grid legs and 325 stainless steel pins. In both sub-assemblies the pins will be filled with stellite pellets to simulate fuel. The sub-assemblies will be supplied in the as manufactured condition.

3.2 All shear cuts will be carried out using the ORNL Birdsboro shear with different designs of tooling, to be agreed with ORNL. Shear tooling will consist of moving and fixed blades and gag. Relevant sub-assembly design information will be supplied by DNE to ORNL to enable ORNL to advise on the design and to manufacture appropriate tooling.

3.3 Shear cuts will be made at nominally 1 inch intervals but where necessary sub-assembly feed will be controlled to ensure that shear cuts are made through grids.

3.4 For each design of shear tooling tested, a minimum of 5 cuts will be made and shear product characterised by visual observation, size analysis and any other suitable methods. The exact number of cuts at any particular condition will depend on further discussion with ORNL on the different types of tooling which should be examined and the necessity to vary other parameters such as gag loads, blade clearance, blade speed which may be modified as experimental results become available. The shear product will initially be characterised at ORNL using ORNL equipment. This includes particle size analysis of the shearing fines; visual examination of wrapper, hulls and grid or by any other suitable method. The shear product will be photographed by ORNL for record purposes. All the shear product and any unsheared sections of dummy sub-assemblies will be packed, identified and returned to DNE for further study and analysis.

3.5 The Birdsboro shear will be instrumented to measure and record for each cut the shearing forces and power with respect to the moving blade position. Also each shear cut will be video recorded with sound. The shearing force and power data along with the video recordings will be returned to DNE for analysis.

4. U.K. Attachments to ORNL

4.1 In addition to the implementation of the "massive shearing" Programme, the UK attachees will be allowed access to, and participation in the design, assessment and development of sub-assembly dismantling and comminution methods and equipment including the remote operation and maintenance aspects of the modular shear.

4.2 The UK attachees will also be allowed access to design and operational information on the ORNL active single pin cropping machine.

5. US Attachments to the PFR Fuel Reprocessing Plant

5.1 The US attachees will be allowed access to, and participate in the abstraction of data pertaining to the handling of PFR irradiated sub-assemblies in the fuel dismantling route.

5.2 The scope of this work will include the heat transfer behaviour of the sub-assembly during different stages of dismantling; covering sub-assembly cleaning, handling and pin comminution, and the development and improvement of the presently installed fuel breakdown equipment including laser cutting of sub-assembly components, fuel pin removal and comminution.