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APPENDIX C

Sample Computer Software Trade Secret License

LICENSE AGREEMENT

This Agreement is made and entered into this _____ day of _____ , 198_____, by and between _____ , an Illinois corporation having a place of business at _____ (hereinafter referred to as LICENSOR), and _____, a _____ corporation having a place of business at _____ (hereinafter referred to as LICENSEE).

WHEREAS, LICENSOR has developed certain technology for a totally integrated merchandise processing system and has developed the necessary computer software to implement the merchandise processing system; and

WHEREAS, LICENSEE desires to establish and operate a merchandise processing system, utilizing the technology and software developed by LICENSOR: and

WHEREAS, LICENSOR is willing to license its technology and software to LICENSEE.

NOW THEREFORE, in consideration of the above premises, the parties do agree as follows:

Article I
Definitions

As used herein, the following terms shall have the indicated meanings:

1.1 "Technology" shall mean all information and know-how of LICENSOR relating to or useful in connection with a totally integrated Merchandise Processing System.

1.2 "Software" shall mean all programs, printouts, and

descriptive material sufficient to implement a Merchandise Processing System.

1.3 "Merchandise Processing System" shall mean a complete computer-controlled retail system, including purchase order preparation; inventory management and control; price ticket preparation; transfer document preparation; invoice, receipt, and purchase order control; vendor payment; current status of open orders; and open to buy control.

1.4 "Program System" shall mean the software and technology necessary to constitute a Merchandise Processing System.

Article II
License

2.1 LICENSOR hereby grants to LICENSEE a nonexclusive license to establish and operate a single Merchandise Processing System and to use any portion of the Program System in any machine-readable form on a single central processing unit and its associated units (together referred to as assigned CPU). A separate license is required for each additional CPU on which any portion of the Program System in any machine-readable form will be used, unless (1) the assigned CPU is inoperative due to malfunction, preventive maintenance, or changes in features or model, or (2) a single CPU is of insufficient capacity to assemble or compile the Program System.

2.2 LICENSEE shall notify LICENSOR in writing of the location of the assigned CPU and any change in the location of the assigned CPU.

2.3 Pursuant to paragraph 2.1 hereof, LICENSOR shall provide LICENSEE all programs (in machine-readable media), printouts, and descriptive material sufficient to implement a Merchandise Processing System. Unless otherwise agreed between the parties, all program application languages shall be ANS COBOL and Basic Assembler Language.

Article III
Installation and Operation of
Merchandise-Processing System

3.1 As promptly as possible after the date hereof, LICENSOR will proceed to disclose to LICENSEE all technology and provide LICENSEE all software sufficient to establish the Program System.

3.2 The Program System is distributed to LICENSEE on an "as is" basis without warranty on any kind except that described in paragraph 7.1. It shall be the responsibility of the LICENSEE to assemble or compile the Program System on LICENSEE'S CPU. Linkage of the Program System with LICENSEE'S existing software or computing equipment will be the burden of the LICENSEE.

3.3 LICENSEE shall, immediately after receipt of the Program System from LICENSOR, commence to assemble or compile the Program System on LICENSEE'S CPU.

3.4 Any modification of the Program System by the LICENSEE is the sole responsibility of the LICENSEE. LICENSEE may modify the Program System for its use only, subject to paragraph 6.1 hereof.

3.5 If LICENSEE encounters difficulties with installation of the Program System which are caused by a defect in the Program System, LICENSOR will provide the necessary assistance to LICENSEE to correct the difficulties after notification of LICENSOR at the address stated below and sufficient description of the difficulties encountered. All such assistance shall be at LICENSOR's expense.

3.6 LICENSEE agrees that it will not permit anyone not in its full-time employ to operate, maintain, or have access to the Program System in such a way that such person could receive information with respect to the Program System without LICENSOR'S prior written consent.

Article IV
License Fees and Payment

4.1 In consideration of the rights and privileges granted by LICENSOR and the Program System to be provided by LICENSOR, LICENSEE agrees to pay LICENSOR a fee and royalty of _____ in the following increments:

(a) _____ at the execution of this Agreement by LICENSEE.
(b) _____ upon delivery of the Program System to LICENSEE.
(c) _____ thirty days after LICENSEE begins use of the Program System, or sixty days after delivery of the Program System, whichever occurs first.

4.2 In addition to the fee and royalty of paragraph 4.1, LICENSEE agrees to pay LICENSOR a royalty of _____ annually for each year LICENSEE employs the Program System, commencing with the 31st day of December of the year following the dated execution of this Agreement and annually on the 31st day of December for each year thereafter.

4.3 The fee and royalties specified in paragraphs 4.1 and 4.2 hereof shall be payable in United States dollars at LICENSOR's address designated below.

Article V
Protection of Trade Secrets

5.1 LICENSEE hereby agrees that the Program System received hereunder is a valuable trade secret of LICENSOR and hereby agrees to maintain it in the strictest confidence. LICENSEE agrees to implement sufficient safeguards to protect the confidentiality of the trade secret in light of its own operating activities, including:

A. LICENSEE shall keep all documents and information supplied under this Agreement segregated in a retention area designated for such material.
B. LICENSEE agrees to limit access to all trade secret material to those employees with a need to use such materials to implement or operate the Program System.

5.2 LICENSEE shall not copy, in whole or in part, any portion of the Program System provided by LICENSOR in written form under this Agreement. Additional copies of written materials may be licensed from LICENSOR at the charges then in effect.

5.3 Any portion of the Program System provided by LICENSOR in machine-readable form may be copied, in whole or in part, in written or machine-readable form, in sufficient number for use by the LICENSEE in the assigned CPU described in paragraph 2.1 hereof or to understand the contents of such machine-readable material, provided, however, that no more than five such copies will be in existence at any one time without prior written consent of LICENSOR. LICENSEE agrees to maintain appropriate records of the number and location of all such copies of the Program System. The original and any copies of the Program System or any portion thereof made by LICENSEE shall remain the property of the LICENSOR.

5.4 Should the original or any copy of the Program System be kept at other than the location of the assigned CPU described in paragraph 2.1 hereof, LICENSEE will notify LICENSOR in writing of the location of the original and each copy.

5.5 LICENSEE shall immediately notify LICENSOR of any information which comes to its attention which does or might indicate that there has been any loss of confidentiality of the trade secret Program System transferred hereunder. In such event LICENSEE shall take all steps within its power to limit the spread of such information, including

taking whatever legal action is possible to terminate such spread.

Article VI
Termination

6.1 Should LICENSEE discontinue use of the Program System, or discontinue this License, LICENSEE agrees to return the original and any copies, or portions thereof, in any form or media, of the Program System within one month of such discontinuance. If LICENSEE has modified the Program System or merged it into other program material to form an updated work, upon such discontinuance the Program System will be completely removed from the updated work and returned to LICENSOR as provided in this paragraph.

6.2 Upon the discontinuance described in paragraph 6.1, any portion of the Program System maintained in machine-readable form in LICENSEE'S CPU shall be destroyed unless upon prior written authorization by LICENSOR some or all of the Program System is allowed to be retained by LICENSEE.

Article VII
Warranties and Liability

7.1 LICENSOR hereby warrants that the Program system licensed under this Agreement is a complete and sufficient system to allow LICENSEE to assemble or compile the Program System on LICENSEE'S CPU and operate a Merchandise Processing System. It is hereby agreed that LICENSOR shall not be liable for any incidental or consequential damages to LICENSEE incurred in the operation of the Program System or to any third parties with respect to the operation of the Program System. LICENSOR'S obligations hereunder are expressly limited to making repairs to or

modifications of the Program System to correct any defect in the Program System as described in paragraph 3.5. In no event shall LICENSOR be liable for hardware-related problems or software problems due to interfacing of the Program System with LICENSEE'S existing hardware or software. LICENSOR shall not be liable for damages resulting from the improper or incorrect usage or operation of the Program System by LICENSEE, its employees, or third parties.

7.2 The foregoing warranty of paragraph 7.1 is in lieu of all other warranties, express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Article VIII
General

8.1 This Agreement is entered into and intended to be performed pursuant to the laws of the State of Illinois, United States of America.

8.2 This Agreement may be executed in counter-parts, any one of which shall constitute an original agreement.

8.3 This Agreement shall inure to the benefit of and be binding upon LICENSOR, or its successors or assigns, but may not be assigned by LICENSEE or by operation of law to any other person, persons, firm or corporation without the express written approval of LICENSOR.

8.4 Notices, payments, or any other communications provided for herein shall be deemed to be given when mailed first class in a sealed envelope, postage prepaid, addressed to LICENSEE as follows:

_____

_____

_____

or addressed to LICENSOR as follows:

_____

_____

_____

_____
(Licensee)

ATTEST: By:_____
Its:_____

_____

_____
(Licensor)

ATTEST: By:_____
Its:_____

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APPENDIX

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Example 1
Disclosure Ag

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MODIFICATION TO SOFTWARE LICENSE
Contract No. _____

This agreement is a modification of the software license applicable to the following software items and related documentation:

Because the Government is constrained by the Federal Acquisation Regulations (FAR) and applicable federal statutes, and because the Defense Department is subject to the Defense FAR Supplement (DFARS), the present software license must be modified to conform to the requirements detailed in these laws and regulations. In particular, any provision of the present software license which is not consistent with the requirements imposed by these laws and regulations, or which impair any Government rights required by these laws and regulations, is null and void. In those situations where a conflict arises between provisions of the present software license and the FAR, the DFARS, and relevant federal statutes, the conflict will be resolved against the provisions found in the present license. In general, state law will not be applicable to any dispute which may arise under the present license.

Among the requirements applicable to the present license are the following:

Contract Disputes Act of 1978 (41 U.S.C. Section 601)

Prompt Payment Act (31 U.S.C. Section 1801)

Default Clause (FAR 52.249-8)

Disputes Clause (FAR 52.233-1)

Termination Clause (FAR 52.249-2)

Rights in Technical Data and Computer Software (DFARS 52.227-7013)

The full text of these and other clauses which are incorporated into the present contract are available from the Contracting Officer.

FOR THE LICENSOR:

_____

FOR THE GOVERNMNENT:

_____
Contracting Officer

LESSONS LEARNED

SOFTWARE

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Practically all commercial computer software acquired by the Army is accompanied by a license which sets forth limitations on how the software is to be used, reproduced, and disclosed. The vendors insist that buyers agree to the terms of the licenses as a condition for receiving the software. These licenses, which vary from vendor to vendor, tend to be relatively restrictive. Many are more restrictive than the minimum rights that the Government has in restricted rights computer software under the Rights in Technical Data and Computer Software clause, DFARS 52.227-7013. This clause is required to be in all contracts for the procurement of software. Going through the various licenses to determine whether they are compatible with the DFARS clause is a laborous task. Even when inconsistencies are noted, the vendors are reluctant to change the wording of their licenses since most of them are boiler plate and are used in their commercial business.

An alternate approach to making a line-by-line review of the vendors' licenses is to add the following provision to the bottom of them: "Any conflict between the terms of this agreement and the provisions of the Rights in Technical Data and Computer Software clause (DFARS 52.227-7013) shall be resolved by the Rights in Technical Data and Computer Software clause". This provision assures that the Government will at least have the minimum rights set forth in the clause. Additionally, vendors are found to be agreeable to its inclusion.

To avoid a tedious line-by-line review of license agreements for commercial software, the inclusion of the statement set forth above secures the minimum rights to the Government.

required by final decree of a court of competent jurisdiction; and do not apply to material furnished to the Contractor by the Government and incorporated in data to which this clause applies.

(End of clause)

8. Section 52.227-19 is added to read as follows:

52.227-19 Commercial Computer Software--Restricted Rights

As prescribed in 27.409(k), insert the following clause:

COMMERCIAL COMPUTER SOFTWARE -- RESTRICTED RIGHTS (JUL 1985)

(a) As used in this clause, "restricted computer software" means any computer program, computer data base, or documentation thereof, that has been developed at private expense and either is a trade secret, is commercial or financial and confidential or privileged, or is published and copyrighted.

(b) Notwithstanding any provisions to the contrary contained in any contractor's standard commercial license or lease agreement pertaining to any restricted computer software delivered under this purrchase order/contract, and irrespective of whether any such agreement has been proposed prior to or after issuance of this purchase order/contract or of the fact that such agreement may be affixed to or accompany the restricted computer software software upon delivery, vendor agrees that the Government shall have the rights that are set forth in paragraph (c) below to use, duplicate or disclose any restricted computer software delivered under this purchase order/contract. The terms and provisions of this contract, including any commercial lease or license agreement, shall be subject to paragraph (c) below and shall comply with Federal laws and the Federal Acquisition Regulation.

(c)(1) The restricted computer software delivered under this contract may not be used, reproduced or disclosed by the Government except as provided below or as expressly stated otherwise in this contract.

(2) The restricted computer software may be--

(i) Used or copied for use in or with the computer or computers for which it was acquired, including use at any Government installation to which such computer or computers may be transferred;

(ii) Used or copied for use in or with backup computer if any computer for which it was acquired is inoperative;

(iii) Reproduced for safekeeping (archives) or backup purposes;

(iv) Modified, adapted, or combined with other computer software, provided that the modified, combined, or adapted portions of the derivative software incorporating any of the delivered, restricted computer software shall be subject to same restrictions set forth in this purchase order/contract; and

(v) Disclosed to and reproduced for use by support service contractors or their subcontractors, subject to the same restrictions set forth in this purchase order/contract.

(vi) Used or copied for use in or transferred to a replacement computer.

(3) If the restricted computer software delivered under this purchase order/contract is published and copyrighted, it is nsed to the Government, without disclosure prohibitions, with the rights set forth in subparagraph (2) above unless expressly stated otherwise in this purchase order/contract.

(4) To the extent feasible the contractor shall affix a Notice substantially as follows to any restricted computer software delivered under this purchase order/contract; or, if the vendor does not, the Government has the right to do so:

"Notice - Notwithstanding any other lease or license agreement that may pertain to, or accompany the delivery of, this computer software, the rights of the Government regarding its use, reproduction and disclosure are as set forth in Goverrnrnment Contract (or Purchase Order) No._____.)

(d) If any restricted computer software is delivered under this contract with the copyright notice of 17 U.S.C. 401, it will be presumed to be published and copyrighted and licensed to the Government in accordance with subparagraph (c)(3) above, unless a statement substantially as follows accompanies such copyright notice: "Unpublished - rights reserved under the copyright laws of the United States."

(End of clause)

9. Section 52.227-20 is added to read as follows:

52.227-20 Rights in Data--SBIR Program.

As prescribed in 27.409(l), insert the following clause:

RIGHTS IN DATA--SBIR PROGRAM (JUL 1985)

(a) Definitions.

"Computer software," as used in this clause, means computer programs, computer data bases, and documentation thereof.

"Data," as used in this clause, means recorded information, gardless of form or the media on which it may be recorded. The term includes technical data and computer software. The term

acquisition of

(1) Existing audiovisual and similar works. The clause at 52.227-18, Rights in Data--Existing Works, is for use in contracts exclusively for the acquisition (without modification) of existing motion pictures, television recordings, and other audiovisual works; sound recordings; musical, dramatic, and literary works; pantomimes and choreographic works; pictorial, graphic, and sculptural works; and works of a similar nature. The contract may set forth limitations consistent with the purposes for which the works covered by the contract are being acquired. Examples of these limitations are (i) means of exhibition or transmission, (ii) time, (iii) type of audience, and (iv) geographical location. If the contract requires that works of the type indicated above are to be modified through editing, translation, or addition of subject matter, etc. (rather than purchased in existing form) the clause at 52.227-17, Rights in Data--Special Works, is to be used. (See 27.405(a).)

(2) Acquisition of existing computer software. (i) When contracting other than from GSA's Multiple Award Schedule contracts for the acquisition of existing computer software (i.e. privately developed software normally vended commercially under a license or lease agreement restricting its use, disclosure, or reproduction), no specific contract clause prescribed in this subpart need be used, but the contract (or purchase order) must specifically address the Government's rights to use, disclose and reproduce the software, which rights must be sufficient for the Government to fulfill the need for which the software is being acquired. Such rights may be negotiated and set forth in the

contract using the guidance concerning restricted rights as set forth in 27.404(e), or the clause at 52.227-19, Commercial Computer Software--Restricted Rights, may be used. Restricted computer software acquired under GSA Multiple Award Schedules contracts and orders are excluded from this requirement. The guidance concerning rights set forth in 27.404(e), as well as those in the clause at 52.227-19, are the minimum rights the Government usually should accept. Thus if greater rights than these minimum rights are needed, or lesser rights are to be acquired, they must be negotiated and set forth in the contract (or purchase order). This includes any additions to, or limitations on, the rights set forth in paragraph (b) of the clause at 52.227-19 when used. Examples of greater rights may be those necessary for networking purposes or use of the software from remote terminals communicating with a host computer where the software is located. [~~Furthermore, an indemnity for patent, copyright or trade secret infringement may be included.~~] If the computer software is to be acquired with unlimited rights, the contract must also so state. In addition, the contract must adequately describe the computer programs and/or data bases, the form (tapes, punch cards, disk pack, and the like), and all the necessary documentation pertaining thereto. [If the acquisition is by lease or license, the disposition of the computer software (by returning to the vendor or destroying) at the end of the term of the lease or license must be addressed.

(ii) If the contract incorporates, makes reference to, or uses a vendor's standard commercial lease, license, or

purchase agreement, such agreement shall be reviewed to assure that it is consistent with (i) above. Caution should be exercised in accepting a vendor's terms and conditions, since they may be directed to commercial sales and may not be appropriate for Government contracts. Any inconsistencies in a vendor's standard commercial agreement shall be addressed in the contract and the contract terms shall take precedence over the vendor's standard commercial agreement. If the clause at 52.227-19, Commercial Computer Software--Restricted Rights, is used, inconsistencies in the vendor's standard commercial agreement regarding the Government's right ot use, duplicate or disclose the computer software are reconciled by that clause.

(iii) If a prime contractor under a contract containing the clause at 52.227-14, Rights in Data--General, with subparagraph (g)(3) (Alternate III) in the clause, acquires restricted computer software from a subcontractor (at any tier) as a separate acquisition for delivery to or for use on behalf of the Government, the contracting officer may approve any additions to, or limitations on the restricted rights in the Restricted Rights Notice of subparagraph (g)(3) in a collateral agreement incorporated in and made part of the contract.

(3) Other existing data and works. Except for existing audiovisual and similar works pursuant to paragraph (b)(1) above, and existing computer software pursuant to paragraph (b)(2) above, no clause contained in this subpart is required to be included in (i) contracts solely for the acquisition of books, periodicals, and other printed items in the exact form in which such items are

COMMERCIAL COMPUTER SOFTWARE--RESTRICTED RIGHTS (APRIL 1985)

(a) Any restricted computer software (including documentation thereof) delivered under this purchase order/contract shall be subject to the "Restricted Rights" required by the NASA FAR Supplement (NFS 18-27.473-2(e) and 18-27.473-4(b)), as set forth in paragraph (d), below. Where the vendor proposes its standard commercial software license, or lease agreement, those applicable portions thereof consistent with Federal laws, standard industry practices, the Federal Acquisition Regulations (FAR) and the NASA FAR Supplement, including the "Restricted Rights" set forth in paragraph (d) below, shall be incorporated into and made a part of this purchase order/contract.

(b) If the vendor proposes its standard commercial software license or lease agreement after this purchase order/contract has been issued, or at or after the time the computer software is delivered, such license or lease agreement shall be deemed incorporated into and made a part of the resulting contract under the same terms and conditions as in paragraph (a) above. For purposes of receiving updates, correction notices, consultation, etc., on the computer software, the NASA Contracting Officer or the NASA Contractor Technical Representative/User may sign any license or lease registration form or card and return it directly to the vendor; however, such signing shall not alter any of the terms and conditions set forth in this clause.

(c) Vendor's acceptance is expressly limited to the terms and conditions of this purchase order/contract. If the specified computer software is shipped or delivered to NASA, it shall be understood that the vendor has unconditionally accepted the terms and conditions set forth in paragraphs (a) and (b) above, and that such terms and conditions constitute the entire agreement between the parties concerning rights in the computer software.

(d) The following "Restricted Rights" of NFS 18-27.473-2(e) shall apply:

(1) The restricted computer software delivered under this purchase order/contract may not be used, reproduced or disclosed by the Government except as provided below or otherwise expressly stated in the purchase order/contract.

(2) The restricted computer software may be --

(i) Used or copied for use in or with the computer for which it was acquired, including use at any Government installation to which such computer may be transferred;

(ii) Used with a backup computer if the computer for which it was acquired is inoperative;

(iii) Reproduced for safekeeping (archives) or backup purposes;

(iv) Modified, adapted, or combined with other computer software, provided that the modified, combined, or adapted portions of the derivative software incorporating restricted computer software shall be subject to the same restricted rights; and

(v) Disclosed and reproduced for use by support contractors or their subcontractors, subject to the same restrictions under which the Government acquired the software.

(3) If the restricted computer software is published, copyrighted computer software it is licensed to the Government, without disclosure prohibitions, with the rights set forth in subparagraph (2) above.

(End of clause)

form) the clause at 18-52.227-77, Rights in Data--Special Works, is to be used. (See 18-27.473-3.)

(b) Separate acquisition of existing computer software. (1) If the contract is for the separate acquisition of existing computer software, no specific contract clause contained in this subpart need be used. However, the contract must specifically address the Government's rights to use, disclose, and reproduce the software and must contain terms obtaining sufficient rights for the Government to fulfill the need for which the software is being acquired. The restricted rights set forth in 18-27.473-2(e) should be used as a guide and are usually the minimum the Government should accept. If the computer software is to be used for networking purposes (i.e., loading a program into the memory of a host computer for use in or with multiple processors, computers, workstations, and terminals which may form a network or system located at a single site or be connected by communications to other networks or systems located at different sites), adequate rights for such purposes must also be obtained. If the computer software is "commercial" computer software (i.e., privately developed software normally vended commercially under a license or lease agreement restricting its use, disclosure, or reproduction) the clause at 18-52.227-79, Commercial Computer Software--Restricted Rights, may be used in the contract or purchase order (see also subparagraph (2) below). When using such clause the contract or purchase order may expressly state any additions to, or limitations on, the restricted rights set forth in subparagraph (d)(2) of the clause. If the computer software is to be acquired with unlimited rights, the contract or purchase order must also so state. In addition, the contract must adequately describe the computer programs and/or data bases, the form (tapes, punch cards, disc pack, and the like), and all the necessary documentation pertaining thereto. If the acquisition is by lease or license, the disposition of the computer software (by returning to the vendor or destroying) at the end of the term of the lease or license must be addressed.

(2) If the contract incorporates, makes reference to, or uses a vendor's standard commercial lease, license, or purchase agreement, such agreement shall be reviewed to assure that it is consistent with subparagraph (1) above. Caution should be exercised in accepting a vendor's terms and conditions since they may be directed to commercial sales and may not be appropriate for Government contracts. Any inconsistencies in a vendor's standard commercial agreement shall be addressed in the contract and the contract terms shall take precedence over the vendor's standard commercial agreement. If the clause 18-52.227-79, Commercial Computer Software--Restricted Rights, is used, inconsistencies in the vendor's standard commercial agreement are reconciled by the clause.

(3) If a prime contractor under a contract containing the clause at 18-52.227-74, Rights in Data--General, with its Alternate III, acquires restricted computer software from a subcontractor (at any tier) as a separate acquisition for delivery to the Government, the contracting officer may approve any additions to or limitations on the restricted rights in the Restricted Rights Notice of subparagraph (g)(3) in a collateral agreement incorporated in and made part of the prime contract. (See also 18-27.473-2(e).)

(c) Other existing works. Except for existing audiovisual and similar works as discussed in paragraph (a) above, and existing computer software as discussed in paragraph (b) above, no clause contained in this subpart need be included in (i) contracts where the only data to be acquired consists solely of books, publications, and similar items in the exact form in which such items exist prior to the request for purchase (i.e. the off-the-shelf purchase of such items) unless reproduction rights of such items are to be obtained or (ii) contracts resulting from sealed bidding that require only existing data (other than limited-rights data) to be delivered unless reproduction rights for such data are to be obtained. If reproduction rights are to be obtained, such rights must be specifically set forth in the contract.

18-27.473-5 Contracts awarded under Small Business Innovative Research (SBIR) Program.

The clause at 18-52.227-80, "Rights in Data--SBIR Program, is for use in all Phase I or Phase II contracts awarded under the Small Business Innovative Research (SBIR) Program established pursuant to Pub. L. 97-219 (the Small Business Innovation Development Act of 1982). The clause is limited to use solely in contracts awarded under the SBIR Program, and is the only data rights clause to be used in such contracts.

18-27.474 Procedures--acquisition of data.

(a) General. (1) The requirements for data to be delivered under a contract should strike a balance between NASA's policies of providing for the widest practical and appropriate dissemination of the results of NASA's research and development activities, protecting a contractor's legitimate proprietary interest, providing for full and open competition, and obtaining adequate documentation to operate and maintain items and components or use processes necessary for NASA to carry out its missions and objectives.

(2) It is NASA's practice to determine, to the extent feasible, its data requirements in time for inclusion in solicitations. The data requirements are subject to revision during contract negotiations. Since the preparation, reformatting, maintenance and updating, cataloguing, and storage of data represents an expense to both the Government and the contractor, efforts should be made to keep the contract data requirements to a minimum consistent with subparagraph (1) above.

Software License Agreement

THIS AGREEMENT, by and between the UNITED STATES GOVERNMENT, as represented by the Secretary of the Army and officers executing this agreement (hereinafter called GOVERNMENT), and _____ _____ (hereinafter called CONTRACTOR) [(as a corporation organized and existing under the laws of the State of _____ _____), (a partnership consisting of _____), (an individual trading as _____)], of the city/county of _____ in the State of _____.

WHEREAS, CONTRACTOR has developed at private expense, _____ _____, hereinafter called Software Technology; and

WHEREAS, the GOVERNMENT and CONTRACTOR desire to set the terms and conditions of a license to the Government of CONTRACTOR's Software Technology developed at CONTRACTOR'S private expense and the applications or adaptations of the foregoing which may be contained in software and its documentation delivered under any Government contract and follow-on or future contracts; and

WHEREAS, the GOVERNMENT and CONTRACTOR have mutually agreed upon a schedule listing the existing CONTRACTOR's Software Technology in Attachment I hereto; and

WHEREAS, CONTRACTOR warrants and represents that it owns certain property rights in the Software Technology; and

WHEREAS, CONTRACTOR warrants that it has the right to license the Software Technology; and

WHEREAS, the GOVERNMENT desires a license under CONTRACTOR's Software Technology;

Now, THEREFORE, in consideration of the grant, release, and agreements hereinafter recited, the parties have agreed as follows:

ARTICLE 1. DEFINITIONS

For the purpose of this AGREEMENT the following words and phrases shall have the following meanings:

1.1 "Software Technology" means software and associated documentation listed in Attachment I whether or not used in support of a Government contract and all other CONTRACTOR's privately developed software technology that is used to support the work performed for the GOVERNMENT during the term of this AGREEMENT.

1.2 "Computer" means a data processing device capable of accepting data, performing prescribed operations on the data, and supplying the results of these operations; for example, a device that operates on discrete data by performing arithmetic and logic processes on the data, or a device that operates on analog data by performing physical processes on the data.

1.3 "Computer data base" means a collection of data in a form capable of being processed and operated on by a computer.

1.4 "Computer program" means a series of instructions or statements in a form acceptable to a computer, designed to cause the computer to execute an operation or operations. Computer programs include operating systems, assemblers, compilers, interpreters, data management systems, utility programs, sort-merge programs, and ADPE maintenance/diagnostic programs, as well as applications programs such as payroll, inventory control, and engineering analysis programs. Computer programs may be either machine-dependent or machine-independent, and amy be general-purpose in nature or be designed to satisfy the requirements of a particular user.

1.5 "Computer software" means computer programs and computer data bases.

1.6 The term "computer software documentation" means technical data, including computer listings and printouts, in human-readable form which (a) documents the design or details of computer software, (b) explains the capabilities of the software, or (c) provides operating instructions for using the software to obtain desired results from a computer.

1.4 "Restricted rights means rights that apply only to computer software,

ARTICLE 2. LICENSE

2.1 CONTRACTOR grants to GOVERNMENT a non-exclusive license under CONTRACTOR'S copyright and under CONTRACTOR'S Software Technology to modify the software and associated documentation in order to produce a derivative CONTRACTOR'S version thereof and to use the Software Technology for its own internal use. The Government's rights shell include, as a minimum, the right to--

(a) Use computer software with the computer for which or with which it was acquired, including use at any Government installation to which the computer may be transferred by the Government;

(b) Use computer software with a backup½ computer if the computer for which or with which it was acquired is inoperative;

(c) Copy computer programs for safekeeping (archives) or backup purposes; and

(d) Modify computer software, or combine it with other software, subject to the provision that those portions of the derivative software incorporating restricted rights software are subject to the same restricted rights.

ARTICLE 3. PAYMENT

The rights granted hereunder are contingent upon the payment to CONTRACTOR for the Software Technology after receipt of invoice and delivery to GOVERNMENT in accordance with the contract of which this license is a part.

ARTICLE 4. RIGHT TO COPY OR MERGE

4.1 Subject to the terms and conditions of this AGREEMENT, the Software Technology may be copied in whole or in part, for GOVERNMENT'S internal use only.

4.2 With reference to copies it makes of the Software Technology: GOVERNMENT agrees to reproduce any CONTRACTOR'S copyright notice and other proprietary legend, appearing thereon and to include the same on all copies it makes in whole or in part. Such copyright notice(s) may appear in any of several forms, including machine-readable form, and GOVERNMENT agrees to reproduce such notice in each form in which it appears to the extent it is physically possible to do so.

ARTICLE 5. PROGRAM REMAINS CONTRACTOR's PROPERTY

5.1 Title to the Software Technology and all rights therein shall remain vested in CONTRACTOR. Title to any copies made by GOVERNMENT in whole or in part, shall remain vested in CONTRACTOR or its licensor.

5.2 GOVERNMENT agrees not to provide or otherwise make available in any form the Software Technology to any person other than employees of GOVERNMENT or CONTRACTOR's without prior written consent of CONTRACTOR except that if the Software Technology object code form is embodied in GOVERNMENT'S equipment, the transfer of such equipment shall convey to GOVERNMENT's transferee a license to use the Software Technology in such equipment under terms commensurate with the terms set forth in this Agreement and COVERNMENT rights under this Agreement shall terminate upon such transfer.

ARTICLE 6. TERMINATION

Termination of this license agreement shall be subject to the terms and conditions set forth in the contract of which this license agreement is a part.

ARTICLE 7. MAINTENANCE

CONTRACTOR responsibility, if any, for maintenance or field service of Software Technology or derivative versions are set forth in the contract of which this license is a part.

ARTICLE 8. DISCLAIMER OF WARRANTY

8.1 Contractor shall not be liable for incidental or consequential damages arising from use of the Software Technology. This disclaimer of liability extends to licensee, to licensee's transferees and to licensee's customers or users of products.

8.2 CONTRACTOR does not represent or warrant that the Software Technology furnished hereunder are free of infringement of any third party patents, copyrights or trade secrets.

ARTICLE 9. JURISDICTION

This Agreement shall be governed and interpreted by the laws applicable to the Governmmnet of the United States.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed as of the day and year of the last signature hereto.

GOVERNMENT	CONTRACTOR
By_____ authorized signature	By_____ authorized signature
Title_____	Title_____
Date_____	Date_____

H

U.S. ARMY LABORATORY COMMAND

PISCES PROJECT

PATENT INVESTIGATION &

SECURITY CODIFICATION

EVALUATION SYSTEM

"PISCES"
PROJECT

Patent & Trademark Office (PTO)

- Invention Secrecy Act 1951
  35 USC 181 - 188

- Secrecy Orders (S.O.) 1 yr.
  PTO on advice of DoD

- Foreign Filing Licenses / Permits (S.O.)

- DoD Review - 90 days

PISCES will provide:

- Timely, coordinated, unified review of U.S. Patent Applications (P.A.'s)

  Basis for recommending S.O.

- Annual review of existing Secrecy Orders

- Analysis of Foreign Patents/Applications provided USA for defense purposes

- Review / define / analyze Foreign Patents not provided for Defense Purposes

Example: 60,000 patents annually , Soviet Bloc countries

by country

by technology (MCTL)

-Characterize Emerging Technologies

(Worldwide)

- Basis for Trends and Forecasts

-Increase Tech Base by incorporation

- Foster Reverse Technology Transfer

- Assist Government Agencies in Defining Foreign Capabilities

- Support DIA Project Socrates

  Input Pisces data to National Data Bases

- Dynamic tech expert directory/matrix for all critical tech areas (Army)

PISCES Project

Data bases will be Classified
to insure access control

Inventor Confidentiallity Protected

Project Administration :

- Formally task/suspense

  Patent Application Evaluation / Review
  Secrecy Order Review

- Access Control Accountability of reviewers (required by statute and PTO on U.S. PA's)

- Administrative and Informational Reports (as required)

Data Bases :

(1) MCTL
Key Word List

(2) Baseline U.S. Patents

(3) Secrecy Orders

(4) Foreign Patent Accessions

(5) AMC Tech/Mission Profiles (Labs)

(6) Army Technical Experts List

(7) Working Patent Application Files

(8) Next Generation and Notional Systems Defined Tech Barriers

TRADEMARKS IN THE ARMY

Major William V. Adams
Patents, Copyrights, and Trademarks Division

I. Introduction

A. Terminology: Trademarks, Service Marks, Collective Membership Marks and Certification Marks.

B. Functions of Marks.

C. Bases for Protection of Marks.

D. Acquisition of Rights in Marks.

II. Rationale for Federal Registration of Army Marks (See "Be All You Can Be and The Army Mule," The Army Lawyer, December 1986, at 52).

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B. Application Preparation and Prosecution.

C. Post Registration: Avoiding Abandonment, Amendment, Continued Use (15 U.S.C. § 1058), Continuous Use--Incontestibility--(15 U.S.C. § 1065), and Renewal.

D. Policing the Mark and Oppositions

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A. Resources to Detect Possible Infringement.

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J

FEDERAL TECHNOLOGY TRANSFER ACT

OF

1986

PL 99-502

SIGNED INTO LAW
20 OCT 1986

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

PRINCIPAL POINTS

* AMENDS THE STEVENSON-WYDLER ACT OF 1980 (PL 96-480)
* STRENGTHENS POLICY MAKING TECHNOLOGY TRANSFER PART OF LAB MISSION
* LAB WITH MORE THAN 200 S&E PERSONNEL MUST HAVE A FULL TIME ORTA
* EACH AGENCY MUST REPORT ANNUALLY WITH BUDGET SUBMISSION
* ESTABLISHES THE FEDERAL LABORATORY CONSORTIUM
* PROVIDES AUTHORITY FOR GOVERNMENT LABS TO ENTER INTO COOPERATIVE R&D AGREEMENTS
* PROVIDES 15% OF ROYALTIES TO INVENTORS AND THE MAJORITY OF THE BALANCE TO LABS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

SECTION TOPICS

SECTION 1 - SHORT TITLE

SECTION 2 - COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS

SECTION 3 - ESTABLISHMENT OF FEDERAL LABORATORY CONSORTIUM

SECTION 4 - UTILIZATION OF FEDERAL TECHNOLOGY

SECTION 5 - FUNCTIONS OF THE SECRETARY OF COMMERCE

SECTION 6 - REWARDS FOR TECHNICAL PERSONNEL OF FEDERAL AGENCIES

SECTION 7 - DISTRIBUTION OF ROYALTIES RECEIVED BY AGENCIES

SECTION 8 - EMPLOYEE ACTIVITIES

SECTION 9 - MISCELLANEOUS AMENDMENTS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

COOPERATIVE R&D AGREEMENTS

THE DIRECTOR OF EACH FEDERAL LABORATORY MAY BE PERMITTED TO:

1) ENTER INTO COOPERATIVE R&D AGREEMENTS
2) NEGOTIATE LICENSING AGREEMENTS

AGREEMENTS MAY BE MADE WITH:

* OTHER FEDERAL AGENCIES
* UNITS OF STATE AND LOCAL GOVERNMENT
* INDUSTRIAL ORGANIZATIONS
* PUBLIC AND PRIVATE FOUNDATIONS
* NON-PROFITS (INCLUDING UNIVERSITIES)
* OTHER PERSONS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

COOPERATIVE R&D AGREEMENTS

* ACCEPT FUNDS, PERSONNEL, SERVICES, AND PROPERTY FROM COLLABORATING PARTIES
* SUPPLY ANY OF THESE, EXCEPT FUNDS, TO COLLABORATING PARTIES
* GRANT (OR AGREE TO GRANT IN ADVANCE) PATENT LICENSES, ASSIGNMENTS OR OPTIONS FOR INVENTIONS OF LAB EMPLOYEES
* WAIVE RIGHT OF OWNERSHIP, EXCEPT FOR LICENSE, TO INVENTIONS MADE BY COLLABORATORS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

COOPERATIVE R&D AGREEMENTS

1) GIVE SPECIAL CONSIDERATION TO SMALL BUSINESSES AND CONSORTIA OF SMALL BUSINESSES

2) GIVE PREFERENCE TO BUSINESS UNIT LOCATED IN U.S. AND AGREEING TO MANUFACTURE IN U.S.

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

COOPERATIVE R&D AGREEMENTS

* AGENCY MAY ISSUE REGULATIONS ON PROCEDURES BUT IMPLEMENTATION SHALL NOT BE DELAYED
* AGENCY MUST REVIEW STANDARDS OF CONDUCT AND PROVIDE GUIDELINES FOR LIKELY SITUATIONS
* AGENCY HEAD MUST DISAPPROVE OR REQUIRE MODIFICATION OF ANY AGREEMENT WITHIN 30 DAYS
* AGENCY MUST MAINTAIN A RECORD OF ALL AGREEMENTS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

ESTABLISHMENT OF FEDERAL LABORATORY CONSORTIUM

* THE LAW PROVIDES A CHARTER FOR THE FLC

* MEMBERSHIP CONSISTS OF FEDERAL LABORATORIES WITH 200 OR MORE FULL-TIME EQUIVALENT SCIENTIFIC, ENGINEERING AND RELATED TECHNICAL POSITIONS AND OTHERS WHICH WISH TO JOIN

* REPRESENTATIVES TO THE CONSORTIUM SHALL BE A SENIOR STAFF MEMBER FROM EACH MEMBER LABORATORY AND FROM EACH FEDERAL AGENCY WITH MEMBER LABORATORIES

* THE DIRECTOR OF NBS SHALL PROVIDE ADMINISTRATIVE SUPPORT SERVICES TO THE FLC

* FEDERAL AGENCIES SHALL SEND FUNDS EQUAL TO .005% OF THEIR INTERNAL R&D BUDGET TO NBS FOR SUPPORT OF FLC IF THIS AMOUNT IS $\geq$\$10K

* HEADS OF FEDERAL AGENCIES AND DIRECTORS OF LABORATORIES MAY PROVIDE ADDITIONAL FUNDS AS THEY DEEM APPROPRIATE

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

ESTABLISHMENT OF FEDERAL LABORATORY CONSORTIUM

THE FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER SHALL, IN COOPERATION WITH LABORATORIES, AGENCIES, AND CLIENT GROUPS:

1) DEVELOP TRAINING COURSES AND OTHER METHODS TO INCREASE THE AWARENESS OF LAB EMPLOYEES OF COMMERCIAL POTENTIAL OF THEIR TECHNOLOGY

2) FURNISH ADVICE AND ASSISTANCE TO AGENCIES AND LABORATORIES ON TECHNOLOGY TRANSFER

3) PROVIDE A CLEARINGHOUSE TO REFER REQUESTS FOR ASSISTANCE TO THE APPROPRIATE LABORATORY OR LABORATORIES

4) FACILITATE COMMUNICATION AND COORDINATION BETWEEN ORTA'S

5) ASSIST LABORATORIES TO USE APPROPRIATE TRANSFER MECHANISMS AND ESTABLISH TECHNICAL VOLUNTEER PROGRAMS

6) FACILITATE COOPERATION BETWEEN ORTA'S AND REGIONAL, STATE AND LOCAL TECHNOLOGY TRANSFER ORGANIZATIONS

7) ASSIST UNIVERSITIES, BUSINESSES, NON PROFITS, STATE AND LOCAL GOVERNMENTS, AND REGIONAL ORGANIZATIONS IN ESTABLISHING PROGRAMS TO ENCOURAGE TRANSFER

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

ESTABLISHMENT OF FEDERAL LABORATORY CONSORTIUM

* THE FLC SHALL SEEK ADVICE ON PROGRAM EFFECTIVENESS IN EACH FLC REGION FROM REPRESENTATIVES OF ITS CONSTITUENCIES

* THE CHAIRMAN OF THE CONSORTIUM SHALL SUBMIT AN ANNUAL REPORT TO THE PRESIDENT, SPECIFIED CONGRESSIONAL COMMITTEES, AND EACH FUNDING AGENCY

* THE CONSORTIUM SHALL ARRANGE FOR 5% OF ITS FUNDS TO BE GRANTED OR AWARDED TO ESTABLISH DEMONSTRATION PROJECTS IN TECHNOLOGY TRANSFER

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

UTILIZATION OF FEDERAL TECHNOLOGY

EXPANDS THE FOLLOWING POLICY STATEMENT OF STEVENSON-WYDLER:

1) THE FEDERAL GOVERNMENT WILL STRIVE TO TRANSFER ITS TECHNOLOGY

BY ADDING:

2) TECHNOLOGY TRANSFER IS A RESPONSIBILITY OF EACH LABORATORY SCIENCE AND ENGINEERING PROFESSIONAL

3) EACH LAB DIRECTOR SHALL ENSURE TRANSFER EFFORTS ARE CONSIDERED POSITIVELY IN LAB JOB DESCRIPTIONS, PROMOTION POLICIES, AND S&E JOB PERFORMANCE EVALUATION

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

UTILIZATION OF FEDERAL TECHNOLOGY

THE REVISED FUNCTIONS OF THE ORTA'S ARE:

1) PREPARE APPLICATIONS ASSESSMENTS FOR SELECTED R&D PROJECTS BELIEVED TO HAVE COMMERCIAL APPLICATIONS

2) PROVIDE AND DISSEMINATE INFORMATION ON FEDERALLY OWNED OR ORIGINATED TECHNOLOGY

3) COOPERATE WITH AND ASSIST THE NATIONAL TECHNICAL INFORMATION SERVICE, THE FEDERAL LABORATORY CONSORTIUM, AND OTHER ORGANIZATIONS LINKING LABS WITH POTENTIAL USERS

4) PROVIDE TECHNICAL ASSISTANCE TO STATE AND LOCAL GOVERNMENT OFFICIALS

5) PARTICIPATE IN REGIONAL, STATE AND LOCAL PROGRAMS DESIGNED TO FACILITATE AND STIMULATE TECHNOLOGY TRANSFER

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

UTILIZATION OF FEDERAL TECHNOLOGY

CHANGES SECTION 11(B) OF STEVENSON-WYDLER TO REQUIRE:

1) LABORATORIES HAVING 200 OR MORE FULL-TIME EQUIVALENT SCIENTIFIC, ENGINEERING AND RELATED TECHNICAL POSITIONS SHALL PROVIDE ONE OR MORE FULL-TIME EQUIVALENT POSITIONS FOR THE ORTA

2) INDIVIDUALS IN ORTA POSITIONS SHALL BE INCLUDED IN THE MANAGEMENT DEVELOPMENT PROGRAM

* IT IS UNEQUIVOCALLY CONGRESSIONAL INTENT TO HAVE TECHNOLOGY TRANSFER AS THE PRIMARY JOB OF AT LEAST ONE FULL-TIME PROFESSIONAL

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

UTILIZATION OF FEDERAL TECHNOLOGY

* AMENDS SECTION 11(D) TO ELIMINATE THE DESIGNATION OF THE CENTER FOR THE UTILIZATION OF FEDERAL TECHNOLOGY

* CLARIFIES THAT THE NATIONAL TECHNICAL INFORMATION SERVICE SHOULD RESPOND TO REQUESTS FOR PUBLISHED TECHNICAL INFORMATION AND REFER REQUESTS FOR ASSISTANCE TO THE FLC

* CHANGES AGENCY REPORTING TO REQUIRE REPORT ANNUALLY TO THE CONGRESS AS PART OF THE AGENCY'S ANNUAL BUDGET SUBMISSION

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

FUNCTIONS OF THE SECRETARY OF COMMERCE

* MAKE AVAILABLE TO AGENCIES DOC EXPERTISE IN INVENTION COMMERCIALIZATION

* DEVELOP AND DISSEMINATE MODEL COOPERATIVE R&D AGREEMENTS

* REPORT EVERY 2 YEARS TO THE PRESIDENT AND CONGRESS ON THE USE OF AUTHORITIES IN THIS ACT

* REPORT WITHIN A YEAR TO THE PRESIDENT AND CONGRESS ON COPYRIGHT PROVISIONS AND ANY OTHER BARRIERS TO TRANSFER OF GOVERNMENT SOFTWARE

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

REWARDS FOR TECHNICAL PERSONNEL

FEDERAL AGENCIES WITH INTERNAL R&D BUDGETS GREATER THAN $50M SHALL IMPLEMENT A CASH AWARDS PROGRAM FOR TECHNICAL PERSONNEL FOR:

1) INVENTIONS, INNOVATIONS OR OUTSTANDING TECHNICAL CONTRIBUTIONS OF VALUE FROM COMMERCIAL APPLICATION OR CONTRIBUTION TO MISSION

2) EXEMPLARY ACTIVITIES THAT PROMOTE DOMESTIC TECHNOLOGY TRANSFER

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

DISTRIBUTION OF ROYALTIES BY AGENCIES

ROYALTIES FROM LICENSING AND ASSIGNMENT OF INVENTIONS SHALL BE RETAINED BY THE AGENCY AND DISPOSED OF AS FOLLOWS:

1) 15% TO THE INVENTOR OR CO-INVENTORS UP TO $100K FOR EACH PERSON (MAY BE EXCEEDED WITH PRESIDENTIAL APPROVAL)

2) BALANCE OF INCOME GOES TO AGENCY LABORATORIES UP TO 5% OF BUDGET BEYOND WHICH ONLY 25% IS RETAINED

3) MAJORITY OF INCOME FOR LABORATORIES GOES TO THOSE WHERE INVENTIONS OCCURRED

4) FUNDS IN EXCESS OF LIMITS OR UNUSED BY THE END OF THE YEAR SUCCEEDING THE YEAR RECEIVED GOES TO THE TREASURY

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

DISTRIBUTION OF ROYALTIES BY AGENCIES

FUNDS TO LABS MAY BE USED IN FISCAL YEAR RECEIVED OR THE FOLLOWING YEAR FOR:

1) EXPENSES FOR LICENSING BY LAB, AGENCY OR OTHER ORGANIZATIONS

2) REWARDS FOR SCIENTIFIC, ENGINEERING OR TECHNICAL PERSONNEL

3) INCREASED SCIENTIFIC EXCHANGE AMONG AGENCY LABORATORIES

4) EDUCATION AND TRAINING OF EMPLOYEES TO INCREASE MISSION AND TRANSFER PRODUCTIVITY

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

DISTRIBUTION OF ROYALTIES BY AGENCIES

* AN AGENCY, HAVING GIVEN NOTICE WITHIN 90 DAYS MAY HOLD FUNDS FOR PAYMENT OF INVENTORS, BUT MUST IMPLEMENT AN ALTERNATIVE PROGRAM WITHIN 2 YEARS FOR SHARING ROYALTIES WITH INVENTORS EMPLOYED BY THE AGENCY WHEN THE INVENTION WAS MADE AND WHO ARE NAMED ON LICENSED INVENTIONS

* PAYMENT TO INVENTORS IS RETROACTIVE TO DATE OF ENACTMENT OF THIS SECTION

* A REPORT OF INCOME AND EXPENDITURES MADE UNDER THIS SECTION SHALL BE MADE WITH ANNUAL AGENCY BUDGET SUBMISSIONS

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

DISTRIBUTION OF ROYALTIES BY AGENCIES

AGENCIES MAY PROVIDE AN ALTERNATIVE PROGRAM FOR SHARING ROYALTIES WITH INVENTORS PROVIDED THAT:

1) PROGRAM PROVIDES A FIXED MINIMUM PAYMENT FOR EACH INVENTOR FOR EACH YEAR INCOME IS RECEIVED

2) PROGRAM PROVIDES A PERCENTAGE TO EACH INVENTOR EACH YEAR ROYALTIES EXCEED A THRESHOLD AMOUNT

3) TOTAL PAYMENTS TO ALL SUCH INVENTORS EXCEED 15% OF TOTAL AGENCY ROYALTIES EACH FISCAL YEAR

4) PROGRAM PROVIDES INCENTIVES TO EMPLOYEES WHO CONTRIBUTE TO FURTHER DEVELOPMENT OF INVENTIONS FOR LICENSING

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

EMPLOYEE ACTIVITIES AND MISCELLANEOUS AMENDMENTS

* AN AGENCY WITH RIGHT OF OWNERSHIP SHALL ALLOW THE INVENTOR TO RETAIN TITLE IF IT DOES NOT INTEND TO FILE FOR A PATENT

99TH CONGRESS
2d Session
HOUSE OF REPRESENTATIVES
REPORT
99-953

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986

OCTOBER 2, 1986.—Ordered to be printed

Mr. FUQUA, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 3773]

The committee of conference on the disagreeing votes of the two Houses on the amendments of the Senate to the bill (H.R. 3773) to amend the Stevenson-Wydler Technology Innovation Act of 1980 to promote technology transfer by authorizing Government-operated laboratories to enter into cooperative research agreements and by establishing a Federal Laboratory Consortium for Technology Transfer within the National Science Foundation, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate to the text of the bill and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "Federal Technology Transfer Act of 1986".

SEC. 2. COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS.

The Stevenson-Wydler Technology Innovation Act of 1980 is amended by redesignating sections 12 through 15 as sections 16 through 19, and by inserting immediately after section 11 the following:

"SEC. 12. COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS.

"(a) GENERAL AUTHORITY.—Each Federal agency may permit the director of any of its Government-operated Federal laboratories—

"(1) to enter into cooperative research and development agreements on behalf of such agency (subject to subsection (c) of this

section) with other Federal agencies; units of State or local government; industrial organizations (including corporations, partnerships, and limited partnerships, and industrial development organizations); public and private foundations; nonprofit organizations (including universities); or other persons (including licensees of inventions owned by the Federal agency); and

"(2) to negotiate licensing agreements under section 207 of title 35, United States Code, or under other authorities for Government-owned inventions made at the laboratory and other inventions of Federal employees that may be voluntarily assigned to the Government.

"(b) ENUMERATED AUTHORITY.—Under agreements entered into pursuant to subsection (a)(1), a Government-operated Federal laboratory may (subject to subsection (c) of this section)—

"(1) accept, retain, and use funds, personnel, services, and property from collaborating parties and provide personnel, services, and property to collaborating parties;

"(2) grant or agree to grant in advance, to a collaborating party, patent licenses or assignments, or options thereto, in any invention made in whole or in part by a Federal employee under the agreement, retaining a nonexclusive, nontransferrable, irrevocable, paid-up license to practice the invention or have the invention practiced throughout the world by or on behalf of the Government and such other rights as the Federal laboratory deems appropriate; and

"(3) waive, subject to reservation by the Government of a nonexclusive, irrevocable, paid-up license to practice the invention or have the invention practiced throughout the world by or on behalf of the Government, in advance, in whole or in part, any right of ownership which the Federal Government may have to any subject invention made under the agreement by a collaborating party or employee of a collaborating party; and

"(4) to the extent consistent with any applicable agency requirements and standards of conduct, permit employees or former employees of the laboratory to participate in efforts to commercialize inventions they made while in the service of the United States.

"(c) CONTRACT CONSIDERATIONS.—(1) A Federal agency may issue regulations on suitable procedures for implementing the provisions of this section; however, implementation of this section shall not be delayed until issuance of such regulations.

"(2) The agency is permitting a Federal laboratory to enter into agreements under this section shall be guided by the purposes of this Act.

"(3)(A) Any agency using the authority given it under subsection (a) shall review employee standards of conduct for resolving potential conflicts of interest to make sure they adequately establish guidelines for situations likely to arise through the use of this authority, including but not limited to cases where present or former employees or their partners negotiate licenses or assignments of titles to inventions or negotiate cooperative research and development agreements with Federal agencies (including the agency with which the employee involved is or was formerly employed).

"(B) If, in implementing subparagraph (A), an agency is unable to resolve potential conflicts of interest within its current statutory framework, it shall propose necessary statutory changes to be forwarded to its authorizing committees in Congress.

"(4) The laboratory director in deciding what cooperative research and development agreements to enter into shall—

"(A) give special consideration to small business firms, and consortia involving small business firms; and

"(B) give preference to business units located in the United States which agree that products embodying inventions made under the cooperative research and development agreement or produced through the use of such inventions will be manufactured substantially in the United States and, in the case of any industrial organization or other person subject to the control of a foreign company or government, as appropriate, take into consideration whether or not such foreign government permits United States agencies, organizations, or other persons to enter into cooperative research and development agreements and licensing agreements.

"(5)(A) If the head of the agency or his designee desires an opportunity to disapprove or require the modification of any such agreement, the agreement shall provide a 30-day period within which such action must be taken beginning on the date the agreement is presented to him or her by the head of the laboratory concerned.

"(B) In any case in which the head of an agency or his designee disapproves or requires the modification of an agreement presented under this section, the head of the agency or such designee shall transmit a written explanation of such disapproval or modification to the head of the laboratory concerned.

"(6) Each agency shall maintain a record of all agreements entered into under this section.

"(d) DEFINITION.—As used in this section—

"(1) the term 'cooperative research and development agreement' means any agreement between one or more Federal laboratories and one or more non-Federal parties under which the Government, through its laboratories, provides personnel, services, facilities, equipment, or other resources with or without reimbursement (but not funds to non-Federal parties) and the non-Federal parties provide funds, personnel, services, facilities, equipment, or other resources toward the conduct of specified research or development efforts which are consistent with the missions of the laboratory; except that such term does not include a procurement contract or cooperative agreement as those terms are used in sections 6303, 6304, and 6305 of title 31, United States Code; and

"(2) the term 'laboratory' means a facility or group of facilities owned, leased, or otherwise used by a Federal agency, a substantial purpose of which is the performance of research, development, or engineering by employees of the Federal Government.

"(e) DETERMINATION OF LABORATORY MISSIONS.—For purposes of this section, an agency shall make separate determinations of the mission or missions of each of its laboratories.

"(f) RELATIONSHIP TO OTHER LAWS.—Nothing in this section is intended to limit or diminish existing authorities of any agency.".

Section 11 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3710) is amended—

(1) by redesignating subsection (e) as subsection (f); and

(2) by inserting after subsection (d) the following:

"(e) ESTABLISHMENT OF FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER.—(1) There is hereby established the Federal Laboratory Consortium for Technology Transfer (hereinafter referred to as the 'Consortium') which, in cooperation with Federal laboratories and the private sector, shall—

"(A) develop and (with the consent of the Federal laborotary concerned) administer techniques, training courses, and materials concerning technology transfer to increase the awareness of Federal laboratory employees regarding the commercial potential of laboratory technology and innovations;

"(B) furnish advice and assistance requested by Federal agencies and laboratories for use in their technology transfer programs (including the planning of seminars for small business and other industry);

"(C) provide a clearinghouse for requests, received at the laboratory level, for technical assistance from States and units of local governments, businesses, industrial development organizations, not-for-profit organizations including universities, Federal agencies and laboratories, and other persons, and—

"(i) to the extent that such requests can be responded to with published information available to the National Technical Information Service, refer such requests to that Service, and

"(ii) otherwise refer these requests to the appropriate Federal laboratories and agencies;

"(D) facilitate communication and coordination between Offices of Research and Technology Applications of Federal laboratories;

"(E) utilize (with the consent of the agency involved) the expertise and services of the National Science Foundation, the Department of Commerce, the National Aeronautics and Space Administration, and other Federal agencies, as necessary;

"(F) with the consent of any Federal laboratory, facilitate the use by such laboratory of appropriate technology transfer mechanisms such as personnel exchanges and computer-based systems;

"(G) with the consent of any Federal laboratory, assist such laboratory to establish programs using technical volunteers to provide technical assistance to communities related to such laboratory;

"(H) facilitate communication and cooperation between Offices of Research and Technology Applications of Federal laboratories and regional, State, and local technology transfer organizations;

"(I) when requested, assist colleges or universities, businesses, nonprofit organizations, State or local governments, or regional organizations to establish programs to stimulate research and to encourage technology transfer in such areas as technology program development, curriculum design, [illegible]erm reseı planning, personnel needs projections, and productivity asse ments; and

"(J) seek advice in each Federal laboratory consortium region from representatives of State and local governments, large and small business, universities, and other appropriate persons on the effectiveness of the program (and any such advice shall be provided at no expense to the Government).

"(2) The membership of the Consortium shall consist of the Federal laboratories described in clause (1) of subsection (b) and such other laboratories as may choose to join the Consortium. The representatives to the Consortium shall include a senior staff member of each Federal laboratory which is a member of the Consortium and a representative appointed from each Federal agency with one or more member laboratories.

"(3) The representatives to the Consortium shall elect a Chairman of the Consortium.

"(4) The Director of the National Bureau of Standards shall provide the Consortium, on a reimbursable basis, with administrative services, such as office space, personnel, and support services of the Bureau, as requested by the Consortium and approved by such Director.

"(5) Each Federal laboratory or agency shall transfer technology directly to users or representatives of users, and shall not transfer technology directly to the Consortium. Each Federal laboratory shall conduct and transfer technology only in accordance with the practices and policies of the Federal agency which owns, leases, or otherwise uses such Federal laboratory.

"(6) Not later than one year after the date of the enactment of this subsection, and every year thereafter, the Chairman of the Consortium shall submit a report to the President, to the appropriate authorization and appropriation committees of both Houses of the Congress, and to each agency with respect to which a transfer of funding is made (for the fiscal year or years involved) under paragraph (7), concerning the activities of the Consortium and the expenditures made by it under this subsection during the year for which the report is made.

"(7)(A) Subject to subparagraph (B), an amount equal to 0.005 percent of that portion of the research and development budget of each Federal agency that is to be utilized by the laboratories of such agency for a fiscal year referred to in subparagraph (B)(ii) shall be transferred by such agency to the National Bureau of Standards at the beginning of the fiscal year involved. Amounts so transferred shall be provided by the Bureau to the Consortium for the purpose of carrying out activities of the Consortium under this subsection.

"(B) A transfer shall be made by any Federal agency under subparagraph (A), for any fiscal year, only if—

"(i) the amount so transferred by that agency (as determined under such subparagraph) would exceed $10,000; and

"(ii) such transfer is made with respect to the fiscal year 1987, 1988, 1989, 1990, or 1991.

"(C) The heads of Federal agencies and their designees, and the directors of Federal laboratories, may provide such additional support for operations of the Consortium as they deem appropriate.

"(8)(A) The Consortium shall use 5 percent of the funds provided in paragraph (7)(A) to establish demonstration projects in technology transfer. To carry out such projects, the Consortium may arrange for grants or awards to, or enter into agreements with, nonprofit State, local, or private organizations or entities whose primary purposes are to facilitate cooperative research between the Federal laboratories and organizations not associated with the Federal laboratories, to transfer technology from the Federal laboratories, and to advance State and local economic activity.

"(B) The demonstration projects established under subparagraph (A) shall serve as model programs. Such projects shall be designed to develop programs and mechanisms for technology transfer from the Federal laboratories which may be utilized by the States and which will enhance Federal, State and local programs for the transfer of technology.

"(C) Application for such grants, awards, or agreements shall be in such form and contain such information as the Consortium or its designee shall specify.

"(D) Any person who receives or utilizes any proceeds of a grant or award made, or agreement entered into, under this paragraph shall keep such records as the Consortium or its designee shall determine are necessary and appropriate to facilitate effective audit and evaluation, including records which fully disclose the amount and disposition of such proceeds and the total cost of the project in connection with which such proceeds were used.".

SEC. 4. UTILIZATION OF FEDERAL TECHNOLOGY.

(a) RESPONSIBILITY FOR TECHNOLOGY TRANSFER.—Section 11(a) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3710(a)) is amended—

(1) by inserting "(1)" after "POLICY.—"; and

(2) by adding at the end thereof the following new paragraphs:

"(2) Technology transfer, consistent with mission responsibilities, is a responsibility of each laboratory science and engineering professional.

"(3) Each laboratory director shall ensure that efforts to transfer technology are considered positively in laboratory job descriptions, employee promotion policies, and evaluation of the job performance of scientists and engineers in the laboratory.".

(b) RESEARCH AND TECHNOLOGY APPLICATIONS OFFICES.—(1) Section 11(b) of such Act (15 U.S.C. 3710(b)) is amended—

(A) by striking out "a total annual budget exceeding $20,000,000 shall provide at least one professional individual full-time" and inserting in lieu thereof "200 or more full-time equivalent scientific, engineering, and related technical positions shall provide one or more full-time equivalent positions";

(B) by inserting immediately before the next to last sentence the following new sentence: "Furthermore, individuals filling positions in an Office of Research and Technology Applications shall be included in the overall laboratory/agency management development program so as to ensure that highly competent technical managers are full participants in the technology transfer process.";

(C) by striking out "requirements set forth in (1) and/or (2) of this subsection" in the next to last sentence and inserting in lieu thereof "requirement set forth in clause (2) of the preceding sentence"; and

(D) by striking out "either requirement (1) or (2)" in the last sentence and inserting in lieu thereof "such requirement".

(2) Section 11(c) of such Act (15 U.S.C. 3710(c)) is amended—

(A) by striking out paragraph (1) and inserting in lieu thereof the following:

"(1) to prepare application assessments for selected research and development projects in which that laboratory is engaged and which in the opinion of the laboratory may have potential commercial applications;";

(B) by striking out "the Center for the Utilization of Federal Technology" in paragraph (3) and inserting in lieu thereof "the National Technical Information Service, the Federal Laboratory Consortium for Technology Transfer,", and by striking out "and" after the semicolon;

(C) by striking out "in response to requests from State and local government officials." in paragraph (4) and inserting in lieu thereof "to State and local government officials; and"; and

(D) by inserting immediately after paragraph (4) the following new paragraph:

"(5) to participate, where feasible, in regional, State, and local programs designed to facilitate or stimulate the transfer of technology for the benefit of the region, State, or local jurisdiction in which the Federal laboratory is located."

(c) DISSEMINATION OF TECHNICAL INFORMATION.—Section 11(d) of such Act (15 U.S.C. 3710(d)) is amended—.

(1) by striking out "(d)" and all that follows down through "shall—" and inserting in lieu thereof the following:

"(d) DISSEMINATION OF TECHNICAL INFORMATION.—The National Technical Information Service shall—";

(2) by striking out paragraph (2);

(3) by striking out "existing" in paragraph (3), and redesignating such paragraph as paragraph (2);

(4) by striking out paragraph (4) and inserting in lieu thereof the following:

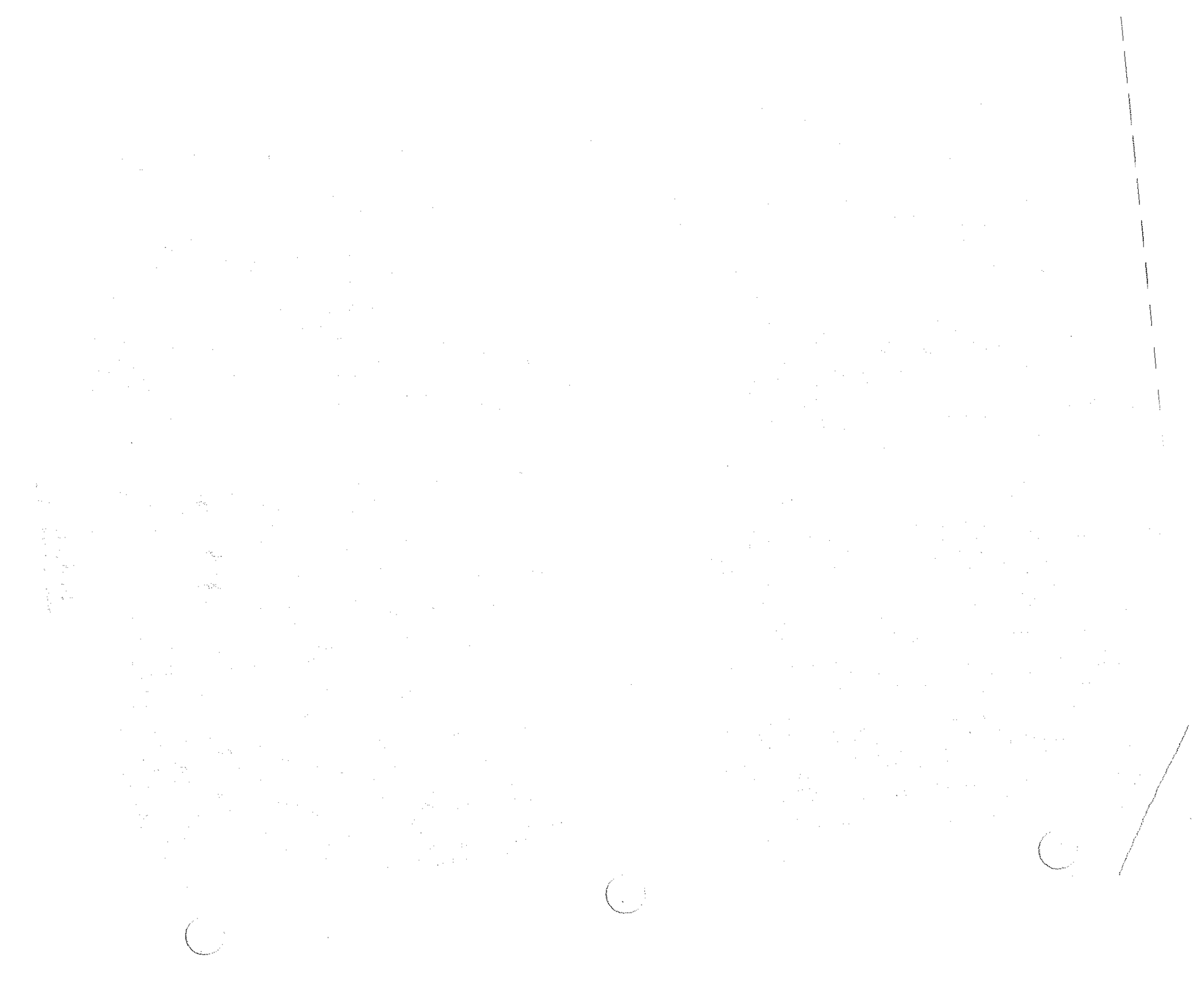
"(3) receive requests for technical assistance from State and local governments, respond to such requests with published information available to the Service, and refer such requests to the Federal Laboratory Consortium for Technology Transfer to the extent that such requests require a response involving more than the published information available to the Service;";

(5) by redesignating paragraphs (5) and (6) as paragraphs (4) and (5), respectively; and

(6) by striking out "(c)(4)" in paragraph (4) as so redesignated and inserting in lieu thereof "(c)(3)".

(d) AGENCY REPORTING.—Section 11(f) of such Act (15 U.S.C. 3710(e)) (as redesignated by section 3(l) of this Act) is amended—

(1) by striking out "prepare biennially a report summarizing the activities" in the first sentence and inserting in lieu thereof "report annually to the Congress, as part of the agency's annual budget submission, on the activities"; and



(2) by striking out the second sentence.

SEC. 5. FUNCTIONS OF THE SECRETARY OF COMMERCE.

Section 11 of the Stevenson-Wydler Technology Innovation Act of 1980 (as amended by the preceding provisions of this Act) is further amended by adding at the end thereof the following new subsection:

"(g) FUNCTIONS OF THE SECRETARY.—(1) The Secretary, in consultation with other Federal agencies, may—

"(A) make available to interested agencies the expertise of the Department of Commerce regarding the commercial potential of inventions and methods and options for commercialization which are available to the Federal laboratories, including research and development limited partnerships;

"(B) develop and disseminate to appropriate agency and laboratory personnel model provisions for use on a voluntary basis in cooperative research and development arrangements; and

"(C) furnish advice and assistance, upon request, to Federal agencies concerning their cooperative research and development programs and projects.

"(2) Two years after the date of the enactment of this subsection and every two years thereafter, the Secretary shall submit a summary report to the President and the Congress on the use by the agencies and the Secretary of the authorities specified in this Act. Other Federal agencies shall cooperate in the report's preparation.

"(3) Not later than one year after the date of the enactment of the Federal Technology Transfer Act of 1986, the Secretary shall submit to the President and the Congress a report regarding—

"(A) any copyright provisions or other types of barriers which tend to restrict or limit the transfer of federally funded computer software to the private sector and to State and local governments, and agencies of such State and local governments; and

"(B) the feasibility and cost of compiling and maintaining a current and comprehensive inventory of all federally funded training software.".

SEC. 6. REWARDS FOR SCIENTIFIC, ENGINEERING, AND TECHNICAL PERSONNEL OF FEDERAL AGENCIES.

The Stevenson-Wydler Technology Innovation Act of 1980 (as amended by the preceding provisions of this Act) is further amended by inserting after section 12 the following new section:

"SEC. 13. REWARDS FOR SCIENTIFIC, ENGINEERING, AND TECHNICAL PERSONNEL OF FEDERAL AGENCIES.

"The head of each Federal agency that is making expenditures at a rate of more than $50,000,000 per fiscal year for research and development in its Government-operated laboratories shall use the appropriate statutory authority to develop and implement a cash awards program to reward its scientific, engineering, and technical personnel for—

"(1) inventions, innovations, or other outstanding scientific or technological contributions of value to the United States due to commercial applications or due to contributions to missions of the Federal agency or the Federal Government, or

"(2) exemplary activities that promote the domestic transfer of science and technology developed within the Federal Government and result in utilization of such science and technology by American industry or business, universities, State or local governments, or other non-Federal parties.".

SEC. 7. DISTRIBUTION OF ROYALTIES RECEIVED BY FEDERAL AGENCIES.

The Stevenson-Wydler Technology Innovation Act of 1980 (as amended by the preceding provisions of this Act) is further amended by inserting after section 13 the following new section:

"SEC. 14. DISTRIBUTION OF ROYALTIES RECEIVED BY FEDERAL AGENCIES.

"(a) IN GENERAL.—(1) Except as provided in paragraphs (2) and (4), any royalties or other income received by a Federal agency from the licensing or assignment of inventions under agreements entered into under section 12, and inventions of Government-operated Federal laboratories licensed under section 207 of title 35, United States Code, or under any other provision of law, shall be retained by the agency whose laboratory produced the invention and shall be disposed of as follows:

"(A)(i) The head of the agency or his designee shall pay at least 15 percent of the royalties or other income the agency receives on account of any invention to the inventor (or co-inventors) if the inventor (or each such co-inventor) was an employee of the agency at the time the invention was made. This clause shall take effect on the date of the enactment of this section unless the agency publishes a notice in the Federal Register within 90 days of such date indicating its election to file a Notice of Proposed Rulemaking pursuant to clause (ii).

"(ii) An agency may promulgate, in accordance with section 553 of title 5, United States Code, regulations providing for an alternative program for sharing royalties with inventors who were employed by the agency at the time the invention was made and whose names appear on licensed inventions. Such regulations must—

"(I) guarantee a fixed minimum payment to each such inventor, each year that the agency receives royalties from that inventor's invention;

"(II) provide a percentage royalty share to each such inventor, each year that the agency receives royalties from that inventor's invention in excess of a threshold amount;

"(III) provide that total payments to all such inventors shall exceed 15 percent of total agency royalties in any given fiscal year; and

"(IV) provide appropriate incentives from royalties for those laboratory employees who contribute substantially to the technical development of a licensed invention between the time of the filing of the patent applicatioin and the licensing of the invention.

"(iii) An agency that has published its intention to promulgate regulations under clause (ii) may elect not to pay inventors under clause (i) until the expiration of two years after the date of the enactment of this Act or until the date of the promulgation of such regulations, whichever is earlier. If an agency makes such an election and after two years the regulations have not been promulgated, the agency shall make payments (in accordance with clause (i)) of at least 15 percent of the royalties involved, retroactive to the date of the enactment of this Act. If promulgation of the regulations occurs within two years after the date of the enactment of this Act, pay-

ments shall be made in accordance with such regulations, retroactive to the date of the enactment of this Act. The agency shall retain its royalties until the inventor's portion is paid under either clause (i) or (ii). Such royalties shall not be transferred to the agency's Government-operated laboratories under subparagraph (B) and shall not revert to the Treasury pursuant to paragraph (2) as a result of any delay caused by rulemaking under this subparagraph.

"(B) The balance of the royalties or other income shall be transferred by the agency to its Government-operated laboratories, with the majority share of the royalties or other income from any invention going to the laboratory where the invention occurred; and the funds so transferred to any such laboratory may be used or obligated by that laboratory during the fiscal year in which they are received or during the succeeding fiscal year—

"(i) for payment of expenses incidental to the administration and licensing of inventions by that laboratory or by the agency with respect to inventions which occurred at that laboratory, including the fees or other costs for the services of other agencies, persons, or organizations for invention management and licensing services;

"(ii) to reward scientific, engineering, and technical employees of that laboratory;

"(iii) to further scientific exchange among the government-operated laboratories of the agency; or

"(iv) for education and training of employees consistent with the research and development mission and objectives of the agency, and for other activities that increase the licensing potential for transfer of the technology of the Government-operated laboratories of the agency.

Any of such funds not so used or obligated by the end of the fiscal year succeeding the fiscal year in which they are received shall be paid into the Treasury of the United States.

"(2) If, after payments to inventors under paragraph (1), the royalties received by an agency in any fiscal year exceed 5 percent of the budget of the Government-operated laboratories of the agency for that year, 75 percent of such excess shall be paid to the Treasury of the United States and the remaining 25 percent may be used or obligated for the purposes described in clauses (i) through (iv) of paragraph (1)(B) during that fiscal year or the succeeding fiscal year. Any funds not so used or obligated shall be paid into the Treasury of the United States.

"(3) Any payment made to an employee under this section shall be in addition to the regular pay of the employee and to any other awards made to the employee, and shall not affect the entitlement of the employee to any regular pay, annuity, or award to which he is otherwise entitled or for which he is otherwise eligible or limit the amount thereof. Any payment made to an inventor as such shall continue after the inventor leaves the laboratory or agency. Payments made under this section shall not exceed $100,000 per year to any one person, unless the President approves a larger award (with the excess over $100,000 being treated as a Presidential award under section 4504 of title 5, United States Code).

"(4) A Federal agency receiving royalties or other income as a result of invention management services performed for another Federal agency or laboratory under section 207 of title 35, United States Code, shall retain such royalties or income to the extent required to offset the payment of royalties to inventors under clause (i) of paragraph (1)(A), costs and expenses incurred under clause (1) of paragraph (1)(B), and the cost of foreign patenting and maintenance for such invention performed at the request of the other agency or laboratory. All royalties and other income remaining after payment of the royalties, costs, and expenses described in the preceding sentence shall be transferred to the agency for which the services were performed, for distribution in accordance with clauses (i) through (iv) of paragraph (1)(B).

"(b) CERTAIN ASSIGNMENTS.—If the invention involved was one assigned to the Federal agency—

"(1) by a contractor, grantee, or participant in a cooperative agreement with the agency, or

"(2) by an employee of the agency who was not working in the laboratory at the time the invention was made.

the agency unit that was involved in such assignment shall be considered to be a laboratory for purposes of this section.

"(c) REPORTS.—(1) In making their annual budget submissions Federal agencies shall submit, to the appropriate authorization and appropriation committees of both Houses of the Congress, summaries of the amount of Royalties or other income received and expenditures made (including inventor awards) under this section.

"(2) The Comptroller General, five years after the date of the enactment of this section, shall review the effectiveness of the various royalty-sharing programs established under this section and report to the appropriate committees of the House of Representatives and the Senate, in a timely manner, his findings, conclusions, and recommendations for improvements in such programs.".

SEC. 8. EMPLOYEE ACTIVITIES.

The Stevenson-Wydler Technology Innovation Act of 1980 (as amended by the preceding provisions of this Act) is further amended by inserting after section 14 the following new section:

"SEC. 15. EMPLOYEE ACTIVITIES.

"(a) IN GENERAL.—If a Federal agency which has the right of ownership to an invention under this Act does not intend to file for a patent application or otherwise to promote commercialization of such invention, the agency shall allow the inventor, if the inventor is a Government employee or former employee who made the invention during the course of employment with the Government, to retain title to the invention (subject to reservation by the Government of a nonexclusive, nontransferrable, irrevocable, paid-up license to practice the invention or have the invention practiced throughout the world by or on behalf of the Government). In addition, the agency may condition the inventor's right to title on the timely filing of a patent application in cases when the Government determines that it has or may have a need to practice the invention.

"(b) DEFINITION.—For purposes of this section, Federal employees include 'special Government employees' as defined in section 202 of title 18, United States Code.

"(c) RELATIONSHIP TO OTHER LAWS.—Nothing in this section is intended to limit or diminish existing authorities of any agency.".

SEC. 9. MISCELLANEOUS AND CONFORMING AMENDMENTS.

(a) REPEAL OF NATIONAL INDUSTRIAL TECHNOLOGY BOARD.—Section 10 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3709) is repealed.

(b) CHANGES IN TERMINOLOGY OR ADMINISTRATIVE STRUCTURE.—(1) Section 3(2) of the Stevenson-Wydler Technology Innovation Act of 1980 is amended by striking out "centers for industrial technology" and inserting in lieu thereof "cooperative research centers".

(2) Section 4 of such Act is amended—

(A) by striking out "Industrial Technology" in paragraph (1) and inserting in lieu thereof "Productivity, Technology, and Innovation";

(B) by striking out "'Director' means the Director of the Office of Industrial Technology" in paragraph (3) and inserting in lieu thereof "'Assistant Secretary' means the Assistant Secretary for Productivity, Technology, and Innovation";

(C) by striking out "Centers for Industrial Technology" in paragraph (4) and inserting in lieu thereof "Cooperative Research Centers";

(D) by striking out paragraph (6), and redesignating paragraphs (7) and (8) as paragraphs (6) and (7), respectively; and

(E) by striking out "owned and funded" in paragraph (6) as so redesignated and inserting in lieu thereof "owned, leased, or otherwise used by a Federal agency and funded".

(3) Section 5(a) of such Act is amended by striking out "Industrial Technology" and inserting in lieu thereof "Productivity, Technology, and Innovation".

(4) Section 5(b) of such Act is amended by striking out "DIRECTOR" and inserting in lieu thereof "ASSISTANT SECRETARY", and by striking out "a Director of the Office" and all that follows and inserting in lieu thereof "an Assistant Secretary for Productivity, Technology, and Innovation.".

(5) Section 5(c) of such Act is amended—

(A) by striking out "the Director" each place it appears and inserting in lieu thereof "the Assistant Secretary";

(B) by redesignating paragraphs (7) and (8) as paragraphs (9) and (10), respectively; and

(C) by inserting immediately after paragraph (6) the following new paragraphs:

"(7) encourage and assist the creation of centers and other joint initiatives by State or local governments, regional organizations, private businesses, institutions of higher education, nonprofit organizations, or Federal laboratories to encourage technology transfer, to stimulate innovation, and to promote an appropriate climate for investment in technology-related industries;

"(8) propose and encourage cooperative research involving appropriate Federal entities, State or local governments, regional organizations, colleges or universities, nonprofit organizations, or private industry to promote the common use of resources, to improve training programs and curricula, to stimulate interest in high technology careers, and to encourage the effective dissemination of technology skills within the wider community;".

(6) The heading of section 6 of such Act is amended to read as follows:

"SEC. 6. COOPERATIVE RESEARCH CENTERS."

(7) Section 6(a) of such Act is amended by striking out "Centers for Industrial Technology" and inserting in lieu thereof "Cooperative Research Centers".

(8) Section 6(b)(1) of such Act is amended by striking out "basic and applied".

(9) Section 6(e) of such Act is amended to read as follows:

"(e) RESEARCH AND DEVELOPMENT UTILIZATION.—In the promotion of technology from research and development efforts by Centers under this section, chapter 18 of title 35, United States Code, shall apply to the extent not inconsistent with this section.".

(10) Section 6(f) of such Act is repealed.

(11) The heading of section 8 of such Act is amended by striking out "CENTERS FOR INDUSTRIAL TECHNOLOGY" and inserting in lieu thereof "COOPERATIVE RESEARCH CENTERS".

(12) Section 8(a) of such Act is amended by striking out "Centers for Industrial Technology" and inserting in lieu thereof "Cooperative Research Centers".

(13) Section 19 of such Act (as redesignated by section 2 of this Act) is amended by striking out "pursuant to this Act" and inserting in lieu thereof "pursuant to the provisions of this Act (other than sections 12, 13, and 14)".

(c) RELATED CONFORMING AMENDMENT.—Section 210 of title 35, United States Code, is amended by adding at the end thereof the following new subsection:

"(e) The provisions of the Stevenson-Wydler Technology Innovation Act of 1980, as amended by the Federal Technology Transfer Act of 1986, shall take precedence over the provisions of this chapter to the extent that they permit or require a disposition of rights in subject inventions which is inconsistent with this chapter.".

(d) ADDITIONAL DEFINITIONS.—Section 4 of such Act (as amended by subsection (b)(2) of this section) is further amended by adding at the end thereof the following new paragraphs:

"(8) 'Federal agency' means any executive agency as defined in section 105 of title 5, United States Code, and the military departments as defined in section 102 of such title.

"(9) 'Invention' means any invention or discovery which is or may be patentable or otherwise protected under title 35, United States Code, or any novel variety of plant which is or may be protectable under the Plant Variety Protection Act (7 U.S.C. 2321 et seq.).

"(10) 'Made' when used in conjunction with any invention means the conception or first actual reduction to practice of such invention.

"(11) 'Small business firm' means a small business concern as defined in section 2 of Public Law 85-536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration.

"(12) 'Training technology' means computer software and related materials which are developed by a Federal agency to train employees of such agency, including but not limited to software for computer-based instructional systems and for interactive video disc systems.".

(e) REDESIGNATION OF SECTIONS TO REFLECT CHANGES MADE BY PRECEDING PROVISIONS.—(1) Such Act (as amended by the preceding provisions of this Act) is further amended by redesignating sections 11 through 19 as sections 10 through 18, respectively.

(2)(A) Section 5(d) of such Act is amended by inserting "(as then in effect)" after "sections 5, 6, 8, 11, 12, and 13 of this Act."

(B) Section 8(a) of such Act is amended by striking out the last sentence.

(C) Section 9(d) of such Act is amended by striking out "or 13" and inserting in lieu thereof "10, 14, or 16."

(3) Section 13(a)(1) of such Act (as redesignated by paragraph (1) of this subsection) is amended by striking out "section 12" in the matter preceding subparagraph (A) and inserting in lieu thereof "section 11."

(4) Section 18 of such Act (as redesignated by paragraph (1) of this subsection) is amended by striking out "sections 12, 13, and 14" and inserting in lieu thereof "sections 11, 12, and 13."

(f) CLARIFICATION OF FINDINGS AND PURPOSES.—(1) The second sentence of section 2(10) of such Act (15 U.S.C. 3701(10)) is amended by inserting ", which include inventions, computer software, and training technologies," immediately after "developments."

(2) Section 3(3) of such Act (15 U.S.C. 3702(3)) is amended by inserting ", including inventions, software, and training technologies," immediately after "developments."

And the Senate agree to the same.

That the House recede from its disagreement to the amendment of the Senate to the title of the bill and agree to the same.

DON FUQUA,
DOUG WALGREN,
STAN LUNDINE,
MANUEL LUJAN, Jr.,
SHERWOOD L. BOEHLERT,
Managers on the Part of the House.

JACK DANFORTH,
FRITZ HOLLINGS,
DON RIEGLE,
SLADE GORTON,
LARRY PRESSLER,
Managers on the Part of the Senate.

JOINT EXPLANATORY STATEMENT OF THE COMMITTEE OF CONFERENCE

The managers on the part of the House and the Senate at the conference on the disagreeing votes of the two Houses on the amendments of the Senate to the bill (H.R. 3773) to amend the Stevenson-Wydler Technology Innovation Act of 1980 to promote technology transfer by authorizing Government-operated laboratories to enter into cooperative research agreements and by establishing a Federal Laboratory Consortium for Technology Transfer within the National Science Foundation, and for other purposes, submit the following joint statement to the House and the Senate in explanation of the effect of the action agreed upon by the managers and recommended in the accompanying conference report:

The Senate amendment to the text of the bill struck out all of the House bill after the enacting clause and inserted a substitute text.

The House recedes from its disagreement to the amendment of the Senate with an amendment which is a substitute for the House bill and the Senate amendment. The differences between the House bill, the Senate amendment, and the substitute agreed to in conference are noted below, except for clerical corrections, conforming changes made necessary by agreements reached by the conferees, and minor drafting and clarifying changes.

The following section-by-section analysis explains actions of the managers in the conference report to accompany H.R. 3773.

SECTION 1.—SHORT TITLE

The Conferees chose to use the Senate version of the title: "Federal Technology Transfer Act of 1986."

SECTION 2.—COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS

There were marked similarities between the House and Senate-passed versions of this section. Both reflected the concern that the Federal laboratories need clear authority to do cooperative research and that they need to be able to exercise that authority at the laboratory level. Both permit the laboratories to enter into cooperative research and development agreements with a wide range of parties. Both strive to make the entering of these agreements as easy as possible from the point of view of the private sector participant, while protecting the legitimate concerns of the government. This authority is optional in both versions and is not intended to affect previously existing cooperative agreement authority, such as the Space Act provisions, which for almost three decades have permitted NASA laboratories to enter into cooperative agreements.

The conferees deleted the House version's requirement of an agency plan within 180 days of enactment of the section. Instead of

requiring a plan or regulations, the conference version of the legislation makes regulations optional and makes it clear that implementation of the cooperative research and development authority can begin in advance of any regulations.

The conferees adopted many of the modifications the Senate made to the House-passed version of this section. The conference version specifically states that a laboratory may accept funds, personnel, and services, and collaborating parties may accept the same, with the exception of funds, as their contribution under a cooperative agreement. It applies to any inventions occurring under a cooperative R&D agreement, the long-standing tradition of reserving the right in the government to a paid-up non-exclusive license in that invention. It also clearly gives permission to present and former federal employees of a laboratory to be a party to efforts to commercialize that laboratory's inventions, to the extent they can do so and not be in violation of agency requirements and standards of conduct.

The conditions on the exercise of the cooperative agreement authority which were part of the Agency Plan under the House version of the legislation are still to be considered by the laboratories in deciding with whom to contract. Special consideration is still to be given to small businesses and consortia involving small business. The purpose of this requirement is to ensure access by these groups to the laboratories and is not intended to limit access by non-profit organizations and universities.

The provisions from both versions dealing with the preference to U.S. business units were accepted. Therefore, laboratories are to give preference to business units located in the United States which agree to domestic manufacture. When evaluating whether to grant access by a foreign company, the Federal laboratories may examine the willingness of the foreign government to open its own laboratories to U.S. firms.

The House-passed provisions on conflict of interest are retained as is, and its provisions for review of a cooperative research and development agreement and for limited headquarters review of agreements are accepted substantially as passed by that body.

SECTION 3.—ESTABLISHMENT OF FEDERAL CONSORTIUM FOR TECHNOLOGY TRANSFER

The conferees recommend adopting the Senate decisions to affiliate the Federal Laboratory Consortium with the National Bureau of Standards and to establish a program for demonstration projects in technology transfer. They further recommend funding the consortium at House-recommended levels.

Both the House and the Senate-passed versions of this legislation address the need of the Federal Laboratory Consortium (FLC) to have a permanent connection with a federal agency and a more predictable source of funding for the next five years. These two changes will permit the FLC, which has operated with very limited funding for much of its 15 years, to coordinate its program better and to expand its efforts at permitting the technology transfer officers of the various Federal laboratories to work more closely together. It is the clear intent of both Houses that, to the extent possible, the existing programs and initiatives of the FLC be continued uninterrupted as the organizational changes required by the Act are made. As soon as practical after enactment, the current FLC officers are asked to begin the FLC's transition by convening a meeting both of the current FLC representatives and of representatives of any laboratories added to the Consortium by this Act. Because of the twin goals of continuity and increased effectiveness for the FLC, these efforts should not await funds transfers under the FLC set-aside provision.

The Federal Laboratory Consortium is expected to remain a networking organization of the Federal laboratories and their technology transfer officers. The consortium is to function as a clearinghouse of information and has purposely been established with a small budget and small paid staff so that the volunteer spirit that has made the organization a success to date will continue. The consortium is not to engage directly in the transfer of technology. Rather, it is expected to help the laboratories that develop the technology to do a better job of transferring it by themselves or through appropriate agents.

The conferees felt, however, for the FLC to perform this function properly, increased funding is necessary for such projects as expanding the Consortium's electronic mail system and strengthening its regional operations. These efforts, plus the planned re-establishment at the National Bureau of Standards of a small Washington presence, led the conferees to recommend that the FLC set-aside be the House-passed figure of .005% to fund the operations of the organization. Five percent of these funds would be used to cover the Senate-passed program of demonstration projects in technology transfer. The Conferees see these demonstrations as a useful complement to the Federal Laboratory Consortium. At least two such demonstrations are to be funded over the five year life of the demonstration program, and the Consortium should look for diversity both in the types of demonstrations funded and in the states hosting the demonstrations. The Federal Laboratory Consortium is expected to develop program specifications, but the conferees expect the actual competition and awards process to be conducted at the request of the FLC either by a federal agency or by a laboratory with existing capabilities to administer such a program.

The conferees recommend establishment of the House-passed concept of regional advisors for the Federal Laboratory Consortium but did not choose to establish formal advisory committees. These volunteers will provide insights from the business community which will help the consortium stay on target in its efforts to make the laboratories helpful and accessible to the business community. The conferees also recommend inclusion of the Senate provision authorizing the Consortium to encourage laboratories, when requested, to assist interested organizations and businesses in various facets of technology program planning and curriculum design.

SECTION 4.—UTILIZATION OF FEDERAL TECHNOLOGY

The House and Senate-passed versions of this section, designed to upgrade the status of laboratory professionals who do technology transfer, were similar. The conferees recommend accepting from

the House version, the policy statement that technology transfer is a responsibility of every laboratory's scientific and engineering professional, and the requirement that technology transfer professionals be included in overall laboratory/agency management development programs. From the Senate version, the conferees recommend inclusion among the functions of technology transfer professionals, participation, where feasible, in state, local and regional technology transfer efforts. The House requirements of technology transfer reports as part of agency annual budget submissions is retained.

SECTION 5.—FUNCTIONS OF THE SECRETARY

The conferees recommend acceptance of the Senate's two additions to the bill's lists of duties of the Secretary of Commerce. The Secretary is required to submit biennial reports to the President and the Congress on the use by agencies of Stevenson-Wydler Act authorities. The original Stevenson-Wydler Act required one such report. The Secretary also is required to submit a one-time report to the President and Congress on copyright provisions and other types of legal barriers which limit the transfer of federally funded computer software and on the feasibility and cost of compiling and maintaining a current and comprehensive inventory of federally funded training software. The report is to identify recurring problems rather than to attempt to compile a comprehensive list of barriers facing individual software projects.

SECTION 6.—REWARDS FOR SCIENTIFIC, ENGINEERING, AND TECHNICAL PERSONNEL OF FEDERAL AGENCIES

This section is identical in the House and Senate versions of this legislation.

SECTION 7.—DISTRIBUTION OF ROYALTIES RECEIVED BY FEDERAL AGENCIES

Both the House and Senate-passed versions of this section direct agencies to retain royalties from the licensing or assignment of inventions and to allocate them to their government-operated laboratories. Both versions have identical limits on the amount of money the laboratories may retain. Both have similar uses to which the laboratory directors may allocate the money, one of which is to reward employees of the agency for innovative work, both in furtherance of the agency's mission and in advancing inventions with commercial potential.

The Senate bill additionally directs agencies to allocate at least 15% of royalties from an invention to the inventor or coinventors, before allocating the remainder to its laboratories. The House had chosen not to include a percentage royalty share, preferring to leave maximum flexibility in rewarding inventors with laboratory management.

The conferees recommend acceptance of a compromise provision, which requires agencies either to allocate at least 15% of royalties from an invention to the inventor or coinventors, or to promulgate

regulations providing an alternative set of rights in the inventor whose invention produces royalties for the government.

The conferees believe agencies should have the flexibility to formulate royalty payments to employees that best meet the unique circumstances of each agency and that meet the purpose of the Act. At the same time, the conferees agree that providing a predictable, guaranteed reward from royalties to federally employed inventors provides a strong incentive to report, develop, and help license inventions with commercial potential.

The conferees agree that royalty sharing alone, although effective, is an imperfect tool in promoting technology transfer. The process of turning an invention into a successful commercial product is complex, and involves the work of more than just the inventors. Within a laboratory a team of scientists and engineers, beyond those involved in patenting an invention, may contribute to its development and licensing, and their contribution may be as important to the commercial success of the invention as that of the inventors. In addition, a single, fixed royalty share may be an inadequate reward for an inventor, depending on the amount of royalties received.

Therefore, the conferees believe that laboratory directors should use the authority in section 14(a)(1)(B)(ii) to reward those employees who contribute to innovative work, in mission-related work with or without commercial potential. Similarly, agencies that choose to promulgate rules to set alternative royalty percentages should consider tiered allocation of royalties, which give more weight to the inventor's contribution when royalty income is small, but which also recognize the contributions of a wider team.

In the Federal laboratories, depending on size, a percentage of royalties could be allocated to the research team or project, in addition to the inventor's share, before the remainder is allocated to the Laboratory Director. Such an allocation is possible without formal rulemaking, provided the allocation is in addition to the minimum inventor's share of 15% under clauses 14(a)(1)(A)(i) or (A)(ii).

The initial 15 percent allocation for royalties is to take effect on enactment of the bill unless an agency publishes its intention to promulgate rules. The 15% or any alternative allocation is to apply to all royalty income received by an agency in a given year, including that from inventions patented and licensed before the date of enactment of this Act, and is to continue for as long as the agency receives income from an invention, including after the inventors may have left the agency. The compromise provides that a Federal employee may not receive more than $100,000 per year in royalty income without the approval of the President. This coincides with the limits on agencies' statutory authority to make cash awards to employees.

If an agency's rulemaking is completed within two years after enactment and the 15 percent royalty sharing has not gone into effect, the effective date of royalty sharing under the rule is to be the effective date of the Act. If there is no rule within two years of enactment and royalty sharing is not in effect, 15% mandatory royalty sharing is to go into effect for that agency retroactive to the date of enactment. If a rule goes into effect more than two years

after enactment, the effective date of the royalty sharing under the rule for that agency is to be the same as the effective date of the rule.

The conferees wish to stress the flexibility of the compromise on royalty sharing. It is intended to give each agency the freedom to devise different employee award systems that accomplish the purposes of the Act and that best meet the unique needs, cultures, and technology transfer problems of the agencies' laboratories. In order to strengthen the program so that all agencies can benefit from what is learned in the varying approaches to royalty sharing, Comptroller General report has been mandated evaluating the first five years of this royalty sharing program.

The conferees value the licensing activities that have been performed by the National Technical Information Service for other agencies including other parts of the Department of Commerce. Section 14(a)(6) has been added to permit NTIS to continue this work without interruption after enactment.

The conferees are in agreement that there are inherent differences in the way public sector and private sector employees can be rewarded. Furthermore, they have provided agencies with flexibility in the establishment of programs to reward inventors. The conferees, therefore, do not expect any particular agency's approach for rewarding inventors, whether it includes 15 percent mandatory royalty sharing or not, to be viewed as setting a precedent for the private sector.

SECTION 8.—EMPLOYEE ACTIVITIES

The conferees recommend acceptance of this provision from the Senate version of the legislation as modified. The provision is intended to assure that a Government employee has a chance to obtain title to an invention if the government does not plan to arrange for the commercialization of the invention. The conferees recommend giving the inventor an automatic right to request an invention where the government neither intends to file for a patent nor intends to promote the transfer of this information to the U.S. private sector by alternate means.

SECTION 9.—MISCELLANEOUS AND CONFORMING AMENDMENTS

The only significant difference between the House and Senate versions of these provisions is the Senate's addition of two new responsibilities for Department of Commerce's Office of Productivity, Technology and Innovation. The conferees recommend inclusion of both new responsibilities: promotion of joint initiatives in technology transfer and encouragement of cooperative programs among all appropriate parties regarding development and dissemination of technological skills.

DON FUQUA,
DOUG WALGREN,
STAN LUNDINE,
MANUEL LUJAN, Jr.,
SHERWOOD L. BOEHLERT,
Managers on the Part of the House.
JACK DANFORTH,
FRITZ HOLLINGS,
DON RIEGLE,
SLADE GORTON,
LARRY PRESSLER,
Managers on the Part of the Senate.

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THE WHITE HOUSE

Office of the Press Secretary
(Los Angeles, California)

For Immediate Release April 10, 1987

EXECUTIVE ORDER

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FACILITATING ACCESS TO SCIENCE AND TECHNOLOGY

By the authority vested in me as President by the Constitution and laws of the United States of America, including the Federal Technology Transfer Act of 1986 (Public Law 99-502), the Trademark Clarification Act of 1984 (Public Law 98-620), and the University and Small Business Patent Procedure Act of 1980 (Public Law 96-517), and in order to ensure that Federal agencies and laboratories assist universities and the private sector in broadening our technology base by moving new knowledge from the research laboratory into the development of new products and processes, it is hereby ordered as follows:

Section 1. Transfer of Federally Funded Technology.

(a) The head of each Executive department and agency, to the extent permitted by law, shall encourage and facilitate collaboration among Federal laboratories, State and local governments, universities, and the private sector, particularly small business, in order to assist in the transfer of technology to the marketplace.

(b) The head of each Executive department and agency shall, within overall funding allocations and to the extent permitted by law:

(1) delegate authority to its government-owned, government-operated Federal laboratories:

(A) to enter into cooperative research and development agreements with other Federal laboratories, State and local governments, universities, and the private sector; and

(B) to license, assign, or waive rights to intellectual property developed by the laboratory either under such cooperative research or development agreements and from within individual laboratories.

(2) identify and encourage persons to act as conduits between and among Federal laboratories, universities, and the private sector for the transfer of technology developed from federally funded research and development efforts;

(3) ensure that State and local governments, universities, and the private sector are provided with information on the technology, expertise, and facilities available in Federal laboratories;

(4) promote the commercialization, in accord with my Memorandum to the Heads of Executive Departments and Agencies of February 18, 1983, of patentable results of federally funded research by granting to all contractors, regardless of size, the title to patents made in whole or in part with Federal funds, in exchange for royalty-free use by or on behalf of the government;

(5) implement, as expeditiously as practicable, royalty-sharing programs with inventors who were employees of the agency at the time their inventions were made, and cash award programs; and

(6) cooperate, under policy guidance provided by the Office of Federal Procurement Policy, with the heads of other affected departments and agencies in the development of a uniform policy permitting Federal contractors to retain rights to software, engineering drawings, and other technical data generated by Federal grants and contracts, in exchange for royalty-free use by or on behalf of the government.

Sec. 2. Establishment of the Technology Share Program. The Secretaries of Agriculture, Commerce, Energy, and Health and Human Services and the Administrator of the National Aeronautics and Space Administration shall select one or more of their Federal laboratories to participate in the Technology Share Program. Consistent with its mission and policies and within its overall funding allocation in any year, each Federal laboratory so selected shall:

(a) Identify areas of research and technology of potential importance to long-term national economic competitiveness and in which the laboratory possesses special competence and/or unique facilities;

(b) Establish a mechanism through which the laboratory performs research in areas identified in Section 2(a) as a participant of a consortium composed of United States industries and universities. All consortia so established shall have, at a minimum, three individual companies that conduct the majority of their business in the United States; and

(c) Limit its participation in any consortium so established to the use of laboratory personnel and facilities. However, each laboratory may also provide financial support generally not to exceed 25 percent of the total budget for the activities of the consortium. Such financial support by any laboratory in all such consortia shall be limited to a maximum of $5 million per annum.

Sec. 3. Technology Exchange -- Scientists and Engineers. The Executive Director of the President's Commission on Executive Exchange shall assist Federal agencies, where appropriate, by developing and implementing an exchange program whereby scientists and engineers in the private sector may take temporary assignments in Federal laboratories, and scientists and engineers in Federal laboratories may take temporary assignments in the private sector.

Sec. 4. International Science and Technology. In order to ensure that the United States benefits from and fully exploits scientific research and technology developed abroad,

(a) The head of each Executive department and agency, when negotiating or entering into cooperative research and development agreements and licensing arrangements with foreign persons or industrial organizations (where these entities are directly or indirectly controlled by a foreign company or government), shall, in consultation with the United States Trade Representative, give appropriate consideration:

(1) to whether such foreign companies or governments permit and encourage United States agencies, organizations, or persons to enter into cooperative research and development agreements and licensing arrangements on a comparable basis;

(2) to whether those foreign governments have policies to protect the United States intellectual property rights; and

(3) where cooperative research will involve data, technologies, or products subject to national security export controls under the laws of the United States, to whether those foreign governments have adopted adequate measures to prevent the transfer of strategic technology to destinations prohibited under such national security export controls, either through participation in the Coordinating Committee for Multilateral Export Controls (COCOM) or through other international agreements to which the United States and such foreign governments are signatories.

(b) The Secretary of State shall develop a recruitment policy that encourages scientists and engineers from other Federal agencies, academic institutions, and industry to apply for assignments in embassies of the United States; and

(c) The Secretaries of State and Commerce and the Director of the National Science Foundation shall develop a central mechanism for the prompt and efficient dissemination of science and technology information developed abroad to users in Federal laboratories, academic institutions, and the private sector on a fee-for-service basis.

Sec. 5. Technology Transfer from the Department of Defense. Within 6 months of the date of this Order, the Secretary of Defense shall identify a list of funded technologies that would be potentially useful to United States industries and universities. The Secretary shall then accelerate efforts to make these technologies more readily available to United States industries and universities.

Sec. 6. Basic Science and Technology Centers. The head of each Executive department and agency shall examine the potential for including the establishment of university research centers in engineering, science, or technology in the strategy and planning for any future research and development programs. Such university centers shall be jointly funded by the Federal Government, the private sector, and, where appropriate, the States and shall focus on areas of fundamental research and technology that are both scientifically promising and have the potential to contribute to the Nation's long-term economic competitiveness.

Sec. 7. Reporting Requirements. (a) Within 1 year from the date of this Order, the Director of the Office of Science and Technology Policy shall convene an interagency task force comprised of the heads of representative agencies and the directors of representative Federal laboratories, or their designees, in order to identify and disseminate creative approaches to technology transfer from Federal laboratories. The task force will report to the President on the progress of and problems with technology transfer from Federal laboratories.

(b) Specifically, the report shall include:

(1) a listing of current technology transfer programs and an assessment of the effectiveness of these programs;

(2) identification of new or creative approaches to technology transfer that might serve as model programs for Federal laboratories;

(3) criteria to assess the effectiveness and impact on the Nation's economy of planned or future technology transfer efforts; and

(4) a compilation and assessment of the Technology Share Program established in Section 2 and, where appropriate, related cooperative research and development venture programs.

Sec. 8. Relation to Existing Law. Nothing in this Order shall affect the continued applicability of any existing laws or regulations relating to the transfer of United States technology to other nations. The head of any Executive department or agency may exclude from consideration, under this Order, any technology that would be, if transferred, detrimental to the interests of national security.

RONALD REAGAN

THE WHITE HOUSE,
April 10, 1987.

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THE WHITE HOUSE

Office of the Press Secretary
(Los Angeles, California)

For Immediate Release April 10, 1987

FACT SHEET

"Facilitating Access to Science and Technology"

The Executive Order on Facilitating Access to Science and Technology initiates a number of steps designed to promote cooperation between the Federal Government, State and local governments, industry and academia in cooperative research and the commercialization of research. These steps will:

1. Direct Federal departments and agencies to improve the transfer of federally developed technology and technical information to the marketplace by:

   -- encouraging Federal laboratories to collaborate with State and local governments, universities and business, particularly small business, through cooperative research and development agreements;

   -- licensing intellectual property developed through the cooperative research and development agreements or by individual Federal laboratories;

   -- encouraging "science entrepreneurs" to act as conduits between Federal laboratories, universities, and the private sector;

   -- implementing royalty-sharing programs for Federal inventors; and

   -- developing a uniform Federal policy permitting Federal contractors to retain rights to software, engineering drawings, and other federally generated technical data, in exchange for royalty-free use by the government.

2. Direct the Secretaries of Agriculture, Commerce, Energy, and Health and Human Services and the Administrator of the National Aeronautics and Space Administration to select one or more of their laboratories to participate in the "Technology Share Program," involving multi-year joint basic and applied research with consortia of U.S. firms and universities.

3. Direct the President's Commission on Executive Exchange to assist Federal agencies in developing and implementing an exchange program whereby scientists and engineers in the private sector may take temporary assignments in Federal laboratories and scientists and engineers in Federal laboratories may take temporary assignments in the private sector.

4. Direct:

   a. Federal agencies, when negotiating or entering into cooperative research and development agreements and licensing arrangements with foreign persons or industrial organizations directly or indirectly controlled by a foreign company or government, to give consideration in consultation with the

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(OVER)

United States Trade Representative to whether the country: offers comparable research and development and licensing opportunities for U.S. nationals and companies and protects U.S. intellectual property rights;

b. the Secretary of State to develop a recruitment policy encouraging scientists and engineers from across the Federal Government, academia, and industry to serve in U.S. embassy assignments abroad; and

c. the Secretaries of State and Commerce and the Director of the National Science Foundation to develop a central mechanism for the prompt and efficient dissemination of science and technology information developed abroad to users in Federal laboratories, academic institutions, and the private sector on a fee-for-service basis.

5. Direct the Secretary of Defense to identify within 6 months a list of funded technologies that would be potentially useful to U.S. industries and universities and to then accelerate efforts to make these technologies more readily available.

6. Direct Federal agencies to examine the potential for including the establishment of university-based research centers in engineering, science, or technology in the strategy and planning for any future R&D programs. Such centers would be jointly funded by the Federal Government, the private sector, and, where appropriate, the States and would focus on areas of fundamental research and technology that are both scientifically promising and have the potential to contribute to the nation's long-term economic competitiveness.

7. Direct the Director of the Office of Science and Technology Policy to convene within 1 year an interagency task force of Federal research agencies and their laboratories to assess the progress in transferring technologies from Federal laboratories and to develop and disseminate additional creative approaches to technology transfer.

The President's intention to issue an Executive order was announced in January as part of his 43-point Competitiveness Initiative.

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THE WHITE HOUSE

Office of the Press Secretary
(Los Angeles, California)

For Immediate Release April 10, 1987

STATEMENT BY THE PRESIDENT

I believe a vigorous science and technology enterprise involving the private sector is essential to our economic and national security as we approach the 21st century. Accordingly, I have today issued an Executive Order "Facilitating Access to Science and Technology."

It is important not only to ensure that we maintain American preeminence in generating new knowledge and know-how in advanced technologies, but also that we encourage the swiftest possible transfer of federally developed science and technology to the private sector. All of the provisions of this Executive order are designed to keep the United States on the leading edge of international competition.

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by Kevin McDermott

Government R&D

A wealth of new product ideas

The U.S. government spent about $55 billion in researching new technologies this year, about $20 billion of it in government laboratories. A lot of good ideas will come out of that spending, even if some of those ideas turn out to be far from the original intention of the research.

In theory, these good ideas are available for commercialization, but practice has been something else. The U.S. government holds about 28,000 patents on technology developed with its research funds, but only 4 percent of these patents have ever been licensed for commercial product development. "Much of it has tremendous significance," says D. Bruce Merrifield of government-sponsored R&D. "It's really advanced technology that can keep us at the leading edge in a competitive global economy, and yet we're failing to take advantage of it."

Man with a cause

The commercial development of government patents has been something of a personal cause for Merrifield since he joined the Department of Commerce four years ago from The Continental Group, where he had been vice president for technology and venture management. As assistant secretary for productivity, technology and innovation, Merrifield has targeted the transfer of government technology as a particular objective of his office.

Until recently, the policy of the federal government was to take ownership of technology developed with its research funds and then license it non-exclusively. The National Institutes for Health, for example, have done just that with a process developed in their labs that may someday lead to a cure for AIDS—and become a hot product for the companies that produce it.

The typical government patent, like that licensed by NIH, is technology at its incipient stage, the early spade work of product development; in Merrifield's experience, the gestation period from new research to commercial product will still be from five to seven years. But while it will be left to private companies to invest the time, the money and the risk in commercializing the new technology, ideas hatched under government sponsorship can provide the germ of unexpected new products.

A product opportunity

Over the years, research funded by the U.S. Army in particular has spawned a wide range of commercial products—everything from freeze-dried coffee to the use of irradiation in sterilizing and preserving food. Funding from the Army, as well as the National Institutes of Health, also supported the early work on a cheap and speedy technique that uses laser light to identify viruses and bacteria without the usual time-consuming process of growing cultures. Research on the technique was conducted at the Los Alamos National Laboratory in New Mexico, the major nuclear research laboratory in the United States, which is run by the University of California for the Department of Energy. The Army's original purpose was to explore ways of identifying organisms that might have military uses, and NIH was interested in basic biological research, but Santa Fé venture capitalist David Silver saw a commercial opportunity and put together a company called Mesa Diagnostics to exploit its product potential. The government granted Mesa an exclusive license.

The government holds about 28,000 patents on technology developed with its research funds, but only 4 percent have ever been licensed for commercial development.

Silver was alerted to the existence of the Los Alamos technology at a meeting the laboratory sponsored several years ago to promote the commercial potential of its work. Mesa then put together a very creative financing package using $6 million from the Prudential-Bache research-and-development limited-partnership pool, and another $2 million from state development funds, venture capital and a bank loan. The company turned around and gave Los Alamos $4 million to continue working on the diagnostic technique to bring it to the next stage of product development. That's $4 million in research funding the government laboratory would not have if it had not licensed its technology to Mesa.

The accessibility problem

Until recently, comparatively little was done to make businesses aware of the existence of such new technology. It was published, of course, but in general it was swept into the always-growing whirlpool of information about new technology. As a result, U.S. companies have, on the whole, taken little advantage of a trove of basic R&D developed at taxpayer expense—although Merrifield notes that "the Japanese and everybody else have been blanketing this area and subsidizing its commercial development."

An important part of the effort to make government-sponsored research more accessible to private interests is the current

restructuring of the National Technical Information Service. NTIS, the world's largest database, is, in effect, a giant catalog of government research. Among its other functions, NTIS publishes documents containing abstracts of new research sponsored by the federal government. Merrifield hopes that the data can be reorganized to make it "not a passive database but an active listing of developments that have specific industrial significance."

Taking the issue to Congress

But of even more potential value to the private sector—small business in particular—is the present effort to broaden the scope of legislation intended to encourage the transfer of government-sponsored technology.

In 1980, Congress passed the Bayh-Dole bill, which for the first time allowed small businesses and universities doing federally funded work in their own laboratories to take ownership of their research and even earn royalties by licensing it. Last year Congress extended Bayh-Dole, for the first time allowing a federal lab the same privilege with the proviso that royalties from licensing be returned to the lab's treasury to fund further research. The extension was again sponsored by Sen. Robert Dole (R-Kan.), who seems to be everywhere these days as he lays the groundwork for his run for the White House in 1988.

The original intention of Bayh-Dole and its subsequent extension was to create incentives that would build bridges to the private sector and broaden the usefulness of government-sponsored research, creating new products and, perhaps, even new businesses. As another technology specialist in the Department of Commerce, Dr. Norman Latker, director of federal technology management policy, describes it, "The whole thrust behind this legislation is start-ups."

Going further

Congress has so far shown considerable receptiveness to the philosophy that lay behind Bayh-Dole and its extension, which is that giving government-sponsored researchers incentives for transferring their ideas to the private sector and giving the managers of research programs wider discretion in encouraging that to happen will pay off for all concerned.

Two bills now being considered in Congress would take this philosophy of decentralizing technology management still further, but their future on Capital Hill is less certain. The first, S.64, would make law an executive order of 1983, which extended the rights and benefits of Bayh-Dole to big businesses, in particular to those that manage government labs, such as the Oak Ridge, Tenn., nuclear lab managed by Martin-Marietta Corp.

The other legislative initiative, S.65, gives more authority to the managers of government labs in dealing with the private sector. Under S.65, government labs would be free to arrange cost-sharing deals with private companies to conduct further R&D. A more controversial part of the bill is the proposal that government employees be rewarded for their research with a portion of the royalties from the licensing of their ideas. Inventors in federal labs, whether they work for the government or under contract, would be permitted a minimum of 15 percent of the royalty stream.

Interested parties

It is likely that Congress will vote on the two new bills sometime between now and next October. Of the two, S.64 is likely to have the more difficult time of it, since it is a bill that brings advantages to big companies, which are never the sentimental favorites on Capital Hill that small businesses are.

However, S.65 also has its opponents, both in and out of government. A considerable amount of opposition has come from patent

attorneys within government agencies who, in testimony before the House Committee on Science and Technology, have objected on principle that the government must maintain control of its own technology.

Merrifield dismisses this opposition as the tendency of bureaucracy to perpetuate itself, saying rather bluntly that the real reason federal patent lawyers resist the concept of decentralizing the process of technology transfer is that it threatens what he calls "their sinecure for life" in various agencies.

"They really don't have anything to do," Merrifield says of the typical government patent lawyer. "It's a make-work job that they've developed for themselves."

More important than that, he argues, the present system of technology transfer has just not worked. "When you take ownership and warehouse the technology in Washington," he says, "far from the government laboratories where the work was done, there's a limited understanding of what the work was all about. You impose an incredible bureaucratic process."

The typical government patent is technology in its incipient stage. It is the early spadework of product development.

Private-sector objections

A perhaps surprising source of opposition to S.65 comes from certain private-sector interests. One such group is the Intellectual Property Owners Organization, a lobbying group composed primarily of the chief patent counsels for major corporations. According to its executive director Herb Wamsley, IPO supports the concept of decentralizing technology management but objects that allowing inventors a portion of the royalties from the licensing of their ideas would be a precedent for legislation requiring similar schemes in private industry. Furthermore, says Wamsley, rewarding only the person designated as the inventor of a technology ignores the practical reality that in any research effort many people can play important roles.

Wamsley claims that as S.65 is now written this provision would not promote productivity in federal labs. IPO's testimony in the House evidently had some sympathetic ears, since a staff redraft of the House version of the bill would replace the provision allowing 15 percent of royalties to inventors with flat cash awards for creative research. The awards would not be tied to the marketability of an idea and could be given to researchers other than the nominal inventors of a technology.

Merrifield calls IPO's objections "spurious," pointing out, for example, that private industry has lots of ways to compensate an inventor, not only with royalties but with bonuses or salary increases. Government at present has no such flexibility for compensating its research people above and beyond their basic salaries. Besides, says Merrifield, referring to his own experience managing R&D in the private sector, "Industry could care less what goes on in government."

As for the formula for providing royalties, he argues that opponents have misunderstood it, saying that it allows the managers of government research a flexible system of rewards. As evidence that such a reward system can work, he points to the experience of universities, where creators of patented technology commonly receive between 40 and 50 percent of royalties.

The outlook

Although the Department of Commerce has taken a strong position in Congress in favor of extending Bayh-Dole, Merrifield believes that passage of the new bill has been slowed because "up until now the Office of Management and Budget has not been willing to put the administration on the line, primarily because of these very disruptive tactics of the patent lawyers, who've been feeding them misinformation."

However valid Merrifield's characterization of the opposition, it is likely that a vote on both S.64 and S.65 will come up in the next 12 months. The sense one gets is that, in one form or another, both bills will make it through Congress.

Merrifield is confident. One encouraging sign, he says, is that the Japanese are reportedly "concerned that this technology pool will dry up for them if we get this legislation through."

An outsider in government

Merrifield's confidence is understandable, since on the whole he has had very good luck with Congress since joining government four years ago. For instance, the National Cooperative Research & Development Act of 1984, which permitted consortia of companies to work together on major R&D projects, passed unanimously in both houses in the final weeks before Congress adjourned last year. When he first came to Commerce, says Merrifield, "I wouldn't have given you a nickel for the chances of getting the antitrust laws changed."

For most people, "glacial" is the adjective that comes to mind first in discussing the federal government's capacity for action, but "surprisingly," says Merrifield, "things happen, and they seem to happen more rapidly than you might expect." □

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Patricia W. Hamilton, Editor

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Patricia W. Hamilton

Patricia W. Hamilton, Editor

Chicago University, National Lab Seek Profit From Ideas

* * *

School, Argonne Set Venture To Help Commercialize Scientific Discoveries

By FRANK E. JAMES
Staff Reporter of THE WALL STREET JOURNAL

CHICAGO—The University of Chicago said it created a joint venture with Argonne National Laboratory to help commercialize scientific discoveries made at the two institutions.

The formation of Argonne National Laboratory/University of Chicago Development Corp., or ARCH, represents the first time a national laboratory and its research-university partner have teamed up to commercialize their discoveries. The University of Chicago operates Argonne as a contractor for the U.S. Department of Energy.

The move comes as the federal government is trying to stimulate the transfer of technology from federal laboratories to private industry. The effort is a response to the longstanding problem of most government-lab discoveries not being commercialized because of bureaucratic red-tape or corporate apathy. Companies have been unwilling to pursue such taxpayer-financed discoveries because they haven't easily been able to gain proprietary rights to the patents.

In 1984, Congress made it possible for companies to gain title to discoveries stemming from research at such labs as Argonne, although the law wasn't effective until July. And in legislation Congress passed last week, federal labs received authority to set up cooperative research-and-development pacts with businesses. The legislation also calls for government researchers whose inventions are licensed to get 15% of license revenue or a fixed payment.

The university also said that Steven Lazarus, group vice president of health-care services for Baxter Travenol Laboratories Inc., based in Deerfield, Ill., will head the venture.

The university said professors and students at its graduate school of business will provide the venture with marketing proposals and business plans for the new technologies. Mr. Lazarus also has been appointed associate dean of the business school.

Argonne, the first national laboratory and one of the largest such laboratories, does research in a variety of fields, including nuclear and alternative energy, biomedicine, the physical sciences and the environment. Its annual budget is about $230 million and it has 4,000 employees.

The joint venture will be financed by the university and Argonne for its first five years and will be self-sustaining after that, the university said. Alan Schriesheim, Argonne's director, said in addition to the licensing of discoveries to businesses, the venture will allow the partners to get equity stakes in companies that may be started to develop the partnership's ideas.

Bill Aims to Ease Transfer of Technology From Federal Laboratories to Businesses

By TIMOTHY K. SMITH
Staff Reporter of THE WALL STREET JOURNAL

Clifford Hesseltine's experience as a U.S. government scientist was classic. He did some research on toxins, published results that caught the eye of industrialists with a problem, and won a government citation for saving an industry.

The citation was the Third Order of the Rising Sun, bestowed on behalf of the Emperor of Japan, in recognition of Mr. Hesseltine's service to Japan's soy-sauce brewing industry.

The taxpayer-funded research done in the 700 or so federal laboratories should be a rich mine of ideas that U.S. businesses can develop into new technologies. But it hasn't worked that way. Most American companies shun the laboratories, and the technology that comes out of them usually goes to foreign countries.

"Private companies do not take seriously looking for new technology" at the federal laboratories, says Clifford Lanham, executive secretary of the Federal Laboratory Consortium for Technology Transfer, an umbrella group.

Problems on Both Ends

Transfer of technology from the U.S. government to corporations is rife with problems on both ends. Finding and developing basic research at companies rarely commands a priority as high as quarterly profits. And at the government laboratories, red tape and legal obstacles prevent most inventions with commercial potential from ever getting out the door.

"The labs spend about $18 billion a year" on research, says Bruce Merrifield, the Commerce Department's assistant secretary for productivity, technology and innovation. "I would say that about 95% of (their work) has not been been available for commercial development."

But that may soon change. A House-Senate conference panel yesterday completed negotiations on a bill that would make it easier for companies to exploit government research, primarily by removing administrative hurdles and giving laboratories incentives to commercialize their ideas. The legislation now goes to the House and the Senate for final votes, and sources on Capitol Hill say its chances for passage are good.

"We see this as landmark legislation," Mr. Merrifield says. "It seems so obvious and so much in the national interest."

He and other proponents of the bill argue that one reason the American technological edge has been slipping is that unlike other countries, the U.S. has been unable to narrow the gap between basic and applied research. That, they say, is why the U.S. still wins plenty of Nobel prizes but no longer seems able to build a decent automobile.

Congressional Action

Prodded by Congress, federal laboratories have been trying to promote their inventions in recent years, with varying degrees of enthusiasm and success. A 1980 law required the laboratories to appoint part-time officers to encourage technology transfer. Another law passed the same year permitted some laboratories—but not all—to do cooperative research with outside entities such as universities and small businesses. And legislation in recent years allows federal laboratories to get exclusive rights to inventions and license them—keeping some of the revenue.

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Still, the bureaucracy remains nightmarish, and progress has been slow. Glenn Kuswa, technology transfer manager at the Department of Energy's Sandia National Laboratories in Albuquerque, N.M., describes the arduous journey an invention takes from his laboratory to the market. "It's checked for classification, and if it's not classified, it's sent to the local DOE office to see if a search for licensing should be made. Then it goes to Washington for evaluation, and if it looks promising, we write a disclosure, and it goes to a patent attorney and gets sent off to the patent office. The end result is a patent that is owned by DOE. If the inventor wants to, he can ask for license rights." Mr. Kuswa adds that from the time the inventor asks for a license until the product is developed is usually more than a year.

And that's just one laboratory owned by one agency; rules and procedures differ at laboratories owned by the Defense Department, NASA, the National Institutes of Health and other branches of the government. "It's going to take a while to turn this dinosaur around," Mr. Lanham says.

The new bill would grant blanket authority to all federal laboratories to set up cooperative research-and-development agreements with businesses. It would provide money to expand a communications system linking federal laboratories, giving businesses centralized access to a smorgasbord of government research. It would raise the status of technology transfer officers and make their positions full-time. Perhaps most important, it would reward government researchers whose inventions are licensed, requiring the laboratories to give them either 15% of license revenue or a fixed minimum payment.

Optimism at Labs

Officials at the laboratories are optimistic about the bill. "There has been a slow change, but now it almost looks like we might be on an exponential change curve," Mr. Lanham says.

But there are some problems that the bill can't address. There is, for instance, the basic difference in the cultures of scientists and businessmen. Scientists generally disseminate their findings as widely as possible; businessmen keep information secret to make money. "There is a feeling that the growth of science takes place by a vigorous exchange of information among scientists, and anything that inhibits that exchange is detrimental," says James Wyckoff, liaison officer for state and local governmental affairs at the National Bureau of Standards in Gaithersburg, Md.

And some of the agencies running federal laboratories fear that injecting a dose of entrepreneurship could divert researchers' attention from larger national goals and cause laboratories to compete with one another. "The question is: What is the mission of the labs? Is it to develop near-term technologies for development, or to focus on long-term research, national security and so forth?" says Vid Beldavs, executive director of the Technology Transfer Society, Indianapolis.

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Reviving the spirit of enterprise: Role of the Federal labs

Since a 1983 report of the White House Science Council recommended strengthening the role of Federal laboratories in America's R&D, progress in transferring technology has ranged from impressive to modest. Congress is accelerating the action.

Paul A. Blanchard and Frank B. McDonald

About 400 research facilities officially classified as Federal laboratories[1] employ nearly 185 000 of the nation's scientists and engineers and account for roughly $18 billion per year—a third of all Federal R&D funding in fiscal 1985. Most of this support went to a relatively few large centers devoted to energy and weapons research, high-energy physics experiments, medical programs and space science and exploration. Besides the multipurpose national labs such as Sandia, Argonne, Los Alamos and the National Bureau of Standards, which perform a broad range of R&D activities, the full roster includes a diversity of installations, including the Boll Weevil Research Laboratory; the National Radio Astronomy Observatory; the Insect Attractant, Behavior and Basic Biology Center; the FBI Laboratory; and even the National Zoo. Despite the contributions of the Federal labs, how they can enrich the nation's R&D enterprise with "public technology" has been a subject of concern in Washington for decades.

One recent study of the problem was conducted by a panel of the White House Science Council. After a year-long review, the panel, headed by David Packard, chairman of Hewlett-Packard Co and former deputy secretary of the Defense Department, issued a slender report[2] in 1983 that spoke to issues relating to the management of the laboratories—their missions, funding and personnel systems. But of greater importance, the report called for increased interaction between the laboratories and commercial firms to make the labs "more responsive to national needs." The Packard report accused some of the labs of working without clear purpose and contributing inadequately to the nation's good. The Packard panel recommended that the size of each lab be "allowed to increase or decrease (to zero if necessary) depending on mission requirements," arguing that "preservation of the laboratory is not a mission." What the labs needed to do was develop more alliances with universities and corporations and simplify government procurement procedures, the report stated.

Such recommendations were not surprising because the panel had been instructed at the outset by George A. Keyworth II, who was then the President's science adviser and director of the White House Office of Science and Technology Policy, to ask whether the nation gets an adequate return on the taxpayer's investment in the Federal labs and whether the labs are helping to stimulate the country's industrial competitiveness.

White House concern with these issues was also expressed in President Reagan's suggestion of a Department of International Trade and Industry and his appointment of the Commission on Industrial Competitiveness in 1983 (see box, page 45). Congress, for its part, is also taking increasing notice of the way government-funded R&D is translated into the commercial enterprise—most pointedly, the conditions under which Federal labs contribute best to new goods and services that are likely to benefit the country's world trade. In the current session of Congress no fewer than four bills have been introduced, in the nature of amendments to or substitutes for the 1980 Stevenson–Wydler Technology Innovation Act (P.L. 96–480), to improve the transfer of technology from Federal labs and to promote commercialization.

Prior to the Stevenson–Wydler Act, Federal agencies were not explicitly required to engage in technology-transfer activities, with the sole exception of NASA. The Stevenson–Wydler Act directs the agencies "to ensure the full use of the results of the nation's Federal investment in research and development." To do this, the law creates an elaborate procedure: It calls for each Federal lab to set up an Office of Research and Technology Application to identify ideas and technologies with commercial potential. Once found, information about those concepts is to be sent to a newly organized Center for the Utilization of Federal Technology at the Commerce Department's National Technical Information Service. NTIS is responsible for collecting and disseminating information about Federally funded R&D to possible users. However, NTIS has little experience or interest in technology-transfer matters, particularly as these involve licensing and royalties, and Congress has

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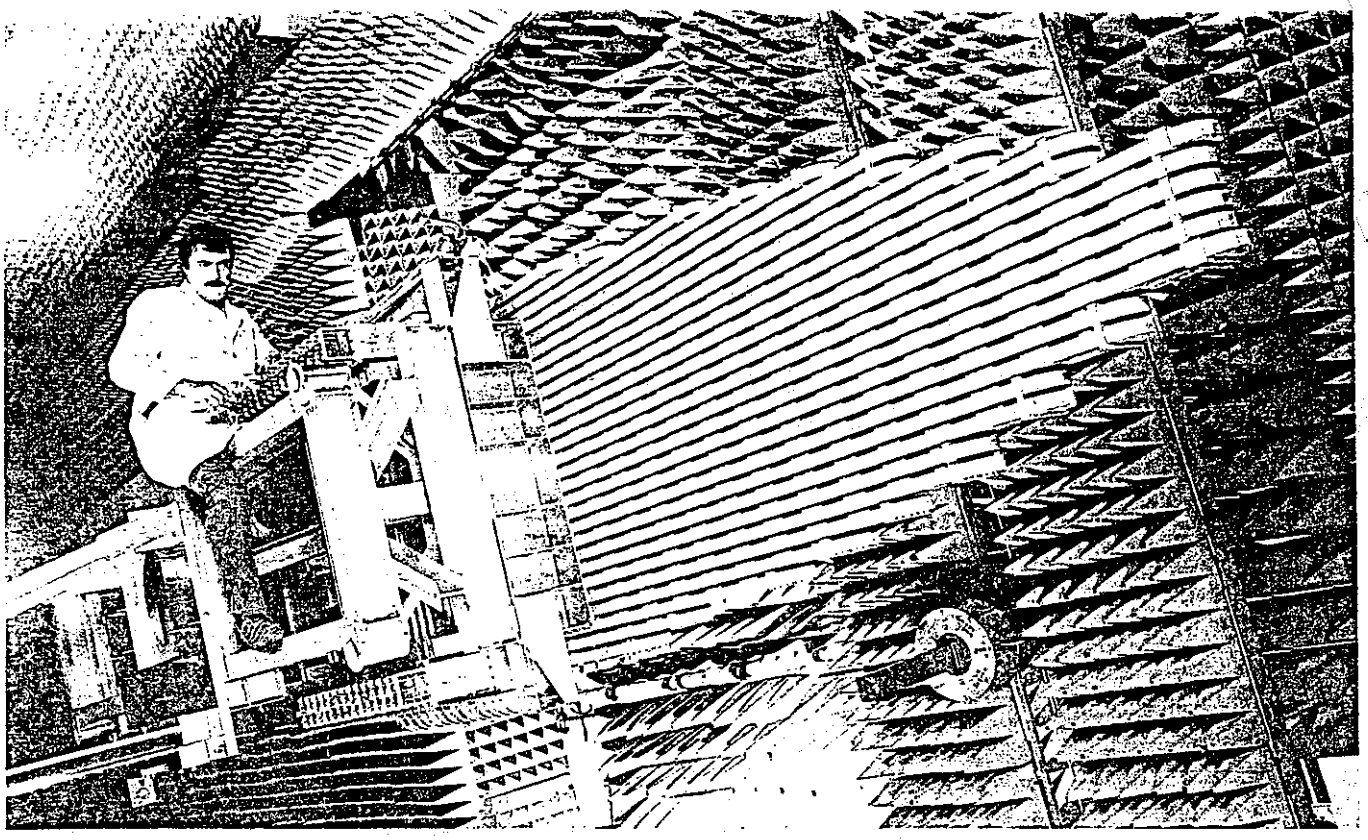


Microwave antenna, constructed indoors at the National Bureau of Standards in Boulder, Colorado, provides calibration of far-field satellite antennas and phased-array radar stations. NBS provided the design for computer programs for this technology to 18 different US corporations and government agencies.

not provided funding to the agencies for establishing or operating research and technology applications offices at the labs.

The bills introduced in the current, 99th Congress are intended to correct the Stevenson–Wydler Act and stimulate more technology transfer. Hearings on the proposed legislation were held in the House last May and the Senate in August. As recently as 18 November, another bill, H.R. 3773, championed by the House Committee on Science and Technology, was dropped into the hopper with bipartisan blessings. The measure is working its way through Congress with unaccustomed support and speed (see box, page 47).

Obviously, a sea change of sweeping significance has occurred since the Packard report. So much has happened, in fact, that even the conclusions of the working groups established by OSTP to assess the response by Federal agencies to the Packard report may be so much flotsam and jetsam amid the new currents. The findings of those working groups were released in the summer of 1984 as a progress report.[3] This article originally was intended to discuss the conclusions of the Working Group on External Interactions, which examined the relationships of the Federal laboratories with universities and industry. It now includes later developments.

Lab research, Federal style

The Federal laboratories are essentially a post-World War II phenomenon, though the Agriculture Department's extension service was founded in the 19th century. The agricultural extension service has provided a wide variety of educational, research and technical programs that have helped make America's farmers the world's most productive. Agriculture's labs and those organized by other agencies were originally founded to carry out well-defined missions or to take on specific sets of tasks and responsibilities. Over the years, however, research programs have changed substantially at many of these installations.

As the labs have grown in size, cost and function, their significance to science and technology has increased apace. Since World War II they have been the recipients of a sizable proportion of Federal R&D funds. For the record, annual Federal outlays for R&D programs, which stood at about $100 million in the late 1930s, increased to $10 billion by 1962 and reached about $52 billion in 1985. The Federal laboratories account for about one-third of current government outlays for R&D.

Consider the returns to the nation of just one of them—the Naval Research Laboratory, founded in 1923 at the suggestion of Thomas Alva Edison. From it have issued an array of achievements, including radar, sonar and Teflon as well as synthetic lubricants for aircraft engines, rocket probes of Earth's atmosphere and magnetosphere, and several cardiac instruments. Last year NRL registered its 3000th patent, and last October one of its 1700 scientists, Jerome Karle, won the Nobel Prize for chemistry.[4]

Another Nobel laureate working in a Federal laboratory is Rosalyn Yalow. For her work on human hormone chemistry, performed at the Veterans Administration research center in Brooklyn, she shared the prize in medicine in 1977. The National Institutes of Health boasts four Nobel laureates—Marshall W. Nirenberg (1968), Julius Axelrod (1970), Christian Anfinsen (1972) and D. Carleton Gajdusek (1976). The Department of Energy and, before it, the Atomic Energy Commission have had a peculiar relationship with scientists. Most of them have been engaged at the labs through their respective universities; thus, they are not considered Federal employees. But as members of DOE-supported research centers, Ernest O. Lawrence, Edward McMillan, Luis Alvarez, Burton Richter, Glenn Seaborg and other Nobel Prize winners add to the luster of Federal labs.

Efforts by the government to ensure that the nation is receiving an optimal return on its investment reach back more than two decades. In 1962 President Kennedy, concerned about the growth of spending for Federal R&D, asked David Bell, then director of the Bureau of the Budget, to lead a cabinet-level study of the laboratories in the

mission agencies. The Bell report[5] called for reforms that were to become familiar themes in later years: The agencies needed to support world-class, cutting-edge research in their labs; laboratory directors needed to have more discretionary authority, along with relief from the burdens of excessive review and supervision by the agencies; and salaries for key laboratory scientists, engineers and technicians needed to be raised to attract the ablest people.

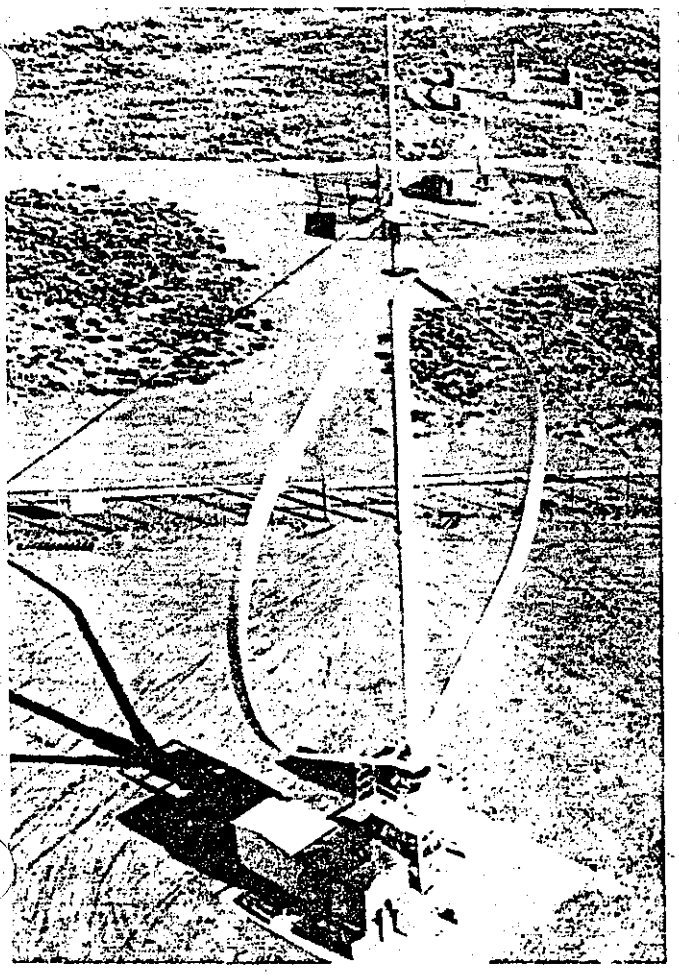
Several other advisory bodies endorsed these recommendations in a series of reports during the 1970s. The reports bore such stirring titles as *Power to the States: Mobilizing Public Technology, Intergovernmental Uses of Federal R&D Centers and Laboratories, Public Technology: A Tool for Solving National Problems* and *Action Now: Partnerships—Putting Technology to Work*. Among the options proposed in these reports were technology transfer from the Federal laboratories to state and local jurisdictions and to various public and private cooperative ventures, with the aim of speeding up the introduction of commercial products and techniques.

This theme had important adherents. In an address to Congress on science and technology in March 1972, President Nixon announced a new effort to improve the nation's economic well-being and quality of life. He called for partnerships among Federal labs, state and local governments, industries, universities, and other research organizations to apply Federally sponsored R&D to civilian needs. In his statement, Nixon said, "Federal research and development activities generate a great deal of new technology which could be applied in ways that go well beyond the immediate mission of the supporting agency."

Cooperative programs

Partly in response to Nixon's speech, the National Science Foundation established RANN (the Research Applicable to National Needs program), as well as the Intergovernmental Science and Public Technology and Community Technology Incentives program. None of these has withstood the test of time.

One of the more promising programs promoting the use of government-backed R&D for product development in the commercial world is the Federal Laboratory Consortium for Technology Transfer. The consortium was organized in 1971 by 11 Defense Department laboratories to help move technology developed specifically for DOD to local governments and commercial companies. By 1974 it had expanded to include labs from other agencies, and since the enactment of the Stevenson–Wydler Act the consortium has consisted of almost 300 Federal labs from 11 different agencies. Part of the consortium's success is attributable to its unique structure. The act requires the lab directors to name research and technology application officers, who, as members of the consortium, seek to encourage transfers. In testimony before the House Science Research and Technology Subcommittee last May, the efforts of these lab technology-transfer officers were characterized as often limited, tentative and uneven. Witnesses said a smoothly operating, systematic technology-transfer process requires greater resources and commitment than the *ad hoc* consortium and the lab people have been able to muster. For this reason alone, supporters of pending bills in Congress sought to place the consortium in NSF, thereby giving it legal authority, funding stability and management structure.



Vertical-axis wind turbine, neglected for nearly 50 years, based on a design called a troposkien (from the Greek word meaning "turning rope") first proposed by a French inventor, D. J. M. Darrieus, is under development at Sandia Laboratories as an alternative energy source. Though laughed at as "egg beaters," the turbines offer advantages over standard horizontal-axis technology because they operate at ground level, adjust to wind shifts and can be built more cheaply.

The latest reexamination of the Federal laboratories dates from the appointment of Keyworth as the President's science adviser in May 1981. As a former leader of the Physics Division at Los Alamos National Laboratory, Keyworth had encountered firsthand many of the problems and issues facing the laboratories. When Keyworth arrived in Washington, a major review of nine Department of Energy multiprogram laboratories was already taking place. The ensuing report[6] by the Energy Research Advisory Board in 1982 clarified the roles of the DOE facilities and recommended steps to increase interactions with external groups to promote technology transfer to the private sector.

Packard panel sets the stage

Early that same year Keyworth commissioned a more broadly conceived review of the Federal laboratories and selected Packard to head it. The Packard report did not advocate the wholesale transfer of Federal laboratory programs to private industry, as some observers had expected it would, in keeping with the Reagan Administration's philosophy. Instead, the Packard panel took pains to define the R&D roles appropriate to the laboratories, going on to make recommendations consistent with the missions and functions of Federal research centers.

A Presidential panel argues for R&D partnerships

Only weeks after the Packard report reached the White House, President Reagan appointed a 30-member Commission on Industrial Competitiveness under the chairmanship of John A. Young, president of Hewlett-Packard. Its purpose was to identify how corporate America might more quickly and easily translate scientific research and technological innovation into commercial products, services and manufacturing processes and to recommend government policies to improve the nation's competitive position in world markets. The commission's report, *Global Competition: The New Reality*, recognized, among its many observations and conclusions, that US industry must make optimal use of the research capabilities and research results within Federal laboratories.

"One way is to increase R&D cooperation between Federal laboratories and specific industries," states the report, released last February by the Commerce Department. "As a result of discussions in this committee, the Office of Science and Technology Policy is leading an effort that has brought together national laboratories with expertise in materials science and the steel industry to generate leapfrog technology applicable to steel production." Steel is an industry that has been particularly plagued by the absence of innovation. Not coincidentally, the only government member of the Young commission was George A. Keyworth II, OSTP's director, who instigated the "steel initiative." "It is hoped this pilot effort will stimulate additional cooperative research between Federal laboratories and other industries that might benefit from Federal research," the report states.

The trouble, as the Young commission sees it, is that "government-funded mission-oriented R&D," as practiced in the Federal labs, "is not a major contributor to industry's ability to innovate and produce." For almost two decades after World War II, says the Young report, government agencies and laboratories abetted the commercial development of such prime innovations as computers, semiconductors and jet aircraft. "Today, however, industry has long surpassed the government as the main source of technological innovation, and the government has increasingly become a net user, not a provider, of industrial technology," the report argues.

Indeed, among its recommendations the Young report urges that nondefense Federal agencies require the labs to foster industrial competitiveness through their R&D and that a cabinet-rank Department of Science and Technology be created to "transform the current, fragmented formulation of policies for science and technology . . . and improve the management of Federal R&D in laboratories and agencies" under its jurisdiction.

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Among seven basic laboratory roles, the panel concluded, are the obligations to "build and manage large multiuser technical facilities and encourage industry and universities to use them," to "contribute . . . to the education of scientists and engineers in applied research" and to develop commercial products "only when that work has industry cooperation and is directly related to the laboratory's unique capability." Noting that these roles are intermediate between those of universities and industry, the Packard report went on to urge the laboratories, universities and industry to "fulfill their proper roles and complement one another, so that the research contributes to US leadership in technologies and products."

Nothing in the report's recommendations startled those familiar with policy issues relating to the labs. Apart from proposals to create a separate personnel system for the laboratories and to provide multiyear funding, there was nothing even controversial in the recommendations. Some critics maintained that the report added little new or useful to the national debate about the future of the laboratories. Indeed, the recommendations of the Packard report are similar to those made in the Bell report more than 20 years before. Both sets of conclusions, then, tend to reinforce the verdict that the Federal labs offer an exceptional source of R&D for commercial technologies.

Keyworth saw to it that the Packard study was followed immediately by a second inquiry designed to emphasize the report's recommendations and to gauge the responses to those recommendations by Federal agencies. Thus in August 1983, only a month after he had been briefed on the Packard recommendations, President Reagan directed OSTP and the Office of Management and Budget "to lead an interagency effort to respond to the central thrust of the report." During the spring of 1984 four working groups examined what progress the agencies and their labs had made in implementing the Packard recommendations. The groups compiled detailed status reports of the actions taken by all major Federal agencies. Accordingly, the sections of the overall progress report treating laboratory missions, personnel, funding and management deal largely with issues internal to the Federal government.

The issues considered by our Working Group on External Interactions, by contrast, involve universities and industry and may in that sense be considered of wider public-policy interest. The working group's assignment was not without its challenges. First of all, the Packard report is brief—only 12 pages long, apart from the summary and appendices—and consequently offers little or no detailed guidance in carrying out its recommendations. The working group also needed to interpret the recommendations in the light of the differences observed between the ways the laboratories interact with the universities on the one hand and with industry on the other. A third challenge arose from the disclosure, following the completion of the Packard report, of several irregularities in military procurement, such as $670 toilet seats for the Navy and $7000 coffeepots for the Air Force. Such cases threatened to affect Federal procurements generally.

Finally, the working group had to confront the great diversity of the Federal laboratory system itself. As a practical matter, the working group sought first to understand the fundamental features of external interactions of the most successful and productive laboratories, with a view toward framing recommendations applicable to the larger number of Federal laboratories. Although the working group consulted other reports dealing with external laboratory interactions, it found that the goals and recommendations enunciated in the Packard report were themselves the most useful point of departure for the task at hand.

Access to Federal labs

The Packard report recommended that Federal laboratories "should encourage much more access to their facilities by universities and industry." While industrial R&D firms perform some basic research and also develop military hardware, their main functions are to create, provide and sell useful products and services. It follows that the main reason to make laboratory facilities available to industry is to promote commercial development.

By contrast, access to the Federal laboratories by universities is likely to contribute fundamentally to strengthening a complementary relationship. Both laboratories and universities are committed to the search for an understanding of basic physical phenomena. They share needs for improved state-of-the-art research instrumentation, for instance. Moreover, laboratories are almost entirely dependent upon universities for the training of their management, administrative, scientific and technical staffs. Assistance to universities—and, more broadly, a strong interaction with educational institutions generally—therefore is in the self-interest of the laboratories, as well as in the national interest.

The working group found that implementation of the Packard recommendation for greater access to laboratory facilities has been widespread. Some Federal laboratories, such as the National Bureau of Standards, are renowned for their long tradition of providing access to external groups. Indeed, the record of achievement is impressive. Take the case of NBS's Automated Manufacturing Research Facility, which has been helping to develop the factory of the future with dozens of major industrial firms. NBS provides a test bed for both hardware and software systems—among these, robot vision devices that direct robot arms electronically, laser position-measuring devices that enable computers to direct tooling operations, instruments for detecting changes in sonic signatures that can anticipate drill failures, and near-field microwave antennas that simplify measuring and calibrating far-field radiating characteristics for satellite antennas and phased-array facilities.

Another instance of laboratory–industry partnership is taking place at Keyworth's suggestion: Argonne National Laboratory is forming an R&D venture with US Steel, Armco, Bethlehem, LTV and National Steel. The plan is for steel-company scientists and engineers to work alongside lab researchers developing new technologies to replace obsolete coke ovens and blast furnaces. Electromagnetic casting may be one way of improving products while cutting costs. The Argonne project is fundamental to Keyworth's "steel initiative," whose goal is to develop "leapfrog technology" that will not only help restore the industry's badly eroded position in world markets but also place it well ahead of foreign competitors. The idea is to develop generic technologies that the entire industry will share.

Soon after the steel project was proposed, Keyworth asked the national laboratories to identify ongoing or planned research that might benefit other ailing industries. Argonne suggested that its development of an adiabatic engine could help the farm-machinery industry. Soon afterward Caterpillar and John Deere Co spoke to laboratory officials about setting up some sort of research project in advanced engines, electronic controls and continuously variable transmissions. Unlike the steel initiative, the off-road equipment project will attempt to develop specific products rather than basic technology.

Increasingly, Federal labs are spawning grounds for new-technology ventures. In the 35 peacetime years of the Oak Ridge National Laboratory from its origin in the Manhattan Project of World War II until 1980, some 20 companies were launched with technologies developed by the lab. In the next four years, between 1980 and 1984, more than 30 spinoffs led to the formation of new companies.

Several venture-capital companies have been founded on R&D produced in Federal labs. For example, viruses and bacteria have been identified in minutes, rather than the days or weeks needed with existing methods, by a technique involving laser beams developed at Los Alamos in a project funded by the National Institutes of Health. Just as the lab set out to find companies that might want to acquire the new process, a Chicago venture capitalist happened to visit Los Alamos, seized upon the concept and raised enough money to develop a commercial prototype. He then organized a company, Mesa Diagnostics, with an exclusive license to market the technology.

The Solar Energy Research Institute has developed two prototypes of insulated glass—one using coatings that reflect heat and cold, the other using a vacuum rather than an inert gas between panes. Vacuum-insulated double-glazed windows, according to SERI, improve thermal insulation by a factor of 10 over conventional double-panel windows. SERI is now working with several companies interested in such technologies. SERI has also developed a technique for producing continuous ribbons of silicon for making photovoltaic cells. Exclusive license for the process has been granted to Arthur D. Little Enterprises, which is about to announce a fabricator for the ribbons.

The primary reason for such progress is easy to identify: Provision of access to facilities lies almost entirely within the jurisdictions and the means of the laboratories themselves. Given the freedom to act without the need for agency reviews, authorizations and approvals, laboratory directors and managers can rapidly and effectively provide the access envisioned by the Packard panel. There is still room for improvement, however. Many Federal laboratories have programs to promote personnel exchange, but the flow of laboratory scientists and engineers into educational settings remains weak. Some career laboratory staff members may spend 30 years or more within the same walls, never to refresh or upgrade their education or training at external institutions. In addition, much more could be done to bring students and faculty into the laboratories, where they would perform research in the national interest while simultaneously furthering their education and experience.

Many laboratories have attempted to hire more students and faculty but have been thwarted by the current system of quotas on "full-time-equivalent" employees. These personnel ceilings are intended to control the growth of Federal agencies. In practice, however, the full-time-equivalent quotas force laboratory managers to choose between temporary student and faculty hires, on the one hand, and retention of permanent laboratory staff on the other. At the least, the working group concluded, student and faculty hirings should be exempt from such quotas. Additional interchanges of personnel between laboratories and universities are also desirable at the senior level. Even if other circumstances are favorable, however, differences in pension benefits can work against such appointments. These impediments should be removed, the working group agreed. The foregoing conclusions led the working group to offer recommendations of its own:

- ▶ Collaborative relationships with educational institutions should be incorporated into the laboratory mission.
- ▶ Programs to provide students and faculty with opportunities to work in Federal laboratories should be expanded.
- ▶ Student and faculty job positions at government-operated laboratories should be exempt from full-time-equivalent personnel quotas.
- ▶ Programs to increase interchanges between university and laboratory personnel should be strengthened, particularly those that bring permanent laboratory staff to university and other educational settings.
- ▶ Legislation should be sought to permit retention of pension benefits for scientists and engineers who move between Federal laboratories and universities.

R&D interactions with industry

The Packard report recommended that R&D interactions between Federal laboratories and industry "should be greatly expanded by more exchange of knowledge and personnel, collaborative projects, and industry funding of laboratory work, provided an oversight mechanism is established to prevent unfair competition." The R&D interactions referred to, of course, are two-way

A bill for Federal labs gains speedy action

Few legislative bills have won so much political support as quickly as H.R. 3773. Introduced in the House of Representatives on 18 November by more than a dozen members, including Don Fuqua, the Florida Democrat who heads the Committee on Science and Technology, and Robert Michel, the Illinois Republican who is House minority leader, and incorporating parts of three other bills, it would amend the Stevenson–Wydler Technology Innovation Act of 1980 by authorizing government-operated laboratories to enter into joint R&D agreements with states and localities or corporations and universities. On 9 December, the measure was approved unanimously in the House and went to the Senate, where it is championed by the majority leader, Robert Dole, a Republican from Kansas.

Among its provisions, the bill requires the agencies to establish cash-award programs as incentives for Federal labs and their workers to produce discoveries and inventions that may be commercialized. The bill omits the most controversial issue of other proposed legislation: It does not require that government inventors get "at least 15%" of the royalties on any development licensed for commercial use—a reward formula that some, both inside and outside of government, fear may change the nature of much Federal laboratory work from basic studies to short-term research with potential commercial value. H.R. 3773 gives lab directors great flexibility to use the royalties or other income derived from inventions at their labs to reward their staff people as well as to spend such money for a variety of purposes, including advancing scientific exchanges among government-operated labs and educating and training workers.

H.R. 3773 would also institutionalize the Federal Consortium for Technology Transfer, placing it in the National Science Foundation. If the bill becomes law, the consortium, which now operates *ad hoc* within some 300 Federal labs to help move R&D into the wider world, would develop guidebooks, conduct seminars and serve as a clearinghouse for requests from states, businesses, universities and other private parties to foster technology transfer.

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in nature. Industrial experience, research results and management techniques might profitably be transferred in many instances to Federal laboratories. At the very least, industrial scientists and managers need to participate more fully in the initial planning of laboratory research programs.

The primary thrust of the Packard panel's recommendation, however, lies in the opposite direction—the transfer of technology developed in the Federal laboratories to business and industry. This view is shared by Congress, as evidenced by the Stevenson–Wydler Act and the bills now before it. The working group was impressed by the large number of instances of technology transfer already on record. We have referred to only a few in this article. The group nevertheless agreed with the Packard panel that Federal laboratories could do even more to transfer technology to the private sector.

Renewed efforts in this direction are required by the growing dependence of US industry on technology, the worldwide challenge to US industrial leadership and the ever-increasing sophistication and rate of development of technology itself. Progress toward transferring technology to industry has been less widespread and more uneven than progress toward greater access to lab facilities.

First of all, technology transfer is an inherently difficult process: It requires development of the technology itself, advancement of the technology to a stage permitting practical application and recognition by both the developer and potential user that a transition can occur (which itself assumes effective contact and communication between the two parties). Another set of difficulties arises from legal and policy issues lying outside laboratory jurisdiction and control—for example, the features of enabling legislation and, especially, Federal patent policy. Many of these issues are now being considered by the Department of Commerce, which has the chief responsibility for implementing the Stevenson–Wydler Act. Additional helpful proposals have been prepared by the Department of Energy in response to the ERAB report. These two currents of activity, together with the influence of the Packard report, appear to have produced a renewed commitment to technology transfer in most Federal agencies. The working group offered recommendations of its own to speed this process:

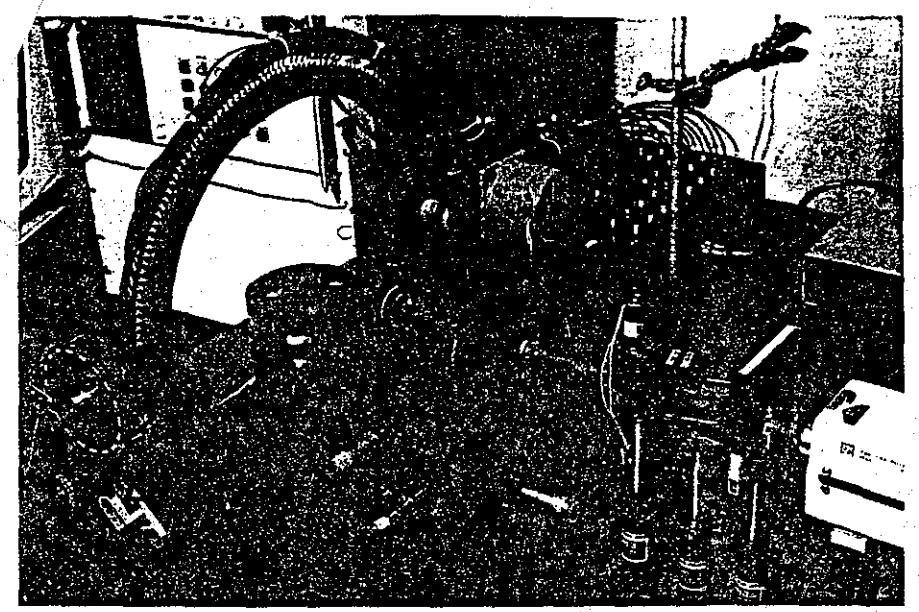
- Agencies and laboratories should promote means by which US industry can participate in identifying the nation's basic research needs.
- The transfer of technology to private industry should be incorporated into the laboratory mission so as to provide management focus and a positive environment for this work. Laboratories should involve industry in technology planning at the earliest appropriate time, strengthen techniques to determine the commercial potential of new laboratory technology, and obtain modest additional funds to facilitate the spinoff of laboratory technology.
- The authority of the laboratories should be extended to permit them to enter into a wide variety of cooperative research projects and to allow them to provide an incentive program for laboratory inventors.
- The authority of government-owned, government-operated laboratories should be extended to allow them to grant patent rights in existing or future inventions to industry, universities or nonprofit organizations.
- Organization incentives and training programs should be developed at the laboratories to promote technology transfer and the commercialization of laboratory research results.
- The Federal government should endorse the granting of patent rights in advance to all laboratory contractors.
- Guidelines should be established concerning the transfer of technology from Federal laboratories to foreign organizations.
- The Department of Commerce should draft proposals to ensure that implementation of the foregoing recommendations does not result in unfair competitive practices by the Federal laboratories.

A little perspective on these recommendations is in order. First, the working group concluded that industry should be brought into the process of technology transfer at the very beginning, when basic research needs at the laboratories are initially identified. Some laboratories appear to be making good progress toward this objective through use of advisory bodies whose members include industry representatives.

Second, it seems essential to make technology transfer part of the laboratory-mission statement in those cases in which this has not already been done.

The next four working-group recommendations offer more specific suggestions to speed technology transfer. As a practical matter, stronger incentives are needed for both partners in the technology-transfer process, but especially for industry. The working group benefited from the studies of both ERAB and the President's Commission on Industrial Competitiveness[7] in this connection.

Moreover, the working group recognized an acute need for guidelines on the transfer of technology to foreign organizations, particularly in areas that affect the nation's international competitive position. A balanced, two-way transfer is required, and knowledge gained from foreign organizations should be exploited to this nation's advantage.



Automated-manufacturing research at NBS. This device measures surface roughness: The semicircular array contains 87 sensors that monitor the light from a He–Ne laser scattered by the metal surface being tested.

Finally, the working group noted the need for procedures to preclude unfair competitive practices—a danger identified in the Packard report.

Simplifying Federal procedures

The Packard panel recommended that contracting by agencies and laboratories of universities and industry to conduct research and development "should be encouraged by simplifying the necessary Federal procurement procedures. The procurement process should give laboratory directors greater flexibility in contracting." The report reflects the widely held view that Federal labs would contract out more R&D work if it were simpler to do so. The working group concurred with this conclusion.

The Federal procurement process now requires some 135 000 employees to handle transactions through 1600 offices. Such transactions were governed through 1983 by 6300 pages of regulations. Fortunately, there is hope for progress in the form of a recent and thorough study of Federal procurement regulations by the National Academy of Public Administration. The recommendations advanced in the academy's report[8] appear to enjoy the widespread support of Federal procurement executives and to offer the best available approach to continued, systematic progress in this area. Accordingly, the working group concluded that it could do no better than to bring greater attention to the academy's findings. The action required would be government-wide and enormously complex.

Because revision of Federal procurement procedures lies entirely beyond the control of individual laboratories, and largely beyond control of the agencies themselves, only modest progress has been made since the Packard report. To make matters worse, the working group discovered that other factors can restrict the numbers of external contracts awarded by Federal laboratories. Poor management practices, such as an internal laboratory requirement for many levels of review and approval, can constitute a major barrier to the contracting process. On the other hand, laboratory directors and managers may often have quite legitimate reasons to retain significant fractions of R&D work in-house. In some cases, laboratories may be required by parent agencies to provide direct R&D support for regulatory processes. In others, directors may need to maintain a minimum level of expertise in various scientific and technical fields, simply to ensure that they can continue to be intelligent buyers of additional support services in those fields. These points need to be more widely understood by support contractors, who are apt to perceive the complexity of the procurement regulations as the sole cause of frustration or delay.

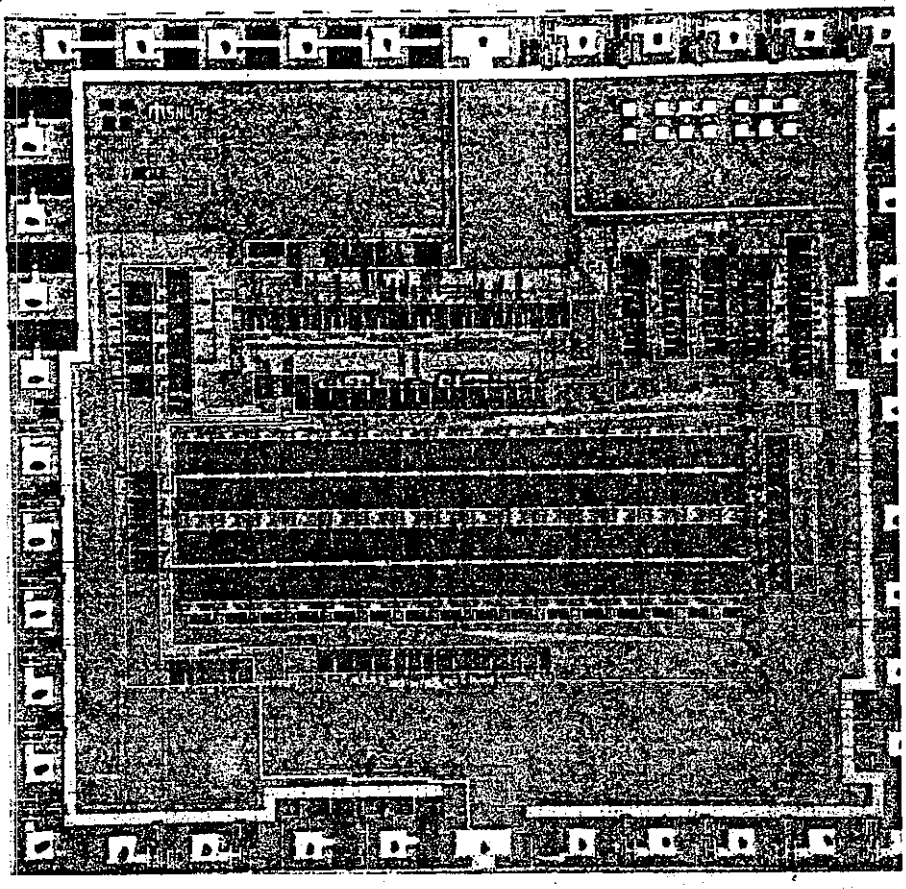
As it happened, a second major procurement issue arose during 1983, after the Packard report had been completed: the drive within the Federal government to foster greater competition among bidders for contract awards. This concern stemmed from accounts of irregularities in military procurements. By the time the working-group study was under way, this issue had eclipsed interest in the complexity of the procurement regulations themselves. In reaction, Congress began to consider legislation designed to restrict acceptance of unsolicited contract proposals and discourage award of sole-source contracts—measures that could seriously impede the procurement of basic research results from university groups.

The effort to broaden procurement competition had actually started somewhat earlier. For example, P.L. 98–72 was enacted in 1983 to improve small-business access to Federal procurement opportunities. This law requires that a proposed procurement of $10 000 or more be publicized in the *Commerce Business Daily*, with eight exceptions, one of which covers a "unique or innovative unsolicited research proposal, the publication of which would disclose original or innovative research." The working group learned, however, that this vital provision was being unevenly interpreted. Some procurement officials were choosing to require that all university proposals be advertised, arguing that they could not be expected to determine whether a given proposal was "unique and innovative" or not.

The danger of this development was compounded by various Congressional proposals during 1983 that would have treated the procurement of basic research essentially on a par with military hardware acquisitions. It appeared to the working group that the benefits of peer review, long used to weigh the value of proposals for basic research, were being overlooked in the debate on competition in procurement. Peer review is certainly a form of competition—albeit not the price competition appropriate to military hardware procurements—and this point needed to be made and understood more widely. Finally, the working group could not ignore the increasing delay between proposal submission and contract award observed in Federal agencies, even though the Packard report did not mention this problem explicitly. A fundamental timetable for basic university research is set by the academic calendar and the pace of graduate-school training. Significant progress on a research problem must usually be made within a matter of months. Such research cannot be sustained if the time required for a decision on awarding, rejecting or renewing a contract stretches to a year or beyond, as is now often the case.

Here, then, is how the working group's own recommendations stood at the conclusion of its task in May 1984:

▶ The Federal government should continue to support the 1983 recommendations of the National Academy of Public Administration, which are aimed at a systematic reduction in the complexity of Federal procurement regulations.



Radiation hardened against single-event upsets, this integrated circuit developed at Sandia Laboratories will be used in the attitude-control computer of NASA's Project Galileo spacecraft. Seen here is an enlarged slice of a 4-bit microprocessor, about 0.15 inches on each side and containing 2700 transistors. A single-event upset occurs when a high-energy particle passes through a transistor, causing a voltage surge that scrambles binary-digit information.

▶ Legislation and executive orders designed to increase competition for Federal contract awards should also protect the procurement of innovative basic research.

▶ The peer-review system should be defended as a form of selection appropriate to the procurement of basic research, meeting the concern for competition in procurement.

▶ All agencies should adopt the objectives of the National Science Foundation for the funding of basic research: a decision on award within six months of proposal receipt, a proposal length of less than 15 pages and the safeguarding of the technical proposal as the property of the proposer.

With respect to competition in procurement, at least, the story has a happy ending. University representatives and others brought their case to Congress, and provisions of the Competition in Contracting Act of 1984 are favorable to the procurement of basic-research from universities. The act broadens the definition of "competitive procedures" by including the selection by peer or scientific review of basic research proposals submitted in response to a broad agency announcement of interest. Because many, if not most, research proposals are already submitted in response to some agency statement of interest and reviewed in this way, the act nicely implements the working group's third recommendation.

The act also authorizes the use of "other than competitive procedures" in certain circumstances. Two are important to universities: the establishment or maintenance of an essential engineering, research or development capability at an educational or other nonprofit institution or Federally funded research and development center; and the funding of a unique and innovative research proposal through award of a sole-source contract. Taken together, these provisions should help to ensure the vitality of university research and the preservation of the present partnership of universities, industry and Federal laboratories in the national R&D enterprise.

In summary, the composite progress report compiled by OSTP does not include all of the points and recommendations made by the Working Group on External Interactions. However, many of the most important recommendations, together with suggestions of the other three working groups, appear in sections outlining "Future directions" that ought to be seriously considered by the Federal government. If these actions are taken, there appears to be the best chance in two decades that the reforms originally envisioned in the Bell report will actually be completed.

* * *

In addition to McDonald and Blanchard, the working group included the following members: Robin Brett (US Geological Survey, Department of the Interior), Philip Chen (National Institutes of Health, Department of Health and Human Services), Alan Claflin (Department of Energy), Don Ehreth (Environmental Protection Agency), James Hall (Department of Agriculture), Leslie Meredith (National Aeronautics and Space Administration), Donald Potter (Department of Defense), E. J. Richards (Department of Transportation), Howard Sorrows (National Bureau of Standards, Department of Commerce) and Jack Williams (Department of Commerce). Other regular participants were Norman Kreisman (Department of Energy) and Giora Pelled (Department of Defense, but affiliated with the National Science Foundation during the working-group study).

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The Wall Street Journal No. 10

?OMISING PARTNERSHIP

New law attempts to ease transfer of technology from government labs

By TIMOTHY K. SMITH

CORPORATIONS have developed much new technology through their campus links. But while these relationships have blossomed, companies have largely turned their backs on another source of new ideas: federal laboratories.

No one doubts the fertility of federal research; it's just that Uncle Sam's laboratories often are bloated and difficult to communicate with. Getting through the bureaucracy to obtain and exploit a government invention has been difficult in most cases and impossible in some, and U.S. businesses have learned to steer clear.

Uncle Sam's labs often are bloated and difficult to communicate with.

But government officials are hoping that a new law passed in October will make the 700 or so federal laboratories more attractive. The law provides incentives for government researchers to have their work commercialized, lowers some bureaucratic hurdles and seeks to hammer home the message that technology transfer is an explicit mission of the laboratories. If it works, proponents say, businesses will have a vast new technological resource to draw on.

Laboratory officials say they have lots of new technology ready to go. At the government's Harry Diamond Laboratories in Adelphi, Md., for instance, researchers have developed a way to make medical equipment that can stand up to the harsh environment of a nuclear magnet. A monator, a device that uses a strong electromagnetic field to diagnose diseases.

Currently, hospitals using these machines "can diagnose people who are relatively well, but not people who are very sick, because the life-support equipment can't stand" the powerful magnetic pull created by the machines, says Clifford Lanham, chief of research and technology applications. "So there is going to be a need very shortly for life-support equipment that can stand up to a lot of electromagnetic pulsation."

Mr. Lanham, who is also the executive secretary of the Federal Laboratory Consortium for Technology Transfer, an umbrella group, says the laboratory is looking for a private-sector developer for the technology. "We're hoping the legislation will make it easier," he says.

Other laws passed in recent years have tried to encourage technology transfer by letting individual laboratories obtain exclusive rights to their inventions, letting them keep some of the revenue from inventions that are licensed, letting some of them establish joint ventures with small businesses and requiring all of them to appoint part-time technology transfer officers.

At some laboratories, this has worked. Researchers at the Oak Ridge National Laboratory in Oak Ridge, Tenn., recently came up with an alloy, called nickel aluminide, that is three times stronger than steel at room temperature and gets even stronger as it gets hotter. Realizing that it had obvious advantages for engine parts, they obtained a patent and granted an exclusive license to Cummins Engine Co. to use the material in large diesels. (Cummins says it is still studying the alloy and hasn't yet decided whether to put it into production.)

Still, that kind of technology transfer remains the exception. The rule, as Mr. Lanham describes it, is for government-funded technology to sink into the bureaucratic bog.

Using the same principle that permits the development of tough life-support equipment, "you can make a device that can withstand total immersion in molten steel for hours," Mr. Lanham says. "We felt that that would be very useful for the steel industry. The steel industry said 'Great, where can we buy one?' But (the) technology is all tied up in 400 or so nonexclusive patents," which, because they give no protection against imitators, kill corporate interest.

The problem "starts with the character of the agencies involved—the unbelievable convoluted bureaucracies," says Donald Jared, technology transfer manager at Oak Ridge. "And very frequently, when something is developed it is put under some kind of (security) classification. Even now there is no periodic review to say 'Hey guys, the Russians have had this for 10 years, so now we can make it public.'"

Not surprisingly, U.S. businesses have preferred to look to the universities and elsewhere for new technology. "I know very well from people in this company that there is a definite reticence to even getting involved in government technologies, maybe because in the past there has been a lot of difficulty, a lot of red tape," says Judith Hopkins, a Baxter Travenol Laboratories official who regularly scouts universities for ideas.

Adds Frank Buno, director of new product suggestions at Becton, Dickinson & Co., "We have met with many government laboratories, but we haven't been very successful in uncovering things that have been going on."

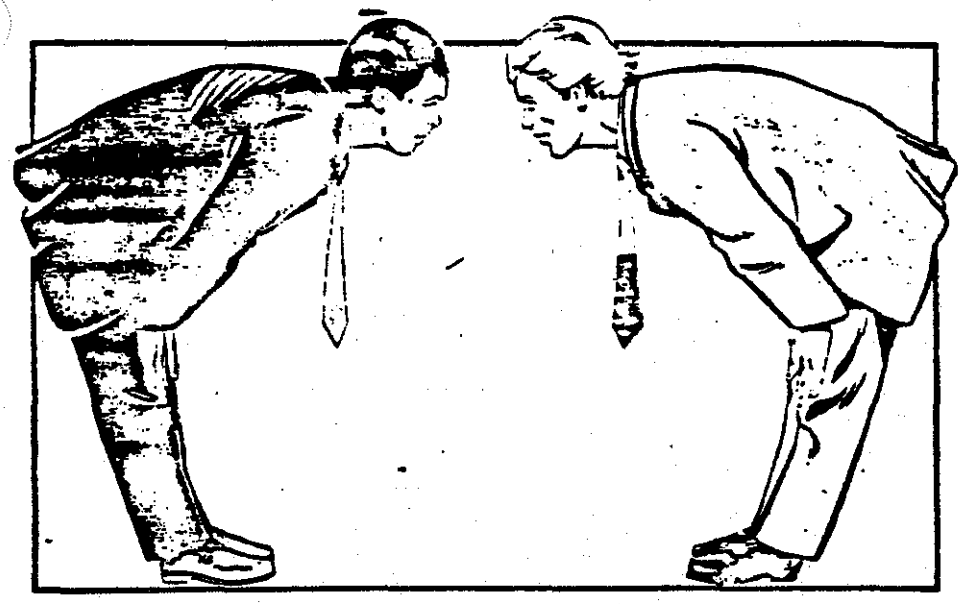
The problem "starts with the character of the agencies involved—the unbelievable convoluted bureaucracies."

The new law seeks to change that by building on earlier legislation. Among other things, it establishes a system for rewarding individual researchers whose inventions are developed, grants the laboratories blanket authority to establish joint ventures with outsiders and raises the status of technology transfer officers.

If it succeeds, the trickle of new technologies leaving the federal laboratories could turn into a steady and profitable stream. After all, the laboratories spend about $18 billion a year on research, government officials say.

But turning the bureaucracies around will be a long job. Asked for a figure more specific than "about $18 billion" for total research spending, a spokesman for the National Science Foundation says, "We don't have the funds to do a survey that would turn up that kind of number. We've been trying to do this kind of study for quite a number of years."

HIGH TECHNOLOGY



Clash of the titans

After steel, motor cars, consumer electronics and cheap microchips, Japan has begun to challenge American pre-eminence in the one industrial area the United States has long cherished as its own: high technology. The two are girding up for a trade war in high-tech that threatens to be bloodier than anything yet. Nicholas Valéry reports on the strengths and weaknesses of the two technological superpowers

The recent movie "Gung Ho" gets a lot of laughs out of the many misunderstandings that ensue when a Japanese car firm moves into a sad little town in Pennsylvania. Stereotypes abound: dedicated Japanese managers putting in double shifts, lazy American loudmouths slowing down the assembly line—with the locals winning a baseball match between the two sides only through brute force and intimidation.

All good clean fun. In real life, however, American workers—despite the popular myth—remain the most productive in the world (see the feature on the next page). In terms of real gross domestic product (GDP) generated per employed person, the United States outstrips all major industrial countries, Japan included (chart 1). The problem for Americans is that the rest of the world has been catching up. In the decade from the first oil shock to 1983, increases in annual productivity in the United States had been roughly a seventh of those of its major trading partners.

In the 1960s, American companies held all the technological high cards and dominated the world's markets for manufactured goods. The United States supplied over three-quarters of the television sets, half the motor cars and a quarter of the steel used around the world. Yet, a mere two decades later, Japan had taken America's place as the dominant supplier of such products.

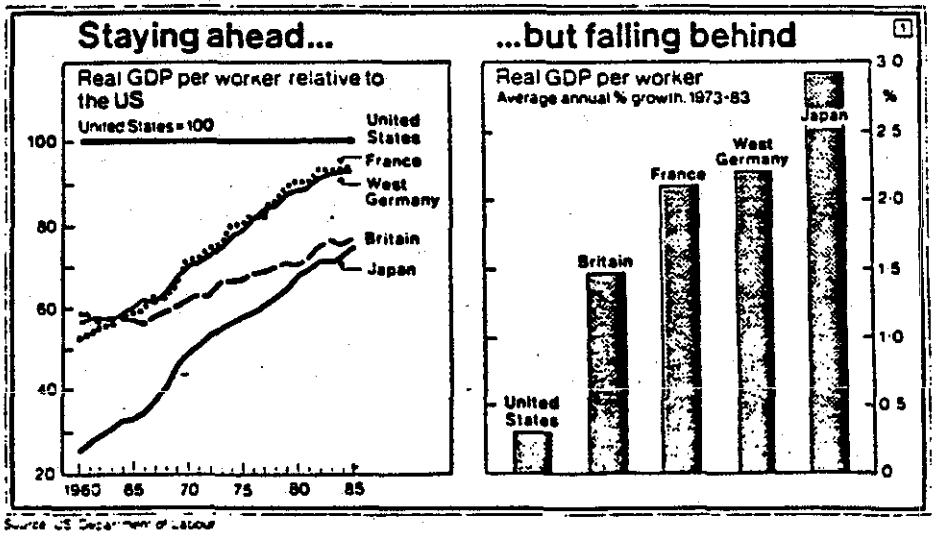
The agony for Americans does not end there. Over the past 25 years they have seen:

- Their share of world trade fall from 21% in 1960 to 14% in 1985.
- The American trade balance go from a surplus of $5 billion in 1960 to a deficit of $150 billion last year.
- More worryingly still, the country's trade balance in manufactured goods slip from a healthy surplus of $11 billion as recently as 1981 to a deficit of $32 billion last year—approaching 1% of America's total output.
- The volume of its manufacturing exports tumble 32% over the past five years—with every $1 billion of exports lost costing an estimated 25,000 American jobs.

Angry and confused, businessmen in the United States have had to stand by and watch as "smokestack" industry all around them has been snuffed out. Then came the unthinkable: if the Japanese could thrash them in mainstream manufacturing, would they give them a mauling in high technology, too?

By the beginning of the 1980s, it began to look as if they would. It became clear that the Ministry of International Trade and Industry (MITI) in Tokyo had "targeted" not just semiconductors and computers but all of America's high technology industries—from aerospace to synthetic materials—for a blitzkrieg attack.

Six years on, Japan has scored some



Source: US Department of Labour

Power to the elbow

Americans work every bit as hard as (and often a lot harder than) the Japanese—and generate proportionately more wealth in the process. The average output of American workers last year was $36,800. The Japanese equivalent was $22,500 (at an average 1985 exchange rate of Y220 to the dollar).

But labour productivity is only half the story. The amount of capital applied to a worker's elbow is crucial, too. The traditional definition of productivity (output per hour of all workers) makes it difficult to measure these inputs separately. True, the definition reflects all the factors that contribute to rising output—from advances in technology, better utilisation of capacity, improvements in the way production is organised and sharper management, to harder efforts by the workers themselves as well as the impact of changes in the amount of capital employed.

In 1983, the American Bureau of Labour Statistics introduced a yardstick called multifactor productivity. This shows the changes in the amount of capital as well as labour used in production. Reworking its data for 1950-83, the bureau found that multifactor productivity in the United States increased at an average annual rate of 1.7% for the period. As output per hour over the same period increased by an annual 2.5%, capital productivity inched up by only a modest 0.8% a year.

Overall, America's multifactor productivity has shown two distinct trends over the past 35 years. Up till the first oil shock of 1973, the country experienced an annual 2% multifactor growth; then an annual average of only 0.1% from 1973 to 1981. The post-OPEC slowdown seems to have resulted from high interest rates keeping the brakes on capital spending, while more people were having to work longer hours to hang on to their jobs.

How did the Japanese fare? The driving force behind the Japanese economy over the past 25 years has been the high growth in capital input. Mr Dale Jorgenson and his colleagues at Harvard University reckon it has been roughly double that in the United States. Growth rates in labour productivity have been much the same for the two countries. All told, the growth in Japanese productivity outstripped that in the United States until 1970, when productivity growth began to slow dramatically in Japan. Thereafter, with Vietnam behind it and two oil shocks ahead, the American economy flexed its muscles and coped more effectively. Then the competitive advantage started to move back in America's favour.

The interesting thing is what has happened since the last recession. Multifactor productivity in the United States has been running at an average of 5% a year, while the growth in labour productivity is now averaging nearly 4% a year. That means that productivity of capital employed is now growing at well over 6% a year.

Could this be the first signs of the productivity pay-off from the $80 billion that Detroit spent on new plant and equipment over the past half dozen years; the combined (additional) $180 billion invested by the airlines since deregulation, telecommunications firms since the AT&T consent decree and the Pentagon since President Reagan's defence build-up began in 1980? It looks remarkably like it.

notable hits. A group of American economists and engineers met for three days at Stanford University, California, last year to assess the damage*. They concluded that Japanese manufacturers were already ahead in consumer electronics, advanced materials and robotics, and were emerging as America's fiercest competitors in such lucrative areas as computers, telecommunications, home and office automation, biotechnology and medical instruments. "In other areas in which Americans still hold the lead, such as semiconductors and optoelectronics, American companies are hearing the footsteps of the Japanese", commented the Stanford economist Mr Daniel Okimoto.

How loud will those footsteps become? American industry may have been deaf in the past, but it certainly isn't any more. And never forget that Americans are a proud and energetic people. More to the point, they are prone to periodic bouts of honest self-reflection—as if, throughout their two centuries of nationhood, they have been impelled forward by a "kick up the backside" theory of history.

Once every couple of decades, America has received a short and painful blow to its self-esteem; Pearl Harbour, Sputnik, Vietnam are recent examples. What follows then is usually a brief and heart-searching debate along with a detailed analysis of the problem, then an awesome display of industrial muscle coupled with unexpected consensus between old adversaries—most notably between Congress, business and labour.

With its ceaseless shipments of cameras, cars, television sets, video recorders, photocopiers, computers and microchips, Japan unwittingly supplied the latest kick up the broad American buttocks. After witnessing Japanese exporters almost single-handedly reduce Pittsburgh's steel industry to a smouldering heap, drive Detroit into a ditch, butcher some of the weaker commodity microchip makers of Silicon Valley, and threaten America's remaining bastions of technological clout—aircraft and computers—then, and finally then, American lethargy ceased.

This survey tries to assess the strengths and weaknesses of the world's two technological superpowers. For if the past decade has seen some of the ugliest recrimination between Washington and Tokyo over trade issues generally, imagine what the coming decade must have in store. Henceforth, industrial competition between America and Japan is going to range fiercely along the high-tech frontier—where both countries take a special pride in their industrial skills and cherish sacred beliefs about their innate abilities.

The question that ultimately has to be answered is whether America is going to allow the Japanese to carry on nibbling away at its industrial base without let, hindrance or concession? Or are the Americans (as some bystanders have begun to suspect) "about to take the Japanese apart"?

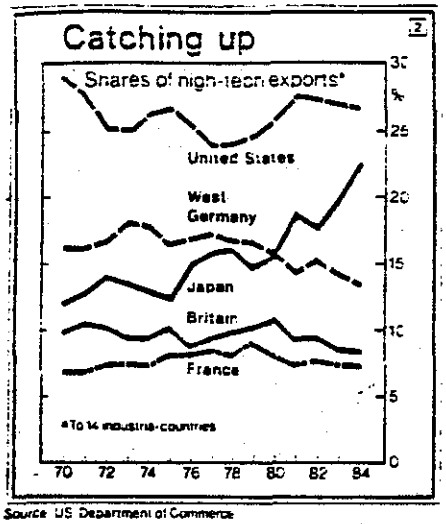
With the gloves now off, which of the two technological heavyweights should one put some money on? In the blue corner, Yankee ingenuity? In the red, Japanese production savvy?

*Symposium on Economics and Technology held at Stanford University, March 17-19 1985. Now published as "The Positive Sum Strategy: Harnessing Technology for Economic Growth" by National Academy Press, Washington, DC.

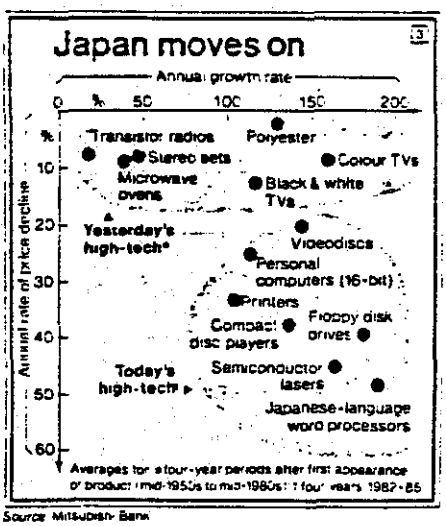
Copycat turns leader?

Is Japan still a technological free-loader—or has it become a pacesetter in high-tech?

America may still have the largest share of high technology exports, but Japan is catching up fast. It skipped smartly past West Germany to become the second largest supplier of high-tech goods in 1980 (chart 2 on next page). Only in three high-tech industries—communications and electronics, office automation, and ordnance—have American companies increased their market share.



Source US Department of Commerce



Source Mitsubishi Bank

The Japanese know they do not have a chance in fields that are either defence-related (for example, weapons, aircraft, satellites and avionics) or too dependent on imported energy or raw materials (like petrochemicals). But they see everything else as up for grabs. Even in lasers, software and computer-integrated engineering—where American pre-eminence was long thought unassailable—the Japanese have begun to make inroads.

Who would have thought it possible a decade ago? Of the 500 breakthroughs in technology considered seminal during the two decades between 1953 and 1973, only 5% (some 34 inventions) were made in Japan compared with 63% (315 inventions) in the United States. Despite its large, well-educated population, Japan has won only four Nobel prizes in science: American researchers have won 158. It is not hard to see why Japan has been considered more an imitator than innovator.

Stanford University's Mr Daniel Okimoto lists half a dozen reasons for Japan's lack of technological originality in the past:

- As an industrial latecomer, it has always been trying to catch up.
- The Japanese tendency towards group conformity has made it difficult to win a hearing at home for radical ideas.
- Research in Japanese universities is bureaucratic, starved of cash and dominated by old men.
- The venture-capital market is almost non-existent.
- Lifetime employment, along with a rigid seniority system, stifles innovation inside industry.
- And the traditional heavy gearing (high debt-to-equity ratio) of much of Japanese industry has made firms think twice about taking risks.

All these things—and more—have been true to some extent in the past; but all are also changing. The deregulation of Tokyo's financial markets, for instance, is forcing Japanese companies to reduce their levels of debt (see accompanying feature on next page). This, in turn, is making them more adventurous, while at the same time helping ferment a number of venture-capital funds.

Japan's "invisible" balance of technological trade (its receipts compared with payments for patent royalties, licences, etc) which had a ratio of 1:47 a couple of decades ago came within a whisker of being in balance last year. That said, Japan still buys its high-tech goods and knowhow predominantly in the West and sells them mainly to the developing world.

In certain industries, however, Japanese manufacturers have already started bumping their heads against the ceiling of current knowhow. There are no more high-tech secrets to be garnered from abroad in fibre optics for telecommunications, gallium arsenide memory chips for superfast computers, numerically-controlled machine tools and robots, and computer disk-drives, printers and magnetic storage media. In all these, Japan now leads the world. Today, Japanese-language word processors represent the cutting edge of high-tech in Japan—taking over the technological (but hardly export-leading) role that colour television played earlier (chart 3).

Although it is no longer quite the technological free-loader it was in the past, is Japan's new reputation as a pacesetter in high-tech justified? A new image has certainly emerged over the past few years of Japan as an invincible Goliath, capable of vanquishing any rival, whatever the field. Yesterday, the smokestack sectors. Today, high technology. Tomorrow, services. . . "Which is the 'real' Japan?" asks Mr Okimoto:

> Is it a technological imitator and industrial over-achiever? Or is Japan an astute learner and unbeatable colossus? Will Japan dislodge the United States from its current position of dominance in high technology as convincingly as it did in the smokestack sectors? Or has it reached the limits of its phenomenal postwar growth?

Japan is all these things and more. And to understand what the future holds, and whether America is up against a David or a Goliath, means looking closely at the frontiers of modern electronics. For the country that commands the three most crucial technologies of all—semiconductors, computing and communications—will most assuredly command the mightiest industrial bandwagon of the twenty-first century.

Made in the USA

Just as Japan has begun to muscle into high-tech, America has raised the technological stakes. The name of the game now is ultra-tech

High technology is an American invention. Despite the near meltdown at Three Mile Island, broken helicopters in the Iranian desert and recent disasters on the launch pad, Americans remain the supreme practitioners of this demanding and arcane art. And while the United States has racked up large deficits on its international trading account, it has enjoyed growing surpluses in its worldwide sales of high-tech goods. Or, rather, it did so until recently. Once again, blame the Japanese.

Five years ago, America sold the world $23.6 billion more technological widgets than it bought. That handy surplus had dwindled, says America's Department of Commerce, to a token $5 billion by 1984 (chart 7 on later page). Meanwhile, foreigners had grabbed three-quarters of the world's current $300 billion in high-tech trade. In the process, Japan has gone from being a small-time tinkerer in the 1960s to becoming (as in everything else) the Avis of high technology to America's Hertz.

Even so, trade in high-technology goods remains a crucial breadwinner for the United States. Since the mid-1960s, high-tech's share of American manufactured goods sold around the world has gone from a little over a quarter to close to a half.

Office automation is now America's most competitive high-tech industry as well as its biggest revenue-earner abroad. Selling its trading partners computers, copiers and word processors brought in

Technology's top ten

How high is the high in high-tech? Difficult to say. Most economists at least agree that high technology products embody an "above average" concentration of scientific and engineering skills. As far as the National Science Foundation in Washington is concerned, this means anything produced by organisations employing 25 or more scientists and engineers per 1,000 employees and spending over 2.5% of net sales on R&D.

The American Department of Commerce is a bit more scientific. Its definition of high-tech is derived from input-output analyses of the total R&D spent on a spectrum of individual products. Thus an aircraft gets credit for not only the R&D done in developing the airframe, but also the relevant contribution of the avionics supplier and even the tyre maker. Using this definition, high-tech industry is a ranking of the ten most "research-intensive" sectors, where the tenth has at least double the R&D intensity of manufacturing generally (table 1).

A laudable effort, but not without criticism. First, such a definition focuses entirely on products, ignoring the booming business in high-tech processes—and, increasingly, high-tech services as well. Second, it favours systems (that is, collections of interdependent components) over individual widgets, as well as products manufactured by large companies rather than small firms.

Third, because the data come of necessity from broad industrial categories, anomalies crop up—like cuckoo clocks being labelled high-tech because they fall within the eighth-ranking group, professional instruments.

Fourth, and perhaps most damning, the Commerce Department's definition is based on Standard Industrial Classification (SIC) codes—many of which have been rendered irrelevant by technological changes that have occurred since the SIC codes were last overhauled in 1972.

Table 1: Product range

	HIGH-TECH SECTOR	EXAMPLES OF PRODUCTS
1	Missiles and spacecraft	Rocket engines; satellites and parts
2	Electronics and telecoms	Telephone and telegraph apparatus, radio and TV receiving and broadcast equipment, telecoms equipment, sonar and other instruments, semiconductors, tape recorders
3	Aircraft and parts	Commercial aircraft, fighters, bombers, helicopters, aircraft engines, parts
4	Office automation	Computers, input-output devices, storage devices, desk calculators, duplicating machines, parts
5	Ordnance and accessories	Non-military arms, hunting and sporting ammunition, blasting and percussion caps
6	Drugs and medicines	Vitamins, antibiotics, hormones, vaccines
7	Inorganic chemicals	Nitrogen, sodium hydroxide, rare gases, inorganic pigments, radioactive isotopes and compounds, special nuclear materials
8	Professional and scientific instruments	Industrial process controls, optical instruments and lenses, navigational instruments, medical instruments, photographic equipment
9	Engines, turbines and parts	Generator sets, diesel engines, non-automotive petrol engines, gas turbines, water turbines
10	Plastics, rubber and synthetic fibres	Various chemicals derived from condensation, polycondensation, polyaddition, polymerisation and copolymerisation; synthetic resins and fibres

$20 billion in 1984. Along with aircraft, electronics and professional instruments, these "big four" account for more than three-quarters of the United States' exports of high technology (table 2). Despite the popular myth, America exports only modest amounts of missiles and aerospace products. But fears that foreigners may eventually storm even the high frontier of aerospace keep Washington officials awake at night.

Of the ten industrial sectors designated high-tech (see feature above), America has managed to increase its share of the global market in only two: office automation and electronics. For which, it should thank the likes of IBM, Hewlett-Packard, Digital Equipment, Xerox, ITT, RCA, General Electric, Texas Instruments and a host of brainy technological-based businesses scattered around the West Coast, Rockies, Sunbelt, Mid-Atlantic and New England.

A common cry in Washington is that this "narrowing" of America's high-tech base is one of the most disturbing problems facing the United States today. Others see this trend as more or less inevitable—and perhaps even to be encouraged. Trade ministers in Western Europe, for instance, only wish they had such "problems"; Japanese bureaucrats are doing all they can to create similar "problems" back home.

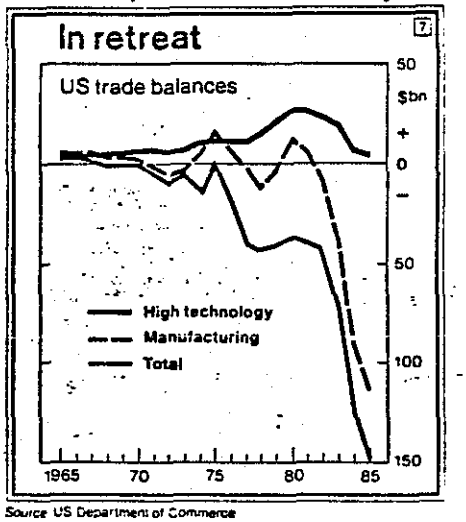
The reason is simple. These so-called "problems" concern a focusing of all the underlying technologies that have come to drive the computing, office automation and communications industries. All three provide the tools for handling information; and information—its collation, storage, processing, transmission and use elsewhere—will, quite literally, be the oil of the twenty-first century (see the survey on information technology in *The Economist*, July 12 1986).

All that noisy jostling going on right now between the IBMs, Xeroxs and AT&Ts of the corporate world is merely the

Table 2: High-tech exports in 1984

High-tech sector	American exports		Others' exports*	
	Value	% of total	Value	% of total
Office automation	$19.7bn	22.4	$6.5bn	14.5
Electronics & telecoms	$14.4bn	22.0	$53.8bn	29.4
Aircraft and parts	$13.5bn	20.7	$15.4bn	8.4
Profess'l instruments	$7.2bn	11.0	$27.0bn	14.7
Plastics, rubber, etc	$4.4bn	6.7	$26.5bn	14.5
Inorganic chemicals	$3.5bn	5.4	$10.9bn	6.0
Engines and turbines	$3.2bn	4.9	$10.7bn	5.9
Drugs and medicines	$2.7bn	4.1	$10.7bn	5.9
Missiles and spacecraft	$1.0bn	1.5	$0.6bn	0.3
Ordnance	$0.8bn	1.3	$0.7bn	0.4

*Of the 14 other countries (apart from America) exporting high-tech goods, France, West Germany, Japan and Britain accounted for three-quarters of total trade.
Source: US Department of Commerce.



Source: US Department of Commerce

Crying all the way to the bank

One thing Americans have learned is that having the world's most productive labour force does not guarantee industrial competitiveness. At least three other things are needed. The first is to keep a lid on wages. The second concerns exchange rates. The third involves the return on capital employed. All three have been seen lately as spanners in the American works.

Take wages. During the ten years before 1973, real wages for American workers had increased steadily at an average rate of 2.6% a year. But ever since the first oil shock, real wages in the United States have stagnated. So American labour is becoming more competitive, yes?

Unfortunately no. When fringe benefits are included, hourly compensation for blue-collar workers in the United States has continued to rise. American labour has sensibly been taking raises less in cash than kind. Total compensation for American industrial workers—a modest $6.30 an hour in 1975—had climbed to $9.80 an hour by 1980 and to $12.40 by 1983.

Compared with Japan, hourly labour costs in America went from being on average a little over $3 more expensive in 1975 to becoming nearly $6 more so by 1983 (chart 4). So much for narrowing the $1,900 gap between making a motor car in Nagoya compared with Detroit.

Ah, yes, but hasn't the dollar tumbled dramatically? It has indeed—from a 1985 high of over Y260 to the dollar to a low this year of Y150 or so. In trade-weighted terms, that represents a drop for the dollar of 28% in 15 months. Meanwhile, the trade-weighted value of the yen has appreciated by over 40%.

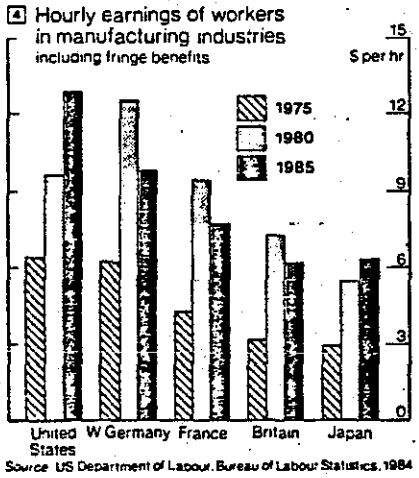
What about differences between America and Japan in terms of return on capital? Here things are actually better than most American businessmen imagine. True, real rates of return earned by American manufacturing assets in the 1960s were substantially higher than investments in financial instruments, while things were briefly the other way round during the early 1980s (chart 6). On the face of it, capital for buying equipment or building factories seems twice as expensive in America as in Japan.

Today's most cited account comes from Mr George Hatsopoulos of Thermo Electron Corporation in Massachusetts. Comparing the cost of (non-financial) capital in the two countries between 1961 and 1983, Mr Hatsopoulos found real pre-tax rates ranged between 6% and 10% for Japanese firms and anything from 13% to 20% for their American counterparts.

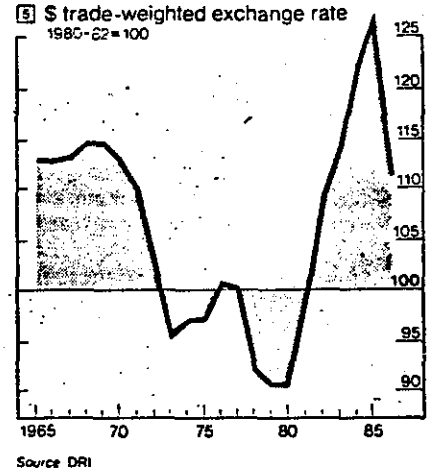
The conventional explanation for this difference is that Japanese firms are more highly geared (leveraged) and thus benefit because debt generally costs less than equity—interest payments being deducted from pre-tax profits, while dividends come out of taxed earnings.

Then there is Japan's two-tier interest rate structure, which is carefully regulated to favour business debt at the expense of consumer credit. Throw in a banking system that is bursting at the seams with yen being squirrelled away by housewives worried about school fees, rainy days and the ever-present threat of their husband's early (and often unpensioned) retirement. All of which, say American trade officials, adds up to a financial advantage that makes it tough for American firms to compete.

What is studiously ignored in the financial folklore about Japan Inc is the fact that, over the past decade, Japanese manufacturers have been getting out of debt as fast as decently possible (see the survey on corporate finance in *The Economist*, June 7 1986). The most compelling reason right now is because Tokyo's financial markets have joined the fashionable trend towards liberalisation. With old controls over the movement of capital going out of the window, Japanese interest rates are destined to become more volatile. So who wants to be highly geared when interest rates are rising or (worse) becoming less predictable?



Source US Department of Labour, Bureau of Labour Statistics, 1984



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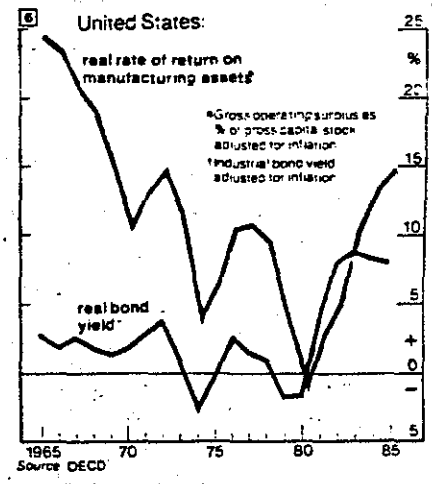


Source OECD

Another thing Japanese manufacturers resent about some of these allegedly cheap industrial loans are the strings and hidden costs involved. The most punishing are the so-called "compensating balances" which a borrower has to deposit (at a considerably lower interest rate) with the bank offering the industrial loan. And so he has to borrow more money—at higher cost and with greater restrictions—than he actually needs.

Yet another thing that muddies the water is the way debt in Japanese balance sheets is grossly overstated by western standards. For one thing, the compensating balances, though they are actually deposits, are recorded as borrowings. Then there is the habit Japanese companies have of doing much of their business on credit, especially with suppliers and subsidiaries. This makes their accounts payable and receivable look huge—in fact, twice as large as in America.

Other factors inflating debt among at least the bigger Japanese companies are things like non-taxable reserves for special contingencies and (if they pay them) pensions. The last time figures were collected in Japan (in 1981), employees in large corporations with established retirement plans were divvying up 15-20% of their companies' capital through their pension contributions. All of which showed up in their corporate accounts as debt.

All that said, Japanese companies are on balance more highly geared than American corporations; and, overall, the cost of financing industry has been lower in Japan than in the United States. But at most only 20% lower, and nothing like the 50% lower claimed by lobbyists in America.

clatter of these three industrial sectors (each with its own distinctive style of manufacturing, procurement and customer support) being forged together by their underlying technologies into a single, ultra-tech activity called information services.

Yes, beyond high-tech in the industrial spectrum lies ultra-tech—today a mere multi-billion-dollar stripling of a business, but by the year 2000 potentially a trillion-dollar leviathan. As such, ultra-tech alone will come to dwarf all manufacturing sectors before the century is out. America is well on the way to making that happen. A lap or two behind, Japan at least is getting up speed. Europe is barely in the race.

Chips with everything

Gone are the days when American semiconductor firms short-sightedly sold their licences and knowhow to Japanese microchip makers

America's electronics firms have maintained their global leadership in all branches of their business save one. They kissed goodbye to consumer electronics (television, hi-fi, video recorders, etc) as customers across the country voted with their pockets for shiny boxes with flashing lights and labels like Panasonic, Technics, JVC and Sony.

The American electronics industry came close to allowing much the same to happen in microchips. In 1982, Silicon Valley took a caning when the Japanese started flooding the market with cheap 64k RAMs (random-access memory chips capable of storing over 64,000 bits of computer data). Most beat a hasty retreat up or out of the market.

From having a dozen mass producers of dynamic-RAMs in 1980, only five American chip makers were still in the high-volume memory business by 1983. Today, there are effectively only two or three with the capacity to produce the latest generation of memory chips (1 megabit RAMs) in anything like economic volumes. Meanwhile, the six Japanese firms that plunged into the memory-chip business back in the early 1970s are still around—and now have a 70% share of the dynamic-RAM market in America.

Microchips have been the engine powering Japan's drive into high-tech generally. But before it could join the microchip generation, Japan had to find a way of disseminating this vital American technology throughout its fledgling semiconductor industry. The trick adopted was, first, to protect the home market, and then to bully abler firms into joining government-sponsored research schemes—one run by the Japanese telephone authority NTT and the other by the Ministry of International Trade and Industry—to develop the knowhow for making their own very large-scale integrated (VLSI) circuits.

Next, by "blessing" VLSI as the wave of the future and crucial to Japan's survival, the government triggered a scramble among the country's electronics firms (encouraged by their long-term investment banks) to build VLSI plants. The net result was massive over-capacity (first in 64k RAMs and then in 256k versions), abundant local supply for the domestic consumer electronics makers and an impelling urgency to export (or dump) surplus microchips abroad.

This targeting ploy had been tried before. Japanese manufacturers found it worked moderately well with steel, much better with motorcycles, better still with consumer electronics and best of all with semiconductors. The only requirement was a steeply falling "learning curve" (that is, rapidly reducing unit costs as production volume builds up and manufacturers learn how to squeeze waste out of the process).

The trick was simply to devise a forward-pricing strategy that allowed Japanese manufacturers to capture all the new growth that their below-cost pricing created in export markets, while underwriting the negative cashflow by cross-subsidies and higher prices back home.

The Americans finally lost their patience when the Japanese tried to do a repeat performance with pricier memory chips called EPROMs. The price fell from $17 each when the Japanese first entered the American market with their EPROM chips early in 1985 to less than $4 six months later. Intel, National Semiconductor and Advanced Micro Devices promptly filed a joint petition, accusing the Japanese of dumping EPROMs on the American market at below their manufacturing costs in Japan (then estimated to be $6.30 apiece). The issue is currently being used by Washington as a battering ram to breach the wall Japan has erected around its own $8 billion semiconductor market back home.

For America, this get-tough policy has come only just in time. Japan now enjoys a 27% share (to America's 64%) of the world's $42 billion semiconductor market. And while cut-throat competition may make memory chips a loss-leader, acquiring the technology for producing RAMs has given Japan's microcircuit makers a leg-up in getting to grips with more complex semiconductors used in computer graphics, communications and video equipment.

So far, however, it has not helped Japanese chip makers to loosen the stranglehold that American semiconductor firms have on the lucrative microprocessor business. Where 256k RAMs have become commodity products that sell wholesale for $1 or so each, 32-bit microprocessors from the likes of Motorola, Intel, National Semiconductor, Texas Instruments, AT&T and Zilog cost hundreds of dollars apiece. Between them, these six American chip makers control 90% of the world market for the latest generation of microprocessors, leaving just 10% for the rest of the American semiconductor industry, Europe and Japan.

Fortunately for the Americans, micro-

Street map for a microchip circuit

processors are not like memory chips. Being literally a "computer-on-a-chip", they are vastly more complex and cannot be designed in any routine manner. Sweat, insight and inspiration are needed every step of the way. And they have to be designed with their software applications in mind. Americans have been doing this longer, and are better at it, than anyone else.

More to the point, American firms are not parting with their patents as readily as they did in the past. Hitachi has been trying (with little luck) to persuade Motorola to sell it a licence for making its advanced 68020 microprocessor. Meanwhile, Japan's leading electronics firm, NEC, is having to defend itself in the American courts for infringing one of Intel's microprocessor patents.

With America's new, stricter copyright laws making it difficult to imitate American designs, Japanese chip makers are being shut out of all the major markets for microprocessors. Fujitsu, Matsushita, Mitsubishi and Toshiba are all gambling on a microprocessor design called TRON developed at the University of Tokyo. But nobody, least of all NEC or Hitachi, holds out much hope for the TRON design winning a big enough share of the market in its own right to be economic—at least, not until the mid-1990s. And, by then, Silicon Valley will have upped the technological stakes again.

When, late at night, the conversation gets down to *honne* (brass tacks), even Japan's ablest microchip wizards despair at ever matching Silicon Valley's mix of entrepreneurial and innovative flair. "Japan is powerful in only one sub-field of a single application of semiconductors tied to a specific line of products", bemoans Mr Atsushi Asada of Sharp Corporation.

Calculus of competition

Aping IBM has given Japan's computer makers a toe-hold in the market—but largely on Big Blue's terms

America's response to Japan's challenge in microchips is being repeated in computers. Here, Japan's specialty has been making workalike copies of IBM's big office machines (mainframes). The most one can say about these "plug-compatible" computers is that they have managed to prevent IBM from swamping the Japanese home market completely. Big Blue has to put up with being number two in Japan. Overall, however, Japanese compatibles have had only a marginal impact on the $150 billion computer business worldwide.

American manufacturers have established an almost impregnable position in mainframes and minicomputers—the stuff of corporate sales and accounting departments. And in the push to put a microcomputer on every desk, a handful of American firms (IBM, Compaq, Apple, Atari and Commodore) have been feeding the market a feast of cleverer, faster and (in many cases) cheaper machines that have left Japan's "IBMulators" nibbling on the leftovers of yesterday's lunch. In the personal-computer market, the IBM clone makers having the most impact come mainly from low-cost South Korea and Taiwan rather than Japan.

Meanwhile, in developing the programs that make computers tick, American software engineers have been every bit as clever as their chip-designing colleagues in Silicon Valley. In the process, they have increased their share of the world's software market (worth $40 billion a year) from under 65% a decade ago to over 75% today.

All this does not mean Japan's computer industry is a write-off. Its component suppliers have quietly established a significant position for themselves in the United States and elsewhere. In personal computers, for instance, Japanese machines account for less than 2% of the $14 billion annual sales of PCs in America. But Japanese components and peripherals (chips, disk-drives, keyboards, monitors, printers, etc) account for nearly 30% of the market's wholesale value.

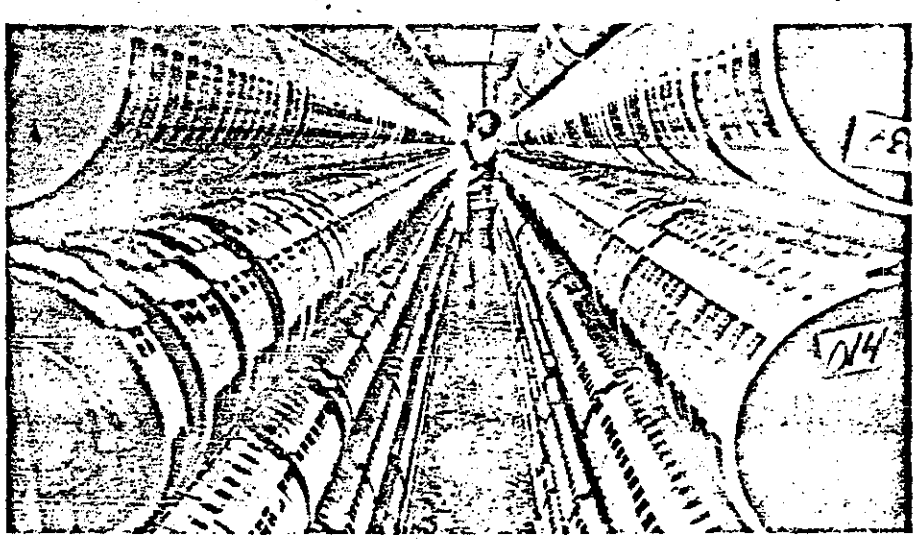
Most of Japan's computer makers came a cropper by riding a bit too blindly on IBM's coat-tails. Lacking the home-grown programming skills, Fujitsu, Hitachi and Mitsubishi made their computers imitate IBM's so they could sell cheaper versions to customers who were already using IBM machines equipped with the necessary software. That worked well until the slumbering giant woke up.

Then, in 1979, IBM introduced its 4300 series computers at a price that shook not just rival Japanese makers, but other American suppliers too. Since then, IBM's aggressive price-cutting and frequent model changes have made life tough for the plug-compatible trade.

Not only is IBM automating vigorously (the company is spending $15 billion over the next four years to achieve lower production costs than anyone in Asia), but it has also begun flexing its technological muscles. Its R&D expenditure is now running at $3.5 billion a year—more than all other computer manufacturers combined. Though for antitrust reasons it will never say so publicly, IBM is nevertheless determined to trample the plug-compatible makers down—both in the personal-computer end of the business as well as among its mainframe competitors.

One of the dodges being adopted is to incorporate more "microcode" in its computers' operating systems (the basic programs that manage a machine's internal housekeeping and support the customers' applications software). Used as an offensive weapon, microcode replaces parts of the computer's electrical circuitry, making it possible to change the whole character of a machine long after it has been installed at a customer's premises. The implication is that IBM can then sell products that can be continuously enhanced—something customers appreciate and will pay a premium for.

Starting with its 3081 series in 1981, IBM caught the competition off guard with a new internal structure called XA ("extended architecture") which allows customers to update their machines with packets of microcode whenever IBM decrees the market needs a shake-up. This



Software needs space

expected to grow to $83 billion by 1987. American manufacturers have 42% of it; Japanese firms 8-9%. But that has not prevented Japan from becoming a major exporter of telecoms products. It now sells well over $1 billion worth of telephone equipment abroad, a quarter of it even to the United States. How did that happen?

The main reason is the size of the American market itself. Though the American share of the global telecoms business is five times bigger than Japan's, practically all of it is at home. Some 90% of the domestic market is controlled by the mighty American Telephone and Telegraph ("Ma Bell"). GTE has 10% of the American market, while ITT has traditionally sold its telephone equipment almost exclusively abroad.

Until the deregulation of the American phone system in the wake of AT&T's 1982 consent decree, Ma Bell's manufacturing arm (Western Electric) directed its entire production effort at meeting just the needs of the various Bell phone companies around the country. It got all its inventions and designs from the legendary Bell Laboratories in New Jersey, and neither imported nor exported a single transistor.

Bell Labs has been responsible for a blizzard of innovations (transistor, laser, stored-program control, optical fibres, etc) that have driven down the real cost of communications and raised the quality and availability of telephone service throughout the United States. But because of AT&T's preoccupation in the past with just the domestic market, the best of its technology has had little direct impact on the rest of the world. The door to export sales was thus left ajar for telecoms suppliers elsewhere—from Europe (Siemens, Ericsson, Thomson, GEC and Philips), Canada (Northern Telecom and Mitel) and Japan (NEC, Oki, Fujitsu and Hitachi).

American firms retain their dominant position in supplying switching and transmission equipment. But the Japanese have mounted a serious challenge based on their growing expertise in transmitting messages on the backs of light beams. Made out of cheap silica instead of costly copper, optical fibres can carry three times the telephone traffic of conventional cables, need few repeater stations to boost the signals and send them on their way, are immune to electrical interference and do not corrode like metal wires.

The early American lead in fibre optics, built up by Western Electric and Corning Glass, has been chipped away by scientists at NEC, Sumitomo and Japan's telephone authority (NTT). Apart from learning how to manufacture low-loss fibres, Japanese companies have become superb at making the minute lasers, light-emitting diodes and minuscule receivers used for projecting and catching the messages.

Hand in glove with fibre optics is the growing trend towards digital transmission—sending spoken or picture messages coded as the ones and zeros of computerspeak. The transmission part is easy, but optical switching has presented horrendous headaches and the competition here is fierce.

But American makers have used their know-how to better commercial ends. In particular, digital transmission has been used to speed the growth in data traffic between big computer systems, especially those owned by airlines, banks, insurance companies and financial institutions. Here, the Federal Communications Commission has taken the initiative, by freeing America's telecommunications networks so anyone can plug in, switch on and sell an information service. Other countries—Britain and West Germany particularly—have been inexplicably making life as difficult as possible for their own infopreneurs.

The lesson has not been wasted on telecommunications mandarins in Japan. They have seen how getting the government off the back of the telephone companies in America has spurred a vibrant free-for-all in "value-added networking", creating numerous jobs in information services and giving local manufacturers a headstart in carving out a piece of a brand new high-tech business for themselves.

This new communications freedom—even more than the changes in digital switching and new transmission technologies—is one of the key driving forces behind the merger between computing, office automation and telecommunications that is beginning to take place with the United States. Last year, computer maker IBM absorbed Rolm, a leading manufacturer of digital private-branch exchanges. At the same time the telephone giant, AT&T, broadened its growing base in computing and office equipment by buying 25% of Olivetti in Italy. The leader of the office-automation pack, Xerox, is still suffering from a surfeit of exotic technology dreamed up by engineering wizards at its PARC laboratories in California.

Japan has no intention of being left behind. The government in Tokyo is pressing on with its plan to privatise as much of its telecommunications services as possible. And while the big names of the Japanese telecoms business (Fujitsu, Hitachi, NEC and Oki) may have deficiencies of their own, each is nevertheless a big name in computing too. And though smaller, all are more horizontally integrated than AT&T, IBM or Xerox.

Will Japan close the technological gap in telecoms with America? Quite possibly. But only through setting up shop in the United States. The reason concerns one missing ingredient, now as essential in telecoms as in computing: ingenious software. Just as Motorola and Texas Instruments have built semiconductor factories in Japan to learn the secrets of quality and cost control, Japanese firms will have to establish telecoms plants in the United States if they are to acquire the necessary software skills. NEC has now done so—for precisely that reason.

Getting smart

Manufacturing is also going high-tech, threatening to turn today's dedicated factories full of automation into relics of the past

Microchips, computers and telecoms equipment will be to the next quarter century what oil, steel and shipbuilding were to the years between Hiroshima and the Yom Kippur war. More than anything else, these three technologies will fuel the engine of economic growth in countries that learn to manage their "smart" machinery properly. This will hasten not so much the trend towards service jobs, but more the revitalisation of manufacturing itself.

Manufacturing? That grimy old metal-bashing business which the more prosperous have been quietly jettisoning for better-paid office jobs in the service sector? It is true that manufacturing jobs in all industrial countries (save Italy and Japan) have been shed continuously since 1973. In the United States, employment in manufacturing industry fell 2.5% last year to less than 20% of the civilian workforce.

But looking at jobs alone is misleading. In terms of manufacturing's contribution to GNP, for instance, little has changed. In fact, manufacturing's share of value added (at current prices) in America was 22% of GNP in both 1947 and 1984, and has wavered narrowly within the 20-25% band for close on 50 years. So much for de-industrialisation.

Manufacturing still means big business in anybody's book. It currently contributes $300 billion and 20m jobs to the American economy; about $350 billion (at today's exchange rate) and 15m jobs in Japan. But manufacturing is really a matter of how you define it. Traditional measures based on Standard Industrial

has thrown the plug-compatible makers on the defensive, forcing them to devote more of their development resources than they can afford to trying to anticipate IBM's next round of operating system changes and to try to match them with hurriedly engineered modifications to their hardware. That involves digging ever deeper into their profit margins.

America's other computer firms are also pushing this trend towards replacing hardware with software wherever possible. Writing and "debugging" the programs now accounts for 50-80% of their budgets for developing new computers. Two reasons, then, why American computer executives are smiling:

- At a stroke, the trend towards greater use of software helps neutralise the one great advantage their Japanese competitors have long possessed—namely, the ability to manufacture well-made mechanical components at a modest price.
- And it changes the business of manufacturing computers from being heavily capital-intensive to becoming more brain-intensive. The large pool of experienced programmers and diverse software firms in the United States puts the advantage firmly in American hands.

The Japanese response has been to launch another government-sponsored scheme, this time to help the country's computer makers invent "intelligent" machines for tomorrow. The ten-year fifth-generation project, based largely on "dataflow" concepts pioneered at Massachusetts Institute of Technology, will have cost $450m by the time it is completed in 1992. The aim is to create computers able to infer answers from rough information presented to them visually or orally. Even Japanese scientists working on the project are not sure whether such goals are realistic.

The Americans are not leaving anything to chance. Congress has been persuaded to relax the antitrust rules so that rival manufacturers can collaborate on advanced research without running foul of the law. Two of the first collaborative research institutions to spring up aim to match any challenge the Japanese might offer in computing, software and components for the 1990s. In one, the Semiconductor Research Corporation, 13 microchip companies have clubbed together to form a non-profit consortium for supporting research on advanced integrated circuits at American universities. The consortium is now doling out $35m a year to designers of tomorrow's microchips.

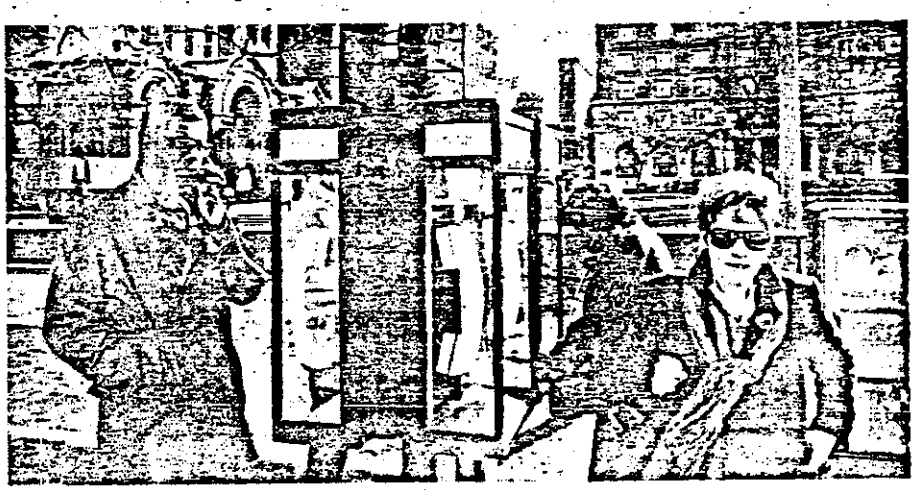
The other institution, the Microelectronics and Computer Technology Corporation (MCC), is an interesting experiment in its own right. Set up as a joint venture in 1983 by initially ten (now 21) rival American computer and semiconductor companies, MCC has 250 scientists carrying out research at its headquarters in Austin, Texas, to the tune of $75m a year. What is for sure, says Mr Bobby Inman, MCC's chief executive and former deputy director of the CIA, "MCC wouldn't have occurred except for MITI."

But the most orchestrated response of all to the Japanese challenge in computing comes not from IBM, Silicon Valley or collaborative consortia of American chip makers and computer firms. Though it is rarely in the public headlines, the Pentagon has been pouring barrels of cash into computing. Its Defence Advanced Research Projects Agency (DARPA) in Washington has been playing busy midwife to some of the most exotic technology of all for computers, communications and electronic equipment generally.

Its VHSIC (very high-speed integrated circuit) project alone has pumped $300m over the past five years into advanced methods for making the superchips needed for radar, missiles, code-breaking and futuristic computers. Also earmarked for DARPA is a reported $1 billion for sponsoring a range of supercomputers which, say insiders, "will outperform anything the Japanese can develop under their super-speed computing project or their fifth-generation programme."

At least a dozen "fifth-generation bashers" have surfaced as research projects around the United States, mainly in university laboratories, but also in small start-up companies founded by academics, entrepreneurs and engineering emigrés from the mainframe computer industry. The latest supercomputer to go public (the prototype was shipped last year to the American navy) is a cluster of boxes a yard square capable of calculating over a billion instructions per second (the Japanese government hopes to have a similar greyhound of a computer by 1992). The group that built it spun off mainly from nearby Massachusetts Institute of Technology to form their own company, Thinking Machines. The firm is now taking orders for a bigger brother with four times the processing power.

If only a handful of the score or so of American groups building advanced computers survives, the United States is going to enlarge its existing technology base in computing over the next decade by as much new engineering talent as its rivals have in totality. And that, not least for the Japanese, is a sobering thought.



Reach out and crush someone

Even more than breakthroughs in telecommunications technology, America's new deregulated freedom to plug in, switch on and sell an information service is breeding a whole new generation of infopreneurs

Americans complain about it, but if truth be told they still have the best and cheapest telephone system in the world. Japan's is a good one too—about as good as the Bell System was in the late 1960s. Which means it is reliable and cheap when making calls within the country, but not particularly good at performing electronic tricks like automatic call-forwarding, call-waiting, short-code dialling, credit-card billing, conference calling—all things Bell users take for granted today.

Americans also take for granted the choice of being able to dial long-distance numbers using alternative carriers who offer cheaper rates. Liberating the phone system from the state monopoly's clutches (so customers may choose what they want instead of what they are given) has barely begun in Japan.

The United States is the world's dominant supplier as well as its most prolific user of telephone equipment. The global market, worth $57 billion in 1982, is

Classification codes continue to give the impression that making anything in a factory is going the same way as smokestack industry generally—up in smoke. Yet software engineering alone is an explosive new "manufacturing" industry that barely enters the American Treasury Department's calculations of growth, let alone its vision of what constitutes industry.

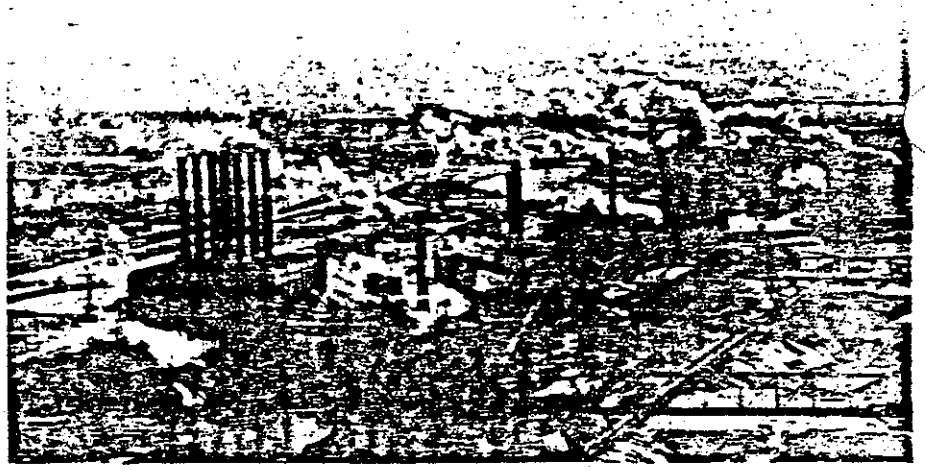
What is for sure is that the new battle in manufacturing competitiveness and productivity is going to be fought in the fields of process and design technology. Here is what Mr Daniel Roos of Massachusetts Institute of Technology has to say:

> Over the next 25 years, all over the world, semi-skilled labour—whether cheap or expensive—will rapidly give way to smart machinery as the key element in competitiveness. Neither cheap Korean labour nor expensive American labour is our real problem. Rather the challenge lies in rapidly introducing and perfecting the new generations of design and process equipment—and the complex social systems that must accompany them.

It does not require an MIT professor to explain why conventional manufacturing is limping out and new computerised forms of design and fabrication are muscling in. Using the favoured yardstick of productivity (return on investment after discounting for the current cost of money) even back-of-the-envelope calculations show only two factors really count. Energy costs are irrelevant, being typically 3-4% of factory costs. Much the same is true for labour, which now accounts for only 5-15% of total costs.

"The only significant, and controllable, factors are material costs and production volume", preaches Dr Bruce Merrifield of the American Department of Commerce. Thus, with roughly 30% of material costs being in inventory, a "just-in-time" delivery system (like the Japanese *kanban* method for supplying components to motor manufacturers) could improve the real return on investment by as much as 15%.

. . . to robots . . .



From smokestack . . .

Getting manufacturing volumes right is trickier. Here high technology is making the whole notion of the special-purpose factory—with its automated equipment purring smoothly along as it churns out millions of identical parts all made to the same high standard of precision—a relic of the smokestack past. The marketplace is much more competitive today, no longer accepting the 10-12 year product life cycles needed to justify the investment of such dedicated plants. The pace of technological change is demanding that manufactured goods be replaced every four or five years; in consumer electronics, every two or three years.

The Japanese factory devoted solely to turning out 10,000 video recorders a day with a handful of operators is the end of the line—not quite yet, but destined shortly to become, a magnificent anachronism and epitaph to the age of mass production. It was a brief and grimy era, spanning just the single lifetime from Henry Ford to Soichiro Toyoda. To take its place, a whole new concept of manufacturing is being hustled out of the laboratory and on to the factory floor. This is the final melding of microchips, computers, software, sensors and telecoms to become in themselves the cutting tools of manufacturing industry.

The retooling of America

Flexible make-anything factories are beginning to sprout across America, bringing back jobs that had slipped offshore

American engineers call it CIM. Computer-integrated manufacturing—hurried into the workplace by a kind of Caesarian section—has arrived before managers have had a chance to find out what they really want or are able to handle. The trouble—and there have been plenty of teething troubles—is that CIM has a grown-up job to do right now. To corporate America, it is the one remaining way of using the country's still considerable clout in high technology to claw back some of the manufacturing advantage Japan has gained through heavy investment, hard work and scrupulous attention to detail.

American companies began pouring big money into high-tech manufacturing around 1980. All told, firms in the United States spent less than $7 billion that year on computerised automation. Today they are spending annually $16 billion, mostly on more sophisticated CIM equipment. By 1990, investment in computer-integrated manufacturing will have doubled to $30 billion or more, forecasts Dataquest of San Jose, California.

General Motors has spent no less than $40 billion over the past five years on factories of the future. Even its suppliers are being hooked into GM's vast computerised information net, allowing them to swap data with the giant motor maker as a first step towards integrating them wholly within its CIM environment. IBM has been spending $3 billion a year on computerising its manufacturing processes. In so doing, it has been able to bring numerous jobs, previously done offshore, back into the United States. Pleased with the results so far, IBM has raised its investment in CIM to an annual $4 billion.

The heart of a CIM plant is a flexible manufacturing shop which can run 24

hours a day, but which is capable of being retooled in minutes rather than days, and able to turn out hundreds of different products instead of being dedicated to just one line. The difference between the best of traditional automation (for example, Toyota's Corolla line in Nagoya) and the best of new style CIM plants (for example, General Electric's household-appliance centre in Kentucky) is that the former automates just the flow of material through the factory, while the latter automates the total flow of information needed for managing the enterprise—from ordering the materials to paying the wages and shipping the finished goods out of the front door.

The aim of CIM is not simply to reduce the amount of direct labour involved in manufacturing a product (only 5-15% of the cost). The real savings come instead from applying strict computer and communications controls to slash the amount of waste (typically 30% of the cost) through having up-to-the-minute information on tool wear, while minimising the handling, management and overhead charges (rarely less than 40%) by knowing precisely where items are at any instant during the manufacturing process. The net result is that a CIM factory has a much lower breakeven point than a highly automated conventional plant. The majority of the CIM plants now onstream in the United States break even at half the level of a conventional plant (typically 65-70% of full capacity). And because it does not have to operate flat out from the start to be efficient, a CIM plant makes it easier and cheaper to launch new products. That spells shorter life cycles—and hence more frequent (and more attractive) model updates.

That would be reason enough for enterprising high-tech companies to invest in CIM. But a number of American corporations are being encouraged for other, more strategic, reasons to integrate their computerised manufacturing processes. The Pentagon sees CIM as a nifty way of allowing manufacturing capacity to be sprinkled lightly across the land, instead of being concentrated heavily in targeted areas along the Ohio Valley, parts of Illinois and up through Michigan.

The generals also see CIM plants—with their rapid response and flexible, make-anything nature—as handy standby capacity ready to be instantly reprogrammed to meet the military surge of a national emergency. Apart from its costly military stockpiles, the Pentagon has to underwrite a good deal of redundant and idle capacity among America's defence contractors. That is a political luxury it can no longer afford.

Pressure from other parts of Washington is also helping to usher high-tech

... to CIM

manufacturing into American factories. To government gurus like Dr Bruce Merrifield, the attraction of these flexible manufacturing plants is that they are ideal not just for industrial giants like General Electric, Westinghouse or IBM, but even more so for the tens of thousands of tiny workshops across the country. While Japan has two-thirds of its industrial output within the grasp of broad-based *keiretsu* manufacturing groups, American industry by contrast has always relied heavily on its 100,000 or so independent subcontracting firms. In metal working, for instance, 75% of the parts made in the United States are manufactured by small independent workshops in batches of 50 or less.

The American Commerce Department sees no antitrust reasons why smaller firms should not band together to share a flexible manufacturing centre, making spindles for washing machines one minute, wheel bearings the next, then switching to precision mounts for a microscope maker, crankshafts for diesel engines, microwave cavities for radar equipment, nose-cones for missiles and so on. This would reduce the investment risk for the individual firms, while providing a higher return for the CIM plant as a whole. It could also help rebuild much of the industrial base of rustbowl America.

Let the daisies grow

Bureaucratic guidance is still no match for a fertile economy where anything can take root and flower

Who, then, is better suited to life on the high road of technology—America or Japan? The answer is complicated by the way the two industrial superpowers have honed their separate skills in wholly separate ways (table 3). American technology is overwhelming in big systems, software, computing and aerospace. But nobody can touch Japan in the process technologies that underlie conventional manufacturing. American technology reaches out for the unknown: Japan's bends down to tend the commonplace.

The differences in style mirror the differences in ideals that the two peoples hold dear. The Japanese have a saying: "The nail that stands up will be hammered flat." The Americans say: "Let the daisies grow." So it is hardly surprising that American technology is individualistic, often erratic and always iconoclastic. Japan's, if anything, is pragmatic, geared primarily to problem-solving and hustled along by a herd-instinct.

To date, Japan's high-tech success has been almost exclusively with developments that were predictable—like packing more and more circuits into dynamic RAM chips, or making video recorders smarter and smaller. This is a result of having total mastery of the process technologies. While all the basic breakthroughs for making semiconductors—electron beam lithography, ion implantation, plasma etching, etc—came from the United States, Japanese firms improved the ideas step by step until their equipment was a match for anything made abroad.

By carrying out development continu-

Table 3: Balance of forces

Japanese strengths	American strengths
Applied research and development	Basic research
Incremental improvements	Breakthroughs and inventions
Commercial applications	Military applications
Process and production technology	New product design
Components	Systems integration
Hardware	Software
Predictable technologies	Less predictable technologies
Quality control	New functionalities
Miniaturisation	New architectural designs
Standardised, mass volume	Customisation

Source: "The Positive Sum Strategy", National Academy Press, Washington DC, 1986

ously in small incremental steps (instead of the American way of great quantum leaps every decade or so). Japanese firms have been able to bombard customers with a barrage of new models offering yet better value, quality and reliability. American firms, by contrast, have traditionally made cosmetic improvements every few years, and then brought out complete model overhauls once a decade or so. That has made their products look long in the tooth, then suddenly change dramatically—often for the worse while design bugs and production wrinkles are sorted out.

American technology has also tended to be geared for use mainly at home (for example, telephone systems, motor cars). With its smaller domestic market, Japanese technology has been forced to look farther afield. The Stanford economist, Mr Daniel Okimoto, makes the point that though Japanese firms have excelled at technologies tied closely to commodities with huge export markets (for example, continuous casting in steel, emission-control for motor cars, optical coatings for camera lenses), lately they have begun to do well in technologies for domestic use too. Some examples include gamma interferon and Interleukin II in pharmaceuticals, digital switching and transmission in telecommunications. And with their breakthroughs in gallium arsenide semiconductors, optoelectronics, superceramics and composite materials, the Japanese have shown themselves selectively capable of innovating at the frontier of knowledge as well as anyone.

On the whole, however, Japanese firms have been less successful with technologies that are inherently complex, not particularly predictable and dependent upon ideas springing from basic research. Making jet engines is one such technology. Designing air-traffic-control radars is another. Developing computer-aided design and manufacturing systems is a third. And despite MITI's "targeting" of lasers as a technology to be conquered, little progress has been made here to date—because not enough basic research has been done in the necessary branch of physics.

Such incidents point to serious problems in Japan's educational system. While Japanese youngsters out-perform western school children in all meaningful tests of mathematics and science, their training stresses rote learning rather than critical analysis and creative synthesis. At university, their skills in problem-solving are enhanced at the expense of their abilities to conceptualise.

As faculty members, Japanese academics are civil servants unable to fraternise as paid consultants in industry during the summer vacation. So Japan has none of the cross-fertilisation between basic research and commercial development that characterises MIT and Route 128, Stanford and Silicon Valley and a hundred other campuses across America. Also, because all the leading universities in Japan are state-owned and run rigidly by a conservative central bureaucracy, it is difficult to allocate grants (by peer-review) to the most deserving researchers rather than the most senior.

In the days when Japan could storm th

Lift-off for the airborne economy

Forget about America's underground economy of do-it-yourselfers pushing hamburger carts, paint brushes and illicit drugs. Above the conventional economy, a star-spangled wealth launcher lifted off three or four years ago—to take advantage of the soaring power and plummeting cost of microchips, the breakup of the geriatric telephone monopoly, the chimera of President Reagan's space shield and, above all, the technological collision of computing, communications and office automation. Meet America's exciting new airborne economy.

The first thing to understand is that nobody is quite sure how well even America's conventional economy is performing, let alone its underground or overground components. The only items reported properly seem to be imports and unemployment. The trouble is that the economy is changing so fast—from old-fangled businesses based on metal bashing and carting things around to new-fangled ones that massage, transmit and memorise scraps of information. What is for sure, the leading economic indicators—those monthly headlines that send shockwaves around the world's financial markets—seriously underestimate some of the most important growth sectors within the United States.

Because the statistics have not kept pace with the way American business is becoming internationalised, computerised and more service-oriented, the picture the statisticians paint depicts an economic landscape of a decade or two ago. Here are some examples of lagging statistical response:

- Companies are classified by industrial sectors using definitions last updated in 1972.
- Twenty years after computers swept manual accounting into the dustbin, the first price index for computers has just been introduced—and is still incomplete. Where America's computing costs have been assumed to be fixed, henceforth they will be deemed to fall (as they have actually been doing) by at least 14% a year—adding nearly 1% to GNP.
- An archaic processing system for logging foreign trade, confronted with a 90% increase in imports over the past decade, is ignoring America's growth in foreign sales. A significant proportion (some say 15-20%) of American exports now goes unreported.
- Measures of family income, designed in an age when welfare was a dirty word, omit non-cash components such as company fringe benefits for professionals (pension rights, deferred income plans, health and life insurance, etc) and in-kind government assistance for the poor (food stamps, rent subsidies, etc).
- Poverty is still defined by consumption patterns of the mid-1950s, when a family of three spent a third of its income on food. The same food basket today costs a fifth the equivalent family's income.

Don't snigger. Despite budgetary cuts, the American statistical system is still one of the best in the world. Its only real weakness is that—employment figures aside—the statistics used for determining, say, GNP or growth tend to be by-products of non-statistical agencies (such as the Internal Revenue Service, the Customs Service, Medicare and the Department of Agriculture). As such, they are far from being as clean, complete or timely as the experts would like.

Consider some recent anomalies caused by the quickening pace of technological change. With 70% of Americans being employed in the service sector, you might be tempted to categorise the United States as essentially a service-based economy. It is. But you would not think so from the Standard Industrial Classification (SIC) used in generating the input-output tables for measuring GNP. This has 140 three-digit codes for manufacturing firms, only 66 for services. Moreover, since the SIC system was last revised in 1972, whole new business activities (for example, video rental, computer retailing, software retailing, discount broking, factory-owned retail outlets) have sprung up, while others have withered away.

Nuts and bolts, for instance, are in an SIC category all of their own, employing a grand total of just 46,000 people. Envelope makers, again with their own SIC category, provide fewer than 25,000 jobs. Yet one SIC code in the service sector alone, general medical and surgical hospitals, now covers some 2.3m people. Lots of high-tech service businesses—including computer stores and software publishers and manufacturers—do not even qualify for their own SIC codes yet.

There is no reason why all SIC categories should be the same size. But the imbalance exaggerates the importance of traditional manufacturing at the expense of services in the American economy. Above all, it allows whole sections of America's booming high-tech economy to go unreported.

Back to the future

A glimpse or two at the future will dispel any doubts about Yankee ingenuity as it probes the limits of tomorrow's technology. First, to Silicon Valley where Mr Alan Kay, refugee from such technological hotbeds as DARPA, Stanford, Xerox PARC and Atari, is nowadays visionary-at-large at Apple Computer. Building on the learning theories of John Dewey and Jean Piaget, Mr Kay is trying to create a "fantasy amplifier"—a computer with enough power to outrace the user's senses, enough memory to store library loads of reference material, and enough clever software to couple man's natural desire for exploring fantasies with his innate ability to learn from experiment.

The concept, called "Dynabook", combines the seductive power of both a video game and a graffiti artist's spray-can with the cultural resources of a library, museum, art gallery and concert hall combined. Difficult to make? You bet, especially if the whole gizmo has to fit in a package no bigger than a notepad and be cheap enough for every schoolkid to own.

Smalltalk is the computer language Mr Kay has developed to allow kids to converse with the fantasy amplifier. The rest of the ingredients are all technologically imaginable, just prohibitively expensive and unwieldy for the time being. But a decade ago the first personal computer was just being built at considerable expense. Its functional equivalent today costs less than $50. Still only in his mid-40s, Mr Kay has ample time to put a Dynabook in the hands of millions of youngsters with open minds and a sense of wonder still intact.

Next, meet Mr Ted Nelson, gadfly, prophet and self-confessed computer crackpot, with a lifetime's obsession wrapped up in an enormous program called (after Coleridge's unfinished poem) Xanadu. Boon or boondoggle, nobody is quite sure. But the giant piece of software for steering one's own thought processes (including alternative paths, mental backtracks and intellectual leaps) is hardly lacking in ambition or vision.

Conceived originally by Mr Nelson while a student at Harvard as simply a note-keeping program for preserving his every thought, Xanadu has evolved into a total literary process: creating ideas; organising the thoughts, with traces showing backtracks, alternative versions and jumps to cross-referenced documents; manipulating the text; publishing the results; and logging a share of the royalties to every other author cited.

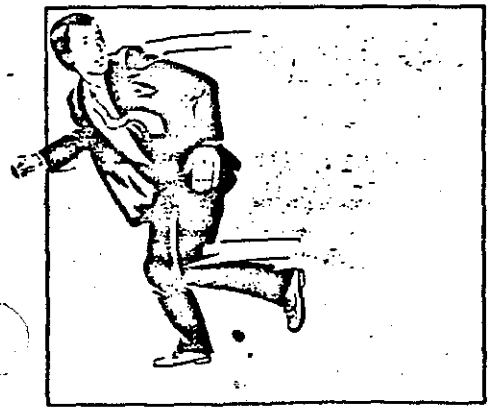
Every document in Xanadu's database has links to its intellectual antecedents and to others covering related topics. The linked references work like footnotes, except that Xanadu offers an electronic "window" through which they can be accessed there and then. Because the whole process works in a non-sequential way, the inventor calls the output "hypertext".

Mr Nelson looks forward to the day when anybody can create what he or she wants—from recipes to research papers, sonnets to songs—and put it into Xanadu's database and quote or cite anybody else. Royalties and sub-royalties, monitored automatically by the host computer, would be paid according to the amount of time a user was on-line and reading a specific document. It sounds pretty wild at the moment, but hypertext could be commonplace before the century is out.

industrial heights with foreign licences, homegrown development and production excellence, the inadequacies of its educational system and academic research hardly mattered. But such shortcomings are becoming increasingly a problem as high-tech competition intensifies.

Nor can Japan call on its little firms to provide the invigorating fillip of innovation such enterprises provide in the United States. And with their lifetime employment practices, Japan's big technology-based corporations rarely get a chance to attract high-flying talent from outside. Technological diffusion between small firms and large corporations, and between companies generally as engineers swap jobs, is one of the more invigorating forces for innovation in the United States.

Nor, also, is there an adequate way in Japan for financing risky innovation outside the big corporations. Since 1978, American equity markets have raised $8 billion for start-ups in electronics alone and a further $3.3 billion for new biotech companies. Over the same period, Japan's venture-capital investments in high-tech have totalled just $100m.



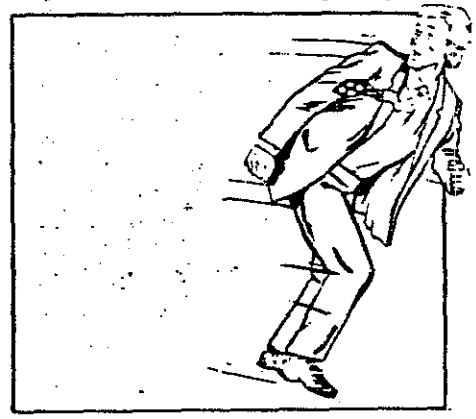
Lacking all these things, the Japanese have sought a substitute. This is one of the main reasons for MITI's special emphasis on collaborative research projects—as in VLSI or fifth-generation computers. To Mr Gary Saxonhouse of the University of Michigan, Japan's lauded industrial policies are little more than a substitute for the ingredients that American companies enjoy from their vibrant capital and labour markets.

As for MITI's infamous industrial targeting, many Japanese (as well as foreigners) have long doubted its effectiveness and believe it is now wholly inappropriate anyway. All technologies have started moving simply too fast to wait upon the whim of bickering bureaucrats. It is not as though Japanese civil servants have shown themselves any better at picking industrial winners than officials elsewhere; and none has bettered the invisible hand of the marketplace.

Apart from possessing vastly greater resources of well-trained brains, more diverse and flexible forms of finance, and a bigger and more acquisitive domestic market, America has one final, decisive factor moving in its favour—the pace of innovation itself.

High-tech products tend to have two things in common: they fall in price rapidly as production builds up (they possess steep learning curves) and they get replaced fairly frequently (they have short life cycles). The trend in high-tech is towards things becoming steeper and shorter. So the competitive advantage of being first to market is going increasingly to outweigh almost everything else.

This spells an end to the traditional low-risk, low-cost approach that Japanese companies have used so successfully to date—coming in second with massive volume and forward prices after others have primed the market. Henceforth, Japanese firms are going to have to take the same technological risks—and pay the same financial penalties—as everyone else. And that puts the advantage decidedly on the side of Yankee ingenuity.



Japan Is Racing to Commercialize New Superconductors

Discovery Prompts Frantic Research Effort; U.S. Response Is Measured

By Stephen Kreider Yoder
Staff Reporter of The Wall Street Journal

TOKYO—In the corner of Prof. Shinichi Uchida's laboratory at the University of Tokyo, across from the bottles of liquid nitrogen, stands a bunk bed.

Until recently it was little used. Then, on Feb. 15, a University of Houston press conference announced the latest breakthrough in the science of superconductivity, a development with potentially enormous commercial applications.

The lab and its bunks here seldom have been empty since.

For three weeks Prof. Uchida's 12-researcher team worked around the clock, seven days a week to duplicate the Houston results. Sleeping in shifts, they cooked their meals in a tiny kitchenette while their latest batch of experimental ceramic pellets baked in the lab's kiln.

In other labs, in company board rooms and in the offices of the powerful Ministry of Trade and Industry, or MITI, the Houston breakthrough has galvanized Japan. Scientists, industrialists and government officials have responded frantically, convinced they can, and must, walk away with the commercial applications. "When it comes time to make something out of it," predicts Prof. Shoji Tanaka, who is Prof. Uchida's boss, "the Japanese will have the upper hand."

In the U.S., by contrast, the reaction has been more measured. Labs are busy, but there isn't any nationally coordinated drive for commercialization. Leaders in superconductivity research caution that much science remains to be done first. "You must keep in mind that the scientific scene is changing so rapidly that to decide (on specific applications) on the basis of what is known today would be a mistake," says John Armstrong, director of the research division at International Business Machines Corp. It would also be wrong, he thinks, "to turn this into a race between East and West."

Here in Tokyo, however, the race is already on, showing once again the competitive drive and speed with which Japan can seize on Western science.

New materials that conduct electricity at warmer temperatures with almost no loss of power, have "opened a fantastic world of future industries," says Masatoshi Urashima, a MITI official. Because previous superconductors operated only at extremely low and expensive-to-maintain temperatures, the new materials make economical the creation of tiny, superfast computers, magnetically floating trains, long-distance power lines that don't waste electricity and even appliances that use almost no power.

The discovery meshes with technologies Japan has refined for years. Japan has a train using superconductivity that is almost ready for commercial use. It travels at more than 250 miles an hour while hovering five inches above a track on a magnetic cushion created by superconducting coils. Japan's shipbuilders, meanwhile, have spent $23 million to build a fast ship propelled by superconducting magnets.

NEC Corp. and others already have produced prototypes of superconducting computer chips; the West gave up trying to do so four years ago. Such giant electronics concerns as Hitachi Ltd. are supplying the West with millions of dollars of superconducting equipment. And Japan's leading role in industrial ceramics will help it develop ceramic superconductors. "A lot of revolutionary things are going to come up and a lot of it is going to come from Japan," says David L. Keller, a technology analyst with James Capel & Co., a British securities firm. "The Japanese will dramatically lead the rest of the world."

The Japanese government already is organizing that. Four days after the Houston bombshell, Japan's Science and Technology Agency announced its intent to form a research consortium of Japanese companies, universities and government labs. A week later, the consortium was in place, including such industrial giants as NEC, Toshiba Corp., Nippon Steel Corp. and Mitsubishi Electric Corp. "We've gathered all the leading-edge researchers in superconductivity in Japan," says Koji Yamaguchi, the agency official overseeing research. "We need to get everybody together to share information and decide how to move."

'THE OBJECTIVE,' says Japan's leading business newspaper, 'is to organize industry to get the jump on the West in applications and commercialization for a huge new market.'

MITI, the agency that picks and funds national projects like the one that helped Japanese makers dominate the memory chip business, began moving on the day of the announcement. It already is polishing up an existing feasibility study on a superconducting power plant and plans to have a working model built by 1992.

"The objective is to organize industry to get the jump on the West in applications and commercialization for a huge new market," says Nihon Keizai Shimbun, Japan's leading business daily. The earliest application, researchers say, could be superconducting computer chips that would enable creation of a shoe box-sized supercomputer. IBM and most other U.S. companies abandoned research in 1983 on the chips, called Josephson Junction devices, partly because of the complications of cooling with helium. That left NEC, Hitachi and a MITI lab to refine the technology with little foreign competition.

For all the government-inspired organization, Japan's research labs didn't wait for government orders when they heard the news from Houston last month.

Elements of Surprise

At the University of Tokyo, Mr. Uchida sat his researchers down in front of a large periodic table of the elements. For hours they debated which elements Houston could possibly have used. While they were still guessing, a rumor came over the phone that the material was fluoric. Students ran out and bought fluorinated chemicals. For three days they tried out hundreds of combinations until they found the rumor was false.

Acting on another tip that the Houston material was dark green, the researchers mixed all the plausible chemicals that would become green when fired, again with no success. (The material needs to be fired further until it is black, they found later.) Then a news report said a Chinese lab had achieved superconductivity at 100 degrees Kelvin (minus 173 degrees Celsius) using a ceramic with ytterbium in it and researchers attacked that. The report proved wrong—the element was yttrium. (Ironically, the University of Tokyo lab later found, by coincidence, that ytterbium works. The lab patented the discovery.)

Finally at 2 a.m. March 1, they got superconductivity. "It was an other-worldly experience," says Prof. Uchida. They drank a toast and launched back into another week of experiments, this time to refine the resulting ceramic. On March 8 they announced a purified form. On Wednesday the lab finally took a holiday.

Meanwhile, labs at Tohoko University, Hokkaido University and a government research facility in Tokyo have burst forth with rapid-fire announcements of their advances in superconductivity. They and other labs have been snatching up the ingredients for superconductors so fast that there are shortages. Suppliers have run out

of yttrium, for example, and labs must wait three weeks for orders to be filled.

'The Real Thing'

Prof. Uchida's lab has been flooded by calls and visits from companies. Sumitomo Electric Industries Ltd. researchers brought in some rudimentary wire made from superconducting ceramic. Engineers from Toshiba, Fujitsu Ltd. and Hitachi have visited the lab to keep watch on developments. "Company people have the conviction that this is finally the real thing. A lot are starting to pick it up. . . . They see that superconductivity is a sure thing and they want to get on to application," says Prof. Uchida.

Of course, there is scientific and commercial excitement in the U.S., too, but it's less frenetic and isn't centrally controlled. Scientists say indications of an incipient breakthrough came as early as April 1986, when researchers at IBM's laboratory in Zurich, Switzerland, reported they had achieved superconductivity in a new class of materials, the metal oxide ceramics. This galvanized researchers throughout the world. By November, the Japanese and Chinese had confirmed the IBM discovery and by December, scientists in Houston and at American Telephone & Telegraph Co.'s Bell Laboratories were reporting important advances with the new materials.

About 5,000 physicists jammed the ballroom of the Hilton Hotel in New York Wednesday night for an unprecedented special session on superconductors at the annual meeting of the American Physical Society. They listened to the presentation of 60 papers on superconductivity research done largely within the last two to three months. Although scientists from U.S. universities dominated the program, there were reports from IBM, Bell Labs, Westinghouse Electric Corp. and Exxon Corp. as well as from Japanese, Chinese and Canadian scientists.

The breakthrough generated tremendous excitement among Bell Labs scientists, says Robert A. Laudise, director of the laboratories' inorganic chemistry branch. "Usually, research managers are coaching people to do this or that," Mr. Laudise notes. "But in this case we had people coming around from all different disciplines wanting to know if there was anything in this for their area," he says.

Too Soon for Applications

"We've had a lot of people going without sleep," Mr. Laudise says. But he agrees with IBM's Mr. Armstrong that it's still too soon for anyone to settle on specific applications of the superconductors. "We're not trying to make any specific devices or systems," he says.

Bell Labs researchers are, however, trying to fabricate various superconducting materials into experimental devices. At Wednesday's APS meeting they displayed a superconductor in the form of a flexible ceramic tape that can be formed and then hardened into a shape to fit a superconducting device.

Researchers at General Electric Co.'s big research and development center in Schnectady, N.Y., agree that it's too soon to jump into an industrial competition with anyone, including the Japanese.

Jury Is Still Out

"In the materials field, the events of the last several weeks have been quite spectacular, but in the applications sense, the jury is still very much out," says Michael Jefferies, manager in the center's engineering physics laboratory.

Until recently, the GE lab didn't have a group of scientists working on superconducting materials. "But we're now trying to confirm and duplicate the results that are being reported," Mr. Jefferies says.

Guy Donaruma, vice president for research at the University of Alabama in Huntsville, says governmental agencies and private concerns have shown a keen interest in the university's superconductivity research, which duplicated the Houston breakthrough.

"Wherever I go around town somebody buttonholes me and asks how we're coming along or when can we use this," Mr. Donaruma says. Some inquiries have come from the space and defense related agencies in the area, including the Marshall Space Flight Center and the U.S. Army Missile Command, he says.

In Palo Alto, Calif., where Stanford University recently announced a breakthrough in fabricating a superconducting thin film, useful in electronic devices, a news conference last week was packed with industry people. Several other scientists have called for more information for use in making a superpowerful magnet used by geological researchers. Niels Reimers, director of Stanford's technology licensing office, said, however, that he hasn't been fielding many industry inquiries.

Crash Programs

In Japan, however, companies that already sell conventional superconducting wire to the U.S. have begun crash programs to commercialize the new discovery. Fujikura Ltd. and Sumitomo Electric, for example, say they have developed rudimentary wire out of the new ceramic, despite skepticism among some scientists that the material won't lend itself to wiremaking.

Like their U.S. counterparts, Japanese makers temper their euphoria with warnings that too little is known about the new ceramic superconductor to tell when and how the material will be commercialized.

Aside from possible problems in forming brittle ceramic into wire, the new superconductor still can't handle enough current to be used in heavy applications such as power plants. Superconductors also don't work well with alternating current, the type of electricity used in most of the world's power equipment.

But Japanese labs are convinced they can solve the problems over the next several years. Now that the West has made the basic breakthrough, they say, the ball is in their court. "It will be difficult and will take time," says Kasumasa Togano, a government scientist. "But that's precisely where Japan's labs and makers have the edge."

Still, he and other researchers admit to a twinge of hurt pride. "To be honest, we're following in the footsteps of the U.S.," Mr. Togano says. "Here, again, the originality is coming from the West. We have a measure of sadness about that."

JERRY E. BISHOP IN NEW YORK CONTRIBUTED TO THIS ARTICLE

COMMERCE DEPARTMENT'S FINAL RULE ON GOVERNMENT PATENT POLICY

52 Fed. Reg. 8552.

DEPARTMENT OF COMMERCE

Office of the Assistant Secretary for Productivity, Technology and Innovation

37 CFR Part 401

[Docket No. 41278-7006]

Rights to Inventions Made by Nonprofit Organizations and Small Business Firms

AGENCY: Assistant Secretary for Productivity, Technology and Innovation.

ACTION: Final rule.

SUMMARY: Public Law 98-620 amended Chapter 18 of Title 35, United States Code, dealing with patent rights in inventions made with Federal funding by nonprofit organizations and small business firms. It also reassigned responsibility for the promulgation of regulations implementing 35 U.S.C. 202 through 204 and the establishment of standard funding agreement provisions from the Office of Mangement and Budget (OMB) to the Secretary of Commerce. This rule makes final the interim final rule published in the Federal Register on July 14, 1986, and incorporates minor changes as a result of comments received on the interim final rule.

EFFECTIVE DATE: April 17, 1987.

FOR FURTHER INFORMATION CONTACT: Mr. Norman Latker, Director, Federal Technology Management Policy Division, Office of Productivity, Technology and Innovation, U.S. Department of Commerce, Room 4837, Washington, DC 20230. Phone: 202-377-0659.

SUPPLEMENTARY INFORMATION:

Background

Public Law 98-620 amended Chapter 18 of Title 35, United States Code, and assigned regulatory authority to the Secretary of Commerce. The Secretary has delegated his authority under 35 U.S.C. 206 to the Assistant Secretary for Productivity, Technology and Innovation. Section 206 of Title 35 U.S.C. requires that the regulations and the standard funding agreement be subject to public comment before their issuance. Accordingly, on April 4, 1985, the Assistant Secretary published a notice of proposed rulemaking in the Federal Register (50 FR 13524) for public comment. As noted at that time, the regulation closely follows OMB Circular A-124 which the regulation replaced. Differences between the proposed rule and the Circular were highlighted in Supplementary Information accompanying the notice of proposed rulemaking.

Additionally, to comply fully with section 206 of Title 35 U.S.C., the Department published in the Federal Register (51 FR 25508) on July 14, 1986, a final interim rule and requested comments by September 12, 1986.

Copies of all comments received were made available for public inspection in the Department's Central Reference Records Inspection Facility (CRRIF), Room 6628 in the Hoover Building.

Information about the availability of these records for inspection may be obtained from Mrs. Hedy Walters at (202) 377-3271.

Treatment of Substantative Comments on Interim Final Rule.

A number of comments from eight (8) different sources were received on the interim final rule in response to the July 14, 1986 notice.

The Department of Energy (DOE) submitted five comments on the interim final rule. All of the comments were found to have merit and have been incorporated in the final rule as follows:

DOE's first comment relates to a suggested clarification in the discussion portion of the interim final rule relating to § 401.3(a) (2). DOE's concern is that the discussion suggests that the right of the government to declare exceptional circumstance for national security reasons is limited to "some limited situations" and that application of this section is therefore limited to situations where the invention report is classified. DOE correctly points out that this is not consistent with the actual language of the regulation. We agree that the words "some limited situations" should not have been included in the discussion portion of the July 14, 1986 notice.

DOE's second comment states that the reference in the discussion portion of the interim final rule, in § 401.14(b) to nuclear weapons programs is inaccurate. We agree that the word nuclear should not have been included in the discussion of § 401.14(b).

DOE's third comment suggests that § 401.3(c) be revised to be consistent with § 401.14(b), which permits DOE to draft a substitute clause. We agree and have included the words, "or substitute thereto" after the reference to § 401.14(b) in § 401.3(c).

Another DOE comment suggests that § 401.13(c) (2) goes beyond the similar provision of OMB Circular A-124 by appearing to preclude confidential disclosure of patent applications or information which is part of a patent application obtained under the clause to other agencies or contractors of government agencies. We have clarified this by adding the following additional language to the end of § 401.13(c) (2):

> This prohibition does not extend to disclosure to other government agencies or contractors of government agencies under an obligation to maintain such information in confidence.

DOE also suggests that § 401.13(c)(3) is unnecessary in view of § 401.13(c)(1). However, DOE suggests that if it is retained, § 401.13(c)(3) should be limited to the same time period as § 401.13(c)(1). We agree but have made no change because the language of § 401.13 (c) (3) already refers back to and incorporates the § 401.13(c)(3) already refers back to and incorporates the § 401.13(b)(1) limitation.

DOE also states that in § 401.15, first sentence, third word from the last word, "of" should be "or". We agree and have made this change.

Finally, DOE suggests that § 401.15(b) should have the following five words added at the end: "Unless it has been licensed." We agree and have included these five words at the end of § 401.15(b).

Another person submitted six comments which have been treated as follows:

The first comment suggests that a statement be added to § 401.3(c) as follows: "the Department of Energy may only exercise the exception at § 401.3(a) (4) with regard to inventions at the facility that are made directly and primarily with funds provided by either the Department's naval nuclear propulsion or nuclear weapons related programs." This comment was not accepted since the statute does not use these terms. Further, all determinations made under section 401(a)(4) by DOE are subject to review by the Department of Commerce under § 401.14(f) and each determination will be examined to ensure compliance with the law.

The second comment points out that in order to make a determination under § 401.3(a) (4), an agency must find one of the conditions set out in § 401.3(a) (1), (2) or (3). We disagree with this interpretation as § 401.3(a) (4) is independent of § 401.3(a) (1), (2) and (3).

A third comment suggests that consideration should be given to adding language to § 401.5(g) requiring the contractor to return a significant or a major portion of income to the facility at which the invention was made. This issue was disposed of in the earlier interim final rule notice of July 14, 1986, on page 25509 under the discussion of § 401.5(f). The matter of royalty disposal is one that is best left to negotiations between the interested parties.

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The fourth comment relates to the language in § 401.5(g) regarding the physical location of contractor employees responsible for licensing of facility inventions. The comment suggests that 401.5(g) expressly state that contractors be obligated to maintain personnel responsible for licensing at the facility. However, another person requested that the subsection not be interpreted strictly to *require* that such a person be physically located at the facility. Section 202(c)(7)(C) of Pub. L. 98–620 indicates that licensing be done at the facility, "to the extent it provides the most effective technology transfer . . .". We believe this language precludes arbitrarily requiring that licensing personnel be located at the facility.

A fifth comment recommended requiring DOE funding agreements to conform to the language prescribed by § 401.14(b)(2) when the exception at § 401.3(a)(4) is used. This was not accepted. Although we have, in fact, permitted DOE to use a substitute clause for that set out in § 401.14(b)(2), we will be reviewing all agency regulations including DOE's to ensure compliance with the law and regulations, including all substitute clauses contained in agency regulations.

The final comment of this second person is that we modify the statement in § 401.15(a) that "within 90 days after receiving . . ." to read: Within 90 days after receiving a request and supporting information or sooner if a statutory bar to patenting is imminent, the agency shall either make a determination or inform the contractor of why a determination has not yet been made and when one can reasonably be expected." This comment was not accepted. At this time, this is a matter best left to the parties to determine on a case-by-case basis.

A number of comments were also received regarding a typographical error in the "Background" section on page 25510 of the July 14, 1986 **Federal Register** notice. The word "not" was inadvertently left out of the last sentence of the first paragraph discussing § 401.7. The sentence should have read as follows: "this change has been made because small business preference is not intended to inhibit industrial support of university research."

Two comments were received that relate to the exceptions to be made for handling of inventions if they are under research at a government-owned, contractor-operated facility (GOCO):

The first comment relates to the requirement in § 401.5(g) that specifies that income be used for purposes "consistent with research and development mission and objectives of the facility." The commenter suggests it would be preferable that a university be able to direct the net royalty income to the most promising research needs, which may not necessarily be consistent with the objective of the GOCO facility. We cannot accept this suggestion since the language in the regulation is based on the statute—Pub. L. 98–620.

The second comment goes on to state that § 401.5(g) further specifies that if a licensing program is successful, then above a certain point, 75 percent is to be paid to the U.S. Treasury. The suggestion is that this reduces the incentive to be successful, and recommends the deletion of this requirement. Again, we cannot accept this suggestion since the regulatory language herein is based on the statute—Pub. L. 98–620.

A third comment references the special clause entitled, "patent rights to nonprofit DOE facility operations." The comment states that this clause removes a subject invention funded by the naval nuclear propulsion or weapons related programs of DOE from the normal presumption of rights to the contractor, and requires the petitioning process that was in effect before the enactment of Pub. L. 96–517. The concern is that if these programs are exempted, then there may be additional proposals to delete other programs from the full operations of Pub. L. 96–517. The comment then concludes by recommending that this special clause not be implemented. We cannot accept this recommendation since the statute, Pub. L. 98–620, gives DOE the discretionary authority to use this for its naval nuclear propulsion or weapons related programs.

Another comment received relates to § 401.14(c)(1), which calls for disclosure by a contractor to the contracting government agency of each "subject invention . . ." within two months of the time it is disclosed by the inventor in writing. The commenter complains that two months is "too harsh." We do not accept this comment for two reasons. (1) The statute, Pub. L. 98–620, uses the words "reasonable time" and we think two months is reasonable; and (2) § 401.14(c)(4) allows extensions of time at the discretion of the agency.

One person asked for greater guidance on whether contractor funding of individual scientists at different universities is an educational award within 35 U.S.C. 212 and, if so, what rights such awardees should have. We have not acted on this comment since we do not believe any contractor has the authority to use funding for the educational awards covered by 35 U.S.C. 212.

A comment was submitted that relates to the discussion in the July 14, 1986 notice of § 401.13(b). The concern is that the discussion may be misinterpreted to imply that agencies may not apply the provisions of Pub. L. 98–620 retroactively. This point is well taken. It was our intent in the July 14, 1986 discussion of § 401.13(b) to note only that the Department of Commerce has no authority under the law to require agencies to waive the cap on the term of an exclusive license in a patent clause that predates enactment of Pub. L. 98–620. There is no question that the agencies themselves have authority under the law to waive such cap and the regulations in fact urge them to do so absent a substantive reason to do otherwise.

Another person requested that the Department of Commerce set a time for issuance of draft supplementary regulations relating to foreign filing deadlines at § 401.14(c)(3). As we previously indicated in the interim final rule notice on July 14, 1986, we are considering this matter. Therefore, we see no reason at this time to set a deadline.

Finally, pursuant to requests by two persons, we have included in this final notice, uniform policy guidance in § 401.1(a) to these final regulations similar to that included in OMB Circular A–124. This has been done to ensure clarity and continuity between OMB Circular A–124 and these final regulations with regard to policy.

Rulemaking Requirements

As stated in the proposed notice and the interim final rule, this regulation is not a major rule as defined in Executive Order 12291, and it adds no paperwork burdens. In fact, it reduces certain paperwork requirements of the regulations it replaces. And, as discussed in connection with the proposed rule and the interim final rule, the General Counsel of the Department

of Commerce has certified to the Small Business Administration that this rule will not have a substantial economic impact on a substantial number of small entities.

List of Subjects in 37 CFR Ch. IV

Inventions, Patents, Nonprofit organizations, Small Business firms.

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Date: March 11, 1987.

D. Bruce Merrifield,

Assistant Secretary for Productivity, Technology and Innovation.

Accordingly, Part 401 of Chapter IV of Title 37, the Code of Federal Regulations is revised to read as follows:

PART 401—RIGHTS TO INVENTIONS MADE BY NONPROFIT ORGANIZATIONS AND SMALL BUSINESS FIRMS UNDER GOVERNMENT GRANTS, CONTRACTS, AND COOPERATIVE AGREEMENTS

Sec.

Authority: 35 U.S.C. 206 and the delegation of authority by the Secretary of Commerce to the Assistant Secretary for Productivity, Technology and Innovation at Sec. 3(g) of DOO 10-1.

§ 401.1 Scope.

(a) Traditionally there have been no conditions imposed by the government on research performers while using private facilities which would preclude them from accepting research funding from other sources to expand, to aid in completing or to conduct separate investigations closely related to research activities sponsored by the government. Notwithstanding the right of research organizations to accept supplemental funding from other sources for the purpose of expediting or more comprehensively accomplishing the research objectives of the government sponsored project, it is clear that the ownership provisions of these regulations would remain applicable in any invention "conceived or first actually reduced to practice in performance" of the project. Separate accounting for the two funds used to support the project in this case is not a determining factor.

(1) To the extent that a non-government sponsor established a project which, although closely related, falls outside the planned and committed activities of a government-funded project and does not diminish or distract from the performance of such activities, inventions made in performance of the non-government sponsored project would not be subject to the conditions of these regulations. An example of such related but separate projects would be a government sponsored project having research objectives to expand scientific understanding in a field and a closely related industry sponsored project having as its objectives the application of such new knowledge to develop usable new technology. The time relationship in conducting the two projects and the use of new fundamental knowledge from one in the performance of the other are not important determinants since most inventions rest on a knowledge base built up by numerous independent research efforts extending over many years. Should such an invention be claimed by the performing organization to be the product of non-government sponsored research and be challenged by the sponsoring agency as being reportable to the government as a "subject invention", the challenge is appealable as described in § 401.11(d).

(2) An invention which is made outside of the research activities of a government-funded project is not viewed as a "subject invention" since it cannot be shown to have been "conceived or first actually reduced to practice" in performance of the project. An obvious example of this is a situation where an instrument purchased with government funds is later used, without interference with or cost to the government-funded project, in making an invention all expenses of which involve only non-government funds.

(b) This part implements 35 U.S.C. 202 through 204 and is applicable to all Federal agencies. It applies to all funding agreements with small business firms and nonprofit organizations executed after the effective date of this part, except for a funding agreement made primarily for educational purposes. Certain sections also provide guidance for the administration of funding agreements which predate the effective date of this part. In accordance with 35 U.S.C. 212, no scholarship, fellowship, training grant, or other funding agreement made by a Federal agency primarily to an awardee for educational purposes will contain any provision giving the Federal agency any rights to inventions made by the awardee.

(c) The "march-in" and appeals procedures in §§ 401.6 and 401.11 shall apply to any march-in or appeal proceeding under a funding agreement subject to Chapter 18 of Title 35, U.S.C., initiated after the effective date of this part even if the funding agreement was executed prior to that date.

(d) At the request of the contractor, a funding agreement for the operation of a government-owned facility which is in effect on the effective date of this part shall be promptly amended to include the provisions required by §§ 401.3(a) unless the agency determines that one of the exceptions at 35 U.S.C. 202(a)(i) through (iv) § 401.3(a)(8) through (iv) of this part) is applicable and will be applied. If the exception at § 401.3(a)(iv) is determined to be applicable, the funding agreement will be promptly amended to include the provisions required by § 401.3(c).

(e) This regulation supersedes OMB Circular A-124 and shall take precedence over any regulations dealing with ownership of inventions made by small businesses and nonprofit organizations which are inconsistent with it. This regulation will be followed by all agencies pending amendment of agency regulations to conform to this part and amended Chapter 18 of Title 35. Only deviations requested by a contractor and not inconsistent with Chapter 18 of Title 35, United States Code, may be made without approval of the Secretary. Modifications or tailoring of clauses as authorized by § 401.5 or §401.3, when alternative provisions are used under § 401.3(a)(1) through (4), are not considered deviations requiring the Secretary's approval. Three copies of proposed and final agency regulations supplementing this part shall be submitted to the Secretary at the office set out in § 401.16 for approval for consistency with this part before they are submitted to the Office of Management and Budget (OMB) for review under Executive Order 12291 or, if no submission is required to be made to OMB, before their submission to the Federal Register for publication.

(f) In the event an agency has outstanding prime funding agreements that do not contain patent flow-down provisions consistent with this part or

earlier Office of Federal Procurement Policy regulations (OMB Circular A-124 or OMB Bulletin 81-22), the agency shall take appropriate action to ensure that small business firms or nonprofit organizations that are subcontractors under any such agreements and that received their subcontracts after July 1, 1981, receive rights in their subject

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inventions that are consistent with Chapter 18 and this part.

(g) This part is not intended to apply to arrangements under which nonprofit organizations, small business firms, or others are allowed to use government-owned research facilities and normal technical assistance provided to users of those facilities, whether on a reimbursable or nonreimbursable basis. This part is also not intended to apply to arrangements under which sponsors reimburse the government or facility contractor for the contractor employee's time in performing work for the sponsor. Such arrangements are not considered "funding agreements" as defined at 35 U.S.C. 201(b) and § 401.2(a) of this part.

§ 401.2 Definitions.

As used in this part—

(a) The term "funding agreement" means any contract, grant, or cooperative agreement entered into between any Federal agency, other than the Tennessee Valley Authority, and any contractor for the performance of experimental, developmental, or research work funded in whole or in part by the Federal government. This term also includes any assignment, substitution of parties, or subcontract of any type entered into for the performance of experimental, developmental, or research work under a funding agreement as defined in the first sentence of this paragraph.

(b) The term "contractor" means any person, small business firm or nonprofit organization which is a party to a funding agreement.

(c) The term "invention" means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code, or any novel variety of plant which is or may be protectable under the Plant Variety Protection Act (7 U.S.C. 2321 *et seq.*).

(d) The term "subject invention" means any invention of a contractor conceived or first actually reduced to practice in the performance of work under a funding agreement; provided that in the case of a variety of plant, the date of determination (as defined in section 41(d) of the Plant Variety Protection Act, 7 U.S.C. 2401(d)) must also occur during the period of contract performance.

(e) The term "practical application" means to manufacture in the case of a composition of product, to practice in the case of a process or method, or to operate in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are, to the extent permitted by law or government regulations, available to the public on reasonable terms.

(f) The term "made" when used in relation to any invention means the conception or first actual reduction to practice of such invention.

(g) The term "small business firm" means a small business concern as defined at section 2 of Pub. L. 85-536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration. For the purpose of this part, the size standards for small business concerns involved in government procurement and subcontracting at 13 CFR 121.5 will be used.

(h) The term "nonprofit organization" means universities and other institutions of higher education or an organization of the type described in section 501(c)(3) of the Internal Revenue Code of 1954 (26 U.S.C. 501(c) and exempt from taxation under section 501(a) of the Internal Revenue Code (26 U.S.C. 501(a)) or any nonprofit scientific or educational organization qualified under a state nonprofit organization statute.

(i) The term "Chapter 18" means Chapter 18 of Title 35 of the United States Code.

(j) The term "Secretary" means the Secretary of Commerce or his or her designee.

§ 401.3 Use of the Standard Clauses at § 401.14.

(a) Each funding agreement awarded to a small business firm or nonprofit organization (except those subject to 35 U.S.C. 212) shall contain the clause found in § 401.14(a) with such modifications and tailoring as authorized or required elsewhere in this part. However, a funding agreement may contain alternative provisions—

(1) When the contractor is not located in the United States or does not have a place of business located in the United States or is subject to the control of a foreign government; or

(2) In exceptional circumstances when it is determined by the agency that restriction or elimination of the right to retain title to any subject invention will better promote the policy and objectives of Chapter 18 of Title 35 of the United States Code; or

(3) When it is determined by a government authority which is authorized by statute or executive order to conduct foreign intelligence or counterintelligence activities that the restriction or elimination of the right to retain title to any subject invention is necessary to protect the security to such activities; or

(4) When the funding agreement includes the operation of the government-owned, contractor-operated facility of the Department of Energy primarily dedicated to that Department's naval nuclear propulsion or weapons related programs and all funding agreement limitations under this subparagraph on the contractor's right to elect title to a subject invention are limited to inventions occurring under the above two programs.

(b) When an agency exercises the exceptions at § 401.3(a)(2) or (3), it shall use the standard clause at § 401.14(a) with only such modifications as are necessary to address the exceptional circumstances or concerns which led to the use of the exception. For example, if the justification relates to a particular field of use or market, the clause might be modified along lines similar to those described in § 401.14(b). In any event, the clause should provide the contractor with an opportunity to receive greater rights in accordance with the procedures at § 401.15. When an agency justifies and exercises the exception at § 401.3(a)(2) and uses an alternative provision in the funding agreement on the basis of national security, the provision shall provide the contractor with the right to elect ownership to any invention made under such funding agreement as provided by the Standard Patent Rights Clause found at § 401.14(a) if the invention is not classified by the agency within six months of the date it is reported to the agency, or within the same time period the Department of Energy does not, as authorized by regulation, law or Executive Order or implementing regulations thereto, prohibit unauthorized dissemination of the invention. Contracts in support of DOE's naval nuclear propulsion program are exempted from this paragraph.

(c) When the Department of Energy exercises the exception at § 401.3(a)(4), it shall use the clause prescribed at § 401.14(b) or substitute thereto with such modification and tailoring as authorized or required elsewhere in this part.

(d) When a funding agreement involves a series of separate task orders, an agency may apply the exceptions at § 401.3(a)(2) or (3) to individual task orders, and it may structure the contract so that modified patent rights provisions will apply to the task order even though

the clauses at either § 401.14(a) or (b) are applicable to the remainder of the work. Agencies are authorized to negotiate such modified provisions with respect to task orders added to a funding agreement after its initial award.

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(e) Before utilizing any of the exceptions in § 401.3(a) of this section, the agency shall prepare a written determination, including a statement of facts supporting the determination, that the conditions identified in the exception exist. A separate statement of facts shall be prepared for each exceptional circumstances determination, except that in appropriate cases a single determination may apply to both a funding agreement and any subcontracts issued under it or to any funding agreement to which such an exception is applicable. In cases when § 401.3(a)(2) is used, the determination shall also include an analysis justifying the determination. This analysis should address with specificity how the alternate provisions will better achieve the objectives set forth in 35 U.S.C. 200. A copy of each determination, statement of facts, and, if applicable, analysis shall be promptly provided to the contractor or prospective contractor along with a notification to the contractor or prospective contractor of its rights to appeal the determination of the exception under 35 U.S.C. 202(b)(4) and § 401.4 of this part.

(f) Except for determinations under § 401.3(a)(3), the agency shall also provide copies of each determination, statement of fact, and analysis to the Secretary. These shall be sent within 30 days after the award of the funding agreement to which they pertain. Copies shall also be sent to the Chief Counsel for Advocacy of the Small Business Administration if the funding agreement is with a small business firm. If the Secretary of Commerce believes that any individual determination or pattern of determinations is contrary to the policies and objectives of this chapter or otherwise not in conformance with this chapter, the Secretary shall so advise the head of the agency concerned and the Administrator of the Office of Federal Procurement Policy and recommend corrective actions.

(g) To assist the Comptroller General of the United States to accomplish his or her responsibilities under 35 U.S.C. 202, each Federal agency that enters into any funding agreements with nonprofit organizations or small business firms shall accumulate and, at the request of the Comptroller General, provide the Comptroller General or his or her duly authorized representative the total number of prime agreements entered into with small business firms or nonprofit organizations that contain the patent rights clause in this part or under OMB Circular A-124 for each fiscal year beginning with October 1, 1982.

(h) To qualify for the standard clause, a prospective contractor may be required by an agency to certify that it is either a small business firm or a nonprofit organization. If the agency has reason to question the status of the prospective contractor as a small business firm, it may file a protest in accordance with 13 CFR 121.9. If it questions nonprofit status, it may require the prospective contractor to furnish evidence to establish its status as a nonprofit organization.

§ 401.4 Contractor appeals of exceptions.

(a) In accordance with 35 U.S.C. 202(b)(4) a contractor has the right to an administrative review of a determination to use one of the exceptions at § 401.3(a) (1) through (4) if the contractor believes that a determination is either contrary to the policies and objectives of this chapter or constitutes an abuse of discretion by the agency. Paragraph (b) of this section specifies the procedures to be followed by contractors and agencies in such cases. The assertion of such a claim by the contractor shall not be used as a basis for withholding or delaying the award of a funding agreement or for suspending performance under an award. Pending final resolution of the claim the contract may be issued with the patent rights provision proposed by the agency; however, should the final decision be in favor of the contractor, the funding agreement will be amended accordingly and the amendment made retroactive to the effective date of the funding agreement.

(b)(1) A contractor may appeal a determination by providing written notice to the agency within 30 working days from the time it receives a copy of the agency's determination, or within such longer time as an agency may specify in its regulations. The contractor's notice should specifically identify the basis for the appeal.

(2) The appeal shall be decided by the head of the agency or by his/her designee who is at a level above the person who made the determination. If the notice raises a genuine dispute over the material facts, the head of the agency or the designee shall undertake, or refer the matter for, fact-finding.

(3) Fact-finding shall be conducted in accordance with procedures established by the agency. Such procedures shall be as informal as practicable and be consistent with principles of fundamental fairness. The procedures should afford the contractor the opportunity to appear with counsel, submit documentary evidence, present witnesses and confront such persons as the agency may rely upon. A transcribed record shall be made and shall be available at cost to the contractor upon request. The requirement for a transcribed record may be waived by mutual agreement of the contractor and the agency.

(4) The official conducting the fact-finding shall prepare or adopt written findings of fact and transmit them to the head of the agency or designee promptly after the conclusion of the fact-finding proceeding along with a recommended decision. A copy of the findings of fact and recommended decision shall be sent to the contractor by registered or certified mail.

(5) Fact-finding should be completed within 45 working days from the date the agency receives the contractor's written notice.

(6) When fact-finding has been conducted, the head of the agency or designee shall base his or her decision on the facts found, together with any argument submitted by the contractor, agency officials or any other information in the administrative record. In cases referred for fact-finding, the agency head or the designee may reject only those facts that have been found to be clearly erroneous, but must explicitly state the rejection and indicate the basis for the contrary finding. The agency head or the designee may hear oral arguments after fact-finding provided that the contractor or contractor's attorney or representative is present and given an opportunity to make arguments and rebuttal. The decision of the agency head or the designee shall be in writing and, if it is unfavorable to the contractor shall include an explanation of the basis of the decision. The decision of the agency or designee shall be made within 30 working days after fact-finding or, if there was no fact-finding, within 45 working days from the date the agency received the contractor's written notice. A contractor adversely affected by a determination under this section may, at any time within sixty days after the determination is issued, file a petition in the United States Claims Court, which shall have jurisdiction to determine the appeal on the record and to affirm, reverse, remand, or modify as appropriate, the determination of the Federal agency.

§ 401.5 Modification and tailoring of clauses.

(a) Agencies should complete the blank in paragraph (g)(2) of the clauses at § 401.14 in accordance with their own or applicable government-wide regulations such as the Federal Acquisition Regulation. In grants and cooperative agreements (and in

contracts, if not inconsistent with the Federal Acquisition Regulation) agencies wishing to apply the same clause to all subcontractors as is applied to the contractor may delete paragraph (g)(2) of the clause and delete the words "to be performed by a small business firm or domestic nonprofit organization" from paragraph (g)(1). Also, if the funding agreement is a grant or cooperative agreement, paragraph (g)(3) may be deleted. When either paragraph (g)(2) or paragraphs (g) (2) and (3) are deleted, the remaining paragraph or paragraphs should be renumbered appropriately.

(b) Agencies should complete paragraph (l), "Communications", at the end of the clauses at § 401.14 by designating a central point of contact for communications on matters relating to the clause. Additional instructions on communications may also be included in paragraph (l).

(c) Agencies may replace the italicized words and phrases in the clauses at § 401.14 with those appropriate to the particular funding agreement. For example, "contracts" could be replaced by "grant," "contractor" by "grantee," and "contracting officer" by "grants officer." Depending on its use, "Federal agency" can be replaced either by the identification of the agency or by the specification of the particular office or official within the agency.

(d) When the agency head or duly authorized designee determines at the time of contracting with a small business firm or nonprofit organization that it would be in the national interest to acquire the right to sublicense foreign governments or international organizations pursuant to any existing treaty or international agreement, a sentence may be added at the end of paragraph (b) of the clause at § 401.14 as follows:

This license will include the right of the government to sublicense foreign governments, their nationals, and international organizations, pursuant to the following treaties or international agreements:

agencies may use substantially similar language relating the government's rights to specific treaties or other agreements identified elsewhere in the funding agreement. The language may also be modified to make clear that the rights granted to the foreign government, and its nationals or an international organization may be for additional rights beyond a license or sublicense if so required by the applicable treaty or international agreement. For example, in some exclusive licenses or even the assignment of title in the foreign country involved might be required. Agencies may also modify the language above to provide for the direct licensing by the contractor of the foreign government or international organization.

(e) If the funding agreement involves performance over an extended period of time, such as the typical funding agreement for the operation of a government-owned facility, the following language may also be added:

The *agency* reserves the right to unilaterally amend this *funding agreement* to identify specific treaties or international agreements entered into or to be entered into by the government after the effective date of this *funding agreement* and effectuate those license or other rights which are necessary for the government to meet its obligations to foreign governments, their nationals and international organizations under such treaties or international agreements with respect to subject inventions made after the date of the amendment.

(f) Agencies may add additional subparagraphs to paragraph (f) of the clauses at § 401.14 to require the contractor to do one or more of the following:

(1) Provide a report prior to the close-out of a funding agreement listing all subject inventions or stating that there were none.

(2) Provide, upon request, the filing date, serial number and title; a copy of the patent application; and patent number and issue date for any subject invention in any country in which the contractor has applied for patents.

(3) Provide periodic (but no more frequently than annual) listings of all subject inventions which were disclosed to the agency during the period covered by the report.

(g) If the contract is with a nonprofit organization and is for the operation of a government-owned, contractor-operated facility, the following will be substituted for paragraph (k)(3) of the clause at § 401.14(a):

(3) After payment of patenting costs, licensing costs, payments to inventors, and other expenses incidental to the administration of subject inventions, the balance of any royalties or income earned and retained by the *contractor* during any fiscal year on subject inventions under this or any successor *contract* containing the same requirement, up to any amount equal to five percent of the budget of the facility for that fiscal year, shall be used by the contractor for scientific research, development, and education consistent with the research and development mission and objectives of the facility, including activities that increase the licensing potential of other inventions of the facility. If the balance exceeds five percent, 75 percent of the excess above five percent shall be paid by the contractor to the Treasury of the United States and the remaining 25 percent shall be used by the *contractor* only for the same purposes as described above. To the extent it provides the most effective technology transfer, the licensing of subject inventions shall be administered by *contractor* employees on location at the facility.

(h) If the contract is for the operation of a government-owned facility, agencies may add the following at the end of paragraph (f) of the clause at § 401.14(a):

(5) The contractor shall establish and maintain active and effective procedures to ensure that subject inventions are promptly identified and timely disclosed and shall submit a description of the procedures to the *contracting officer* so that the *contracting officer* may evaluate and determine their effectiveness.

§ 401.6 Exercise of march-in rights.

(a) The following procedures shall govern the exercise of the march-in rights of the agencies set forth in 35 U.S.C. 203 and paragraph (j) of the clause at § 401.14.

(b) Whenever an agency receives information that it believes might warrant the exercise of march-in rights, before initiating any march-in proceeding, it shall notify the contractor in writing of the information and request informal written or oral comments from the contractor as well as information relevant to the matter. In the absence of any comments from the contractor within 30 days, the agency may, at its discretion, proceed with the procedures below. If a comment is received within 30 days, or later if the agency has not initiated the procedures below, then the agency shall, within 60 days after it receives the comment, either initiate the procedures below or notify the

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The blank above should be completed with the names of applicable existing treaties or international agreements, agreements of cooperation, memoranda of understanding, or similar arrangements, including military agreements relating to weapons development and production. The above language is not intended to apply to treaties or other agreements that are in effect on the date of the award but which are not listed. Alternatively,

contractor, in writing, that it will not pursue march-in rights on the basis of the available information.

(c) A march-in proceeding shall be initiated by the issuance of a written notice by the agency to the contractor and its assignee or exclusive licensee, as applicable and if known to the agency, stating that the agency is considering the exercise of march-in rights. The

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notice shall state the reasons for the proposed march-in in terms sufficient to put the contractor on notice of the facts upon which the action would be based and shall specify the field or fields of use in which the agency is considering requiring licensing. The notice shall advise the contractor (assignee or exclusive licensee) of its rights, as set forth in this section and in any supplemental agency regulations. The determination to exercise march-in rights shall be made by the head of the agency or his or her designee.

(d) Within 30 days after the receipt of the written notice of march-in, the contractor (assignee or exclusive licensee) may submit in person, in writing, or through a representative, information or argument in opposition to the proposed march-in, including any additional specific information which raises a genuine dispute over the material facts upon which the march-in is based. If the information presented raises a genuine dispute over the material facts, the head of the agency or designee shall undertake or refer the matter to another official for fact-finding.

(e) Fact-finding shall be conducted in accordance with the procedures established by the agency. Such procedures shall be as informal as practicable and be consistent with principles of fundamental fairness. The procedures should afford the contractor the opportunity to appear with counsel, submit documentary evidence, present witnesses and confront such persons as the agency may present. A transcribed record shall be made and shall be available at cost to the contractor upon request. The requirement for a transcribed record may be waived by mutual agreement of the contractor and the agency. Any portion of the march-in proceeding, including a fact-finding hearing that involves testimony or evidence relating to the utilization or efforts at obtaining utilization that are being made by the contractor, its assignee, or licensees shall be closed to the public, including potential licensees. In accordance with 35 U.S.C. 202(c)(5), agencies shall not disclose any such information obtained during a march-in proceeding to persons outside the government except when such release is authorized by the contractor (assignee or licensee).

(f) The official conducting the fact-finding shall prepare or adopt written findings of fact and transmit them to the head of the agency or designee promptly after the conclusion of the fact-finding proceeding along with a recommended determination. A copy of the findings of fact shall be sent to the contractor (assignee or exclusive licensee) by registered or certified mail. The contractor (assignee or exclusive licensee) and agency representatives will be given 30 days to submit written arguments to the head of the agency or designee; and, upon request by the contractor oral arguments will be held before the agency head or designee that will make the final determination.

(g) In cases in which fact-finding has been conducted, the head of the agency or designee shall base his or her determination on the facts found, together with any other information and written or oral arguments submitted by the contractor (assignee or exclusive licensee) and agency representatives, and any other information in the administrative record. The consistency of the exercise of march-in rights with the policy and objectives of 35 U.S.C. 200 shall also be considered. In cases referred for fact-finding, the head of the agency or designee may reject only those facts that have been found to be clearly erroneous, but must explicitly state the rejection and indicate the basis for the contrary finding. Written notice of the determination whether march-in rights will be exercised shall be made by the head of the agency or designee and sent to the contractor (assignee of exclusive licensee) by certified or registered mail within 90 days after the completion of fact-finding or 90 days after oral arguments, whichever is later, or the proceedings will be deemed to have been terminated and thereafter no march-in based on the facts and reasons upon which the proceeding was initiated may be exercised.

(h) An agency may, at any time, terminate a march-in proceeding if it is satisfied that it does not wish to exercise march-in rights.

(i) The procedures of this Part shall also apply to the exercise of march-in rights against inventors receiving title to subject inventions under 35 U.S.C. 202(d) and, for that purpose, the term "contractor" as used in this section shall be deemed to include the inventor.

(j) An agency determination unfavorable to the contractor (assignee or exclusive licensee) shall be held in abeyance pending the exhaustion of appeals or petitions filed under 35 U.S.C. 203(2).

(k) For purposes of this section the term "exclusive licensee" includes a partially exclusive licensee.

(l) Agencies are authorized to issue supplemental procedures not inconsistent with this part for the conduct of march-in proceedings.

§ 401.7 Small Business Preference.

(a) Paragraph (k)(4) of the clauses at § 401.14 Implements the small business preference requirement of 35 U.S.C. 202(c)(7)(D). Contractors are expected to use efforts that are reasonable under the circumstances to attract small business licensees. They are also expected to give small business firms that meet the standard outlined in the clause a preference over other applicants for licenses. What constitutes reasonable efforts to attract small business licensees will vary with the circumstances and the nature, duration, and expense of efforts needed to bring the invention to the market. Paragraph (k)(4) is not intended, for example, to prevent nonprofit organizations from providing larger firms with a right of first refusal or other options in inventions that relate to research being supported under long-term or other arrangements with larger companies. Under such circumstances it would not be resonable to seek and to give a preference to small business licensees.

(b) Small business firms that believe a nonprofit organization is not meeting its obligations under the clause may report their concerns to the Secretary. To the extent deemed appropriate, the Secretary will undertake informal investigation of the concern, and, if appropriate, enter into discussions or negotiations with the nonprofit organization to the end of improving its efforts in meeting its obligations under the clause. However, in no event will the Secretary intervene in ongoing negotiations or contractor decisions concerning the licensing of a specific subject invention. All the above investigations, discussions, and negotiations of the Secretary will be in coordination with other interested agencies, including the Small Business Administration; and in the case of a contract for the operation of a government-owned, contractor operated research or production facility, the Secretary will coordinate with the agency responsible for the facility prior to any discussions or negotiations with the contractor.

401.8 Reporting on utilization of subject inventions.

(a) Paragraph (h) of the clauses at § 401.14 and its counterpart in the clause at Attachment A to OMB Circular A-124 provides that agencies have the right to receive periodic reports from the contractor on utilization of inventions. Agencies exercising this right should accept such information, to the extent feasible, in the format that the contractor normally prepares it for its

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own internal purposes. The prescription of forms should be avoided. However, any forms or standard questionnaires that are adopted by an agency for this purpose must comply with the requirements of the Paperwork Reduction Act. Copies shall be sent to the Secretary.

(b) In accordance with 35 U.S.C. 202(c)(5) and the terms of the clauses at § 401.14, agencies shall not disclose such information to persons outside the government. Contractors will continue to provide confidential markings to help prevent inadvertent release outside the agency.

§ 401.9 Retention of Rights by Contractor Employee Inventor.

Agencies which allow an employee/inventor of the contractor to retain rights to a subject invention made under a funding agreement with a small business firm or nonprofit organization contractor, as authorized by 35 U.S.C. 202(d), will impose upon the inventor at least those conditions that would apply to a small business firm contractor under paragraphs (d)(1) and (3); (f)(4); (h); (i); and (j) of the clause at § 401.14(a).

§ 401.10 Government Assignment to Contractor of Rights in Invention of Government Employee.

In any case when a Federal employee is a co-inventor of any invention made under a funding agreement with a small business firm or nonprofit organization and the Federal agency employing such co-inventor transfers or reassigns the right it has acquired in the subject invention from its employee to the contractor as authorized by 35 U.S.C. 202(e), the assignment will be made subject to the same conditions as apply to the contractor under the patent rights clause of its funding agreement. Agencies may add additional conditions as long as they are consistent with 35 U.S.C. 201-206.

§ 401.11 Appeals.

(a) As used in this section, the term "standard clause" means the clause at § 401.14 of this part and the clauses previously prescribed by either OMB Circular A-124 or OMB Bulletin 81-22.

(b) The agency official initially authorized to take any of the following actions shall provide the contractor with a written statement of the basis for his or her action at the time the action is taken, including any relevant facts that were relied upon in taking the action.

(1) A refusal to grant an extension under paragraph (c)(4) of the standard clauses.

(2) A request for a conveyance of title under paragraph (d) of the standard clauses.

(3) A refusal to grant a waiver under paragraph (i) of the standard clauses.

(4) A refusal to approve an assignment under paragraph (k)(1) of the standard clauses.

(5) A refusal to grant an extension of the exclusive license period under paragraph (k)(2) of the clauses prescribed by either OMB Circular A-124 or OMB Bulletin 81-22.

(c) Each agency shall establish and publish procedures under which any of the agency actions listed in paragraph (b) of this section may be appealed to the head of the agency or designee. Review at this level shall consider both the factual and legal basis for the actions and its consistency with the policy and objectives of 35 U.S.C. 200-206.

(d) Appeals procedures established under paragraph (c) of this section shall include administrative due process procedures and standards for fact-finding at least comparable to those set forth in § 401.6 (e) through (g) whenever there is a dispute as to the factual basis for an agency request for a conveyance of title under paragraph (d) of the standard clause, including any dispute as to whether or not an invention is a subject invention.

(e) To the extent that any of the actions described in paragraph (b) of this section are subject to appeal under the Contract Dispute Act, the procedures under the Act will satisfy the requirements of paragraphs (c) and (d) of this section.

§ 401.12 Licensing of Background Patent Rights to Third Parties.

(a) A funding agreement with a small business firm or a domestic nonprofit organization will not contain a provision allowing a Federal agency to require the licensing to third parties of inventions owned by the contractor that are not subject inventions unless such provision has been approved by the agency head and a written justification has been signed by the agency head. Any such provision will clearly state whether the licensing may be required in connection with the practice of a subject invention, a specifically identified work object, or both. The agency head may not delegate the authority to approve such provisions or to sign the justification required for such provisions.

(b) A Federal agency will not require the licensing of third parties under any such provision unless the agency head determines that the use of the invention by others is necessary for the practice of a subject invention or for the use of a work object of the funding agreement and that such action is necessary to achieve practical application of the subject invention or work object. Any such determination will be on the record after an opportunity for an agency hearing. The contractor shall be given prompt notification of the determination by certified or registered mail. Any action commenced for judicial review of such determination shall be brought within sixty days after notification of such determination.

§ 401.13 Administration of Patent Rights Clauses.

(a) In the event a subject invention is made under funding agreements of more than one agency, at the request of the contractor or on their own initiative the agencies shall designate one agency as responsible for administration of the rights of the government in the invention.

(b) Agencies shall promptly grant, unless there is a significant reason not to, a request by a nonprofit organization under paragraph (k)(2) of the clauses prescribed by either OMB Circular A-124 or OMB Bulletin 81-22 inasmuch as 35 U.S.C. 202(c)(7) has since been amended to eliminate the limitation on the duration of exclusive licenses. Similarly, unless there is a significant reason not to, agencies shall promptly approve an assignment by a nonprofit organization to an organization which has as one of its primary functions the management of inventions when a request for approval has been necessitated under paragraph (k)(1) of the clauses prescribed by either OMB Circular A-124 or OMB Bulletin 81-22 because the patent management organization is engaged in or holds a substantial interest in other organizations engaged in the manfacture or sale of products or the use of processes that might utilize the invention or be in competition with embodiments of the invention. As amended, 35 U.S.C. 202(c)(7) no longer contains this limitation. The policy of this subsection should also be followed in connection with similar approvals that may be required under institutional Patent Agreements, other patent rights

clauses, or waivers that predate Chapter 18 of Title 35, United States Code.

(c) The President's Patent Policy Memorandum of February 18, 1983, states that agencies should protect the confidentiality of invention disclosure, patent applications, and utilization reports required in performance or in consequence of awards to the extent permitted by 35 U.S.C. 205 or other applicable laws. The following

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requirements should be followed for funding agreements covered by and predating this Part 401.

(1) To the extent authorized by 35 U.S.C. 205, agencies shall not disclose to third parties pursuant to requests under the Freedom of Information Act (FOIA) any information disclosing a subject invention for a reasonable time in order for a patent application to be filed. With respect to subject inventions of contractors that are small business firms or nonprofit organizations, a reasonable time shall be the time during which an initial patent application may be filed under paragraph (c) of the standard clause found at § 401.14(a) or such other clause may be used in the funding agreement. However, an agency may disclose such subject inventions under the FOIA, at its discretion, after a contractor has elected not to retain title or after the time in which the contractor is required to make an election if the contractor has not made an election within that time. Similarly, an agency may honor a FOIA request at its discretion if it finds that the same information has previously been published by the inventor, contractor, or otherwise. If the agency plans to file itself when the contractor has not elected title, it may, of course, continue to avail itself of the authority of 35 U.S.C. 205.

(2) In accordance with 35 U.S.C. 205, agencies shall not disclose or release for a period of 18 months from the filing date of the application to third parties pursuant to requests under the Freedom of Information Act or otherwise copies of any document which the agency obtained under this clause which is part of an application for patent with the U.S. Patent and Trademark Office or any foreign patent office filed by the contractor (or its assignees, licensees, or employees) on a subject invention to which the contractor has elected to retain title. This prohibition does not extend to disclosure to other government agencies or contractors of government agencies under an obligation to maintain such information in confidence.

(3) A number of agencies have policies to encourage public dissemination of the results of work supported by the agency through publication in government or other publications of technical reports of contractors or others. In recognition of the fact that such publication, if it included descriptions of a subject invention could create bars to obtaining patent protection, it is the policy of the executive branch that agencies will not include in such publication programs copies of disclosures of inventions submitted by small business firms or nonprofit organizations, pursuant to paragraph (c) of the standard clause found at § 401.14(a), except that under the same circumstances under which agencies are authorized to release such information pursuant to FOIA requests under paragraph (c)(1) of this section, agencies may publish such disclosures.

(4) Nothing in this paragraph is intended to preclude agencies from including in the publication activities described in the first sentence of paragraph (c)(3), the publication of materials describing a subject invention to the extent such materials were provided as part of a technical report or other submission of the contractor which were submitted independently of the requirements of the patent rights provisions of the contract. However, if a small business firm or nonprofit organization notifies the agency that a particular report or other submission contains a disclosure of a subject invention to which it has elected title or may elect title, the agency shall use reasonable efforts to restrict its publication of the material for six months from date of its receipt of the report or submission or, if earlier, until the contractor has filed an initial patent application. Agencies, of course, retain the discretion to delay publication for additional periods of time.

(5) Nothing in this paragraph is intended to limit the authority of agencies provided in 35 U.S.C. 205 in circumstances not specifically described in this paragraph.

§ 401.14 Standard patent rights clauses.

(a) The following is the standard patent rights clause to be used as specified in § 401.3(a).

Patent Rights (Small Business Firms and Nonprofit Organizations)

(a) Definitions

(1) "Invention" means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code, or any novel variety of plant which is or may be protected under the Plant Variety Protection Act (7 U.S.C. 2321 et seq.).

(2) "Subject invention" means any invention of the *contractor* conceived or first actually reduced to practice in the performance of work under this *contract*, provided that in the case of a variety of plant, the date of determination (as defined in section 41(d) of the Plant Variety Protection Act, 7 U.S.C. 2401(d)) must also occur during the period of *contract* performance.

(3) "Practical Application" means to manufacture in the case of a composition or product, to practice in the case of a process or method, or to operate in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are, to the extent permitted by law or government regulations, available to the public on reasonable terms.

(4) "Made" when used in relation to any invention means the conception or first actual reduction to practice of such invention.

(5) "Small Business Firm" means a small business concern as defined at section 2 of Pub. L. 85–536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration. For the purpose of this clause, the size standards for small business concerns involved in government procurement and subcontracting at 13 CFR 121.3–8 and 13 CFR 121.3–12, respectively, will be used.

(6) "Nonprofit Organization" means a university or other institution of higher education or an organization of the type described in section 501(c)(3) of the Internal Revenue Code of 1954 (26 U.S.C. 501(c) and exempt from taxation under section 501(a) of the Internal Revenue Code (25 U.S.C. 501(a)) or any nonprofit scientific or educational organization qualified under a state nonprofit organization statute.

(b) Allocation of Principal Rights

The *Contractor* may retain the entire right, title, and interest throughout the world to each subject invention subject to the provisions of this clause and 35 U.S.C. 203. With respect to any subject invention in which the *Contractor* retains title, the Federal government shall have a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the subject invention throughout the world.

(c) Invention disclosure, Election of Title and Filing of Patent Application by *Contractor*.

(1) The *contractor* will disclose each subject invention to the *Federal Agency* within two months after the inventor discloses it in writing to *contractor* personnel responsible for patent matters. The disclosure to the agency shall be in the form of a written report and shall identify the *contract* under which the invention was made and the inventor(s). It shall be sufficiently complete in technical detail to convey a clear understanding to the extent known at the time of the disclosure, of the nature, purpose, operation, and the physical, chemical, biological or electrical characteristics of the invention. The disclosure shall also identify any publication, on sale or public use of the invention and whether a manuscript describing the invention has been submitted

for publication and, if so, whether it has been accepted for publication at the time of disclosure. In addition, after disclosure to the *agency*, the *Contractor* will promptly notify the *agency* of the acceptance of any manuscript describing the invention for publication or of any on sale or public use planned by the *contractor*.

(2) The *Contractor* will elect in writing whether or not to retain title to any such invention by notifying the *Federal agency* within two years of disclosure to the *Federal agency*. However, in any case where

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publication, on sale or public use has initiated the one year statutory period wherein valid patent protection can still be obtained in the United States, the period for election of title may be shortened by the *agency* to a date that is no more than 60 days prior to the end of the statutory period.

(3) The *contractor* will file its initial patent application on a subject invention to which it elects to retain title within one year after election of title or, if earlier, prior to the end of any statutory period wherein valid patent protection can be obtained in the United States after a publication, on sale, or public use. The *contractor* will file patent applications in additional countries or international patent offices within either ten months of the corresponding initial patent application or six months from the date permission is granted by the Commissioner of Patents and Trademarks to file foreign patent applications where such filing has been prohibited by a Secrecy Order.

(4) Requests for extension of the time for disclosure, election, and filing under subparagraphs (1), (2), and (3) may, at the discretion of the *agency*, be granted.

(d) Conditions When the Government May Obtain Title

The *contractor* will convey to the *Federal agency*, upon written request, title to any subject invention—

(1) If the *contractor* fails to disclose or elect title to the subject invention within the times specified in (c), above, or elects not to retain title; provided that the *agency* may only request title within 60 days after learning of the failure of the *contractor* to disclose or elect within the specified times.

(2) In those countries in which the *contractor* fails to file patent applications within the times specified in (c) above; provided, however, that if the *contractor* has filed a patent application in a country after the times specified in (c) above, but prior to its receipt of the written request of the *Federal agency*, the *contractor* shall continue to retain title in that country.

(3) In any country in which the *contractor* decides not to continue the prosecution of any application for, to pay the maintenance fees on, or defend in reexamination or opposition proceeding on, a patent on a subject invention.

(e) Minimum Rights to *Contractor* and Protection of the *Contractor* Right to File

(1) The *contractor* will retain a nonexclusive royalty-free license throughout the world in each subject invention to which the Government obtains title, except if the *contractor* fails to disclose the invention within the times specified in (c), above. The *contractor's* license extends to its domestic subsidiary and affiliates, if any, within the corporate structure of which the *contractor* is a party and includes the right to grant sublicenses of the same scope to the extent the *contractor* was legally obligated to do so at the time the *contract* was awarded. The license is transferable only with the approval of the *Federal agency* except when transferred to the sucessor of that party of the *contractor's* business to which the invention pertains.

(2) The *contractor's* domestic license may be revoked or modified by the *funding Federal agency* to the extent necessary to achieve expeditious practical application of the subject invention pursuant to an application for an exclusive license submitted in accordance with applicable provisions at 37 CFR Part 404 and *agency* licensing regulations (if any). This license will not be revoked in that field of use or the geographical areas in which the *contractor* has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of the *funding Federal agency* to the extent the *contractor*, its licensees, or the domestic subsidiaries or affiliates have failed to achieve practical application in that foreign country.

(3) Before revocation or modification of the license, the *funding Federal agency* will furnish the *contractor* a written notice of its intention to revoke or modify the license, and the *contractor* will be allowed thirty days (or such other time as may be authorized by the *funding Federal agency* for good cause shown by the *contractor*) after the notice to show cause why the license should not be revoked or modified. The *contractor* has the right to appeal, in accordance with applicable regulations in 37 CFR Part 404 and *agency* regulations (if any) concerning the licensing of Government-owned inventions, any decision concerning the revocation or modification of the license.

(f) *Contractor* Action to Protect the Government's Interest

(1) The *contractor* agrees to execute or to have executed and promptly deliver to the *Federal agency* all instruments necessary to (i) establish or confirm the rights the Government has throughout the world in those subject inventions to which the *contractor* elects to retain title, and (ii) convey title to the *Federal agency* when requested under paragraph (d) above and to enable the government to obtain patent protection throughout the world in that subject invention.

(2) The *contractor* agrees to require, by written agreement, its employees, other than clerical and nontechnical employees, to disclose promptly in writing to personnel identified as responsible for the administration of patent matters and in a format suggested by the *contractor* each subject invention made under *contract* in order that the *contractor* can comply with the disclosure provisions of paragraph (c), above, and to execute all papers necessary to file patent applications on subject inventions and to establish the government's rights in the subject inventions. This disclosure format should require, as a minimum, the information required by (c)(1), above. The *contractor* shall instruct such employees through employee agreements or other suitable educational programs on the importance of reporting inventions in sufficient time to permit the filing of patent applications prior to U.S. or foreign statutory bars.

(3) The *contractor* will notify the *Federal agency* of any decisions not to continue the prosecution of a patent application, pay maintenance fees, or defend in a reexamination or opposition proceeding on a patent, in any country, not less than thirty days before the expiration of the response period required by the relevant patent office.

(4) The *contractor* agrees to include, within the specification of any United States patent applications and any patent issuing thereon covering a subject invention, the following statement, "This invention was made with government support under (identify the *contract*) awarded by (identify the Federal agency). The government has certain rights in the invention."

(g) Subcontracts

(1) The *contractor* will include this clause, suitably modified to identify the parties, in all subcontracts, regardless of tier, for experimental, developmental or research work to be performed by a small business firm or domestic nonprofit organization. The subcontractor will retain all rights provided for the *contractor* in this clause, and the *contractor* will not, as part of the consideration for awarding the subcontract, obtain rights in the subcontractor's subject inventions.

(2) The *contractor* will include in all other subcontracts, regardless of tier, for experimental developmental or research work the patent rights clause required by (*cite section of agency implementing regulations or FAR*).

(3) In the case of subcontracts, at any tier, when the prime award with the Federal agency was a contract (but not a grant or cooperative agreement), the *agency*, subcontractor, and the contractor agree that the mutual obligations of the parties created by this clause constitute a contract between the subcontractor and the Federal agency with respect to the matters covered by the clause; provided, however, that nothing in this paragraph is intended to confer any jurisdiction under the Contract Disputes Act in connection with proceedings under paragraph (j) of this clause.

(h) Reporting on Utilization of Subject Inventions

The *Contractor* agrees to submit on request periodic reports no more frequently than annually on the utilization of a subject invention or on efforts at obtaining such utilization that are being made by the *contractor* or its licensees or assignees. Such reports shall include information regarding the status of development, date of first commerical sale or use, gross royalties received by the contractor, and such other data and information as the *agency* may reasonably specify. The *contractor* also agrees to provide additional reports as may be requested by the *agency* in connection with any march-in proceeding undertaken by

the *agency* in accordance with paragraph (j) of this clause. As required by 35 U.S.C. 202(c)(5), the *agency* agrees it will not disclose such information to persons outside the government without permission of the *contractor*.

(i) Preference for United States Industry

Notwithstanding any other provision of this clause, the *contractor* agrees that neither it nor any assignee will grant to any person the

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exclusive right to use or sell any subject inventions in the United States unless such person agrees that any products embodying the subject invention or produced through the use of the subject invention will be manufactured substantially in the United States. However, in individual cases, the requirement for such an agreement may be waived by the *Federal agency* upon a showing by the *contractor* or its assignee that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that under the circumstances domestic manufacture is not commerically feasible.

(j) March-in Rights

The *contractor* agrees that with respect to any subject invention in which it has acquired title, the *Federal agency* has the right in accordance with the procedures in 37 CFR 401.6 and any supplemental regulations of the *agency* to require the *contractor*, an assignee or exclusive licensee of a subject invention to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if the *contractor*, assignee, or exclusive licensee refuses such a request the *Federal agency* has the right to grant such a license itself if the *Federal agency* determines that:

(1) Such action is necessary because the *contractor* or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use.

(2) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by the *contractor*, assignee or their licensees;

(3) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the *contractor*, assignee or licensees; or

(4) Such action is necessary because the agreement required by paragraph (i) of this clause has not been obtained or waived or because a licensee of the exclusive right to use or sell any subject invention in the United States is in breach of such agreement.

(k) Special Provisions for *contracts* with Nonprofit organizations

If the *contractor* is a nonprofit organization, it agrees that:

(1) Rights to a subject invention in the United States may not be assigned without the approval of the *Federal agency*, except where such assignment is made to an organization which has as one of its primary functions the management of inventions, provided that such assignee will be subject to the same provisions as the *contractor*;

(2) The *contractor* will share royalties collected on a subject invention with the inventor, including Federal employee co-inventors (when the agency deems it appropriate) when the subject invention is assigned in accordance with 35 U.S.C. 202(e) and 37 CFR 401.10;

(3) The balance of any royalties or income earned by the *contractor* with respect to subject inventions, after payment of expenses (including payments to inventors) incidential to the administration of subject inventions, will be utilized for the support of scientific research or education; and

(4) It will make efforts that are reasonable under the circumstances to attract licensees of subject invention that are small business firms and that it will give a preference to a small business firm when licensing a subject invention if the *contractor* determines that the small business firm has a plan or proposal for marketing the invention which, if executed, is equally as likely to bring the invention to practical application as any plans or proposals from applicants that are not small business firms; provided, that the *contractor* is also satisfied that the small business firm has the capability and resources to carry out its plan or proposal. The decision whether to give a preference in any specific case will be at the discretion of the *contractor*. However, the *contractor* agrees that the Secretary may review the *contractor's* licensing program and decisions regarding small business applicants, and the *contractor* will negotiate changes to its licensing policies, procedures, or practices with the Secretary when the Secretary's review discloses that the *contractor* could take reasonable steps to implement more effectively the reqirements of this paragraph (k)(4).

(l) Communication

(Complete According to Instructions at 401.5(b))

(b) When the Department of Energy (DOE) determines to use alternative provisions under § 401.3(a)(4), the standard clause at § 401.14(a), above, shall be used with the following modifications unless a substitute clause is drafted by DOE:

(1) The title of the clause shall be changed to read as follows: *Patent Rights to Nonprofit DOE Facility Operators*

(2) Add an "(A)" after "(1)" in paragraph (c)(1) and add subparagraphs (B) and (C) to paragraph (c)(1) as follows:

(B) If the subject invention occurred under activities funded by the naval nuclear propulsion or weapons related programs of *DOE*, then the provisions of this subparagraph (c)(1)(B) will apply in lieu of paragraphs (c)(2) and (3). In such cases the contractor agrees to assign the government the entire right, title, and interest thereto throughout the world in and to the subject invention except to the extent that rights are retained by the contractor through a greater rights determination or under paragraph (e), below. The contractor, or an employee-inventor, with authorization of the contractor, may submit a request for greater rights at the time the invention is disclosed or within a reasonable time thereafter. *DOE* will process such a request in accordance with procedures at 37 CFR 401.15. Each determination of greater rights will be subject to paragraphs (h)–(k) of this clause and such additional conditions, if any, deemed to be appropriate by the *Department of Energy*.

(C) At the time an invention is disclosed in accordance with (c)(1)(A) above, or within 90 days thereafter, the contractor will submit a written statement as to whether or not the invention occurred under a naval nuclear propulsion or weapons-related program of the *Department of Energy*. If this statement is not filed within this time, subparagraph (c)(1)(B) will apply in lieu of paragraphs (c)(2) and (3). The contractor statement will be deemed conclusive unless, within 60 days thereafter, the Contracting Officer disagrees in writing, in which case the determination of the Contracting Officer will be deemed conclusive unless the contractor files a claim under the Contract Disputes Act within 60 days after the Contracting Officer's determination. Pending resolution of the matter, the invention will be subject to subparagraph (c)(1)(B).

(3) Paragraph (k)(3) of the clause will be modified as prescribed at § 401.5(g).

§ 401.15 Deferred determinations.

(a) This section applies to requests for greater rights in subject inventions made by contractors when deferred determination provisions were included in the funding agreement because one of the exceptions at § 401.3(a) was applied, except that the Department of Energy is authorized to process deferred determinations either in accordance with its waiver regulations or this section. A contractor requesting greater rights should include with its request information on its plans and intentions to bring the invention to practical application. Within 90 days after receiving a request and supporting information, or sooner if a statutory bar to patenting is imminent, the agency should seek to make a determination. In any event, if a bar to patenting is imminent, unless the agency plans to file on its own, it shall authorize the contractor to file a patent application pending a determination by the agency. Such a filing shall normally be at the contractor's own risk and expense. However, if the agency subsequently refuses to allow the contractor to retain title and elects to proceed with the patent application under government ownership, it shall reimburse the contractor for the cost of preparing and filing the patent application.

(b) If the circumstances of concerns which originally led the agency to invoke an exception under § 401.3(a) are

not applicable to the actual subject invention or are no longer valid because of subsequent events, the agency should allow the contractor to retain title to the invention on the same conditions as would have applied if the standard clause at § 401.14(a) had been used originally, unless it has been licensed.

(c) If paragraph (b) is not applicable the agency shall make its determination

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based on an assessment whether its own plans regarding the invention will better promote the policies and objectives of 35 U.S.C. 200 than will contractor ownership of the invention. Moreover, if the agency is concerned only about specific uses or applications of the invention, it shall consider leaving title in the contractor with additional conditions imposed upon the contractor's use of the invention for such applications or with expanded government license rights in such applications.

(d) A determination not to allow the contractor to retain title to a subject invention or to restrict or condition its title with conditions differing from those in the clause at § 401.14(a), unless made by the head of the agency, shall be appealable by the contractor to an agency official at a level above the person who made the determination. This appeal shall be subject to the procedures applicable to appeals under § 401.11 of this part.

§ 401.16 Submissions and inquiries.

All submissions or inquiries should be directed to Federal Technology Management Policy Division, telephone number 202–377–0659, Room H4837, U.S. Department of Commerce, Washington, DC 20230.

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