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USAF CRDA NUMBER _____

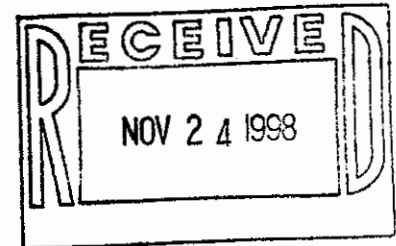
USAF COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT

BETWEEN

Air Force Research Laboratory, Space Vehicles Directorate

And

Management Sciences, Inc.



Article 1. Preamble

- 1.1 This Cooperative Research and Development Agreement (AGREEMENT) for performing the work described in the Work Statement attached hereto as Appendix A is entered into pursuant to 15 U.S.C. § 3710a (as amended) and Air Force Policy Directive 61-3 by and between Management Sciences, Inc., (hereinafter referred to as "COLLABORATOR"), located at 6022 Constitution Avenue NE, Albuquerque, NM 87110, and the United States of America as represented by the Department of the Air Force Research Laboratory, Space Vehicles Directorate (hereinafter referred to as "UNIT"), located at 3550 Aberdeen Avenue SE, Kirtland Air Force Base, NM 87117-5776. The terms and conditions of this AGREEMENT are set forth as follows.

Article 2. Definitions

- 2.1 As used in this AGREEMENT, the following terms shall have the following meanings and such meanings shall be applicable to both the singular and plural forms of the terms:
- 2.2 "CREATED" in relation to any copyrightable work means when the work is fixed in any tangible medium of expression for the first time, as provided for at 17 U.S.C. § 101.
- 2.3 "EFFECTIVE DATE" means the earlier of: (a) the date of the last signature of the duly authorized representatives of the parties and the REVIEWING OFFICIAL; or (b) thirty (30) days after the receipt of a signed copy of this AGREEMENT by the REVIEWING OFFICIAL without that official taking any action thereon.
- 2.4 "GOVERNMENT" means the Government of the United States of America.

- 2.5 "GOVERNMENT PURPOSE LICENSE" or "GPL" means a license to the GOVERNMENT conveying a non-exclusive, irrevocable, worldwide, royalty free license to practice and have practiced an INVENTION for or on behalf of the GOVERNMENT for government purposes and on behalf of any foreign government or international organization pursuant to any existing or future treaty or agreement with the United States, and conveying the right to use, duplicate or disclose copyrighted works or PROPRIETARY INFORMATION in whole or in part and in any manner, and to have or permit others to do so, for government purposes. Government purposes include competitive procurement, but do not include the right to have or permit others to practice an INVENTION or use, duplicate or disclose copyrighted works or PROPRIETARY INFORMATION for commercial purposes.
- 2.6 "INVENTION" means any invention or discovery that is or may be patentable or otherwise protected 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. § 7321 et seq.).
- 2.7 "MADE" in relation to any INVENTION, means the conception or first actual reduction to practice of such INVENTION.
- 2.8 "PROPRIETARY INFORMATION" means information which embodies trade secrets or which is confidential technical, business or financial information provided that such information:
- i) is not generally known, or is not available from other sources without obligations concerning its confidentiality;
 - ii) has not been made available by the owners to others without obligation concerning its confidentiality;
 - iii) is not described in an issued patent or a published copyrighted work or is not otherwise available to the public without obligation concerning its confidentiality; or
 - iv) can be withheld from disclosure under 15 U.S.C. § 3710a(c)(7)(A) & (B) and the Freedom of Information Act, 5 U.S.C. § 552 et seq; and
 - v) is identified as such by labels or markings designating the information as proprietary.
- 2.9 "REVIEWING OFFICIAL" means the authorized representative of the Department of the Air Force who is identified on the signature page of this AGREEMENT.

- 2.10 "UNDER" as used in the phrase "UNDER this AGREEMENT" means within the scope of work performed under this AGREEMENT.

Article 3. Work Statement

- 3.1 Appendix A sets forth the nature and scope of the work performed UNDER this AGREEMENT, including any equipment, maintenance and other support, and any associated reporting requirements.
- 3.2 The COLLABORATOR may inspect GOVERNMENT property identified in Appendix A prior to use. Such property may be repaired or modified at the COLLABORATOR's expense only after obtaining the written approval of UNIT. Any repair or modification of the property shall not affect the title of the GOVERNMENT. Unless UNIT hereafter otherwise agrees, the COLLABORATOR shall, at no expense to UNIT, return all GOVERNMENT property after termination or expiration of this AGREEMENT in the condition in which it was received, normal wear and tear excepted.
- 3.3 The parties agree to confer and consult with each other prior to publication or other public disclosure of the results of work UNDER this AGREEMENT to ensure that no PROPRIETARY INFORMATION or military critical technology or other controlled information is released. Prior to submitting a manuscript for publication or before any other public disclosure, each party will offer the other party ample opportunity to review such proposed publication or disclosure, to submit objections, and to file applications for patents in a timely manner.

Article 4. Financial Obligations

- 4.1 The COLLABORATOR agrees to pay UNIT \$90,000. The first payment of \$30,000 will be made within two (2) weeks after the effective date of this AGREEMENT. A second payment of \$30,000 within 120 days, and a third payment of \$30,000 within 240 days after the effective date.
- 4.2 If during the course of this AGREEMENT COLLABORATOR fails to make timely payments to UNIT, UNIT may immediately stop performance of this AGREEMENT and terminate pursuant to Article 8.
- 4.3 Should this AGREEMENT be terminated for any reason, COLLABORATOR will pay UNIT for expenses incurred through the date of termination. UNIT will return any unexpended balance to the COLLABORATOR.
- 4.4 Payments from copyrights shall be payable by the COLLABORATOR to UNIT in accordance with the provisions of Article 6.

- 4.5 Except as provided for in paragraph 4.4, payments by the COLLABORATOR TO UNIT under this Article shall be made payable to UNIT and mailed to the following address:

AFRL/VSF
3550 Aberdeen S.E.
Kirtland AFB, New Mexico 87117-5776

REF: CRDA #

- 4.6 Royalty or other income from patents shall be payable in accordance with any patent license under Article 5.

Article 5. Patents

- 5.1 Disclosure of INVENTIONS. Each party shall report to the other party, in writing, each INVENTION MADE UNDER this AGREEMENT, promptly after the existence of each such INVENTION, in the exercise of reasonable diligence, becomes known.
- 5.2 Rights in INVENTIONS. Each party shall separately own any INVENTION MADE solely by its respective employees UNDER this AGREEMENT. INVENTIONS MADE jointly by UNIT and the COLLABORATOR employees shall be jointly owned by both parties. The COLLABORATOR shall have an option under 15 U.S.C. 3710a(b)(2) to obtain an exclusive or non-exclusive license at a reasonable royalty rate, subject to the retention of a GPL by the GOVERNMENT, in any INVENTION MADE by UNIT employees UNDER this AGREEMENT. The COLLABORATOR shall exercise the option to obtain a license by giving written notice thereof to UNIT within three (3) months after disclosure of the INVENTION under paragraph 5.1. The royalty rate and other terms and conditions of the license shall be set forth in a separate license agreement and shall be negotiated promptly after notice is given. The COLLABORATOR hereby grants to the GOVERNMENT, in advance, a GPL in any INVENTION MADE by the COLLABORATOR employees UNDER this AGREEMENT.
- 5.3 Filing Patent Applications. The COLLABORATOR shall have the first option to file a patent application on any INVENTION MADE UNDER this AGREEMENT, which option shall be exercised by giving notice in writing to UNIT within three (3) months after disclosure of the INVENTION under paragraph 5.1, and by filing a patent application in the U.S. Patent and Trademark Office within six (6) months after written notice is given. If the COLLABORATOR elects not to file or not to continue prosecution of a patent application on any such INVENTION in any country or countries, the COLLABORATOR shall notify UNIT thereof at least three (3) months prior to

the expiration of any applicable filing or response deadline, priority period or statutory bar date. In any country in which the COLLABORATOR does not file, or does not continue prosecution of, or make any required payment on, an application on any such INVENTION, UNIT may file, or continue prosecution of, or make any required payment on, an application, and the COLLABORATOR agrees, upon request by UNIT, to assign to the GOVERNMENT all right, title and interest of the COLLABORATOR in any such application and to cooperate with UNIT in executing all necessary documents and obtaining cooperation of its employees in executing such documents related to such application. The party filing an application shall provide a copy thereof to the other party. NOTE:

Any patent application filed on any INVENTION MADE UNDER this AGREEMENT shall include in the patent specification thereof the statement: "This invention was made in the performance of a cooperative research and development agreement with the Department of the Air Force. The invention may be manufactured and used by or for the Government of the United States for all government purposes without the payment of any royalty."

- 5.4 Patent Expenses. Unless otherwise agreed, the party filing an application shall pay all patent application preparation and filing expenses and issuance, post issuance and patent maintenance fees associated with that application.

Article 6. Copyrights

- 6.1 The COLLABORATOR shall own the copyright in all works CREATED in whole or in part by the COLLABORATOR UNDER this AGREEMENT, which are copyrightable under Title 17, United States Code. The COLLABORATOR shall mark any such works with a copyright notice showing the COLLABORATOR as an owner and shall have the option to register the copyright at the COLLABORATOR's expense.
- 6.2 The COLLABORATOR hereby grants in advance to the GOVERNMENT a GPL in all copyrighted works CREATED UNDER this AGREEMENT. The COLLABORATOR will prominently mark each such copyrighted work subject to the GPL with the words: "This work was created in the performance of a Cooperative Research and Development Agreement with the Department of the Air Force. The Government of the United States has a royalty-free government purpose license to use, duplicate or disclose the work, in whole or in part and in any manner, and to have or permit others to do so, for Government purposes."
- 6.3 The COLLABORATOR shall furnish to UNIT, at no cost to UNIT, three (3) copies of each work CREATED in whole or in part by the COLLABORATOR UNDER this AGREEMENT.
- 6.4 The COLLABORATOR shall pay to UNIT twenty percent (20%) of all gross income received by the COLLABORATOR or its affiliates from the sale, lease or

rental of any copyrighted work CREATED UNDER this AGREEMENT. The COLLABORATOR shall pay to UNIT fifty percent (50%) of all gross income or royalties received by the COLLABORATOR or its affiliates from the licensing or assignment of any copyrighted work CREATED UNDER this AGREEMENT. Any sale, lease or rental to GOVERNMENT shall not be subject to payments hereunder and shall be discounted in price by a corresponding amount. All such payments to UNIT shall be due and paid on or before the last day of the month next following receipt by the COLLABORATOR of any such gross income or gross royalties. The COLLABORATOR shall provide to UNIT a report at least annually showing all gross income and royalties received. The COLLABORATOR shall make payments due hereunder to UNIT in accordance with paragraph 4.3 of this AGREEMENT. The COLLABORATOR's obligation to make payments to UNIT hereunder shall survive expiration or other termination of this AGREEMENT.

- 6.5 UNIT, at its expense, may require an accounting of income received by the COLLABORATOR and its affiliates and may, at reasonable times and upon reasonable notice to the COLLABORATOR, examine the COLLABORATOR's and any affiliate's books and records to verify the accounting.

Article 7. Proprietary Information

- 7.1 Neither party to this AGREEMENT shall deliver to the other party any PROPRIETARY INFORMATION not developed UNDER this AGREEMENT, except with the written consent of the receiving party. Unless otherwise expressly provided in a separate document, such PROPRIETARY INFORMATION shall not be disclosed by the receiving party except under a written agreement of confidentiality to employees and contractors of the receiving party who have a need for the information in connection with their duties UNDER this AGREEMENT.
- 7.2 PROPRIETARY INFORMATION developed UNDER this AGREEMENT shall be owned by the developing party, and any jointly developed PROPRIETARY INFORMATION shall be jointly owned. GOVERNMENT shall have a GPL to use, duplicate and disclose, in confidence, and to authorize others to use, duplicate and disclose, in confidence, for government purposes, any such PROPRIETARY INFORMATION developed solely by the COLLABORATOR. The COLLABORATOR may use, duplicate and disclose, in confidence, and authorize others on its behalf to use, duplicate and disclose, in confidence, any such PROPRIETARY INFORMATION developed solely by UNIT. PROPRIETARY INFORMATION developed UNDER this AGREEMENT shall be exempt from the Freedom of Information Act, 5 U.S.C. § 552 et seq, as provided at 15 U.S.C. § 3710a(c)(7)(A) & (B). The exemption for PROPRIETARY INFORMATION developed jointly by the parties or solely by UNIT shall expire not later than five

(5) years from the date of development of such PROPRIETARY INFORMATION.

Article 8. Term, Modification, Extension, Termination and Disputes

- 8.1 Term and Extension. The term of this AGREEMENT is for a period of twelve (12) months, commencing on the EFFECTIVE DATE of this AGREEMENT. This AGREEMENT shall expire at the end of this term unless both parties hereto agree in writing to extend it further. Expiration of this AGREEMENT shall not affect the rights and obligations of the parties accrued prior to expiration.
- 8.2 Modification. Any modifications shall be by mutual written agreement signed by the parties' representatives authorized to execute this AGREEMENT and attached hereto. A copy of any modifications will be forwarded to the REVIEWING OFFICIAL for information purposes.
- 8.3 Termination. Either party may terminate this AGREEMENT for any reason upon delivery of written notice to the other party at least three (3) months prior to such termination. Termination of this AGREEMENT shall not affect the rights and obligations of the parties accrued prior to the date of termination of this AGREEMENT. In the event of termination by either party, each party shall be responsible for its own costs incurred through the date of termination, as well as its own costs incurred after the date of termination and which are related to the termination. If UNIT terminates this AGREEMENT, it shall not be liable to the COLLABORATOR or its contractors or subcontractors for any costs resulting from or related to the termination, including, but not limited to, consequential damages or any other costs.
- 8.4 Disputes. All disputes arising out of, or related to, this AGREEMENT shall be resolved in accordance with this Article.
- 8.4.1 The parties shall attempt to resolve disputes between themselves. Resolution attempts must be documented and kept on file by the local Transfer Focal Point. Either party may refer any dispute, in writing that is not disposed of by agreement of the parties, to the REVIEWING OFFICIAL for decision.
- 8.4.2 REVIEWING OFFICIAL. The REVIEWING OFFICIAL shall within sixty (60) days of the receipt of the dispute, notify the parties of the decision. This decision shall be final and conclusive unless, within thirty (30) days from the date of receipt of such copy, either party submits to the REVIEWING OFFICIAL, a written appeal addressed to the Office of the Assistant Secretary of the Air Force (Acquisition), Deputy Assistant Secretary (Science, Technology, and Engineering).

8.4.3 Office of the Assistant Secretary of the Air Force (Acquisition), Deputy Assistant Secretary (Science, Technology, and Engineering). The decision of the Office of the Assistant Secretary of the Air Force (Acquisition), Deputy Assistant Secretary (Science, Technology, and Engineering), or the duly authorized representative, on the appeal shall be final and conclusive.

8.5 Continuation of Work. Pending the resolution of any such dispute, work under this agreement will continue as elsewhere provided herein.

Article 9. Representations and Warranties

9.1 UNIT hereby represents and warrants to the COLLABORATOR as follows:

- 9.1.1 Mission. The performance of the activities specified by this AGREEMENT are consistent with the mission of UNIT.
- 9.1.2 Authority. All prior reviews and approvals required by regulations or law have been obtained by UNIT prior to the execution of this AGREEMENT. The UNIT official executing this AGREEMENT has the requisite authority to do so.
- 9.1.3 Statutory Compliance. UNIT, prior to entering into this AGREEMENT, has (1) given special consideration to entering into cooperative research and development agreements with small business firms and consortia involving small business firms; (2) given preference to business units located in the United States which agree that products embodying an INVENTION MADE UNDER this AGREEMENT or produced through the use of such INVENTION will be manufactured substantially in the United States; and (3) taken into consideration, in the event this AGREEMENT is made with an industrial organization or other person subject to the control of a foreign company or government, 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 with such foreign country.

9.2 The COLLABORATOR hereby represents and warrants to UNIT as follows:

- 9.2.1 Corporate Organization. The COLLABORATOR, as of the date hereof, is a corporation duly organized validly existing and in good standing under the laws of the State of NM.
- 9.2.2 Statement of Ownership. The COLLABORATOR is not a foreign owned or a subsidiary of a foreign owned entity. The COLLABORATOR has the

right to assignment of all INVENTIONS MADE and copyrightable works CREATED by its employees UNDER this AGREEMENT.

- 9.2.3 Authority. The COLLABORATOR official executing this AGREEMENT has the requisite authority to enter into this AGREEMENT and the COLLABORATOR is authorized to perform according to the terms thereof.

Article 10. Liability

- 10.1 Property. All property is to be furnished "as is". No party to this AGREEMENT shall be liable to any other party for any property of that other party consumed, damaged or destroyed in the performance of this AGREEMENT, unless it is due to the gross negligence or willful misconduct of the party or an employee or agent of the party.
- 10.2 COLLABORATOR Employees. The COLLABORATOR agrees to indemnify and hold harmless and defend GOVERNMENT, its employees and agents, against any liability or loss for any claim made by an employee or agent of the COLLABORATOR, or persons claiming through them, for death, injury, loss or damage to their person or property arising in connection with this AGREEMENT, except to the extent that such death, injury, loss or damage arises solely from the negligence of UNIT or its employees.
- 10.3 NO WARRANTY. EXCEPT AS SPECIFICALLY STATED IN ARTICLE 9, OR IN A LATER AGREEMENT, THE PARTIES MAKE NO EXPRESS OR IMPLIED WARRANTY AS TO ANY MATTER WHATSOEVER, INCLUDING THE CONDITIONS OF THE RESEARCH OR ANY INVENTION OR PRODUCT, WHETHER TANGIBLE OR INTANGIBLE, MADE, OR DEVELOPED UNDER THIS AGREEMENT, OR THE MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE OF THE RESEARCH OR ANY INVENTION OR PRODUCT. THE PARTIES FURTHER MAKE NO WARRANTY THAT THE USE OF ANY INVENTION OR OTHER INTELLECTUAL PROPERTY OR PRODUCT CONTRIBUTED, MADE OR DEVELOPED UNDER THIS AGREEMENT WILL NOT INFRINGE ANY OTHER UNITED STATES OR FOREIGN PATENT OR OTHER INTELLECTUAL PROPERTY RIGHT. IN NO EVENT WILL ANY PARTY BE LIABLE TO ANY OTHER PARTY FOR COMPENSATORY, PUNITIVE, EXEMPLARY OR CONSEQUENTIAL DAMAGES.
- 10.4 Other Liability. GOVERNMENT shall not be liable to any other party to this AGREEMENT, whether directly or by way of contribution or indemnity, for any claim made by any person or other entity for personal injury or death, or for property damage or loss, arising in any way from this AGREEMENT, including, but not limited to, the later use, sale or other disposition of research and technical

developments, whether by resulting products or otherwise, whether made or developed UNDER this AGREEMENT, or whether contributed by either party pursuant to this AGREEMENT, except as provided under the Federal Tort Claims Act (28 U.S.C. §§ 2671 et seq.) or other Federal Law where Sovereign immunity has been waived.

Article 11. General Terms and Provisions

- 11.1 Disposal of Toxic or Other Waste. The COLLABORATOR shall be responsible for the removal and disposal from UNIT property of any and all toxic or other material provided or generated by the COLLABORATOR in the course of performing this AGREEMENT. The COLLABORATOR shall obtain at its own expense all necessary permits and licenses as required by local, state, and federal law and regulation and shall conduct such removal and disposal in a lawful and environmentally responsible manner.
- 11.2 Force Majeure. Neither party shall be in breach of this AGREEMENT for any failure of performance caused by any event beyond its reasonable control and not caused by the fault or negligence of that party. In the event such a force majeure event occurs, the party unable to perform shall promptly notify the other party and shall in good faith maintain such part performance as is reasonably possible and shall resume full performance as soon as is reasonably possible.
- 11.3 Relationship of the Parties. The parties to this AGREEMENT and their employees are independent contractors and are not agents of each other, joint venturers, partners or joint parties to a formal business organization of any kind. Neither party is authorized or empowered to act on behalf of the other with regard to any contract, warranty or representation as to any matter, and neither party will be bound by the acts or conduct of the other. Each party will maintain sole and exclusive control over its own personnel and operations.
- 11.4 Publicity/Use of Name Endorsement. Any public announcement of this AGREEMENT shall be coordinated between the COLLABORATOR, UNIT and the public affairs office-supporting UNIT. The COLLABORATOR shall not use the name of UNIT or GOVERNMENT on any product or service which is directly or indirectly related to either this AGREEMENT or any patent license or assignment which implements this AGREEMENT without the prior written approval of UNIT. By entering into this AGREEMENT, UNIT or GOVERNMENT does not directly or indirectly endorse any product or service provided, or to be provided, by the COLLABORATOR, its successors, assignees, or licensees. The COLLABORATOR shall not in any way imply that this AGREEMENT is an endorsement of any such product or service.
- 11.5 No Benefits. No member of, or delegate to the United States Congress, or resident commissioner, shall be admitted to any share or part of this

AGREEMENT, nor to any benefit that may arise therefrom; but this provision shall not be construed to extend to this AGREEMENT if made with a corporation for its general benefit.

- 11.6 Governing Law. The construction, validity, performance and effect of this AGREEMENT for all purposes shall be governed by the laws applicable to the GOVERNMENT.
- 11.7 Waiver of Rights. Any waiver shall be in writing and provided to all other parties. Failure to insist upon strict performance of any of the terms and conditions hereof, or failure or delay to exercise any rights provided herein or by law, shall not be deemed a waiver of any rights of any party hereto.
- 11.8 Severability. The illegality or invalidity of any provisions of this AGREEMENT shall not impair, affect or invalidate the other provisions of this AGREEMENT.
- 11.9 Assignment. Neither this AGREEMENT nor any rights or obligations of any party hereunder shall be assigned or otherwise transferred by any party without the prior written consent of all other parties.
- 11.10 Controlled Information. The parties understand that information and materials provided pursuant to or resulting from this AGREEMENT may be export controlled, classified, or unclassified sensitive and protected by law, executive order or regulation. Nothing in this AGREEMENT shall be construed to permit any disclosure in violation of those restrictions.

Article 12. Notices

- 12.1 Notices, communications, and payments specified in this agreement shall be deemed made if given and addressed as set forth below:
- A. Send formal notices and reports called for UNDER this AGREEMENT by prepaid certified U.S. Mail and address them:

UNIT: AFRL/VSDV
Attn: Dr. Steven Huybrechts
3550 Aberdeen Ave. SE
Kirtland AFB, NM 87117-5776
505/ 846-9371 or DSN246-9371

COLLABORATOR: Management Sciences, Inc.
Attn: Marlene Kay Blemel
6022 Constitution Ave., NE
Albuquerque, NM 87110
505/ 255-8611

- B. Send correspondence on technical matters by prepaid ordinary U.S. Mail and address them:

UNIT: AFRL/VSSE
Attn: James Lyke
3550 Aberdeen Avenue SE
Kirtland AFB, NM 87117-5776
Phone #: 505/ 846-5812 or DSN 246-5812

COLLABORATOR: Management Sciences, Inc.
Attn: Marlene Kay Blemel
6022 Constitution Avenue NE
Albuquerque, NM 87117-5776
Phone #: 505/ 255-8611
Fax #: 505/ 268-6696

IN WITNESS WHEREOF, the Parties have executed this AGREEMENT
in duplicate through there duly authorized representatives as follows:

COLLABORATING PARTY

Management Sciences, Inc.
6022 Constitution Avenue, NE
Albuquerque, NM 87110

Marlene K. Blemel
(Signature of Official) (Date Signed) 8/21/98

MARLENE KAY BLEMEL
President

UNIT

Air Force Research Laboratory,
Space Vehicles Directorate
3550 Aberdeen Avenue SE
Kirtland AFB, NM 87117-5776

Kevin Slimak 20 Oct 98
(Signature of Official) (Date Signed)

KEVIN SLIMAK
Division Chief

REVIEWED AND APPROVED BY
AIR FORCE REVIEWING OFFICIAL

Christine Anderson 8 Nov 98
(Signature) (Date Signed)

MS CHRISTINE ANDERSON
Director, Space Vehicles Directorate

APPENDIX A

WORK STATEMENT

Principal Investigator(s) (PI) of the UNIT: James Lyke, AFRL/VSSE

Principal Investigator(s) (PI) of COLLABORATOR: Mr. Ken Blemel, Management Sciences, Inc.

- 1.0 TITLE: Development of Microcontrollers and Applications Thereof
- 2.0 OBJECTIVE: To develop a cost-reduced Advanced Instrument Controller (AIC) technology. The Government will have use and apply the technology in sensing, monitoring, and controlling diverse applications across a broad spectrum of defense, research, and regulatory agencies. The COLLABORATOR will develop the AIC technology into commercial market devices and products for use in sensing, monitoring, and controlling diverse applications across a broad spectrum of applications including, but not limited to process control, aerospace, automotive and transportation, manufacturing, and domestic situations.
- 3.0 BACKGROUND: The UNIT has developed initial prototypes of the AIC technology for space applications. These devices are comprised of "commercial off the shelf" integrated electronic circuits packaged in multi-chip modules.

The COLLABORATOR develops application software for fault detection, and situation management with interfaces sensors and drivers for use in automated reactive supervision.

- 4.0 TECHNICAL TASKS:
- 4.1 COLLABORATOR will perform market research to identify customer requirements for a specific product that can be satisfied by the AIC and/or variant technology. The requirements will be provided to UNIT. UNIT may help identify support requirements to make the AIC technology as effective as possible for targeted end applications. This task should be completed one (1) month after the effective date of this AGREEMENT.
- 4.2 UNIT will apply best efforts to identify and develop cost reduced forms of the AIC technology relative to Task 1 Requirements. This effort will include the development of a research plan within two (2) months of receipt of Task 1 Requirements. This effort will also include fabrication of the prototype(s).
- 4.3 UNIT will perform end use calibration and testing.

5.0 DELIVERABLES OR DESIRED BENEFITS:

5.1 BENEFITS TO COLLABORATING PARTY: The COLLABORATOR accesses some of the most modern advances in electronics packaging and microelectronics design. The COLLABORATOR for a small fraction of the normal development cost can create AIC prototypes for special applications. The COLLABORATOR will interact with and influence AIC development roadmaps.

5.2 BENEFITS TO THE GOVERNMENT:

5.2.1 Dual-use has been recognized as very important. It gives the government the ability to create low-volume access to high-volume capability without underwriting the cost of infrastructure, which is borne by all users. In this case, it is hoped that the collaboration will result in a volume production of AIC or AIC derivatives to kernel such economies of scale.

5.2.2 Several Air Force commands stand to benefit from the low cost AIC work being done in this CRDA, which will improve the general affordability and hence the range and repertoire of the AIC application. First and most substantially, Air Force Material Command will benefit from the availability of AIC in many system procurements include all war fighting platforms. The Air Force Space Command will especially benefit, since the AIC was originally intended for space application, and has design features to make it easy to extend its application to harsh radiation environments, and since size, weight, and power consumption represent undesirable cost and complexity, the AIC represents a 1500X benefit over previous implementations. Other operational commands could see benefits, including the Air Combat Command, Air Mobility Command, and AF Special Operations Command, since the AIC is extremely ruggedized for field applications, enhances the ability to achieve stealth as a low power, unattended system capable of being embedded within many systems in the field.

5.2.3 The CRDA benefits the war fighter in several ways. First, it allows for smarter systems at a lower cost. All previous work in ruggedized computers resulted in larger, more power hungry and expensive results. The ability to "embed intelligence" economically will improve capability and responsive of the war fighter to a variety of conditions. While the basic AIC allows this, the price makes the technology inaccessible to most aerospace systems save space systems where the unit price is more than offset

in savings due to mass and power reduction. The second CRDA benefit is that the AIC permits the construction of stealthy, distributed processing networks, enabling the "knowledge on demand" capability. AICs are designed to operate in harsh environments with discontinuous power availability, while continuing to gather data. Such features permit the engineering of micro unattended air vehicles (UAVs) or micro-metrology systems that could be scattered about a theater to greater enhance information gathering for the war fighter.

6.0 PRIOR INTELLECTUAL ART:

6.1 UNIT:

AIC and MicroDot (extremely reduced AIC) represent prior ART for which patent coverage is being pursued by AFRL. Prior AIC extension work, also considered to represent AFRL prior ART includes: constant floor plan multichip modules, the so-called "Lazarus" concept; direct inclusion of MEMS-based switching elements for the express purpose of external and internal conductor reassignment; "booster-pack" surface-mount personality modules, agile power, and agile analog. Nothing in this AGREEMENT should be construed to provide the COLLABORATOR with any rights relative to the prior ART.

7.0 FUNDING: COLLABORATOR will be responsible for funding any unique design efforts, special studies, and end use calibration and testing.

8.0 MILESTONES:

- 8.1 Market/requirements study: within one (1) month after effective date.
- 8.2 Research plan: within two (2) months of receipt of Markets/Requirements. This includes fabrication of the prototypes.
- 8.3 Low-cost study: within three (3) months after the effective date of this AGREEMENT.
- 8.4 Definition of new-generation AIC: within five (5) months. It is expected that a new generation AIC will be defined, and any specialty AICs will be defined.
- 8.5 Prototyping of specialty AIC: within nine (9) months, which provides time for design, layout, and fabrication. Any complex AICs could impact this schedule, but simple AICs should not.

- 9.0 REPORTS: Progress reports coincide with progress meetings (handouts acceptable) will be submitted every month. A final report will be submitted final day of expiration date of CRDA or work under the CRDA ends. In addition, parties should send a copy of all reports to the Technology Transfer Support Group.

APPENDIX B

CONTRIBUTION TO PARTIES

UNIT:

Personnel	\$300K
Equipment	\$100K
Facilities	<u>\$100K</u>
TOTAL	\$500K

COLLABORATOR:

Personnel	\$121K
Equipment	\$50K
Cash	<u>\$90K</u>
TOTAL	\$261K

research and has agreed to negotiate CRDAs for developing special low cost versions of the AIC technology.

Sandia National Laboratory. MEOS and MEMS are developed at Sandia National Laboratory. MSI is negotiating a CRDA with SNL to develop special MEMS and MEOS under the ONR STTR contract using investor funds.

Need for Government Furnished Items. We have not included budgets for COTS devices, test equipment, and related items for building, testing, and manufacturing prototype modules because these items will be overhead items or will be purchased under our investor funds. We will request samples of government produced MEMS and micro-circuits that will be used in modules developed for DoD sponsors. Our sponsors have assured us of access to sensors, shipping containers, and related equipment to integrate prototypes for fielding. AFRL at Kirtland AFB, Wright Patterson AFB, and Edwards AFB have assured us of access to laboratory facilities and equipment to test DoD sponsored devices.

USAF Research Facilities. The AFRL at Kirtland AFB has extensive facilities for testing of space systems. We will request the use of the Engineering High Bay facility to test the SENTIENT modules on mockups of the space experiment hardware.

US Navy Research Facilities. MSI has been offered use of NAVAIR laboratory facilities through the offices of Dr. John Wood at the NAVAIR Technology Office in Patuxent River, MD. The Navy will provide research assistance and facilities in return for cooperation in developing SENTIENT instruments for aircraft.

Security Clearances. The COTR will need to determine the need for national security clearances for the facilities and personnel. MSI will comply with all such decisions.

AFRL SENTIENT Instrument #2: The Solar Powered Transportation Experiment (SPTE) is managed by Dr. Kristi Laug, at AFRL Edwards AFB. The SPTE is a proof of principle that a solar lens can focus sufficient heat (3500K) to ignite a hydrogen plasma engine to move objects around in space. If the experiment is successful, a solar “tugboat” will be sent into space to move and position satellites delivered by the advanced space shuttle or reusable vehicles, and to retrieve satellites for repair in space. The Air Force has a lot of hope riding on the SPTE as it will greatly reduce the need for expensive launch vehicles and will make satellite upgrade and repair easy in space.

Technical Approach for the SPTE SENTIENTS

In the SPTE, the general purpose SENTIENTS will sense changes in the focus of the light beam caused by thermally induced structural movement, and then they will attempt real-time correction using dynamic fuzzy controls. The light pattern recognition sensors of the SENTIENT sensory (Instrument #1) package will sense changes in the quality of the focus. The SENTIENTS will drive micromotors, micro blowers, and MEMS (like the Sandia Laboratory MEMS gear train³) to alter structural positioning in order to refocus the light beam used to heat the hydrogen to plasma. The SENTIENT will use the mechanical devices of the package to expand/contract in the joints of the structure to counter flexing caused by the extreme thermal conditions. Figure 3 shows the SPTE with two focusing lenses and SENTIENTS located on the structure and in the joints of the suspension arms.

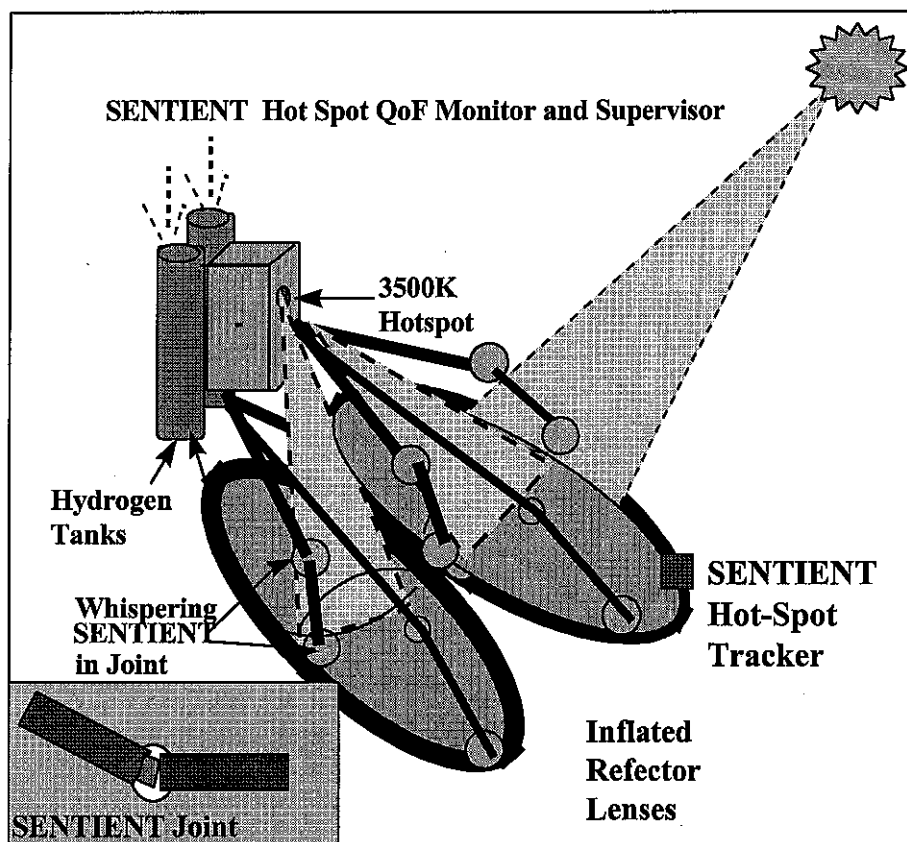


Figure 3. SENTIENTS Combine to Provide Quality of Focus

³ Sniegowski, J., and Garcia E., “Surface Micromachined geartrains driven by an on chip electrostatic microengine,” IEEE Electron Device Letters, vol 17, no 7, p 366, 1996.