

CONTINUATION SHEET**Reference No. of Document Being Continued****Page 2 of 10****PIIN/SIIN** DAAE07-02-C-L078**MOD/AMD** P00003**Name of Offeror or Contractor:** SEPARATION SYSTEMS TECHNOLOGY, INC.

SECTION A - SUPPLEMENTAL INFORMATION

CONTRACT: DAAE07-02-C-L078

PROGRAM: Forward Osmosis Membrane for an Instant Water Hydration Kit

1. The purpose of this Modification, P00003, is to extend the Period of Performance wherever stated in the contract to 31 December 2005 at no additional cost to the Government.
2. This Modification P00003 is issued pursuant to the mutual agreement of the parties based on the written request of the contractor in a letter to this office dated 28 September 2004.
3. Modify the contract as follows:

SECTION	Paragraph	DESCRIPTION
B	N/A	Extend Period of Performance wherever stated to 31 December 2005.
C	C.4.6.2	Design, build and test a prototype is now required within 35 months after award versus 20 months .
C.	C.4.6.3	The requirement to review prototype results, design, build and test a beta prototype is now required within 39 months of the date of award or no later than 31 December 2005.
C.	C.4.6.3.1	The two (2) individual water purification devices shall be delivered by 31 December 2005.
C.	C.5.3	Data Item A003, Interim Report, is required thirty (30) days after completion of technical effort at the end of each fiscal year. Allow fifteen (15) days for Government review and comment. Final report is required thirty (30) days after receipt of Government comments.
F	F.2	Extend Period of Performance of Basic Contract to 31 December 2005.
4. The effective date of this Modification P00003 is 29 September 2004.
5. As a result of modification P00003, the total amount of the contract is neither increased nor decreased.
6. Except as specifically provided in this Modification P00003, all other terms and conditions remain unchanged.

*** END OF NARRATIVE A 002 ***

CONTINUATION SHEET

Reference No. of Document Being Continued
 PIIN/SIIN DAAE07-02-C-L078 MOD/AMD P00003

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT									
0001	<p>SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS</p> <p><u>SERVICES LINE ITEM</u></p> <p>SECURITY CLASS: Unclassified</p> <p>Contractor shall furnish all the supplies and services to accomplish the task specified in Section C Scope of Work.</p> <p>Est. Cost: \$952,370.91 Fixed Fee: 47,618.55 Total Cost: \$999,989.46</p> <p>(End of narrative B001)</p>		LO											
0001AA	<p><u>SERVICES LINE ITEM</u></p> <p>NOUN: FORWARD OSMOSIS IWHK CONTRACT PRON: E122C320EH PRON AMD: 01 ACRN: AA AMS CD: 622601H9111</p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u></p> <table border="0"> <tr> <td>DLVR SCH</td> <td></td> <td>PERF COMPL</td> </tr> <tr> <td><u>REL CD</u></td> <td><u>QUANTITY</u></td> <td><u>DATE</u></td> </tr> <tr> <td>001</td> <td>0</td> <td>31-DEC-2005</td> </tr> </table> <p>\$ 164,022.29</p>	DLVR SCH		PERF COMPL	<u>REL CD</u>	<u>QUANTITY</u>	<u>DATE</u>	001	0	31-DEC-2005		LO		\$ 164,022.29
DLVR SCH		PERF COMPL												
<u>REL CD</u>	<u>QUANTITY</u>	<u>DATE</u>												
001	0	31-DEC-2005												
0001AB	<p><u>TRAVEL</u></p> <p>NOUN: FORWARD OSMOSIS IWHK CONTRACT PRON: E122C320EH PRON AMD: 01 ACRN: AA AMS CD: 622601H9111</p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u></p> <table border="0"> <tr> <td>DLVR SCH</td> <td></td> <td>PERF COMPL</td> </tr> <tr> <td><u>REL CD</u></td> <td><u>QUANTITY</u></td> <td><u>DATE</u></td> </tr> <tr> <td>001</td> <td>0</td> <td>31-DEC-2005</td> </tr> </table> <p>\$ 10,977.71</p>	DLVR SCH		PERF COMPL	<u>REL CD</u>	<u>QUANTITY</u>	<u>DATE</u>	001	0	31-DEC-2005		LO		\$ 10,977.71
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001	0	31-DEC-2005												

CONTINUATION SHEET

Reference No. of Document Being Continued
 PIIN/SIIN DAAE07-02-C-L078 MOD/AMD P00003

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT						
0001AC	<p><u>TRAVEL</u></p> <p>CLIN CONTRACT TYPE: Cost-Plus-Fixed-Fee NOUN: SEP SYS TECH DAAE0702CL078 PRON: E122C398EH PRON AMD: 01 ACRN: AA AMS CD: 622601H9111</p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u></p> <table border="0"> <tr> <td>DLVR SCH</td> <td>PERF COMPL</td> </tr> <tr> <td><u>REL CD</u> <u>QUANTITY</u> <u>DATE</u></td> <td></td> </tr> <tr> <td>001 0 31-DEC-2005</td> <td></td> </tr> </table> <p style="text-align: right;">\$ 48,048.69</p>	DLVR SCH	PERF COMPL	<u>REL CD</u> <u>QUANTITY</u> <u>DATE</u>		001 0 31-DEC-2005			LO		\$ 48,048.69
DLVR SCH	PERF COMPL										
<u>REL CD</u> <u>QUANTITY</u> <u>DATE</u>											
001 0 31-DEC-2005											
0001AD	<p><u>SERVICES LINE ITEM</u></p> <p>CLIN CONTRACT TYPE: Cost-Plus-Fixed-Fee NOUN: SEP SYS TECH DAAE0702CL078 PRON: E122C398EH PRON AMD: 01 ACRN: AA AMS CD: 622601H9111</p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u></p> <table border="0"> <tr> <td>DLVR SCH</td> <td>PERF COMPL</td> </tr> <tr> <td><u>REL CD</u> <u>QUANTITY</u> <u>DATE</u></td> <td></td> </tr> <tr> <td>001 0 31-DEC-2005</td> <td></td> </tr> </table> <p style="text-align: right;">\$ 191,951.31</p>	DLVR SCH	PERF COMPL	<u>REL CD</u> <u>QUANTITY</u> <u>DATE</u>		001 0 31-DEC-2005			LO		\$ 191,951.31
DLVR SCH	PERF COMPL										
<u>REL CD</u> <u>QUANTITY</u> <u>DATE</u>											
001 0 31-DEC-2005											
0001AE	<p><u>SERVICES LINE ITEM</u></p> <p>CLIN CONTRACT TYPE: Cost-Plus-Fixed-Fee NOUN: DAAE0702CL078 SEP SYS TECH PRON: E132C150EH PRON AMD: 01 ACRN: AB AMS CD: 622601H9111</p> <p><u>Inspection and Acceptance</u></p>		LO		\$ 410,000.00						

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Reference No. of Document Being Continued
 PIIN/SIIN DAAE07-02-C-L078 MOD/AMD P00003

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	INSPECTION: Destination ACCEPTANCE: Destination <u>Deliveries or Performance</u> DLVR SCH PERF COMPL <u>REL CD QUANTITY DATE</u> 001 0 31-DEC-2005 \$ 410,000.00				
0001AF	<u>SERVICES LINE ITEM</u> NOUN: SEP SYS TECH DAAE07-02-C-L078 PRON: R342C166R3 PRON AMD: 02 ACRN: AC AMS CD: 622601H9111 <u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination <u>Deliveries or Performance</u> DLVR SCH PERF COMPL <u>REL CD QUANTITY DATE</u> 001 0 31-DEC-2005 \$ 174,989.46		LO		\$ 174,989.46
0002	<u>DATA ITEM</u> SECURITY CLASS: Unclassified				
A001	<u>DATA ITEM</u> NOUN: PROGRAM PLAN SECURITY CLASS: Unclassified <u>Packaging and Marking</u> <u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination <u>Deliveries or Performance</u> DOC SUPPL <u>REL CD MILSTRIP ADDR SIG CD MARK FOR TP_CD</u> 001 3 <u>DEL REL CD QUANTITY DEL DATE</u> 001 1 31-DEC-2005	1	LO	\$ ** NSP **	\$ ** NSP **

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Reference No. of Document Being Continued
 PIIN/SIIN DAAE07-02-C-L078 MOD/AMD P00003

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
A002	<p>FOB POINT: Destination</p> <p>SHIP TO: <u>PARCEL POST ADDRESS</u></p> <p><u>DATA ITEM</u></p> <p>NOUN: PROGRESS STATUS & MANAGEMENT SECURITY CLASS: Unclassified</p> <p><u>Packaging and Marking</u></p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u> DOC SUPPL REL CD MILSTRIP ADDR SIG CD MARK FOR TP CD 001 3 DEL REL CD QUANTITY DEL DATE 001 1 31-DEC-2005</p>	1	LO	\$ ** NSP **	\$ ** NSP **
A003	<p>FOB POINT: Destination</p> <p>SHIP TO: <u>PARCEL POST ADDRESS</u></p> <p><u>DATA ITEMS (A003 & A004)</u></p> <p>NOUN: SCIENTIFIC & TECHNICAL REPORT SECURITY CLASS: Unclassified</p> <p><u>Packaging and Marking</u></p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u> DOC SUPPL REL CD MILSTRIP ADDR SIG CD MARK FOR TP CD 001 3 DEL REL CD QUANTITY DEL DATE 001 1 31-DEC-2005</p> <p>FOB POINT: Destination</p> <p>SHIP TO: <u>PARCEL POST ADDRESS</u></p>	1	LO	\$ ** NSP **	\$ ** NSP **

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

C.1.0 BACKGROUND

Depending on the environmental conditions and the soldier's level of activity the individual soldier requires 1.5 to 3 gallons of water per day to prevent dehydration. A 3-4% deficit of a soldier's total body water (2-3 quarts) significantly reduces performance (up to 48%) and a 6-8% water deficit (4-6 quarts) renders a soldier completely ineffective. Without a personal purification device the individual soldier cannot take advantage of local water sources, often including local tap water, due to concerns regarding water safety. The water may contain indigenous pathogenic organisms, be contaminated by toxic industrial chemicals, or contain chemical or biological threat agents introduced by military or terrorist activity. Therefore, the soldier must rely on resupply through the sustainment system, which must transport 12 to 24 pounds of water to every soldier on the battlefield every day. If the sustainment system is unable to provide the soldier with the amount of water needed the soldier may be forced to drink locally available water risking disease and death. An individual soldier water purification device will reduce the logistics footprint of the force and ensure soldier readiness and safety when cut-off from lines of supply. The proposed individual water purification device will protect the soldier against naturally occurring pathogenic organisms and toxic chemicals, as well as weaponized versions allowing the soldier to take advantage of any locally available fresh water source. The reduced demand for water distribution (50 to 66%) will reduce the projected daily sustainment requirement of the force by 20 to 40% improving sustainability and enhancing agility while protecting the soldiers against natural, military, and terrorist water-borne threats to the soldiers' safety and readiness.

C.2.0 OBJECTIVES

Under this contract the contractor shall develop two (2) individual soldier water purification devices using hollow fiber membranes. These devices shall include an Instant Water Hydration Kit (IWHK) based on a high-flow, high rejection forward osmosis (FO) membrane and a hollow fiber micro-filtration membrane filter device (MFD) to process water for the individual foot soldier.

C.3.0 SYSTEM REQUIREMENTS

C.3.1 The required capabilities for the Instant Water Hydration Kit (IWHK) and Membrane filter device (MFD) are:

- 1) Both the IWHK and MFD systems shall have the ability to be stored and transported at -25 to 140 degrees Fahrenheit when dry and from 32 to 140 degrees Fahrenheit when wet.
- 2) Both systems shall be maintainable and cleanable by the individual soldier in the field.
- 3) Both systems should have a storage life of at least three (3) years.
- 4) Both devices shall be lightweight weighing less than 20 ounces dry weight (excluding consumable nutrient formulation), and capable of being stored in or on the soldier's body and pack and withstanding transport while stored.
- 5) Both systems shall be capable of treating 150 liters of water before the replacement of any non-consumable (nutrient formulation) component.
- 6) The IWHK shall use a salt-rejecting FO membrane that purifies and physically disinfects the product water.
- 7) The IWHK shall purify fresh, brackish, sea water, and NBC contaminated sources to military drinking water standards, as defined in Technical Bulletin Medical (TB Med) 577, under the following water quality ranges, temperature 32 to 140 degrees Fahrenheit, pH 5 to 9, and turbidity up to 140 NTU.
- 8) The IWHK shall be capable of removing and/or destroying biological (bacteria, virus, and protozoan cysts) contaminants to Environmental Protection Agency (EPA) hand held purifier protocol standards.
- 9) The IWHK shall be capable of producing 1 liter of product water in 15 minutes (and 3.5 quarts in 50 minutes) from fresh water sources.
- 10) The IWHK nutrient formulation shall be packaged in a manner to allow rapid replenishment, less than 5 minutes, in the field.
- 11) The membrane filter device (MFD) shall produce 1 liter of filtered water in 5 minutes at a maximum driving pressure of a 10 psi applied pressure.
- 12) The MFD filter shall remove particles larger than or equal to 0.1 micron and removing and/or destroying biological (bacteria [99.9999%], and protozoan cysts [99.9%]) contaminants to EPA Hand Held Purifier Protocol standards (minimum requirement), viral removal [99.99%] to the EPA Hand Held Purifier Protocol standards is desired (objective).
- 13) The MFD shall be able to purify fresh water to military drinking water standards under the following water quality ranges, temperature 32 to 140 degrees Fahrenheit, pH 5 to 9, turbidity up to 140 NTU, and total dissolved solids up to 1000 ppm.
- 14) All components of both systems shall be compatible with present NBC standards and requirements.

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

C.4.0 SCOPE OF WORK

C.4.1 Forward Osmosis Membrane Development. The contractor shall:

C.4.1.1 Develop asymmetric unsupported FO membranes in a hollow fiber configuration that exhibit the high water flow and salt rejection (greater than 95%) required to meet the production rates described in the system requirements section (paragraph C.3.0 above). Concentration polarization within the membrane substrate will be minimized by the following contractor actions:

C.4.1.1.(a) Reduce the thickness of the porous supporting structure of the membrane to enhance solute mixing and sweeping within the substructure thereby reducing internal concentration polarization.

C.4.1.1.(b) Create a membrane having a porous supporting structure with large vertical cylindrical pores to reduce flow resistance in the substructure thereby improving water flow through the membrane substructure.

C.4.1.1.(c)

Develop a membrane with the combined properties of (a) and (b) to decrease both concentration polarization and flow resistance within the membrane substructure.

C.4.1.2 Develop a membrane drying procedure to preserve the transport properties of the membrane after drying. In addition, instant re-wetting of the membrane (low bubble pressure) is required for the FO application.

C.4.1.3 Characterize membrane transport properties pertinent to FO and use the results of these characterization tests to refine further membrane flat sheet casting and/or hollow fiber spinning.

C.4.1.4 Develop hollow fiber CA-FO membranes by aqueous phase inversion processing at the University of Texas. The University of Texas shall develop embedding procedures for potting the fibers in test modules.

C.4.2 Hollow Fiber Micro-filtration Membrane Development. The contractor shall:

C.4.2.1 Survey, identify and acquire MF membrane and /or MF membrane separation devices that may be commercially available in either membrane or device form that meets the requirements of this SOW. Promising candidates identified will be evaluated as described in section 4.3.

C.4.2.2 Develop a hollow fiber micro-filtration (MF) membrane having properties suitable for filtering source water for the individual soldier meeting requirements outlined in section C.3.

C.4.2.3 Spin hollow fiber membranes from candidate materials.

C.4.2.4 Develop embedding materials and procedures for potting the fibers in test modules.

C.4.2.5 Characterize the hollow fibers and use the results of these characterization tests to refine membrane spinning. Once potted the fibers will be characterized in the potted form for pore water flux, pore size distribution, bubble point and molecular weight cut-off.

C.4.3 Characterization of Forward Osmosis and Micro-filtration Membranes. The contractor shall conduct studies of structural and transport properties using methods that shall include, but need not be limited to, the following:

C.4.3.1 Atomic force microscopy (AFM), scanning electron microscopy (SEM), transmission electron microscopy (TEM), contact angle measurements, surface charge determinations.

C.4.3.2 Determination of membrane transport properties of FO and MF membranes in flat sheet and HF configurations under FO and MF conditions using ASTM natural water conditions, EPA Protocol for Hand Held Water Purifiers, and a contractor selected natural water source.

C.4.3.3 Characterize FO membranes under both reverse osmosis and FO test conditions. The FO test conditions will simulate those required for the FO device to meet the requirements outlined in the SOW.

C.4.3.4 Characterize MF membrane fibers for pore water flux, pore size distribution, bubble point and molecular weight cut off. Conduct viral challenge tests of MF hollow fibers on a selected basis.

C.4.4 Forward Osmosis Systems Development -Instant Water Hydration Kit (IWHK) The contractor shall:

C.4.4.1 Develop, build and test IWHK prototypes with newly developed hollow fiber CA FO membranes.

CONTINUATION SHEET	Reference No. of Document Being Continued	Page 9 of 10
	PIIN/SIIN DAAE07-02-C-L078	MOD/AMD P00003

Name of Offeror or Contractor: SEPARATION SYSTEMS TECHNOLOGY, INC.

C.4.4.2 Design, build and test a prototype within 35 months from date of award.*

C.4.4.3 Review prototype results, design, build, and test a beta prototype within 24 months from date of award. The contractor shall provide the government with 5 beta prototypes for demonstration and testing. The Contracting Officer's Technical Representative (COTR) will provide the location of testing within ten days after award of contract.

C.4.5 Formulation of Nutrients for Instant Water Hydration Kit (IWHK). The contractor shall:

C.4.5.1 Develop special nutrient formulations to operate in the IWHK using low molecular weight glucose and fructose.

C.4.5.2 Evaluate the potential advantages and disadvantages of adding simple amino acids (low molecular weight) to the IWHK solution to supply both carbohydrates (from the sugars) and proteins (from the amino acids).

C.4.5.3 Develop a process for screening the taste of the product drink and ensure the taste does not reduce the individuals' water intake.

C.4.6 Micro-filtration Systems Development. The contractor shall:

C.4.6.1 Develop, build and test membrane filter device (MFD) prototypes with selected and/or newly developed hollow fiber MF membranes.

C.4.6.2 Design, build and test a prototype within 35 months after date of award.*

4.6.3 Review prototype results, design, build, and test a beta prototype within 24 months after date of award. The contractor shall provide the government with 5 beta prototypes for demonstration and testing. The Contracting Officer's Technical Representative (COTR) will provide the location of testing within ten days after award of contract.

C.4.6.3.1 Upon completion of all testing, the contractor shall delivery two (2) individual water purification devices as identified in C.2.0 of the contract.

C.5.0 The contractor will conduct a start of work meeting within 30 days after award of contract. In-Process Review meetings shall be coordinated with Contracting Officer's Technical Representative by email.

C.5.1 The contractor shall prepare and deliver a Project Management Plan IAW CDRL item A001. The plan shall include contractual requirements, deliverables, milestones, procedures, costs, and responsibilities. Also, it shall include all information necessary to manage costs, scope and schedule, while satisfying all technical requirements and verifying conformance with contractual requirements.

C.5.2 The contractor shall prepare and deliver monthly Contractor's Progress Status and Management Reports IAW CDRL Item A002. The first report shall be due 45 days after contract award.

C.5.3 The contractor shall prepare and deliver one (1) Interim Technical Report IAW CRDL Item A003, no later than 13 months after contract award. The report will detail the technical work, with pertinent data included, of the development to date and propose a strategy for the upcoming period to meet the requirements outlined in Paragraph C.3.1.

C.5.4 The contractor shall prepare and deliver a Final Technical Report upon completion of the technical effort IAW the requirements of CRDL Item A004. The report shall include experimental findings, theoretical analysis, conclusions and operating instructions for the prototypes.

* Changed by Modification P00003

*** END OF NARRATIVE C 001 ***

CONTINUATION SHEET**Reference No. of Document Being Continued****Page 10 of 10****PIIN/SIIN** DAAE07-02-C-L078**MOD/AMD** P00003**Name of Offeror or Contractor:** SEPARATION SYSTEMS TECHNOLOGY, INC.

SECTION F - DELIVERIES OR PERFORMANCE

DELIVERY OR PERFORMANCE

F.1 All reports in Section C, Statement of Work and as specified on the Contract Data Requirement List (CDRL) DD Form 1423 shall be delivered in accordance with the appropriate CDRL.*

F.2 The period of performance for the entire contractual effort specified in Section C shall be completed within thirty-nine (39) months after date of award.*

F.3 All data delivered under this contract shall be delivered in accordance with the quantities and schedules as specified on the Contract Data Requirement List (CDRL) DD Form 1423, and shall be delivered F.O.B. destination to the email listed in the CDRL.*

F.4 All hardware delivered under this contract shall be delivered F.O.B Destination to the following Address or as otherwise specified: *

Commander
US Army Tank-automotive Command
ATTN: (AMSRD-TR-D/MS110/James Dusenbury xt44145
Receiving Dock, Building 249
6501 East 11 Mile Road
Warren , Michigan 48397-5000

* Changed per Modification P00003, the period of performance wherever stated in the contract is extended to 31 December 2005.

*** END OF NARRATIVE F 001 ***