DEFINITIONS

Architect Services, Engineer Services, Land Surveying Services, Assayer Services, Geologist Services and Landscape Architect Services: Those professional services within the scope of the practice of those services as provided in ARS § 32-101.

Branch Office: A geographically distinct place of business or subsidiary office of a firm that has a key role on the team.

Discipline: Primary technical capabilities of key personnel, as evidenced by academic degree, professional registration, certification, and/or extensive experience.

Firm: Defined in ARS § 32-101(B.19.).

Key Personnel: Individuals who will have major contract responsibilities and/or provide unusual or unique expertise.

SPECIFIC INSTRUCTIONS:

1 . Complete this form for each branch office seeking work under this RFQ.

a . – e. **Firm (or Branch Office) Name and Address.** Self-explanatory.

f. **Year Established**. Enter the year the firm (or branch office, if appropriate) was established under the current name.

g. **Ownership**.

(g1). *Type*. Enter the type of ownership or legal structure of the firm (sole proprietor, partnership, corporation, joint venture, etc.).

(g2). *Small Business Status*. A firm is a small business if the firm has less than 100 employees **or** has gross revenues of $4 million or less.

h.-j. **Point of Contact**. Provide this information for a representative of the firm that the Customer can contact for additional information. The representative must be empowered to speak on contractual and policy matters.

k. **Name of Firm**. Enter the name of the firm.

2. **Employees by Discipline**.

a. Select disciplines from the List of Disciplines (Function Code) listed on Page 3 of 4 Instructions. For employees that do not qualify for any of the disciplines, select Other. *Note: The intended searchable database indicated in the RFQ will be populated from the Qualifications Form I Excel attachment only.*

b. Each person can be counted only twice; once for his/her primary function and once for his/her secondary function. Primary and secondary functions should be indicated by including a “P” or an “S” in column b after the Description Title is given.

c-d. If the form is completed for a firm (including all branch offices), enter the number of employees by disciplines in column c. If the form is completed for a branch office, enter the number of employees by discipline in column d and for the firm in column c.

3. **Profile of Firm's Experience and Annual Average Revenue for Last Year**.

a. Enter the approximate number of projects the firm (or branch) has done attributable by Profile Code listed on Page 3 of 4 Instructions over the last year.

b. Enter the appropriate Profile Codes from Instructions Pages 3 of 4 that represent the type of work the firm (or branch) has done over the last year.

c. Using the Revenue Index Number on Page 3 of 6 Form, indicate the approximate revenue the firm has

earned over the last year per Profile Code entered into the table.

4. **Resumes of Key Personnel Proposed for This Contract.** Complete this section for each key person who will participate in this contract.

    a. Self-explanatory.
    b. Self-explanatory
    c. Total years of relevant experience (block c1), and years of relevant experience with current firm, but not necessarily the same branch office (block c2).
    d. Name, City and State of the firm where the person currently works, which must correspond with one of the firms (or branch office or a firm, if appropriate) listed in Section 1.
    e. Provide information on the highest relevant academic degree(s) received. Indicate the area(s) of specialization for each degree.
    f. Provide information on current relevant professional registration(s) and in which State(s) they are current.
    g. Provide information on any other professional qualifications relating to this contract, such as education, professional registration, publications, organizational memberships, certifications, training, awards, and foreign language capabilities.
    h. Provide information on no more than five (5) projects in the last year which the person had a significant role that demonstrates the person's capability relevant to her/his proposed role in this contract. These projects do not necessarily have to be any of the projects presented in Section 5 for the project team if the person was not involved in any of those those projects or the person worked on other projects that were more relevant than the team projects in Section 5. Use the check box provided to indicate if the project was performed with any office of the current firm. If any of the professional services or construction projects are not complete, leave Year Completed blank and indicate the status in Brief Description and Specific Role.

5. **Example Projects Which Best Illustrate Firms Qualification for this contract.** Select project where multiple team members worked together, if possible, that demonstrate the team's capability to perform work similar to that required for this contract. Complete one Section 5 for each project. List no more than five (5) projects.

    a. Title and Locations of project or contract. For an indefinite delivery contract, the location is the geographic scope of the contract.
    b. Enter the year completed of the professional services (such as planning, engineering study, or design), and/or the year completed if construction. If any of the professional services or the construction projects are not complete, leave Year Completed blank and indicate the status in Brief Description of Project and Relevance to This Contract (block f).
    c. Project Owner or user, such as a government agency or installation, an institution, a corporation or private individual.
    d. Provide the original budget or not to exceed dollar amount for the project.
    e. Provide the Total Cost of the Project. If any of the professional services or construction projects is not complete, indicate the percentage compete and whether this project will be on budget, over or under budget.
    f. Brief Description: Indicate scope, size, and length of project, principle elements and special features of the project. Discuss the relevance of the example project to this contract.

6. **Additional Information**. Use this section to provide additional information you feel may be necessary to describe your firm's qualifications for this contract.

7. **Annual Average Professional Services Revenues of Firm for Last 3 Years**. Complete this block for the firm or branch office for which this form is completed. In column a, enter an approximate percentage of total work attributable to State, Federal or Municipal Work. In column b, enter an approximate percentage of total work attributable to Non-Government work. Percentages should take into consideration work completed over the last 3 years.

8. **Authorized Representative**. An authorized representative of the firm or branch office must sign and date the completed form. Signing attests that the information provided is current and factual. Provide the name and title of the authorized representative who signed the form.

List of Disciplines (Function Codes) for Question 7

Aeronautical Engineer
Agricultural Engineer
Archeologist
Architect
Architectural Engineering
Biologist
CADD Technician
Chemical Engineer
Civil Engineer
Construction Manager
Construction Inspector
Control Systems Engineer
Cost Engineer/Estimator
Ecologist
Electrical Engineer
Environmental Engineer
Environmental Scientist
Fire Protection Engineer
Geodetic Surveyor
Geographic Information System Specialist
Geological Engineer
Geologist
Hydrographic Surveyor
Hydraulic Engineer
Hydrologist
Industrial Engineer
Landscape Architect
Mechanical Engineer
Metallurgical Engineer
Mining Engineer
Nuclear Engineer
Petroleum Engineer
Photogrammetrist
Project Manager
Sanitary Engineer
Soils Engineer
Structural Engineer
Technician/Analyst
Transportation Engineer
Water Resources Engineer

List of Experience Categories (Profile Codes for Question 8)

Acoustics, Noise Abatement
Aerial Photography; Airborne Data and Imagery Collection and Analysis
Activity Centers
Air Pollution Control
Airports; Navaids; Airport Lighting; Aircraft Fueling
Airports; Terminals and Hangars; Freight Handling
Agricultural Development; Grain Storage; Farm Mechanization
Animal Facilities
Anti-Terrorism/Force Protection
Area Master Planning
Auditoriums and Theaters
Automation; Controls; Instrumentation
Barracks; Dormitories
Bridge Design: Bridges
Cartography
Cemeteries *(Planning and Relocation)*
Chemical Processing and Storage
Child Care/Development Facilities
Codes; Standards; Ordinances
Cold Storage; Refrigeration and Fast Freeze
Commercial Building *(Low Rise)*; Shopping Centers
Community Facilities
Communications Systems; TV; Microwave
Computer Facilities
Conservation and Resource Management
Construction Management
Construction Surveying
Corrosion Control; Cathodic Protection Electrolysis
Cost Estimating; Cost Engineering and Analysis; Parametric Costing; Forecasting
Cryogenic Facilities
Construction Materials Testing
Dams *(Concrete; Arch)*
Dams *(Earth; Rock)*; Dikes; Levees
Desalinization *(Process and Facilities)*
Design-Build - Preparation of Requests for Proposals
Digital Elevation and Terrain Model Development
Digital Orthophotography
Dining Halls; Clubs; Restaurants
Dredging Studies and Design
Design & Planning Structured Parking Facilities
Detention Security Systems
Disability / Special Needs
Ecological and Archeological Investigations
Educational Facilities; Classrooms
Electrical Studies and Design
Electronics
Elevators; Escalators; People-Movers
Energy / Water Auditing Savings
Energy Conservation; New Energy Sources
Environmental Impact Studies, Assessments or Statements
Fallout Shelters; Blast-Resistant Design
Fire Protection
Fisheries; Fish Ladders
Forensic Engineering
Garages; Vehicles Maintenance Facilities; Parking
Gas Systems *(Propane; Natural, Etc.)*
Geodetic Surveying: Ground and Airborne
Heating; Ventilating; Air Conditioning
Highways; Streets; Airfield Paving; Parking Lots
Historical Preservation
Hospital and Medical Facilities
Hotels; Motels
Housing (Residential, Multi-Family; Apartments; Condominiums)
Hotels; Motels
Hydraulics and Pneumatics
Hydrographic Surveying
Industrial Buildings; Manufacturing Plants
Industrial Processes; Quality Control
Industrial Waste Treatment
Intelligent Transportation Systems
Infrastructure
Irrigation; Drainage
Judicial and Courtroom Facilities
Laboratories; Medical Research Facilities
Land Surveying
Landscape Architecture
Libraries; Museums; Galleries

Lighting *(Interior; Display; Theater, Etc.)*
Lighting *(Exteriors; Streets; Memorials; Athletic Fields, Etc.)*
Labs - General
Labs – Research – Dry
Labs – Research – Wet
LEED Accredited A/E
LEED Independent 3rd Party Building Commissioning
Mapping Location/Addressing Systems
Materials Handling Systems; Conveyors; Sorters
Metallurgy
Materials Testing
Measurement / Verification / Conservation Water Consumption Savings
Mining and Mineralogy
Medical Related
Modular Systems Design; Fabricated Structures or Components
Mold Investigation
Museums
Nuclear Facilities; Nuclear Shielding
Office Buildings; Industrial Parks
Outdoor Recreation
Petroleum and Fuel *(Storage and Distribution)*
Photogrammetry
Pipelines *(Cross-Country - Liquid and Gas)*
Phase I Environmental
Prisons & Correctional Facilities
Plumbing and Piping Design
Prisons and Correctional Facilities
Product, Machine Equipment Design Pneumatic
Structures, Air-Support Buildings Power Generation,
Transmission, Distribution Public Safety Facilities
Radar; Sonar; Radio and Radar Telescopes
Radio Frequency Systems and Shielding's
Railroad; Rapid Transit
Recreation Facilities *(Parks, Marinas, Etc.)*
Refrigeration Plants/Systems
Rehabilitation *(Buildings; Structures; Facilities)*
Research Facilities
Resources Recovery; Recycling
Roof Infrared Imaging to Identify Water Leaks
Roofing
Safety Engineering; Accident Studies; OSHA Studies
Security Systems; Intruder and Smoke Detection
Seismic Designs and Studies
Sewage Collection, Treatment and Disposal
Soils and Geologic Studies; Foundations
Solar Energy Utilization
Solid Wastes; Incineration; Landfill
Special Environments; Clean Rooms, Etc.
Structural Design; Special Structures
Surveying; Platting; Mapping; Flood Plain Studies
Sustainable Design
Swimming Pools
Storm Water Handling and Facilities
Specifications Writing
Toxicology
Testing and Inspection Services
Traffic and Transportation Engineering
Topographic Surveying and Mapping
Towers *(Self-Supporting and Guyed Systems)*
Tunnels and Subways
Traffic Studies
Transportation
Urban renewals; Community Development
Utilities *(Gas and Steam)*
Value Analysis; Life-Cycle Costing
Warehouse and Depots
Water Resources; Hydrology; Ground Water
Water Supply; Treatment and Distribution
Wind Tunnels; Research/Testing Facilities Design
Waste Water Treatment Facility
Water Well Rehabilitation; Water Well Work
Zoning; Land Use Studies

(If a firm has branch offices, complete for each specific branch office seeking work.)

1. REVISED ADSPO13-00003465*: Annual Request for Qualifications*

a.	FIRM (OR BRANCH OFFICE) NAME:	CEMSol LLC
b.	FIRM (OR BRANCH OFFICE) STREET:	4809 E Thistle Landing Suite 100
c.	FIRM (OR BRANCH OFFICE) CITY:	Phoenix
d.	FIRM (OR BRANCH OFFICE) STATE:	AZ
e.	FIRM (OR BRANCH OFFICE) ZIP CODE:	85044

f.	YEAR ESTABLISHED:	2004

(g1).	OWNERSHIP - TYPE:	LLC – Partnership
(g2)	OWNERSHIP - SMALL BUSINESS STATUS:	Women Owned Small Business

h.	POINT OF CONTACT NAME AND TITLE:	David Cirulli VP Engineering
i.	POINT OF CONTACT TELEPHONE NUMBER:	602-790-5096
j.	POINT OF CONTACT E-MAIL ADDRESS:	dcirulli@cemsol.com

k.	NAME OF FIRM *(If block 1a is a branch office)*:	CEMSol LLC

2. EMPLOYEES BY DISCIPLINE

a. Discipline Title	b. Function: Primary (P) or Secondary (S)	c. No. of Employees - Firm	d. No. of Employees - Branch
Aeronautical Engineer	P	12	No Branches
Control Systems Engineer	S	1	No Branches
Cost Engineer/Estimatro	P	4	No Branches
Ecologist	S	1	No Branches
Electrical Engineer	P	4	No Branches
Environmental Engineering	P	1	No Branches
Environmental Scientist	P	1	No Branches
Geographic Information System Specialist	P	3	No Branches
Industrial Engineer	P	2	No Branches
Mining Engineer	P	2	No Branches
Nuclear Engineer	P	4	No Branches
Petroleum Engineer	P	3	No Branches
Project Manager	P	3	No Branches
Technician/Analyst	P	2	No Branches
Transportation Engineer	p	2	No Branches
Water Resources Engineer	P	2	No Branches
Total		47	No Branches

3. PROFILE OF FIRM'S EXPERIENCE AND ANNUAL AVERAGE REVENUE FOR LAST YEAR

a. Approximate No. of Projects	b. Experience	c. Revenue Index Number *(see below)*
1	Aerial Photography; Airborne Data and Imagery	1
1	Codes; Standards; Ordinances	1
1	Controls and Electronics Engineer	1
1	Value Analysis; Life-Cycle Costing	2
1	Safety Engineering; Accident Studies; OSHA Studies	2
1	Cost Estimating; Cost Engineering and Analysis; Parametric Costing; Forecasting	2
1	Design-Build - Preparation of Requests for Proposals	2

PROFESSIONAL SERVICES REVENUE INDEX NUMBER

1. Less than $100,000
2. $100,000 to less than $250,000
3. $250,000 to less than $500,000
4. $500,000 to less than $1 million
5. $1 million to less than $2 million
6. $2 million to less than $5 million
7. $5 million to less than $10 million
8. $10 million to less than $25 million
9. $25 million to less than $50 million
10. $50 million or greater

4. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT (*Complete one Section 4 for each key person.)*

a. NAME	b. ROLE IN THIS CONTRACT	c. YEARS EXPERIENCE	
DAVID CIRULLI	Engineer	1. TOTAL 25	2. WITH CURRENT FIRM 10

d. FIRM NAME AND LOCATION *(City and State)*
CEMSOL LLC
4809 E THISTLE LANDING

e. EDUCATION *(DEGREE AND SPECIALIZATION)*

BS Aerospace Engineering, Penn State University,
MBA Keller Graduate School, distinction

f. CURRENT PROFESSIONAL REGISTRATION (STATE AND DISCIPLINE)
FAA Designated Engineer

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*
Boeing silver Eagle Award
Orange County Engineering Award
San Diego Society for Software Quality Key Note Speaker Recognition
FAA Software Safety Training
FAA Airworthiness & Systems Training
Professional Program Management Training - PMBOK

H. RELEVANT PROJECTS

1)

(1) TITLE AND LOCATION *(City and State)*
UAS System Compliance Assessment and Cost Analysis (firm held private, available under NDA)
CEMSOL LLC
4809 E THISTLE LANDING

(2) Year Completed
Professional Services 2013
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm
Performed top level safety compliance for UAS airworthiness. Task include cost estimates, project management, safety compliance and technical reports and customer interface as subject matter expert.

2)

(1) TITLE AND LOCATION *(City and State)*
CEMSol LLC
RTCA SC-228
Washington DC

(2) Year Completed estimated 2015
Professional Services in progress
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm
Systems Verification Lead for development of FAA standards for UAS Detect and Avoid Algorithms. Task include verification test plan create, systems level test script development and execution, test report, qualification and conformity. As lead, responsible for multi-disciplined large team coordination, budget, WBS, flight test asset management

3)

(1) TITLE AND LOCATION *(City and State)*
Large Scale Software Development CEMSol LLC
Honeywell & Boeing C-17
Phoenix AZ, Long Beach CA

(2) Year Completed
Professional Services 2010
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm
Responsible for all aspects of software development to DO178B for Weather Radar, Electronic Flight Control, Warning Annunciation systems along with Global Air Traffic Management (GATM) certification. Flight Management System (FMS) application using multiple generation of traditional airplane Avionics architectures. Responsible for system interfaces, card communications, software architecture, system requirements, system validation & verification, customer interface for Boeing 767/757, 747, A320, A340, MD11, J130 and MD80.

4)

(1) TITLE AND LOCATION *(City and State)*
Boeing C-17
Long Beach CA Program Manager

(2) Year Completed
Professional Services 2009
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm
Successfully developed comprehensive basis of estimate (BOE) detailed quote estimates in support of the software supplier management for the next generation C-17 Formation Flying System (FFS) Successfully negotiated effort with Strategic Program Office (SPO) in support of the FFS program
Managed team for comprehensive C-17 avionics GATM compliance

5)

(1) TITLE AND LOCATION *(City and State)*
UAS System Airworthiness and Diagnostic Analysis (firm held private, available under NDA)
CEMSOL LLC
4809 E THISTLE LANDING

(2) Year Completed
Professional Services 2011
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE ☒ Check if project performed with current firm

Developed Mil 516 airworthiness for high altitude long endurance UAS system. Tasked include FHA, FTA, Project System Safety Program and Verification plans.
Installing System Safety capability to SUAV system with both Mil 516 and FAA compliance goals
Developed roadmap to FAA and Mil 516 AW compliance for UAS system with equivalent Part 23 features
Completed SW FMECA for UAV grounds station
Delivered multiple DO-178B and DO-254 training session to clients

4. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT (*Complete one Section 4 for each key person.)*

a. NAME	b. ROLE IN THIS CONTRACT	c. YEARS EXPERIENCE	
Joseph Chu	Lead SW Engineer	1. TOTAL 18	2. WITH CURRENT FIRM 1

d. FIRM NAME AND LOCATION *(City and State)*
CEMSOL LLC
4809 E THISTLE LANDING

e. EDUCATION *(DEGREE AND SPECIALIZATION)*

BACHELOR OF ELECTRICAL ENGINEERING
Concordia University, Montreal, Canada (Major: Control Systems)

D.E.C. IN ELECTRONIC-TECHNOLOGY
Dawson College, Montreal, Canada (Major: Electronic Design and Applications)

f. CURRENT PROFESSIONAL REGISTRATION (STATE AND DISCIPLINE)

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*
Member of the Institute of Electrical and Electronic Engineers (IEEE).
Member of the Dawson College Alumni Association (Electrotech Chapter).

H. RELEVANT PROJECTS

1)

(1) TITLE AND LOCATION *(City and State)*
Honeywell CAS
Embedded Software Development
Phoenix AZ

(2) Year Completed
Professional Services 2011
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[ ] Check if project performed with current firm

Initial developed the engine code for the following functions: MCDU line select, internal manager, Display manager, Page and page management for NG (Next generation) FMS Crew Interface auto generated code. Software coding of validate convert and display format for all Crew Interface for A380 project.
Initial code development of EFIS VSD for B787 (Decision gate, Reference approach vector, waypoints and MAP etc.). Defined IO mapping for B747-8 and G5, and Crew interface requirements for NG FMS. Support of analysis for identified defects found internally or externally to Honeywell Debug and fix the System requirements and software codes SCRs to meet customer build exit criteria.
Software languages/Tools used: C++, C, Ada, MATLAB/Interleaf, Team Center, Rational ClearCase, Rational ClearQuest, Doors, ACM, A661, A429, A739, IOGT, CIT, HMIDB, ITEG, HSS, CodeWizard, Eclipse, FMSpy .

2)

(1) TITLE AND LOCATION *(City and State)*
L3- ACSS
Embedded Software Development
Phoenix AZ

(2) Year Completed estimated 2015
Professional Services 2005
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm

Software development and maintenance of the Display, IO, ATCRBS and MODE S Surveillance for TCAS 3000 system. This includes code implementation as per new customer requirements and fix the existing problem CRs, which have found during the flight test, in field and in house testing.
- Systems design and software development (Embedded C/C++) to DO-178B standards for the TCAS 3000 system.
- Preliminary design of driver-suite for TCAS display and IO modules.
- Design the makefiles for Display and I/O software and test environment build.
- Software languages/Tools used: C++, C/Rational ClearCase, Rational ClearQuest, A653 Sampling & Queuing ports, A429, Multi-View debugger, Valfac.

3)

(1) TITLE AND LOCATION *(City and State)*
787 Avionics Diagnostic System
Embedded Software Development
CEMSol LLC
Phoenix AZ

(2) Year Completed
Professional Services 2009
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[X] Check if project performed with current firm

Responsible for all aspects of software verification for the safety critical diagnostic computer developed for the 78 systems along with Global Air Traffic Management (GATM) certification All scrpte developed to DO178 FAA software standards and independently reviewed for quality assurance.

4)

(1) TITLE AND LOCATION *(City and State)*
CDI Tech Services
Phoenix AZ

(2) Year Completed
Professional Services 2004
Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE
[ ] Check if project performed with current firm

- Prime S/W coding (Visual C++) of Data logger for AS977/AS907 Engines. RS232 to USB protocol decoding was used in this task. (Honeywell AE&S AS907)
Initial S/W development of Binary Converter, a tool that decodes the raw binary data into text format. The text information was used to analyze the maintenance condition and performance of the A/C, which were logged and recorded from each flight test.
- Directly responsible for the development of the following documents: Software Requirement Specification (SRS), Software Design Document (SDD) and Software Test Plan (STP).
- System integration and debugging of the avionics interfaces (ARINC429, USB, RS422 & RS232).
- Responsible for the systems design, coding and certification of ECFR and ECU of engine control systems for BAE RJX and Bombardier RJ airplanes (C++ & Python Scripts). (Honeywell AE&S AS900)
- Initial development of the test utilities tool, test drivers, test scripts and test database for ECFR code in NT environment with HTML (Access 97 Database, C, Python and Java languages), including hardware bench designs, test environment set up and tool qualification for ECU.

5)	(1) TITLE AND LOCATION *(City and State)* *CAE Electronics* *St Laurent CA*	(2) Year Completed Professional Services 2000	Construction *(if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE ☐ Check if project performed with current firm - Development and testing of mathematical models and Real-Time software (C/C++, FORTRAN, PASCAL, MATLAB) to simulate various Avionics systems. This included development and testing of Navigation Radios (VOR, ILS, DME, TACAN, ADF, Marker Beacon), Navigation (IRS, ADIRU, AHRS, GPS), ATC/TCAS, IFF and Flight Instruments. This also included familiarization with and integration with Flight Guidance Control/Autopilot, Flight Management Systems, MCDU BITE, Data loader (Visual C++) and EFIS and EICAS systems. - Prototype simulation of Collins' and Litton's IRS, GPS & AHRS, Honeywell's IRS, ADIRU, SAARU, GPS systems, and ISDU, MSU panels. - Designed and maintained the FMS and MCDU S/W interfaces with other avionics system including FANS, ACARS, Auto pilot, Flight Director, Inertial Navigation, Air Data, Radio Navigation, EFIS-EICAS. - Prime real-time software system engineer, directly responsible for the development of embedded software, SDD, ATM, debugging of the system software and of the avionics interfaces. - On-site installation, integration, testing, and troubleshooting.		

4. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT *(Complete one Section 4 for each key person.)*

a. NAME	b. ROLE IN THIS CONTRACT	c. YEARS EXPERIENCE	
Edward Hopkins	Lead HW Engineer	1. TOTAL 16	2. WITH CURRENT FIRM 1

d. FIRM NAME AND LOCATION *(City and State)*
CEMSOL LLC
4809 E THISTLE LANDING

e. EDUCATION *(DEGREE AND SPECIALIZATION)*

f. CURRENT PROFESSIONAL REGISTRATION (STATE AND DISCIPLINE)

M.S., Electrical Engineering
Thesis: "System Identification for High Dimensional Nonlinear Systems"
B.E., Electrical Engineering
Design: "Low-Cost Inertial Smart Sensor"
B.A., Liberal Arts
Major: Engineering Sciences mod. w/ Computer Science

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*
AIAA GNC (American Institute of Aeronautics and Astronautics, Guidance, Certifications Navigation, and Controls) Conference 2003 in Austin, Texas. Dartmouth College / Thayer School of Engineering Aug, 2000. Seminar: "The Technical Engineer In Transition to Management"Instructor: Ron Read, Senior VP of ITT/Canon.

Publications ● Hopkins, E., Phan, M., "A multiple-cut identification technique for large-dimensional nonlinear systems," Conference Proceedings, AIAA GNC 2003.

H. RELEVANT PROJECTS

	(1) TITLE AND LOCATION *(City and State)*	(2) Year Completed	
1)	*UAS Client (name available upon NDA)* *CEMSol Embedded Hardware Development* *Phoenix AZ*	Professional Services In progress	Construction *(if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE Developing hardware platforms and technology for high reliability safety systems in preparation for UAS deployment in US national airspace Responsible for all hardware design, requirements, programming and test .	[X] Check if project performed with current firm	
	(1) TITLE AND LOCATION *(City and State)*	(2) Year Completed estimated 2015	
2)	Lincoln Electric Embedded HW Engineer *San Diego CA*	Professional Services 2012	Construction (*if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE •TI ARM Stellaris complex hardware drivers for 3-axis motion control system •Application is orbital TIG and MIG arc welding robotics •Motion control for 200A 40V welding torch with ~10 msec positional control •Communication via CAN and CANOpen serial protocol.	[ ] Check if project performed with current firm	
	(1) TITLE AND LOCATION *(City and State)*	(2) Year Completed	
3)	Intellisis Embedded HW Engineer *San Diego CA*	Professional Services 2011	Construction *(if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE R&D arm of defense contractor (voice recognition / pattern-matching) ● Software tools lead for new parallel microprocessor design ● Work with hardware designers to consider new features beneficial to instruction set ● Architect new compiler toolchain based on LLVM backend	[ ] Check if project performed with current firm	
	(1) TITLE AND LOCATION *(City and State)*	(2) Year Completed	
4)	Acutus Medical Embedded HW Engineer *San Diego CA*	Professional Services 2010	Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

☐ Check if project performed with current firm

Application is a catheter based arrhythmia diagnostic tool for electrophysiologists.
● Participated and recommended design solution for embedded layer reading data from AD7762 high performance ADC's to a Blackfin BF561 dual core DSP.
● Author ICD's and design documentation.
● Develop prototype system with eval boards to author initial DSP SW.
● Support PCB schematic design for digital system. Participate in design reviews.
● Port initial software to PCB and support HW test/debug.
● Develop multithreaded MFC serial test/debug app to stream data from DSP to real-time plotting window via 921.6 Kbps serial cable.
● Supported upper layer design decision making and directed concept to using a single board computer running Ubuntu Linux. Evaluated several connection design options including PCIe based FPGA and Fastcom RS422 high speed serial cards to talk to DSP.
● DSP software drivers included: PPI (parallel port), SPI, UART, SPORT, timers, GPIO ISR's, and a GPIO encoding/decoding scheme to talk to a Xilinx CPLD that controlled digital timing lines to drive ADC's. System also includes a DDS and ultrasound.

5)

(1) TITLE AND LOCATION *(City and State)*
Draper Labl
Modeling & Simulation - Embedded HW Engineer
San Diego CA

(2) Year Completed

Professional Services 2008	Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

☐ Check if project performed with current firm -

Development and testing of mathematical models and ●

Integration and test for defense contractor (chiefly Trident II GNC subsystem).
● Manage requirements analysis, design, assembly, integration, test, and operation of Hardware In the Loop (HWIL) testing for high-performance inertial navigation systems.
● Work with software developers and dynamicists responsible for porting Matlab / Simulink models to custom C++ application code and system I/O to Unit Under Test.
● Designed PCB's, FPGA test boards, and Red Hat Linux based (kernel-space) serial device drivers to manage communication links between UUT and dynamical simulation environment.

4. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT *(Complete one Section 4 for each key person.)*

a. NAME	b. ROLE IN THIS CONTRACT	c. YEARS EXPERIENCE	
		1. TOTAL	2. WITH CURRENT FIRM
EDMUND C. BAROTH, PH.D.	Program Manager	30	2

d. FIRM NAME AND LOCATION *(City and State)*
CEMSOL LLC
4809 E THISTLE LANDING

e. EDUCATION *(DEGREE AND SPECIALIZATION)*

f. CURRENT PROFESSIONAL REGISTRATION (STATE AND DISCIPLINE)
Many see below

University of California, Berkeley, California
Ph.D. Mechanical Engineering, June 1981
Thesis Title: Investigation of Supersonic Separated Flow in A Compression Corner by Laser Doppler Anemometry
Major: Fluid Mechanics Minors: Heat Transfer, Mathematics
M.S. Mechanical Engineering, June 1976
City College of New York (CCNY), New York, New York
B.E. Mechanical Engineering, June 1975, cum laude

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*

Patents, Honors

Provisional Patent NPO 42584 “Acceleration/Deceleration Information Sensor,” February 15, 2006
Patent No. 5,317,389 “Method and apparatus for white-light dispersed-fringe interferometric measurement of corneal topography,” May 31, 1994.
Patent No. 5,307,096 “Computer driven optical keratometer,” April 26, 1994.
Patent applied for “Onset of Labor detector,” May 20, 1994.

NASA Group Achievement Award – Computing Systems and Interoperability SIG, (2008)
NASA Group Achievement Award – T&V Systems Integration Groups Support Team, (2007)
JPL Level B Award for ISHM (2005)
NASA Group Achievement Award – Propulsion Measurement Sensor Development Workshop Team, (2004)
Certificate of Appreciation, OSP Program Office, MSFC (2004)
Certificate of Appreciation, Northrop Grumman, (2003)
NASA Certificate of Recognition (2001)
NOVA Award, (2000)
Technical Consultant for NASA Space Transportation Video “Integrated Vehicle Health Management, ” narrated by Mark Hamill, (2000)
JPL Level B Award for IVHM (1999)
Mars Pathfinder Microrover Certificate of Achievement, (1998)
Manned Flight Awareness Award - BETSCE (Brilliant Eyes 10K Sorption Cryocooler Experiment, (1996)
NASA Certificate of Recognition (1995)
JPL Technology Applications Program Group Achievement Award - BETSCE (Brilliant Eyes 10K Sorption Cryocooler Experiment, 1994)
ASME Outstanding Section Award (1993-1994)
NASA Group Achievement Award - GOPEX (Galileo Optical Experiment, 1993)
NASA Certificate of Recognition (1992)
NASA Certificate of Recognition (1991)
NASA Certificate of Recognition (1990)
ASME Region IX Best Newsletter Award (88-89)
NASA Certificate of Recognition (1987)
California State Regents Fellowship (1975)
Mechanical Engineering Alumni Award (1975, City College)
New York State Regents Scholarship (1970-75)

Publications

Books, Magazine Articles

“LabVIEW Enables the Communication Process,” Baroth and Hartsough, pp. 1-14, “Data Acquisition from Space via the Internet,” Baroth and Wells, pp. 185-197, “Advanced LabVIEW Applications for Space Missions,” Baroth and Wells, pp. 199-218, LabVIEW Power Programming, edited by Gary W. Johnson, McGraw Hill, New York, 1998.

“Experience Report: Visual Programming in the Real World,” Baroth and Hartsough, Visual Object Oriented Programming, edited by M. Burnett, A. Goldberg and T. Lewis, Manning Publications, Greenwich, CT, Prentice Hall, 1995, pp. 21-42.

“An Evaluation of LabVIEW 5.0 and HP VEE 5.0,” Baroth et. al., Evaluation Engineering Magazine, Part 1, April, 1999, pp. 64-75, Part 2, May, 1999, pp. 22-28.

“Ethernet Data Acquisition,” McGregor, Baroth and Burns, Evaluation Engineering Magazine, January, 1999, pp. 22-28.

H. RELEVANT PROJECTS

	(1) TITLE AND LOCATION *(City and State)*	(2) Year Completed	
1)	*UAS Client (name available upon NDA)* *CEMSol JPL Liaison and Program Manager* *Phoenix AZ*	Professional Services In progress	Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[X] Check if project performed with current firm

Ran the LMCO development program. Delivered on time, on budget with above expected results.
.

2)

(1) TITLE AND LOCATION *(City and State)*
JET PROPULSION LABORATORY
Program Manager
Pasadena CA

(2) Year Completed estimated 2015

Professional Services 2011

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[ ] Check if project performed with current firm

Exploration Systems and Technology Office (ESTO) (Constellation Office)
Member of Constellation Program's SE&I (System Engineering and Integration) SAvIO (Software and Avionics Integration Office). Technical work at Constellation Program level. Support in System Engineering, Test & Verification, Command & Control, software verification and fault management. Roles include POC for Caution and Warning (C&W) and Test and Verification for Fault Management. Activities include writing and reviewing verification requirements, review of Program and Project level SAvIO architecture, avionics, test & verification, software, fault management and system engineering documents. Member of NASA-wide teams in many of the above areas. Presentations at Constellation review and hosted a C&W TIM at JPL.
.

3)

(1) TITLE AND LOCATION *(City and State)*
JET PROPULSION LABORATORY
Program Manager
Pasadena CA

(2) Year Completed

Professional Services 2009

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[ ] Check if project performed with current firm

Vehicle Health Information Systems, Space Mission Information Technology Office, (982)
Program development for JPL and NASA in ISHM. Extensive contact with other NASA Centers, non-NASA Agencies (DOD) and industry. Participated on NASA-wide ISHM team. Developed industrial relations for Code T/ESTO inter and extra-mural proposals. Interaction with additional JPL technologies (e.g., autonomy, IT). Accomplishments include creating, developing and managing JPL's interest in ISHM by extending it to support NASA (funding of inter/intra-mural proposals), part of CEV ISHM team (lead by ARC) and non-NASA applications (e.g., JSF, SSME, DSN, NAVSEA)
Work with HW lead in designing ARM IP core to control high speed SERDES

4)

(1) TITLE AND LOCATION *(City and State)*
JET PROPULSION LABORATORY
Program Manager
Pasadena CA

(2) Year Completed

Professional Services 2005

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[ ] Check if project performed with current firm

JPL Crew Exploration Vehicle (CEV) Deputy Proposal Manager for Northrop Grumman/Boeing team.
Prepared JPL proposals/task plans for role in CEV. Close partnership with industry to identify areas of collaboration, selection of JPL team members, preparation of statement of work, schedules and reviews for proposal. Managed team members across Engineering Divisions and included Contracts Office and Office of General Council..

5)

(1) TITLE AND LOCATION *(City and State)*
JET PROPULSION LABORATORY
Program Manager
Pasadena CA

(2) Year Completed

Professional Services 2004

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[ ] Check if project performed with current firm - Development and testing of mathematical models and •

Advanced Sensor System Technology Task.
JPL rep. on the NASA-wide team that investigated concepts and technologies to determine the best approach for an integrated vehicle sensor and health management system (IVHM) that enables rapid and reliable servicing of reuseable launch vehicles (RLV). Required interacting with members from other NASA Centers, NASA HQ, and industry. Required close interaction with Program Office at Ames Research Center. Included program development at JPL of wireless, advanced sensors and advanced analysis techniques. Included cost and scheduling for NASA in-house tasks. Co-chair of NASA Sensor Working Group, to coordinate sensor

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT #1 *(Present no more than five (5) projects. Complete one Section 5 for each project.)*		
a. TITLE AND LOCATION *(City and State)* Lockheed Martin – Early Warning Diagnostic Fault Detection Atlanta GA	b. YEAR COMPLETED	
	PROFESSIONAL SERVICES 2011	CONSTRUCTION *(If applicable)*

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER Lockheed Martin	d .DOLLAR AMOUNT OF PROJECT $70,000	e. TOTAL COST OF PROJECT $70,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

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CEMSol has been engaged to assist in the evaluation of the System Health Monitoring technology Inductive Monitoring System (IMS) by Lockheed Martin Aerospace. This technology was written and created by the National Aeronautics & Space Administration (NASA) at Ames Research Center and CEMSol is its licensee and commercial support organization.

The objectives were to:

- Demonstrate the identification process and isolation of anomalous state(s) of the system, prior to failure of the starter control valve (SCV).
- Document the process of applying IMS to the C-130J, including any necessary customization of IMS or the use of extensions or dimensions of IMS for the translation of platform-specific data formats, etc.
- Develop recommendations for further study of the application of IMS to Lockheed Martin Aerospace platforms.

CEMSol has executed an independent analysis of data provided by Lockheed Martin Aerospace, using the IMS (and it's AMISS/ ODVEC Algorithms) technology to demonstrate an automatic and system based fault detection capability. Lockheed Martin Aerospace provided a truncated sampling of data from the SCV valves from the target platform: C-130. The data was from engines from previous flights and various aircraft over a three-year period of time. A correlation analysis to identify and verify the selection of relevant input signals for analysis was deployed. This analysis had no a priori knowledge of the system or of any faults or anomalies. Additionally, the purpose of this analysis was to identify or determine indications of faults or anomalies conditions. Component failure causes were beyond the study scope.

Lockheed Martin Aerospace provided 18 data sets total, from 16 different aircraft and included data from all four engines with a total start events ~200 - ~800 in each data set. The data provided was raw and disparate, so it was necessary to "normalize" and to assign weights to each sensor data. Additional analysis was added by examining minimum and maximum value ranges. Given a set of raw data, the first task was to convert and format the data to make suitable as IMS input data and then refine the processing parameters in order to detect off nominal conditions in the data. That is to flag any events those were non-nominal or out of the ordinary as the input data set contained both normal operations and failure operations scenarios. IMS knowledge base creation uses only normal operational data. Cleaning the data for failure conditions was an extra processing step for this demonstration. The process to convert Lockheed Martin Aerospace data to input to IMS input data is shown as part of the Results section.

All the Engine start up data, including APU, Bleed Air Pressure, etc. from all of the C130 data sets were examined to generate a piecewise linear correlation matrix (a technique that augments the regular correlation calculations to provide results more relevant to IMS for these types of data sets). This helped to narrow the parameters selection to the most relevant ones. As part of the diagnostic refinement process, it is possible that further analysis could reveal that some of these parameters might find more subtle influences and interactions.

Actual IMS tool processing execution times for the anomaly detection analysis of the aircraft tail data set for single engine was less than 1 second on a standard laptop. The IMS knowledge base construction process (used to build the system model used for anomaly detection analysis) also ran in under one second.

Examples of different types of anomalies were detected in the data set and are shown in this report. These were analyzed using the IMS tools which compare the incoming monitored data to the data for normal operation of the engine. These include mechanical anomalies, increased deviations trends as prognostication indicators that warn of possible equipment degradation or pending failure, aborted starts, slow or stalled spin ups anomalies which could be procedure violation, incorrectly applied or interfaced hardware, as well as possible engine malfunction. Also included are too fast start anomalies, which normally may not be considered harmful, but nonetheless this is an unusual or non-nominal event, false start anomalies, where the starter was activated but didn't have APU or bleed air and engine start volatility anomalies, where the engine spins-up and slows down multiple times before it starts. All these were analyzed and plotted using IMS and are shown in the Results section.

As a result of this study, CEMSol was able to recommend early warning indicator for preventative maintenance for the system to ensure uptime reliable service.

This same concept can be applied to Power Management, Water Management, Network Management, Industrial Controls & System Health Management to reduce cost by up to 25% over tradition fault detection and preventative maintenance.

Lockheed Spent $70K and was able to recover 10x the amount in lower maintenance cost and mission delays!!!

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT #2

(Present no more than five (5) projects. Complete one Section 5 for each project.)

a. TITLE AND LOCATION *(City and State)*	b. YEAR COMPLETED	
	PROFESSIONAL SERVICES	CONSTRUCTION *(If applicable)*
Boeing C-17– GATM Airworthiness Compliance Long Beach, CA	2011	

23. PROJECT OWNER'S INFORMATION

c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
Boeing C-17	$365,000	$365,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

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This evaluation covered the legacy C17 airplane configurations as of P99 and any planned updates after that date and prior to P153. The Twenty Eight (28) systems identified in Appendix A are used to support CNS/GATM functionality for the aircraft and evaluated to DO178B certification compliance. The evaluation includes the specific revision level of the system addressed, DO-178B compliance gaps to the GATM software criticality levels and recommended course of action to resolve DO-178B compliance gaps.

Section 3 contains a description of the C-17 Gap Analysis process and general DO178B compliance findings. Also included in this section is an implementation approach for completion of the identified Gap Resolution Actions.

Summary

The detailed DO178B compliance findings for each LRU system are documented in Appendix B. Generation of this data was created by audits of the LRU design data following DO178B approved analysis methods. Each LRU analysis consisted of completion of a 35 page DO178B compliant checklist. Part of the analysis activity included an onsite customer audit by Boeing DO178B Subject Mater Experts (SME) to evaluate the Supplier's capability to meet DO178B process and infrastructure compliance. This onsite audit was completed for all but a few LRUs where either DO178B compliance was already recognized or the lack of auditable software design data made the onsite task unnecessary.

The comprehensive LRU audit evaluated supplier conformance to Configuration Management, Engineering and Quality Assurance processes to determined consistency of process application to the engineering development and support efforts. Table 1 below describes the summary Gap compliance categories associated with the 28 LRU systems evaluated.

Table 1 GAP Summary Compliancy

GAP Summary Compliance Category	LRU Count	Comments
DO-178B Compliant	**7**	Configuration Compliant to DO-178B
Minor gaps	**2**	Minor gaps , no HW/SW changes identified
Moderate to Major	**14**	Moderate to Major re-engineering, LRU SW and/or HW change
Re-Design	**5**	Complete re-engineering or LRU Replacement
Total LRUs	**28**	

The results of this report were used to perform cost analysis on future expenditures on equipment updates to ensure the C-17 could fly the GATM air routes in European airspace. Access to the GATM routes provides a $3,000/flight hour when operating the aircraft in European airspace. ***This was a net savings of over $1.5M annually in reduced operations costs.***

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT #3

(Present no more than five (5) projects. Complete one Section 5 for each project.)

a. TITLE AND LOCATION *(City and State)*	b. YEAR COMPLETED	
	PROFESSIONAL SERVICES	CONSTRUCTION *(If applicable)*
Honeywell – AIMS Diagnostic Software Development Phoenix, AZ	2008	

23. PROJECT OWNER'S INFORMATION

c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
Honeywell	$285,000	$285,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

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Program Overview

The 777 IMA platform developments is the creation of a new generation platform for use on the 777 AIMS. The original 777 AIMS, certified in 1995, contained over one million lines of functional application code. These platform updates will be developed to ensure minimal impact to that code and to the other airplane subsystems that interface with the 777 AIMS. The release of the software and associated documentation for the 777 AIMS platform was classified as DO-178B, Level A. This next generation platform activity will also need to be developed and verified to DO178B Level A criteria for certain portions (e.g. the Rogue partition). The End Item Test function test will be developed to DO178B Level A standards, but no formal testing will be performed.

The HADS development used in the original program will be used during this project. The new generation of the NT based tools set will be used for the development. Even with the goals to maximize reuse of the existing application, it has been determined that some extensive to the software requirements will be necessary. Our Team intends to minimize project cost and schedule by reusing as much as possible of the power-up BITE testing developed for the 777 AIMS 2 platform work.

No formal verification of EIT software will be performed. An EIT Software Verification Test plan will be developed and adopted to ensure that a consistent test philosophy is used by all engineers engaged in this project. The test plan will define minimum criteria for the informal test execution and standards for recording and reporting informal test results.

The objective of this project is to design, document and code the End Item Test requirements to a DO178B level A, then perform verification of this software to DO178B level E. This total End Item Test will consist of a combination of the embedded Power-Up BITE test (level A functionality) and another set of additional tests that are designed to cover the remaining hardware functionality. The tests run in a specially developed test execution environment and exercise the 777 AIMS 2 hardware platform.

Table 1 *Project Summary*

EIT Components	*CPU*	*GG*	*IO*	*Comm*	*Total*
# of Hardware Requirements	Tbd	Tbd	Tbd	Tbd	Tbd
# of Software Requirements	235	199	65	240	739
# EIT	98	83	27	100	308
# SLOCS	7,840	6,640	2,160	8,000	24,640

The project goals are identified:

a. Complete design, code, integration and verification activities with-in the scoped budget and schedule following the procedures specified in this program plan for the following EIT components:

- Processor CCA
- GG Client Card
- IO Client Card
- Comm Client Card

b. Use the EIT functionality early in the hardware development to decrease the hardware time to functional stability

c. Ensure the EIT functionality is ready for use in the early production (red label) units delivery.

Project Activities Synopsis

The following activity list provides a complete list of tasks and activities associated with this project. Detailed description of these tasks and activities are provide in section

1.0 Plan the project : define process, schedule, metrics collection, development environment & training packages

2.0 Draft a Hardware-SRD-EIT Test Matrix

3.0 Complete Tools/Environment training

4.0 Set up SRD and Code/Test Development Environments

5.0 Define EIT Task Work Breakdown:

- 5.1.1 Allocate Hardware Requirements into categories
- 5.1.2 Allocate Hardware Requirements to Software Requirements
- 5.1.3 Allocate Software Requirements to End Item Tests

6.0 Develop End Item Test Software Requirements Document

6.1.1 Review HRD Design requirements allocation

6.1.2 Review existing EIT SRD & Test Documentation

6.1.3 Develop new EIT SRD requirements per standards

7.0 Independently Review EIT Software Requirements Document

8.0 Configure SRD Document

9.0 Develop End Item Test Code

10.0 Compile End Item Test Code

11.0 Build & Integrate End Item Test Code

12.0 Perform ETI Test Code Verification

13.0 Independently Review Code & EIT Test Results

14.0 Configure EIT Test and results

15.0 Perform EIT Tests in support of Hardware R/L releases

16.0 Integrate EIT and Power-Up BITE Tests into an EIT Test Suite

17.0 Execute EIT Test Suite

18.0 Analyze Test Execution (for failures & test coverage)

19.0 Independent Review of Test Suite Results

20.0 Review Hardware-SRD-EIT Test Matrix

21.0 Hold EIT Release Review

22.0 Perform Run for Record (down in final factory test configuration)

23.0 Develop & Review Test Summary Results Report

24.0 Release EIT Test Software to Factory

Implementation of the diagnostic BITE coverage as both run-time and factory acceptance test reduced development cost by 45% and increased effectiveness on the factory ATP. This was a net savings to Honeywell in excess of 2x the development costs.

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT #4 *(Present no more than five (5) projects. Complete one Section 5 for each project.)*		
a. TITLE AND LOCATION *(City and State)* UAS Airworthiness Compliance San Diego, CA	b. YEAR COMPLETED PROFESSIONAL SERVICES 2009	 CONSTRUCTION *(If applicable)*

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER DoD UAS Manufacture San Diego CA (full name available upon NDA)	d .DOLLAR AMOUNT OF PROJECT $425,000	e. TOTAL COST OF PROJECT $4255,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)
Notice

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INTRODUCTION

[redacted] performed an independent Software and Complex Hardware Airworthiness Assessment for the [redacted] UAS program. This assessment included an evaluation of the Airworthiness Qualification Plan (AQP) sections 10 "Diagnostics", 14.3 "Software Safety", 15 "Computer Resources", and the Software AQP Compliance Assessment as well as a DO-178B/DO-254 Capability Analysis. A common theme in the AQP is that DO-178B/DO-254 compliance is a key requirement for satisfying airworthiness in the AQP. This report provides a description on how the [redacted] program meets DO-178B/DO-254 in support of this AQP compliance requirement.

This analysis was completed on only the air vehicle portions of the program with Data Link and Ground Control Station (GCS) areas excluded. However, the Vehicle Specific Module (VSM) portions of the GCS were reviewed. The [redacted] UAS system contains many hardware and software components that made up the basis of this analysis report. For software, this included four Computer Software Configuration Items (CSCIs): Unmanned Aerial Vehicle (UAV), VSM, Payload, and Weapons. These four CSCIs contain 28 Computer Software Components (CSCs) totaling over 258,000 lines of code. On the hardware side, this analysis was performed on approximately 56 Line Replaceable Units (LRU) found on the UAV.

The purpose of this Assessment Report is to identify areas for future improvement, pertinent to the compliance aspects of the AQP and DO-178B/DO-254 for the components cited above.

This review provides only an assessment to compliance to these standards but levies no contractual requirements or authorization for changes in the program of record. The tasks and activities necessary to bring these compliance items to the desired airworthiness remain available for inclusion by [redacted].

The results of this report were used to perform cost analysis on future expenditures on equipment updates to ensure the system could be ready to fly the US national airspace. Access to the US airspace will provide a $1,000/flight hour when operating the aircraft as the need for special COA and chase airplanes will be eliminated. ***This is planned to be a net savings of over $500K annually in reduced operations costs when the UAS return from war operations.***

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT #4 *(Present no more than five (5) projects. Complete one Section 5 for each project.)*		
a. TITLE AND LOCATION *(City and State)* UAS Airworthiness Compliance Requirements Simi Valley,, CA	b. YEAR COMPLETED	
	PROFESSIONAL SERVICES 2013	CONSTRUCTION *(If applicable)*

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER DoD UAS Manufacture Simi Valley CA (full name available upon NDA)	d .DOLLAR AMOUNT OF PROJECT $225,000	e. TOTAL COST OF PROJECT $225,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)
Notice

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As part of the [redacted] Airworthiness effort, a review of [redacted] compliance to the Process Assurance Guidelines for Airborne Electronic Hardware was completed to the standards and guidance specified by RTCA DO-254. This report details CEMSol's evaluation of the [redacted] hardware development on the [redacted] program in support of the overall DO-254 Lifecycle Process compliance. The report output is a list of suggested processes and technology recommendations along with a roadmap to compliance for [redacted] Hardware organization to the reach DO-254 full compliance. This report is one of four reports. The other reports cover Quality Assurance, Configuration Management, and compliance to SW RTCA DO-178B Process Assurance.

The project completed the entire UAS safety analysis, verification tests and software requirements to support the experimental flight test. Due to the sensitive nature of this project, additional information is will be made available after execution of NDA.

6. ADDITIONAL INFORMATION

a. PROVIDE ANY ADDITIONAL INFORMATION YOU FEEL MAY BE NECESSARY TO DESCRIBE YOUR FIRMS QUALIFICATIONS. *(ATTACH ADDITIONAL SHEETS AS NEEDED.)*

Note the key staff are only subset of the personnel expertise available at CEMSol

Projects Solution Specialist

CEMSol is a …

CEMSol offers a wide variety of software engineering talent and technology solutions to clients in the aerospace, avionics, and military industries. Composed of a diverse group of professional software engineers, designers, and technical staff, CEMSol provides software development services and applications to support many areas of application.

Our roots are in aerospace and we still have a strong presence in this sector as a provider of flight management systems to this day. However, we represent over 100 person years of critical software design, development, verification, and certification across multiple platforms and a wide range of application.

Our skills, history and expert system applications interface and operate with all systems ---- particularly in embedded arena.
Further, we have close alliance with JPL and Caltech and are positioned to be a conduit for technology and application that has been created for NASA and DoD and can be reapplied for high impact commercial use.

Additionally, we are a small and woman owned business with deep history in system development and support.
Highlights of our experience and skills:

Application Development
- System Diagnostics/Prognostics
- Embedded Systems
- Configuration Management Process & Procedures
- Software Quality Assurance Process and Procedures
- Software Development Process, Procedures and Checklists
- Tool Qualification and Deployment
- Full Software Life Cycle Project Management

Extensive back ground in Real-Time (hard deadline) Application
Vehicle Performance Monitoring Systems
Engine Performance Monitoring Systems
Embedded Test and Diagnostics
Central Maintenance Systems
Mission Management Systems
Safety and Certified Application Solutions

Avionics
US FAA certified for design, development and training in FAA defined:
- Software (DO 178B)
- Hardware (DO 254)

Offer Migration Plan for Present Software Applications to FAA standards
Extensive Experience in Cockpit Integration
Offer Simulation Tools for Avionic Development, Integration, Test and Training
Flight Monitoring and Management Software

Focus: Areas of Particular Experience and Skill

Certifiable Software Development Team
CEMsol is, in the core, a software development group. The expertise we bring to this subject is very deep. These are the generic steps to full development and deployment and can be applied all development criteria.

Project Planning: Development, validation, and certification

- System Specifications: System goals, requirements, constraints and solution strategies
- Software Requirement Specification: The user audience, product scope, product functions, operating environment, design and implementation constraints, user documentation, assumptions
- Software Design & Coding: System objectives, software requirements, design constraints, data design, architectural design and development
- Software Verification & Certification: Specifies test and validation objectives, to verify software requirements, design constraints in support of system qualification and certification
- Software Quality Assurance (SQA) Plan: All checks and balances for SQA oversight and ensures they comply with regulatory standards
- System Diagnostic and Predictive Software: Application and support tools

Results

- Rapid Software Prototype
- Schedule Demands Adaptation
- Product Quality Identification and Improvement Process
- Failure Analysis Procedures

Extensive Embedded Software Expertise over Many Platforms

- Requirements – DOOR, OO Design
- Design – VAPS, Matlab, Matrix X, Rose, SCADE
- SW Embedded: C, C++, ADA , Pascal, Jovial, Asm, Fortan, Forth
- Firmware: Complex VHDL, DSP
- Test: Rational RTR, LDRA, CSIM
- RTOS: CsLeos, Integrity, VxWorks, OSE
- Embedded Test SW
- System Integrated Test
- Communications Protocols
- Moving Map
- Display Graphics
- Algorithm Development

Safety Critical Systems – Certified Software Design

Very prominent in CEMSol's library is their safety critical software that covers all phases of the air safety critical project lifecycle, compliant with all U.S. FAA certification/compliance standards. This is our roots and we still hold a high degree of efficiency in this sector.

DO-254 (Hardware Design) and 178B (Software) Critical Processes

Following the guidance and procedures outlined in RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, the U.S. Federal Aviation Association assures that the design performs its intended functions in its specified environment, and meets airworthiness requirements. Our skills include:

Flight Hardware Design Criteria - DO-254:

- Integrated System Safety Program Plan (SSPP)
- Preliminary Hazard List (PHL)
- Preliminary Hazard Analysis (PHA)
- Operation and Support Hazard Analysis (O&SHA)
- Safety Assessment Report (SAR)
- System Functional Hazard Analysis (FHA)
- Failure Modes and Effects Analysis (FMEA)
- Failure Modes and Effects Criticality Analysis (FMECA)
- Integrated Software Safety Assurance Plan (SSAP)
- Software Safety Assurance Process
- Plan for Software Aspects of Certification (PSAC)
- Plan for Hardware Aspects of Certification (PHAC)
- MIL-HDBK-516B Department of Defense – Airworthiness Certification Criteria

AZ WILL DESIRE TO PROCURE CEMSOL SERVICES WHEN:

- **Safety is needed as part of the solution**
- **Cost reduction desired through the application of early fault detection, conditioned based maintenance, and advanced diagnostics**
- **Projects that need to deliver on time and on budget**
- **Software that needs to meet performance demands, reliability and safety**

OUR TECHNOLOGY:

CEMSol ADAT – SHINE – BEAM and Integrated System Health

Background

CEMSol will be expertly capable to support the tasks in determining the applicability and relative benefits of inference engine technology to inference engine technologies due to our vast experience with inference engines and sensor data fusion system evaluation we accomplished in technical capability assessment in the commercialization of NASA/JPL technologies of IMS, SHINE and BEAM. Our company has performed similar system evaluation audits for the C-17 sub-system avionic

We are uniquely position to perform the evaluation on an un-biased basis through application of our FAA audit review processes for safety compliance, assessment and creation of baseline metrics as we completed during the Army ERMP Mil 516 airworthiness certification program. And our gap and roadmap closure plans we built for multiple UAV manufactures to reach FAA national airspace. But there is more. Once the compliance evaluation is complete, we then have the system and software know-how to implement the design changes though application our custom in-house Agile software development practice and expert testing capability.

All our staff is capable of security clearance, with a number of our team with active security status.

The AZ Dept Rev can be assured that CEMSol sensor fusion and inference engine experience along with our agnostic approaches to evaluations and capacity to implement what we recommend will provide the best in class capability to support the Arizona projecs with inference engine technology integration. We are not verse and chapter folks who can preach a good sermon, but hands-on dig in the dirt experts in this selective field.

The following sections reflect our cognizant capability and experience in the inference engine and data fusion technology basis.

Data Mining Experience – CEMSol Anomaly Detection and Analysis tool (ADAT)

CEMSol is the commercialization agent and licensee for the NASA developed Inductive Monitoring System (IMS). As such, during our investment decisions we need to gain a deep understanding on the strengths and weakness of the tool to create a viable commercialized CEMSol product. This tool has been used on almost all of NASA missions, including the shuttle and space station. But our clients have requested our evaluation into other application domains such as anomalous severe Weather condition data mining.

The I Anomaly Detection and Analysis tool (ADAT) software is an Integrated System Health Management (ISHM) application developed by NASA and 'shrink wrapped' by CEMSol that uses data mining techniques to produce real-

time health monitoring capability for complex systems. It uses data mining as its core function to derive its results. Data mining for system performance detection is essential and makes it possible to use the wealth of available archived or real time aircraft system data to produce advanced situation monitoring results. These "data driven" tools are capable of characterizing and monitoring interactions between multiple system parameters and can greatly enhance existing practice to provide decision support.

The ADAT tool uses a technique called clustering to analyze archived aircraft data and characterize nominal interactions between selected parameters. This characterization, or model, is compared with real time or archived system data to detect off nominal behavior. ADAT can provide controllers with greater insight into the health, status and performance level of the aircraft systems under their watch. This characterization of normal operation is stored in a knowledge base that can be used for real-time system monitoring or analysis.

Aircraft data is compared with the nominal model built by ADAT to produce a measure of how well that data matches normal behavior captured in the data that were used to build the ADAT knowledge base. Significant deviations from the nominal system model can alert the controller to a system malfunction or precursor to a significant event and need for action.

The ADAT was designed to offer a technique to automatically produce status monitoring knowledge bases for systems that are either difficult to model (simulate) or which require computer models that are too complex to use for real time monitoring. As defined above, machine learning and data mining techniques are used to characterize typical system behavior by extracting general classes of nominal data from archived data sets. ADAT then monitors the system by comparing real time operational data with these classes.

ADAT works with vectors of data values. ADAT analyzes data collected during periods of normal system operation to build the system model. It characterizes how the parameters relate to one another during normal operation by finding areas in the vector space where nominal data tend to fall. These areas are called nominal operating regions and correspond to clusters of similar points found by the ADAT clustering algorithm. These nominal operating regions are stored in a knowledge base that ADAT uses for real-time telemetry monitoring or archived data analysis. During the monitoring operation, ADAT reads real-time or archived data values, formats them into the predefined vector structure, and searches the knowledge base of nominal operating regions to see how well the new data fits the nominal system characterization. For each input vector, ADAT returns the distance that vector falls from the nearest nominal operating region. Data that match the normal training data well will have a deviation distance of zero. If one or more of the data parameters is slightly outside of expected values, a small non-zero result is returned. As incoming data deviate further from the normal system data, indicating a possible malfunction, ADAT will return a higher deviation value to alert users of the anomaly. ADAT also calculates the contribution of each individual parameter to the overall deviation, which can help isolate the cause of the anomaly.

A set of data values is selected from one of these groups and presented to the model would typically compute without conflicts. With a training data set, the knowledge base produced by ADAT will contain the consistent parameter value combinations necessary to effectively characterize and monitor nominal system operation. After learning how the system behaves when operating correctly, ADAT can identify off nominal behavior and send appropriate alert messages to system operators or to an inference engine for action.

ADAT automatically learns typical system behavior by discovering parameter relationships in historical nominal data and constructing general classes representing normal system operation. Operational data are then compared to these classes to detect off-nominal system behavior and to alert operators or other automated systems to possible subsystem failures or impending failures.

- Detects any system anomaly before it grows using an automatic hybrid clustering approach
- Uses highly efficient knowledge base index and search techniques

ADAT uses a flexible technique applicable to most domains with adequate data collection capability—including mechanical, electrical, thermal, environmental, biological, and hybrid systems. Successful applications of ADAT have ranged from real-time monitoring of aircraft engine and control systems to anomaly detection in Space Shuttle wing temperature sensors.

ADAT is coded in the C++ programming language with a simple, adaptable data interface for portability. It has been deployed on numerous computing platforms and integrated with diverse data systems, including flight-qualified hardware on an aircraft 1553 data bus. ADAT represents a significant advance in automated system health monitoring capability.

Many monitoring systems currently deployed by industry rely on individual parameter limit checking or simple trend analysis to detect potentially hazardous off-nominal system performance. ADAT augments that capability with a sensor fusion approach that analyzes relationships between several parameters in order to detect subtle variations in system performance that may not be noticed in single parameters.

This sensor fusion allows ADAT to detect possible problems before individual parameter limits are exceeded and provide an earlier alert to system operators. Since ADAT monitoring knowledge bases are built *automatically* from nominal system data; it is possible to produce an advanced health monitoring capability relatively quickly without the time and effort required for intensive simulation-based monitoring system development.

In many cases, a new ADAT monitoring knowledge base can be produced within minutes. The rapid learning capability of ADAT also allows users to quickly produce a focused analysis of relevant system parameters in response to a system anomaly, or easily reconfigure their monitoring system in the event of a sensor or equipment failure. Because ADAT system knowledge can be derived from real time or archived data, it also provides an historical perspective on system operations and can discover and highlight differences between current and historic system behavior.

ADAT automatically defines groups of consistent system parameter data by examining and generalizing from examples of nominal system data ---- When integrated with the system model capability described in Section 2.1.4 Integrated Systems Diagnostic Design (ISDD), a set of data values selected from one of these groups and presented to the model would typically compute without conflicts.

2.1.2 Inference Engine Experience - SHINE

In addition to ADAT, our expertise exists in additional inference engine tools developed at California Institute of Technology, Jet Propulsion Laboratory, named SHINE. This tool has also been 'shrink-wrapped' for industry by CEMSol.

SHINE

SHINE stands for Spacecraft Health Inference Engine. It is a reusable inference engine (expert system) for the purpose of monitoring, analysis and diagnosis of real-time and non-real-time systems. It is a system developed at NASA to meet many of their demanding and rigorous AI goals for current and future needs. It is a system that was designed to be efficient enough to operate in a real-time environment and to be utilized by non-AI applications written in conventional programming languages such as ADA, C, Fortran and Pascal. The applications can run in a distributed computing environment on remote computers or on a computer that supports multiple programming languages.

SHINE introduces a novel paradigm for knowledge visualization and ultra-fast inference that goes well beyond traditional forward and backward chaining methodology. A sophisticated mathematical transformation based on graph-theoretic Data Flow analysis is introduced, that reduces the complexity of conflict-resolution during the match cycle from O(n2) to O(n) for many kinds of inference operations.

Knowledge-based systems for automated task planning, monitoring, diagnosis and other applications require a variety of software modules based on artificial intelligence concepts and advanced programming techniques. The design and implementation of the modules require considerable programming talent and time and background in theoretical artificial intelligence. Sophisticated software development tools that can speed the research and development of new artificial intelligence applications are highly desirable. SHINE was developed for that purpose. Included in the system are facilities for developing reasoning processes, memory-data structures and knowledge bases, blackboard systems and spontaneous computation daemons.

It is a multi-mission reusable knowledge base software tool for monitoring, analysis and diagnosis of spacecraft and ground systems through forward and backward inference. SHINE advances the state-of-the art in artificial intelligence by enabling solutions to a broad class of problems that previously were considered intractable due to real-time system requirements, high-speed real-time and small size constraints, portability or availability of flight hardware.

SHINE runs on multiple platforms and it has been ported to PCs, MACs, SUNs, VAXs and flight hardware. It is fully reusable and portable requiring less than two days to port from one machine to another that supports Common LISP. In addition, it contains cross compilers for translating a knowledge base to C and C++ without any reliance on the LISP environment.

APPLICATIONS

Since its original inception, SHINE has matured and proven effective on many separate applications, both on-board and off-board. SHINE has contributed to reduced operations cost, improved reliability and safety in five NASA deep space missions that include Voyager, Galileo, Magellan, Cassini and Extreme Ultraviolet Explorer (EUVE). It is being used to perform diagnostics on NASA's Deep Space Network (DSN), it has been delivered to the NASA's X-33 as a component of JPL's Avionics Flight Experiment (AFE) and it has been marketed outside of NASA for various medical applications.

2.1.3 Sensor Data Fusion - BEAM

BEAM is a powerful sensor data analysis system for detection and resolution of system failures and system anomalies. BEAM is appropriate for situations where additional fidelity and deeper analysis is required to resolve system faults. This approach is particularly valuable in operational systems where incipient faults are a concern. The method can be extended to perform simple trending and prognosis of system health, yet requires little additional effort in terms of system modeling.

BEAM has been applied to a wide variety of monitoring problems in aerospace, industrial control, and automated systems. Specific applications of BEAM include turbines and propulsion systems, hydraulic systems, electronics, robotics, and structures.

BEAM offers several capabilities to assist with prognostic assessment and detection of prognostic events. In many cases the early signs of impending failure will be somewhat unpredictable, and manifest as an anomaly in sensor data that does not correspond perfectly to any expected fault signature. BEAM is specifically designed to detect these unusual features, highlighting their presence within large streams of sensor data and tracking their evolution over

time. The BEAM algorithms classify these events according to which sensors are affected and the degree of abnormality in each, allowing users to evaluate whether an incipient fault is stable or spreading to cause a system-wide effect.

Finally, BEAM is also capable of computing a short-term forecast of sensor values based on the current model. This is a form of signal trending that can be used to quickly evaluate the likelihood of a signal anomaly crossing an operating limit. This capability can provide an actionable advance warning to operators. Because the calculation is based upon the most up-to-date sensor information and is not tied to any specific fault model, the method requires little advance fault information and is relatively insensitive to noise or individual variation between systems.

BEAM uses two real-time signal analysis engines, one that models individual sensor signals, and the other that treats the entire system as a whole. These engines construct and continually update a first-principles model of system behavior. This model is then compared to pre-calculated models generated from training data in an automated, off-line process. System problems appear as new components in the model, which can be related to specific sensors and processes, quantified, tracked over time, and projected forward to estimate future trends.

BEAM ingests data from sensors and state variables in a method similar to ADAT, and has the same requirements with respect to timestamps and synchronicity of data. BEAM differs in its algorithmic approach, which is tuned to resolve fine details in signal relationships and transient response, whereas ADAT focuses on static sensor values and system operating points. For many types of system failures, an understanding of failure-induced behavior is important to correctly diagnose the problem. The BEAM model of system behavior is usually broken up into several operating modes to improve accuracy of detection. These system modes may be the same system modes as used by ADAT, or they may be more detailed if needed or desired. BEAM can also be used to help identify distinct but similar modes during the training process, and can supply mode information to ADAT during deployment, as demonstrated in past efforts.

BEAM and ADAT have functioned alongside each other in past deployments, allowing cross-verification of detection and deeper insight into anomalies than would be possible with one tool alone. BEAM and ADAT operating concurrently can classify anomalies with respect to operating point, transient behavior, system-wide failure mode and the resulting system-wide operational margin. In many cases ADAT and BEAM have proven sensitive to more different types of faults, or to different stages of fault evolution. Both tools can also be used to filter serially through large volumes of sensor data, focusing analyst attention on the most novel and significant episodes.

2.1.4 Integrated Systems Design

The Integrated Systems Design process takes into consideration all relative cost drivers for a project. This includes various metrics such as ETTR (MTTR plus Mean Logistics Delay Time) for military type projects, Availability, operational reliability, failure criticality, CONOPs and others. There is no finite answer on just reducing cost. The key is to balance cost, safety and security based on the business case. The core of the ISD process is balancing the project development cost with life cycle management and performance. A good example is the latest integrated glass cockpits. The latest generation flight decks have distributed the traditional functions (HIS, ADC, etc….) into multi-functional computers, control devices and display. CEMSol has participated in the system and software development for all the latest new commercial airplane during the last 2 decades. This integrated system design experience will be directly applicable to support this Navy inference engine project

7. ANNUAL AVERAGE PROFESSIONAL SERVICES REVENUES OF FIRM FOR LAST 3 YEARS
(Includes DOD efforts)*

a.	Percentage of Total Work Attributable to State, Federal and Municipal Government Work:*	60%
b.	Percentage of Total Work Attributable to Non-Government Work:	40%

8. AUTHORIZED REPRESENTATIVE. The foregoing is a statement of facts.

Signature:_____ Date:_____

Name: _____ Title: _____