Mirror Coater Statement of Work

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1 General

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is an airborne observatory that will study the universe in the infrared spectrum. It consists of a Boeing 747SP aircraft modified to mount a 2.5 meter reflecting telescope in the rear fuselage. The primary reflecting mirror for the telescope must be aluminized and re-coated periodically using a custom-designed mirror coater system. With an internal diameter of approximately 4 m, the Mirror Coater is designed to fit both the optic and the attached carbon fiber reinforced polymer (CFRP) mirror cell and outer structure during coating operations.

The Mirror Coating System, consisting of the Mirror Coater and Ground Support Equipment (GSE), is currently located at NASA Ames Research Center at Moffett Field, CA. The Mirror Coater is intended to be moved and installed at the Dryden Aircraft Operations Facility (DAOF) in Palmdale, CA. A new facility has been constructed at the DAOF location in Palmdale to house this system. The purpose of this RFP (Request for Proposal) is to contract to move and install this system and associated hardware at the DAOF in Palmdale, CA.

2 Summary of Work

2.1 Project Summary

The objective of this contract is to plan and execute the move of the SOFIA Mirror Coater and Coating Facility GSE from the current site in hangar N-211 at Ames Research Center, Moffett Field, CA to newly constructed clean room facilities at the NASA DAOF, Palmdale, CA. These efforts include pre-move assessments, documentation, and inspections; system preparation; dismantling; packaging, transportation, and unpacking;

reassembly, plumbing, installation, activation, and performance testing. These efforts also include the associated planning and scheduling of activities, and working with points of contact including Government designated operations personnel. The relocation preparation will include documentation of the approximately 200 as-built electrical lines (both signal and power) between the Power Cabinet and the Control Cabinet. The relocation efforts should include reuse, when possible, of existing electrical and pneumatic lines, vacuum pump lines, fluid cryogen plumbing lines and exhaust lines for all subsystems. The Contractor shall identify components to be re-used in the implementation design, based on the constraints set by the layout of the new facility. The scope of this project includes any necessary design, manufacture, minor facility modifications, and installation of new components as required for the implementation of the system in its new location. As well, the Contractor shall provide a Relocation Plan of what equipment must be dismantled or disassembled and packaged for shipment as well as identification of concern or risk areas with mitigation approaches. This Relocation Plan shall include the approach for packing and crating of each assembly once dismantled for shipment.

The Contractor shall demonstrate that the functionality and performance of MCF subsystems are unchanged after the move is completed.

The Contractor shall provide clean up at the ARC facility, patching any penetrations in walls created by the dismantling or extraction of the mirror coater. Any patches made to walls shall preserve the integrity of the firewalls. The following are approved methods of patching:

If the penetrations are in a stud and gypsum board wall, entire sections of gypsum board containing the penetration on both sides of the wall may be removed from stud(s) to stud(s) and then replaced with new sections of gypsum board of the same thickness and fire rating. Then the new gypsum board joints may be fire taped and then textured and painted. If the penetration is small in size like an electrical outlet, a cut piece of gypsum board may be used to tightly fill a slightly enlarged opening and then held in place by fire taping. In small openings, pieces of gypsum board may be glued to the backside of the opening and then a small new piece of gypsum board is glued or screwed to the piece of backing gypsum board and then fire taped, finished and painted.

The Contractor shall also make modifications to the DAOF facility, as approved by the Government, required to bring the mirror coater to a fully functional state, as defined by the contract performance criteria identified in Section 6.

2.2 Phases of Project

There will be two distinct phases of this project occurring in sequence as follows:

Phase 1: Planning and Installation Design

This phase will encompass the initial planning and design activities for the relocation of the Mirror Coater system. The Contractor shall provide an installation design to be presented at a Project Implementation Review. The full set of requirements for the Project Implementation review is identified in Section 2.7.2 and Attachment A.

Phase 2: Mirror Coater and GSE Relocation to DAOF, Palmdale, CA

This phase encompasses the preparation of all assemblies for dismantling, dismantling of all assemblies as appropriate, packing, crating, and rigging of the chamber and sub-assemblies, the transport of those items, and the unpacking and rigging at the destination. This phase also includes the preparation and modifications of the Mirror Coater Facility at the DAOF, the installation and re-assembly of the Mirror Coater, and the testing to demonstrate that the Mirror Coater was successfully relocated.

Inspections that must occur for both phases are identified in Section B.6 .

2.3 Base Bid and Indefinite Quantity

2.3.1 Base Bid 1

Base Bid work includes the scope of work as outlined in this Statement of Work with the exception of the IQ items.

2.3.2 Indefinite Quantity 2 Design and Manufacture of 2" Rigid Pump Lines

This IQ item may be ordered at the discretion of the government. The scope of this work includes the design and manufacturing of a minimum of 10' of fabricated and installed 2" diameter vacuum piping up to a maximum of 70', inclusive of elbows or other joints as necessary. All of these materials shall adhere to the design, materials and labeling specifications for type T3 piping as found in attachment J.7.6 specification, V095-2-013 Specification For Piping Design and Material For Primary Mirror Coating System SOFIA Project. In addition, all parts shall be detergent and steam cleaned. All components shall be legibly stamped or stenciled per this specification. The fabricators of these components shall not use carbon steel brushes or brushes contaminated with carbon steel. This dependent upon the features of the DAOF Mirror Coating Facility and the contractor's Installation Layout Design, which is subject to approval by the Government.

2.3.3 Indefinite Quantity 3 Design and Manufacture of 6" Rigid Pump Lines

This IQ item may be ordered at the discretion of the government. The scope of this work includes the design and manufacturing a minimum of 3' of fabricated and installed vacuum 6" diameter vacuum piping up to a maximum of 20', inclusive of t-joints, elbows, or other joints as necessary. All of these materials shall adhere to the design, materials and labeling specifications for type T3 piping as found in attachment J.7.6 specification, V095-2-013 Specification For Piping Design and Material For Primary

Mirror Coating System SOFIA Project. In addition, all parts shall be detergent and steam cleaned. All components shall be legibly stamped or stenciled per this specification. The fabricators of these components shall not use carbon steel brushes or brushes contaminated with carbon steel. This is dependent upon the features of the DAOF Mirror Coating Facility and the contractor's Installation Layout Design, which is subject to approval by the Government.

2.4 Contractor Interface Requirements

This project will be executed at two different NASA installations, Ames Research Center (ARC), and the Dryden Flight Research Center (DFRC) Aircraft Operations Facility (DAOF), a leased commercial facility. ARC is a Government installation and falls under Government rules and regulations. The DAOF is also subject to Government rules and regulations, but it is also subject to City of Palmdale building codes and Los Angeles County Fire Code.

The permit to install the Mirror Coater System at the DAOF has already been obtained as it was part of the building construction permit. The Contractor shall adhere to building codes per the City of Palmdale for electrical and seismic bracing requirements. A permit is also required for the removal of the Mirror Coater System at ARC, which will be obtained prior to the start of the relocation effort.

The facilities at ARC and at DAOF fall under different organizations within the NASA organizational structure. As a result, the Contractor shall interface with different individuals for some of the same functions at the two sites. The functions that have - different points of contact at each center are the following: Facility Engineering, Facility Safety, Pressure Systems Safety, and Facility Logistics. The functions that will have the same point of contact at both installations are the COTR, the Project Manager, Mirror Coater System Safety Officer, and the Mirror Coater Operators. The individuals who represent these functions will be the individuals participating in the reviews and submittals approvals. The COTR will facilitate the coordination between the Contractor and these representatives as necessary, see para. G.3.

2.5 Submittals

This section describes the submittals that are required for the technical scope of work. Submittals required to meet Safety and Quality Assurance requirements are identified in Section D.7

The process for submissions is identified in para. A.4.

2.5.1 Approving Authority

Office or designated person authorized to approve submittal.

2.5.2 Submittal Classification

Submittals are classified as follows:

2.5.2.1 Contractor QC Approved (Submittals without a "G" designation)

Contractor shall review all relocation submittals for quality control.
When Government approval is not required, Contractor shall be held responsible for submittal approval and relocation activities per contract documents.

2.5.2.2 Government Approved *(Submittals with a "G" designation)*

Government approval is required for critical documents, designs, materials, processes, schedules and other items as designated by the COTR. Government approval is required for any modifications or deviations from the Solicitation or Accepted Proposal and other items as designated by the COTR.

2.5.2.2.1 Contractor Review

When a technical, schedule, or process deviation is required, the COTR will coordinate with the Contractor. Contractor review is required for the following: changes to or extensions of design, critical material changes, deviations from the solicitation, deviations from the accepted proposal or deviations from the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the COTR. Contractor shall clearly mark all submittals that deviate from the design. The Government will review all submittals designated as deviating.

2.5.3 Submittal Documents

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval.

The following tables identify and describe the submittals required, as well as the timing of the submittal.

<u>Preparatory Submittals</u>

Item	Content	Due Date
List of contact personnel	per Section A.3.1	Contract Initiation Meeting
On-site Personnel List	per Section A.3.3	Contract Initiation Meeting
Project Schedule; G	per Section 4	Contract Initiation Meeting
Relocation Plan; G	The Relocation Plan should include the following: Preparation and Disassembly of components;	5 days prior to Project Implementation Review

	Handling of major elements; Documentation and labeling of electrical connections; Identification of analysis required for safe shipment; Plan for bracing and rigging of structures; Critical Lift Plan per Section XYZ; Installation details; Test plan; Identification and Mitigations for risks	
Activity Hazard Analysis; G	Per Section D.8.1	5 days prior to Project Implementation Review
Quality Assurance and Safety Plan; G		Contract Initiation Meeting
Moving Equipment List	Per Section E.1.2	Contract Initiation Meeting
Request for Confined Space Entry Permit; G	Per Section D.16	Project Implementation Review
Request for Utility Outage/Facility Closure Permit; G	Per Section D.16	Project Implementation Review
Request for Crane Operation Permit; G	Per Section D.16	Project Implementation Review
Request for Open Flame and Hotwork Permit; G	Per Section D.16	Project Implementation Review

Drawings

Item	Due Date
Installation Design Layout	5 days prior to Project Implementation Review
Electrical Interconnection Documentation/Drawings	5 days prior to Project Implementation Review
Design and Fabrication drawings for any manufactured items necessary for installation and reassembly of Mirror Coater System in the DAOF	5 days prior to Project Implementation Review

Inspection Reports/Points

Item	Due Date
Packaging Inspections	Following Packaging
Post-shipment Inspection	Prior to Installation and Re-assembly
Preactivation Systems Inspection	2 days prior to Preactiviation Review
Welding Inspection Reports	2 days prior to Preactiviation Review

Test Procedures

Item	Due Date
Performance Test Procedure; G	5 days prior to Project Implementation Review

Test Reports

Item	Definition	Due Date
Field Quality Control Reports		2 days prior to Preactivation Meeting; deltas at contract closeout
Gas Test Results (for Confined Spaces)		Following each confined space entry
Performance Test Report (following re-assembly of Mirror Coater System)		Prior to contract closeout

Certificates

Item	Explanation	Due Date
Component certifications (as applicable)		2 days prior to Preactivation Review
Welder's Certificate		5 days prior to Project Implementation Review
Training certifications	Certificates shall be submitted for the items in accordance with Appendix B, C, and D (equipment, personnel training, etc.)	Contract Initiation Meeting

Closeout Submittals

Item	Definition	Due Date
As-run Performance Test Report		Prior to Contract Closeout

As-built drawings or schematics		Prior to Contract Closeout

2.6 Supervision

The Contractor shall provide at least one (1) qualified on-site Project Lead. The Project Lead shall have a minimum 10 years experience as a Project Lead on projects similar to this effort in size and complexity.

The Project Lead in this context means the individual with the responsibility for the overall management of the project. The Project Lead cannot be replaced under this contract without the explicit approval of the Government.

2.7 Project Meetings

The Contractor shall support the following project meetings in support of key events.

2.7.1 Contract Initiation Meeting

This will be a meeting between the Contactor Project Lead and key personnel and the COTR and designated government representatives. The purpose of this meeting will be to review and clarify the scope of the project and clarify any questions on the technical tasks and shall be held within 10 days of contract award. This meeting will also include a demonstration of the basic functionality of the Mirror Coater.

2.7.2 Project Implementation Review Meeting

This meeting will be a review meeting within 5 weeks of contract award by the COTR and other government participants or delegates of the plans and designs to be provided by the Contractor. The submittals to be provided by the Contractor for this review are identified as below and shall be provided 5 business days in advance of the review. The culmination of this review shall be a meeting to be held at Ames Research Center. The contractor shall schedule this review with the COTR at least one week in advance.

Ref.	Document
PIR.01	Installation Design Layout Drawings
PIR.02	Electrical Drawings
PIR.03	Activity Hazard Analysis
PIR.04	Proposal for Fabrication
PIR.05	Welding Procedure Specifications (WPSs)
PIR.06	Analysis of welded structures stability for transport
PIR.07	Certifications of Rigging Equipment and

	Operators
PIR.08	Annual/Quadrenial Rigging Equipment Inspections
PIR.09	Signed Code of Safe Practices
PIR.10	Pre-Lift Safety Checklist
PIR.11	Moving Equipment List
PIR.12	Logistics and Site Requirements
PIR.13	Project Schedule (any revisions)

2.7.3 Daily Safety Tag-ups

The Contractor Project Lead shall tag up with a designated representative from the ARC and the DAOF to coordinate activities in operational facilities for the day as well as safety tag-ups with Contractor employees on-site as outlined in para. D.11.2.. The DAOF facilities safety organization holds daily meetings to coordinate the activities for the day in and around the hangar. The topics include major transportation activities, power outages, hazardous activities, etc. The time for these tag ups will be determined after contract award.

2.7.4 Weekly Project Tag-ups

The contractor Project Lead and their Quality Control Manager (if a different individual) shall tag up with the COTR on a weekly basis to coordinate meetings or reviews and discuss status, issues, and any potential delays in schedule once the dismantling of the Mirror Coater has begun. The time for these tag ups will be determined after contract award.

2.7.5 Pre-Critical Lift Safety Tag-up (Loading)

This meeting will be called on the day of the rigging and lift of the chamber onto the truck for transportation. All individuals who will be present for the lift shall participate in this tag-up and sign a sign-in sheet which specifies, name, organization, phone, and email.

2.7.6 Pre-Critical Lift Safety Tag-up (Unloading)

This meeting will be called on the day the chamber is unloaded from the truck and put in place in the Chamber room in the DAOF Mirror Coating Facility. All individuals who will be present for the lift shall participate in this tag-up and sign a sign-in sheet which specifies, name, organization, phone, and email.

2.7.7 Preactivation Review

The Contractor shall schedule and hold meeting to review the status of the Mirror Coater System and all inspection reports to determine that all requirements have been met to activate the system.

3 Project Schedule

The Contractor shall provide the COTR with a Project Schedule for review at the Contract Initiation Meeting. The Contractor shall provide the Project Schedule electronically in MS Project or other negotiated format. The COTR will provide any comments or request clarifications to which the Contractor shall respond prior to the Project Implementation Review, at which final approval will be provided by the Government.

3.1 Schedule and Constraint Dates

The contract initiation may begin as soon as contract award, but the preparation and dismantling of the system may be delayed by up to 4 months depending on a decision to re-coat the Primary Mirror prior to the Mirror Coater relocation. This decision will be made by July 31, 2011.

If the decision is that the Primary Mirror for SOFIA telescope will be recoated this year, the mirror will be removed from the aircraft at the DAOF in Palmdale, flown up to ARC, and recoated in the existing facility. If the decision for the recoat of the mirror is that it can be deferred until 2012, then the move may commence as soon as contract award, the necessary resources are lined up, and approval has been given by the COTR following a Project Implementation Review.

The probability is high, at the time this statement of work is written (May, 2011), that the mirror recoating will be deferred until 2012. If the Mirror Coater move proceeds without delay, the Contractor shall complete a successful demonstration that the Mirror Coater is able to meet the performance criteria outlined in Section 6 by February 16, 2012.

3.2 Project Schedule Requirements

The Contractor shall provide a Project Schedule that includes lines identifying the significant and definable features of the technical tasks of the project to an appropriate level of detail. The Contractor shall include the following items in the Project Schedule:

Schedule Item	Description
Contract Initiation Meeting	This will be a meeting between the Contactor Project Lead and key personnel and the COTR and designation government representatives. The purpose of this meeting will be to review and clarify the scope of the project and clarify any questions on

	the technical tasks. This meeting will also include a demonstration of the basic functionality of the Mirror Coater. The date of this meeting shall be proposed by the contractor and held within 10 days of contract award.
Permit Application	This line item will designate the delivery date of the contractor submittals necessary to request a permit to remove the Mirror Coater from the Ames Facility. These submittals are identified in Section D.16.
Permit Review	This line item designates the review of the permit submittals by the review board as well as the board meeting itself. The contractor shall allow 3 business days for this review to take place.
Project Implementation Review	This schedule line item represents the primary review by the COTR and other government participants or delegates of the plans and designs to be provided by the contractor. The submittals to be provided by the contractor for this review are identified in Section 2.7.2 and shall be provided 5 business days in advance of the review. The culmination of this review shall be a meeting to be held at Ames Research Center. The contractor shall schedule this review with the COTR at least one week in advance.
Packaging and Bracing Inspection	An inspection will be performed by the COTR's designated representative to concur that the packing and bracing will ensure a safe delivery of the Mirror Coater Chamber, sub-assemblies, and GSE.
ARC Facility Closeout Inspection	An inspection will be performed to determine complaince with the specified clean up and patching requirements.
Post-Shipment Inspection	An inspection will be performed upon delivery, prior to unpacking, of the Mirror Coater chamber, sub-assemblies, and GSE were not damaged in shipment.
Assembly Inspection	An inspection will be performed after re-assembly of the Mirror Coater system that all sub-assemblies have been installed properly.
Test Readiness Review	A Test Readiness Review will be conducted that will review the status of the installed system, results of inspections, the hazard mitigations in place, safety issues, test objectives, test procedures, risks identified, adequate coordination of resources, and appropriate training is in place.
Performance Testing	The contractor shall perform testing to demonstrate that the system meets the performance criteria identified in Section 6.

As well as the above noted activities, the Contractor shall include procurement activities, and turnaround times for government review and approval per Section 3.2. Inspections will be performed by the Government and by the Contractor QC Manager.

3.3 Quality Assurance

The Contractor shall designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status). The authorized representative shall be experienced in scheduling projects similar in nature and complexity to this project and shall be experienced in the use of scheduling software that meets the requirements of this specification.

The contractor shall implement all quality control measures specified in Appendix C.

3.4 Schedule Execution

3.4.1 Approved Project Schedule

The project schedule provided by the contractor will be accepted by the government providing it meets the criteria and constraints identified in this SOW. If the schedule does not meet those criteria and constraints, the project schedule will be approved or disapproved by the COTR.

3.4.2 Schedule Status Reports and Updates

The Contractor shall provide a schedule status report at least every 3 weeks showing the progress of each activity and any changes in the schedule to project completion.

4 Technical Description

4.1 General Requirements

The contractor shall comply with all safety requirements specified in Appendix D.

The contractor shall comply with all moving equipment and site control requirements specified in Appendix E.

The contractor shall assess all mechanical elements of the Mirror Coater Systems and the ground support equipment for stability for shipment. This includes any analysis which must be performed to ensure that any structures, particularly the welded structures within the chamber, are safe or can be braced appropriately for shipment.

The contractor shall develop a Relocation Plan to be reviewed prior to the Project Implementation Review. This document shall include the results of the assessment of stability of the mechanical structures for transport, the method proposed to ensure that the electrical connections can be made appropriately during the re-assembly, the plan for bracing, packing and crating the major assembly or sub-assemblies; the plan for dis-assembly and re-assembly, handling of major elements, a critical lift plan, and identification and mitigation strategies for risks.

The contractor shall prepare all portions of the Mirror Coater System for disassembly. This includes safing all pressure lines, pumps, and any other sub-assembly which requires preparation for dismantling and shipment.

The contractor shall dismantle and pack for safe transport all sub-assemblies and ground support equipment. The contractor shall protect all components from any contamination in packing or transport that would impair the ability of the Mirror Coater to pump down to vacuum pressures as specified in the contract performance criteria in Section 6.

The contract shall provide rigging appropriate to transport all large assemblies to the DAOF.

The contractor shall transport all elements of the Mirror Coater System and its ground support equipment to the DAOF in Palmdale, CA.

The contractor shall unload, install, and re-assemble the Mirror Coater System in the DAOF per the general layout identified in EDM-1685-P2 provided in the attachments section.

4.2 Mechanical

4.2.1 Structural

Equipment in the Mirror Coating Facility ranges in scale from small low-mass components to multi-ton subassemblies. Attachments B and C provide relevant structural information.

The attached documents, referred to above, are provided for reference only. The Contractor shall verify the current item configuration and independently assess suitability for item handling and the application of loads. As the Mirror Coating Facility equipment is essential ground support equipment for SOFIA, the Contractor shall provide lift plans for work requiring crane and overhead hoist, as specified in Section 3.2.3.

Currently the Mirror Coater is installed in the ARC mirror coating room in Hangar N-211. It is rigidly mounted to the concrete floor which is 4” higher than the access areas of Hangar N-211. The ramp to the roll-up doorway has a 20:1 grade. The floor areas at DAOF are seamless concrete with no elevation changes. The entrance door to the DAOF room has approximately 1” of clearance beyond the Mirror Coater upper lip, which is the largest full diameter part of the vessel, yet not the widest protuberance. The Contractor shall submit a Critical Lift Plan as specified in Attachment A detailing the method by which the Contractor will bring the vessel through this doorway. The Critical Lift Plan is subject to Government approval. The Government will temporarily disassemble the DAOF doorway if required.

The Contractor shall develop the procedure and means by which the Mirror Coater is removed, transported and installed and shall provide the Government with the

assessments, and analyses that are used to demonstrate that a safe method of disassembly and manipulation is planned. A number of historical photos of the installation are available at the Contractor's request.

Once procedures are approved by the Government, the Contractor shall remove the Mirror Coater equipment from Ames, transport it to the DAOF, and install it at the DAOF in Rooms 114-188 of Hangar Building 703. See attachment J.F for a drawing of the DAOF layout.

The Contractor shall prepare an Installation Layout Design for the Mirror Coater System, including vacuum, pneumatic and fluid lines, in the new facility. If it is not possible to reuse existing rigid plumbing lines in the new installation, the contractor shall bring a proposal for the design and manufacture of rigid pump lines to exercise as Option 1 and 2 at the discretion of the government. All plumbing must be designed and manufactured in accordance with attachment J.7.6.

The Contractor shall secure the Mirror Coater Chamber, cabinets, Chamber Lid Rack, pump stack to the walls or floor per City of Palmdale seismic bracing standards.

At the ARC facility, the contractor shall grind down all protrusions in the floor from existing tie-down bolts, patch the floor with a durable material (such as epoxy), and ensure a smooth surface. The Contractor shall protect the facilities in which work is occurring for this project and restore the facility to the original condition in accordance with FAR 52.236-9 and Section I should any damage be done.

4.2.2 Fluids

Equipment in the Mirror Coating Facility (MCF) that uses fluids in their operation are the Leybold mechanical pump and Roots blower assembly, the CVI cryopumps, the Meissner cryo traps and the gaseous Argon delivery system for the glow discharge cleaning sequence. For disassembly, the Contractor shall properly handle components with fluids, which are the Leybold mechanical pump and Roots blower assembly and the CVI cryopumps.

The fluid used in the mechanical pumping system is an inorganic synthetic material, one of whose trade names is Fomblin (see MSDS for Fomblin in Attachment ___). Under normal conditions, this fluid is non-hazardous to personnel. However, for the protection of the equipment, the Contractor shall insure that the pumps remain in an upright position (as currently installed) during the MCF disassembly, shipment and re-assembly. This is to avoid fluid migrating to areas that could possibly damage the pumps upon restarting. After removal, the Contractor shall seal the system components to prevent contamination during the move.

The two CVI cryopumps and their compressors, as well as the interconnecting braided lines, contain helium at pressures of over 200 psi. Because of the high pressures involved

and the specialized nature of cryopumping equipment, both personnel and equipment hazards are present and this equipment shall only be disassembled by those familiar with this type of equipment. After removal, the Contractor shall seal the system components to prevent contamination during the move.

The Meissner cryo trap delivery system uses LN2 from portable tanks that is only connected during coating chamber operation, and therefore presents no hazard during disassembly, shipment or re-assembly; however, the Contractor shall seal the system components to prevent contamination during the move.

The gaseous Argon delivery system uses a high pressure cylinder that is only connected during coating chamber operation, and therefore presents no hazard, however, the Contractor shall seal the system components to prevent contamination during the move.

4.2.3 Torques

For all fasteners on the Mirror Coater system and ground support equipment, use manufacturer recommended torques.

4.3 Electrical

The principal electrical lines for the MCF provide interconnection between the Control Cabinet, the array of valves, switches and sensors on the Coating Chamber, the Roughing Pumps, the Power Supplies for the Filament Array and Glow Discharge, and the pair of Cryopumps and Cryopump Compressors. The drawings in Attachment J.6.1 are the current installation documents provided by the original coating system developer. They are included to provide the Contractor with background on the technical issues for the move task as well as the overall scale of the task. The government does not warrant that these documents are completely accurate, and it remains the Contractor responsibility to verify such information as required for the performance of the contract. These documents are available as editable AutoCAD files at the request of the Contractor. The photos in Attachment J.6.2 and J.6.3 indicate the current installation. Some of these connections are point-to-point terminations without connectors.

To ensure proper functionality with no failures or damage after the move, the Contractor shall develop wire lists or diagrams and use other methods to record the current connections, make the disconnections, and restore the wiring when installed at DAOF.

The Contractor shall document in the Relocation Plan the proposed means to achieve this task and complete the needed wire list investigations for government approval or disapproval.

The Contractor shall provide the Relocation Plan and the completed wiring list information to the Government for review and approval before any disconnections are

made. These wire lists, photos and other documents shall be available completely via electronic format. No handwritten documents shall be used.

The Contractor shall compare existing electrical lines, conduit and cabinets with what is required for operation of the completed installation after the move, and shall provide and install what is required.

The Contractor shall disconnect ARC facility electrical equipment and remove all wiring back to the closest breaker panel.

4.4 Handling and Transportation

4.4.1 Component Orientation

In order to safely facilitate moving the MCF coating chamber and auxiliary equipment, the Contractor shall remove and pack some components separately (see Section 5).

The Contractor shall document existing MCF component orientation for parts mounted on the coating chamber and auxiliary equipment and ensure that the removed components are re-assembled in the exact orientation as they were before removal for shipping. This shall be accomplished by both photographic and physical documentation of the components before removal from the existing system. In addition, a number of components, such as the cryopumps, must be shipped in preferred orientations. The Contractor shall evaluate each component to be moved and document intended handling and packaging means. How these components are shipped shall be photographed and documented.

4.4.2 Critical Lifts

This job has been deemed a “CRITICAL LIFT” and must meet the following NASA-STD-8719.9/OSHA/ASME30.0 series / AHB 1700.1 requirements/standards:

(1) All rigging (shackles, slings etc.) must have current certifications. Certifications must be reviewed and approved by NASA’s Safety Officer before any lift activity takes place.

(2) All rigging personnel shall have had proper training and the Tmobile crane operator shall have a current CCO license

(3) Mobile\Overhead crane shall have current annual/quadrennial inspection paperwork readily available with a daily inspection to be completed before leaving facility yard or inspection done before operation/lift is to take place

(4) Safety circle meeting/sign in sheet will take place before job begins

(5) All personnel shall have Proper Protective Equipment (PPE) on and in place before job begins.

(6) Personnel Certifications: Crane (overhead) operators license and health unit clearance (physical on record) or contractor-supplied certification

(7) Copy of Critical Lift Plan (reviewed with approval and signed off at job site during the operation.)

(8) For critical lifts, the load shall not exceed 75 percent of the crane's/derrick's rated capacity.

4.4.3 Air-Ride Transport

The Contractor shall use air-ride suspension vehicles for transport or identify any Mirror Coating System equipment that is to be truck-transported by means other than an air-ride suspension equipped truck, along with justification for the appropriateness of alternative means. The NASA COTR or their designated representative must approve any alternate means of transportation of Mirror Coating System or GSE equipment.

4.5 Known Operational Issues

Experience has shown that the programmable logic control subsystem exhibits minor control errors. The symptoms are such that operators must occasionally push command buttons more than once to achieve the desired action. Delays due to malfunctions affecting pump-down times will be subtracted from Contractor performance tests.

The contractor should also be aware that primary chamber for this Coater system was welded like that of a pressure vessel, meaning at wall joints there was a continuous weld on both the inside and the outside of the vessel, unlike a typical vacuum vessel which would be stitch-welded on the outside.

The contractor shall be given a briefing by the operators at the Contract Initiation Meeting on various aspects of the system as well as a demonstration of the performance.

4.6 Startup and Commissioning

After the MCF items have been disassembled at ARC, transported to and re-assembled at the DAOF, and completed passive checks, the Contractor shall announce readiness to begin powered tests. The Contractor shall work with a Government delegated operations team, with the required area expertise, to begin a phased power-up. This startup process will roughly follow the standard integrated systems test, SCI-US-PRO-SV02-2013, which is found in Attachment J.13. The rough sequential order of systems power-up is listed below:

- Rough Vacuum System

- Cryopump: Regeneration and Cool Down
- Meissner Surfaces Operation
- High Vacuum System
- Glow Cleaning System
- Vent System
- Filament Power Supply and Array Checkout

4.7 Component Maintenance

The Contractor shall evaluate and replace as necessary all reusable seals prior to re-use and replace all single-use seals.

The Government will use the MCF move time period to renew certification of specific pressure safety valves. The Contractor shall replace pressure safety valves with Government-provided recertified components. The Contractor is not responsible for the safety certification of the pressure safety valves.

At the discretion of the Government, selected equipment and components within the MCF may be subject to inspection and maintenance actions. The Contractor will not be held responsible for any schedule delays as a result of unanticipated maintenance activities.

5 End Item Deliverables (Closeout Submittals)

The Contractor shall deliver the following items following successful Performance Testing after Installation:

As-run Performance Test Report
As-built drawings or schematics

6 Contract Performance Criteria

The Contractor shall perform the following tests to the specified performance criteria.

6.1 Checks prior to pump actuation

1. Verify sensors read ambient pressures at controller
2. Verify interlock switch status at controller
3. Verify valve control with house air and controller
4. Ohm check Glow rods - electrically isolated from each other and vessel
5. Ohm check Filament bus bars - electrically isolated from each other and vessel
6. Pressure & hold test Meissner lines

7. Fit check of vessel lid and cleats, on vessel and storage stand

6.2 Reactivation Functional Tests

6.2.1 Roughing system

1. Pumping on roughing line (XV-101 valve closed) pump achieves base pressure of < 20 mTorr within 60 seconds, and < 5 mTorr within 15 minutes
2. Pumping on vessel (XV-101 open) and chamber otherwise completely assembled and sealed, vessel pumps down to < 15 mTorr within 180 minutes (this rate of pump down is not required at the first trials, allowing the vessel to sit for several days at test vacuum levels is permitted).
3. Once evacuated, pressure rate of rise <10mTorr in first 24 hours and <3mTorr in successive 24 hour periods.

6.2.2 Meissner coils

1. During activation and through cool down, no pressure rise in the chamber occurs.
2. Coils hold low pressure room temperature gas without rapid loss (separate test gauge required)

6.2.3 Cryopumps

1. Compressor idle and running pressures are within specification (per manufacturer's specifications)
2. Rate of Rise at room temperature < 10mTorr per 24 hours after initial 24 hours
3. Room temperature to < 20K within 180 minutes
4. Base temp < 20K
5. Demonstrate each cryopump pumps vessel from 25 mTorr down to < 5uTorr

6.2.4 Glow Discharge system

1. Demonstrate that power supply can provide 4500 V @ 200 mA; and 3750 V @ 600 mA

6.2.5 Filaments

1. Power balancing similar to performance before disassembly

6.2.6 Vent system

1. Demonstrate that the pneumatically operated valve opens the chamber to the metering valve and that the metering valve has manual control of the venting rate.

Appendix A Administrative Requirements

A.1 Work Hours

All work under this contract shall be performed during normal duty hours for each facility. Normal duty hours at ARC are from 7:00 a.m. to 5:00 p.m. Normal duty hours at the DAOF are from 7:00 a.m. to 5:00 p.m. Weekends and Government holidays are restricted for work. Additional days during Thanksgiving, Christmas, and New Years may also be restricted. This will be discussed further at contract award.

The Contractor shall allow for a maximum of ten (10) days per year where construction activity is not permitted because NASA facilities are closed.

A.2 Government Furnished Property

The contractor will be responsible for moving the equipment identified in Attachment J.6, but there will no additional Government furnished property supplied for the completion of the contract.

A.3 Property Re-use

The Contractor shall plan to re-use, when possible, existing electrical and pneumatic lines, vacuum pump lines, fluid cryogen plumbing lines, exhaust lines, and seals for all subsystems. The Contractor shall identify components to be re-used in the implementation design, based on the constraints set by the layout of the new facility. The Government will approve/disapprove of the plan for re-use at the Project Implementation Review.

A.4 Submittals Preparation and Review

A.4.1 Transmittal Form

The Contractor shall transmit each submittal to the COTR with the transmittal form prescribed by CO and standard for the project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section. The Transmittal form will be provided to the Contractor at contract initiation.

A.4.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review, and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.
Identify submittals with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.
b. Contract number.
c. Date of the drawings and revisions.
d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.
e. Section number of the specification section and applicable drawing numbers by which submittal is required.
f. With a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

A.4.3 Formats of Submittals

A.4.3.1 Formats for Drawings

A. All new AutoCAD drawings shall conform to the following requirements:

1. All drawings shall use the Ames Facilities Engineering Branch standard title block and border. All sheet title blocks for a project shall be labeled with the project title on one line at the top of the title area and the drawing title in the lower section of the title area. Each drawing in a project set shall have a unique title and drawing number. The drawings shall be numbered in accordance with the Ames Systems Engineering drawing numbering system, A013-8901-XR1. The drawing number for this project is A211-1102-G1.

2. All drawings shall be on “D” size sheets. Drawing area of the sheet within the thick border line shall be shall be 533mm x 813mm (21”x32”), there shall be a 25mm (1 inch) margin at the left and right sides of the sheet and a 13mm (0.5-inch) margin at the top and bottom of the sheet.

3. The CAD filename shall be the same as the drawing number and shall be written on the lower right-hand corner of the title block in the box marked “File Name:”.

4. Hatch patterns used on a drawing shall not be exploded.

5. The standard drawing text font shall be Simplex. The standard text height shall be 2.5mm (0.10-inch), however larger text may be used for titles.

6. Color and linetype shall be assigned by layer.

7. If the plot scale is different than the drawing scale it should be noted on the drawing in the lower left border area.

8. Photo images included on AutoCAD drawings should be in JPEG format with descriptive file names. The number of photo images in a drawing set should be limited to the minimum necessary due to the workload involved with inputting these into the database.

9. Before the drawing files are submitted to the Engineering Documentation Center (ECD) all XREF files shall be bound to the drawing and all unnecessary entities (blocks, layers, etc.) shall be purged.

10. Save the entire drawing at full-screen (not zoomed into one area of the drawing) before submitting a drawing file to EDC.

11. If any special plot features were used to show non-standard plot appearance, i.e.: screened/shaded effect etc., provide the acad.pcp (plot configuration parameters) file with the disks, or a list of the plotter type, linetypes, and line weights, if possible.

12. Do not make any hand written revisions or erasures on the hard copies of CAD drawings except for necessary approval signatures. All drawing revisions must be made to the electronic file. CAD drawings with hand written changes or erasures that are not reflected on the electronic file must be retained as pencil drawings in the EDC. Inform EDC personnel if the hard copy of a drawing is not identical to the electronic file.

13. Electronic submittals to EDC shall contain only the drawing files and other files associated with the drawings. Each drawing with photo images or other raster files shall be placed in a separate folder with all the images that are associated with the drawing; the folder shall have the same title as the drawing file.

14. Original drawings shall be signed prior to submittal to EDC. The minimum required approval signatures are Drafter, Checker, Designer, and Project Lead.

15. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

B. Plotting lineweights are assigned by color. All entities are colored by their layers. The following are standard colors for design at NASA Ames.

Color	Pen Number	Widths (mm)
1 RED	3	.5
2 YELLOW	1	.25
3 GREEN	2	.35

4 CYAN	1	.25
5 BLUE	2	.35
6 MAGENTA	2	.35
7 WHITE	2	.35
8 GREY	3	.5
9 DK RED	3	.5
10 DK YELLOW	4	.7
11 DK GREEN	2	.35
12 DK CYAN	1	.25
13 DK BLUE	4	.7
14 DK MAGENTA	3	.5
15 DK WHITE	5	.25 Screened

C. The Ames Standard Drawing Template is included as Attachment L.

A.4.3.2 Format of Inspection Reports

Provide reports on 8 1/2 by 11 inches paper in a complete stapled volume.
Indicate by prominent notation, each report in the submittal. Specify .PDF or .DOC.

A.4.3.3 Format of Test Procedures

Provide reports on 8 1/2 by 11 inches paper in a complete stapled volume.
Indicate by prominent notation, each report in the submittal.

A.4.3.4 Format of Test Reports

Provide reports on 8 1/2 by 11 inches paper in a complete stapled volume.
Indicate by prominent notation, each report in the submittal.

A.4.3.5 Format of Certificates

Provide certificates on 8 1/2 by 11 inches paper. Provide a stapled volume for submittals containing numerous pages.

A.4.4 Submission

Two (2) soft copies on two (2) CD-ROMs and three (3) hard copies of all submittals shall be delivered and divided into individual files with file names stating the submittal number(s) and title(s).

6.2.6.1 Electronic Submittals

The electronic copies of submittals shall be in a format readable by Adobe Acrobat (with Select and Copy enabled to allow for text and graphics transfer), Microsoft (MS) Word 2007, MS Excel 2007, MS-Project 2007, MS-Power Point 2007, or AutoCAD, version 14. Hypertext links may be used to facilitate navigation within the document. In the event of a conflict between the hardcopy and softcopy, the softcopy will take precedence over the hardcopy. Submittals shall include both .DOC and .PDF versions of all textual material. In the event of a conflict between the .DOC and .PDF versions, the .PDF

version will take precedence over the .DOC version. CAD drawings shall be submitted in .DWG file format.

6.2.6.2 Hard Copy Submittals

A. Page size (for text sections of submittals) shall be 8.5 x 11 inches, not including foldouts. The text size shall be single spaced and no less than 12-point font, Times New Roman. Use at least 1-inch margins on the top and bottom and 3/4 inch side margins. Pages shall be numbered sequentially. These limitations shall apply to both electronic and hard copy submittals.

B. Legible tables, charts, graphs, and figures shall be used wherever practical to depict organizations, systems and layout, implementation schedules, and plans. These displays shall be clear, legible and shall not exceed 11 x 17 inches in size. Foldout pages shall fold entirely within the binders and count as two pages. Foldout pages may only be used for large tables, charts, graphs, diagrams, and schematics, but not for pages of text. Matrixes, spreadsheets, focus boxes, and tables shall use single-line spacing and be no smaller than 10-pt font, Arial. Text inside graphics shall be no less than 8-point font, Arial. Otherwise, text may be used sparingly to describe the depicted pictures or graphics and shall use single-line spacing and be no smaller than 10-point font.

A.4.5 Government Review of Submittals

Those submittals requiring government review and approval, unless otherwise designated, shall be returned within 5 business days with comments and/or approval.

A.5 Contract Personnel Requirements

A.5.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors at the Contract Initiation Meeting including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

A.5.2 Identification Badges

The Government will furnish temporary identification badges without charge for each site at which work is conducted (NASA/ARC and NASA/DRFC-DAOF). Application for and use of badges will be as directed. The Contractor shall immediately report instances of lost or stolen badges to the COTR.

Failure to obtain entry approval will not affect the contract price or time of completion.

A.5.3 Personnel List

The Contractor shall submit for approval on NASA Form DFRC-735 or DFRC-736, at least 10 days prior to the desired date of entry, an original alphabetical list of personnel

who require entry into Government property to perform work on the project for each site (NASA/ARC and NASA/DRFC-DAOF. Furnish for each person:

a. Full Name
b. Date and place of birth
c. Citizenship
d. Company
e. Driver's License Number and State of Issue
f. Last 6 digits of Social Security number
g. Green card for legal permanent residents (if applicable)

The request for personnel passes shall be accompanied with the following certification:

"I hereby certify that all personnel on this list are either born U.S. citizens, naturalized U.S. citizens with the naturalization number shown, or legal aliens with the alien registration number indicated."

Signature/Firm Name

A.5.4 Citizenship Requirements

Contractor employees to work at either site (NASA/ARC and NASA/DRFC-DAOF must either be U.S. Citizens or legal permanent residents. Contractor employees will be admitted to the work site only with COTR approval.

Appendix B Quality Control

B.1 QC Program Requirements

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a Quality Assurance and Safety Plan, participation in weekly project meetings, submittal review and approval, testing, inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager or alternate is on the work site.

B.1.1 Quality Control Manager

During the project, the contractor shall provide a Quality Control Manager. The contractor QC Manager must be on the job for all critical or safety-related event. The contractor may designate the Project Lead as the QC Manager if the Project Lead has had appropriate quality assurance training. The contractor shall provide the resume to the Contracting Officer (CO) for approval.

B.1.2 Acceptance

Acceptance of the Quality Assurance and Safety (QAS) Plan is required prior to the start of system preparation for dismantling. The Contractor shall submit the QC Plan seven business days prior to the Project Implementation Review. The COTR shall approve or disapprove the QAS Plan.

B.1.3 Notification of Changes

The Contractor shall notify the COTR, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes will be subject to the acceptance by the CO.

B.2 QC Organization

B.2.1 QC Manager

B.2.1.1 Duties

The Contractor shall provide a QC Manager at the work site to implement and manage the QC program. The QC Manager is required to attend the weekly project meetings, perform submittal review and approval, ensure inspection and testing is performed and provide QC certifications and documentation required in this contract.

B.2.1.2 Qualifications

An individual with a minimum of 5 years combined experience as a project lead, inspector, QC Manager, or project manager on similar size and type vacuum system build and installation contracts. The individual shall be familiar with the requirements of the EM 385-1-1 and have experience in the areas of hazard identification and safety compliance.

B.2.2 Alternate QC Manager Duties and Qualifications

The Contractor shall designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence. The period of absence may not exceed one week at one time, and not more than two work weeks for the duration of the project. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

B.2.3 Quality Assurance and Safety (QAS) Plan

B.2.3.1 Requirements

The Contractor shall provide, for acceptance by the CO, a QAS plan that covers both on-site and off-site work and includes the following with a table of contents listing the major sections.

I. QC ORGANIZATION: A chart showing the QC structure and its relationship to the project side of the organization.

II. NAME(S) AND QUALIFICATIONS: In resume format, for each person performing QC. Include any QC certifications possessed by these individuals.

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Of each person performing QC.

IV. OUTSIDE ORGANIZATIONS: A listing of outside organizations such as consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

V. SUBMITTAL PROCEDURES: Procedures for reviewing, approving and managing submittals.

VI. INSPECTION AND TESTING REPORTS: Inspection and Testing Reports documenting the tests run and the results found, and the person responsible for each inspection or test.

VII. PROCEDURES TO COMPLETE MISHAP AND DISCREPANCY LIST: Procedures to identify, record, track and resolve mishaps and discrepancies.

The records resulting from tracking and resolution of mishaps and discrepancies shall be compiled into an end-item deliverable Field Qualilty Control Report.

VIII. DOCUMENTATION PROCEDURES: Use Government formats.

IX. PROCEDURES FOR TASK CHECKLISTS: For each task provide Checklists. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents.

X. PROCEDURES FOR RELOCATION PERFORMANCE DEMONSTRATION: See Section 11.

B.3 QC Meetings

After the start of move preparation for the Mirror Coater, the QC manager shall attend weekly tag-up meetings with the contractor Project Lead and the COTR and review any upcoming hazards in the next week of work, the status of any outstanding submittals, any discrepancies documented, and the results of any inspections

B.4 Submittal Review and Approval

Procedures for submission, review, and approval of submittals are described in the submittal section of this SOW.

B.5 Testing

Except as stated otherwise in the specification sections, perform sampling and testing required under this contract.

B.5.1 Capability Check

The COTR retains the right to check testing equipment and testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this contract.

B.5.2 Test Results

The Contractor shall cite applicable Contract requirements, tests or analytical procedures used. The Contractor shall provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, the Contractor shall notify the CO immediately through the COTR.

Test results shall be signed by a testing representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the CO through the COTR.

B.6 Government Inspection

Government in-process and end-item inspections will be performed at the work sites by a designated Government representative to assure compliance with the contract requirements, drawings, and technical specifications. The extent of such inspection will depend upon the level of quality and workmanship of the items. The Contractor shall notify the COTR of scheduled inspections a minimum of 48 hours prior to such scheduled inspections.

The Contractor shall give 24-hour advance notice to the COTR of the date when the contract work will begin at the site to allow coordination with the inspection staff. Should the Contractor unexpectedly suspend work at any time prior to completion of the contract, the Contractor shall notify the COTR as soon as possible. If work is suspended for 3 days or longer, the Contractor shall not resume work without notifying the COTR 24-hours in advance.

B.6.1 Dismantling Preparatory Inspection

Prior to disconnection of any electrical items for the Mirror Coater System, the government will inspect the connection diagrams and wiring labeled in preparation for disconnection.

B.6.2 Packaging and Rigging Inspection

The government will inspect the packaging, bracing, and rigging for all components of the Mirror Coater and ground support equipment prior to transport. Fragile items shall be inspected prior to closure of crates or boxes.

ARC Facility Closeout Inspection

An inspection will be performed to determine compliance with the specified clean up and patching requirements.

B.6.3 Post-Shipment Inspections

The government will inspect the Mirror Coater components and all ground support equipment after delivery to the DAOF. Internal and external visual examination (VTE) on the vessel by a certified welding inspector (CWI) after the move (report).

B.6.4 Assembly Inspection

The government or designated representative will inspect the installed Mirror Coater and ground support equipment prior to activation. This will include electrical wiring, seismic bracing, welding, and pressure line connections as well as pressure component certifications.

B.7 Documentation

The Contractor shall maintain current and complete records of on-site and off-site QC program operations and activities. The Project Lead and the QC Manager must prepare and sign the all reports. The reporting of work shall be identified by terminology consistent with the project schedule.

B.7.1 Quality Control Validation

The Contractor shall establish and maintain the following in a series of three ring binders. Binders should be divided and tabbed as shown below. These binders shall be readily available to the Government's Quality Assurance Team during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections, arranged by Activity/Event Number.

c. A current up-to-date copy of the Testing and Plan Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that the modified work was accomplished.

e. A current up-to-date copy of the Discrepancy List.

f. Maintain up-to-date copies of all punch lists issued by the QC Staff on the Contractor and Sub-Contractors and all punch lists issued by the Government.

B.7.2 As-Built Drawings

The QC Manager is required to review adrawings, required by Section X, are kept current on a daily basis and marked to show deviations, which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation, e.g., modification number, RFI number, etc. The QC Manager shall initial each deviation or revision that was approved by the COTR. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the COTR.

The Contractor shall maintain at the jobsite two sets of full-size prints of the contract drawings, accurately marked in red with adequate dimensions, to show all variations between the construction actually provided and that indicated or specified in the contract documents, including buried or concealed construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the contract drawings. Existing utility lines and features revealed during the course of

construction shall also be accurately located and dimensioned. Variations in the interior utility systems shall be clearly defined and dimensioned; and coordinated with exterior utility connections at the building five-foot line, where applicable. Existing topographic features which differ from those shown on the contract drawings shall also be accurately located and recorded. Where a choice of materials or methods is permitted herein, or where variations in scope or character of methods is permitted herein, or where variations in scope or character of work from that of the original contract are authorized, the drawings shall be marked to define the construction actually provided. The representations of such changes shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as necessary to clearly portray the as-built construction. These drawings shall be available for review by the COTR at all times. Upon completion of the work, both sets of the marked up prints shall be certified as correct, signed by the Contractor, and delivered to the COTR for his approval before acceptance.

B.8 Notification of Discrepancies

The contractor shall notify the contractor of any discrepancies within 24 hours.

Appendix C ARC Safety Requirements

C.1 Applicable Requirements

The following chapters of APR 1700.1, Ames Health & Safety Procedural Requirements are applicable:

APR 1700.1 Chapter 11 - Electrical Safety
APR 1700.1 Chapter 15 - Cryogenic Safety
APR 1700.1 Chapter 17 - Lifting Devices and Equipment
APR 1700.1 Chapter 26 - Confined Space Entry
APR 1700.1 Chapter 27 - Construction Safety Management
APR 1700.1 Chapter 31 - Lockout/Tagout
APR 1700.1 Chapter 40 - General Safety For Fall Protection
APR 1700.1 Chapter 44 - Compressed Gas Cylinder Safety

C.2 Hazards

The Contractor shall provide a hazard assessment prior to start of work in the facility where the work is to be performed. The assessment shall, at a minimum, determine potential sources of danger, identify failure modes, and recommend resolutions and a system of risk acceptance for those conditions found in the hardware-facility-environment-human relationship that could cause loss of life, personal injury, and loss of or damage to facilities or mirror coating chamber. This assessment shall also include all mobile cranes and derricks used for critical lifts. In development of the hazard assessment, reference reference Attachment E for the Activity Hazard Analysis form, Activity Hazard Analysis Example, Mirror Coating Facility Safety Assessment Report and the Critical Lift Operations Hazard Assessment Report for the Primary Mirror Assembly.

C.3 Pressure Systems

All fabrication work performed on the vessel and the associated pressure piping shall conform to the original code of construction (ASME Boiler & Pressure Vessel Code Section VIII & ASME B31.3 Process Piping). The organization performing the repair or alteration shall be certified by the National Board of Boiler and Pressure Vessel Inspectors and authorized to use the “R” Symbol Stamp. The contractor shall provide results of all accepted inspections. For any new welds on pressure retaining items, the contractor shall provide welder certification, welding procedures specifications (WPS), and have the welds inspected by a certified weld inspector (CWI).

C.4 Training

The contractor shall provide training for their employees prior to the start of work and corresponding certifications in order perform all tasks associated with this contract. Particular areas of training required for this task are listed below. Training records should be available for review upon request. The contractor shall take the following training classes prior to the start of work

Confined Spaces
Fall Protection
Crane Operation (if Government-owned cranes are to be utilized in move)
Lock-out/Tag-out
Aircraft Hangar and Ramp Safety (ARC)

Appendix D NASA Safety

D.1 NASA's Commitment to Safety

The success of this historic agency starts with an unwavering commitment to safety. The culture of this institution is one of safe accomplishment of our missions, including construction projects. If something about this project, or any task, is unclear, it is required that you, the Contractor, ask for clarification. No activities on this project, or at this Agency, are important enough to compromise the safety of any person. If you suspect something isn't quite right, trust your instincts and your experience, and do something to correct the situation.

NASA's mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.

D.2 The NASA Safety Culture

Safety at NASA is of paramount concern. We assure a commitment to safety by employing systems and processes that ensure the safety of the public, the employees, and assets. We ensure safety in all aspects of personal endeavors and we are committed to ensuring the safety of others. We take ownership for safety. We know every accident is preventable. In the spirit of NASA, the Contractor shall implement the safety provisions of this section to "make known the overlooked and unexpected" to keep all employees safe. The Contractor shall INSTRUCT ALL EMPLOYEES as to the hazards and the precautions to be taken in performance of this contract. The Contractor shall provide and maintain work environments and procedures which will safeguard Contractor employees,

Subcontractors, the Public, Government personnel, and Government property, materials, supplies, and equipment exposed to Contractor operations and activities.

D.3 Construction Safety Goals

The safety provisions of this section are to be implemented by the Contractor so that:

a. Everyone involved in this project goes home as healthy as they arrived.

b. This construction work site is free of recognizable hazards.

c. We have zero lost-time accidents.

d. We have zero injuries in our workplace.

D.4 Construction Safety Strategy

In order to meet these goals every individual working onsite for the Contractor, including Subcontractors, Vendors and their employees, shall:

a. Be involved in making this project safer.

b. Know how to identify hazards.

c. Know how to report hazards and get them fixed.

d. Know their safety and health training needs, have obtained that training, and shall put the concepts to work each and every day while working on this project.

D.5 Compliance

The Contractor shall take safety and health measures in performing work under this Contract. The Contractor shall comply with all applicable federal, NASA/Ames Research Center, NASA/Dryden Flight Research Center (DFRC) Aircraft Operations Facility (DAOF) safety and health requirements and standards. The Contractor shall take all precautions in the performance of work under this contract to protect the safety and health of the Contractor's employees, to protect the safety and health of all persons in or near the jobsite, and to prevent damage to property, materials, supplies and equipment. The Contractor shall comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. The Contractor shall comply with the U.S. Army Corps of Engineers Safety and Health Requirements Manual in effect on the date of the solicitation.

D.6 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NPR 8621.1B	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping w/Change 5 (03/15/2010)
NPR 8715.1	NASA Occupational Safety and Health Programs w/Change 3 (02/13/06)
NASA NPG 8715.3	(2004) NASA Safety Manual
NASA NSS 1740.12	(1993) NASA Safety Standard For Explosives, Propellants and Pyrotechnics
NASA STD 8719.11	(2000) NASA Safety Standard for Fire Protection
APR 1700.1 Chapter 11	Ames Health and Safety Procedural Requirements Electrical Safety
APR 1700.1 Chapter 15	Ames Health and Safety Procedural Requirements Cryogenic Safety
APR 1700.1 Chapter 17	Ames Health and Safety Procedural Requirements Lifting Devices and Equipment
APR 1700.1 Chapter 26	Ames Health and Safety Procedural Requirements Confined Space Entry
APR 1700.1 Chapter 27	Ames Health and Safety Procedural Requirements Construction Safety Management
APR 1700.1 Chapter 31	Ames Health and Safety Procedural Requirements Lockout/Tagout
APR 1700.1 Chapter 40	Ames Health and Safety Procedural Requirements General Safety For Fall Protection
APR 1700.1 Chapter 44	Ames Health and Safety Procedural Requirements Compressed Gas Cylinder Safety

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 20	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

D.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section X.X SUBMITTAL PROCEDURES:

The following items shall be submitted in accordance with Paragraphs 1.8.1 "Contractor's Accident Prevention Plan" and 1.9.1 "Activity Hazard Analysis" of this section. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section).

Quality Assurance and Safety Plan; G
Activity Hazard Analysis; G

The following Requests for Permit shall be submitted in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS" of this section.

Request for Confined Space Entry Permit; G
Request for Utility Outage/Facility Closure Permit; G
Request for Crane Operation Permit; G
Request for Open Flame and Hotwork Permit; G

Test Reports

Records shall be submitted in accordance with paragraph entitled, "Gas Protection," of this section.

Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Quality Assurance and Safety Plan " and "Protection Plan," of this section.

Quality Assurance and Safety Plan

License Certificates

The following shall be submitted with the Contractor's "Daily Report to the Inspector" by 10:00 am the next work day in accordance with Paragraph 1.12.2 "Daily Safety Meetings/Daily Safety Inspections" of this section:

Safety Meeting/Safety Inspection sheets

Safety Meeting Attendance sheets

Confined Space Entry Training Certificates shall be submitted for all Confined Space Entry Attendants/Entry Supervisors prior to any employees entering a confined space. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets(MSDS), G

MSDSs for all chemicals and hazardous materials brought to the jobsite. MSDSs shall be submitted in accordance with Paragraph titled "Material Safety Data Sheets (MSDS)" and Paragraph Titled "Chemicals and Hazardous Materials" of this section. (See also Paragraph Titled "Documents at the Jobsite" of this section.)

Contractor shall submit an Quality Assurance and Safety Plan to the COTR for approval within 17 calendar days after notice to proceed and prior to start of construction at project site. The Quality Assurance and Safety Plan written by the prime Contractor for the specific work and hazards of this contract, shall implement in detail the pertinent requirements of the US Army Corps of Engineers Safety and Health Requirements Manual. The plan shall define how the Contractor will comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. Prior to initiation of work at the job site, the Contractor's Quality Assurance and Safety Plan shall be reviewed, found acceptable, and approved by the COTR.

Quality Assurance and Safety Plan shall encompass both the NASA/ARC and NASA/DFRC-DAOF sites and include, as a minimum, the following:

a. Safety program objectives.

b. Methods to attain safety objectives.

c. Responsibility of key personnel for the Contractor.

d. Safety meetings, surveys, inspections, and reports.

e. Disaster and emergency programs as it applies to the NASA/ARC and NASA/DFRC-DAOF site.

f. Lists of key personnel to be contacted in times of emergency, along with appropriate phone numbers to be used in emergencies.

g. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926 and various safety requirements of NASA NPG 8715.3.

h. Methods to comply with the requirement for immediate reporting of mishaps to the COTR in accordance with NASA NPG 8621.1.

i. Statement that the Contractor will not invalidate the integrity of safety systems without proper authorization.

j. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of accident or an act of nature.This shall include procedures to secure dangerous conditions, protect personnel, and secure work areas. The plan must contain 911 telephone contact procedures specific to NASA/ARC and NASA/DFRC-DAOF (See Paragraph "FIRST AID AND EMERGENCIES" of this section).

k. Procedures for securing the mishap site so that the area remains secure until arrival of a safety investigator. Mishap site will remain secured until released by the COTR.

l. A map with the location and times of operation of the NASA/ARC and NASA/DFRC-DAOF medical dispensary. (This information can be obtained from the COTR.)

m. Procedures describing how chemicals, hazardous materials and hazardous wastes will be handled, managed and disposed of while at NASA/ARC and NASA/DFRC-DAOF.

n. Incorporate plans for the following, as applicable: Lockout/Tagout, Confined Space, Fire Prevention, Electrical Safety, and Fall Prevention/Protection.

o. Incorporate a DFRC-DAOF heat stress monitoring plan. Drinking water shall be made available to workers and workers shall be encouraged to frequently drink small amounts; the water shall be kept reasonably cool.

p. Incorporate a plan on how to protect structures, utilities, flooring, and other facilities immediately adjacent to project activities against damage.

D.7.1 Protection Plan

Structures, utilities, flooring, and other facilities immediately adjacent to project activities shall be protected against damage per FAR 52.236-9 and Section I. The contractor's approach shall be documented in the Quality Assurance and Safety Plan.

D.8 GENERAL SAFETY PROVISIONS

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the COTR to develop a mutual understanding relative to administration of the Accident Prevention Plan. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract for both Ames Research Center and the DAOF.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the COTR of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

D.8.1 Activity Hazard Analysis

Prior to beginning each Definable Feature of Work (DFOW), an activity hazard analysis shall be prepared by the Contractor performing the work. A DFOW is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. Work will not proceed on that phase until the activity hazard analysis has been accepted by the COTR and discussed with all engaged in the activity, including the Contractor, subcontractors, and government on-site representatives.

The Activity Hazard Analysis shall:

a. define the activity to be performed and identify the sequence of work,

b. define the specific hazards anticipated with the activity,

c. define the control measures to be implemented to eliminate or reduce each hazard to an acceptable level,

d. identify the equipment to be used,

e. identify the inspection requirements for that equipment and activity, and

f. list the training requirements for the workers.

An form which may be used to document the AHAs is included in attachment X.

D.8.2 Material Safety Data Sheets (MSDS)

The Contractor shall provide the COTR with a copy of the Material Safety Data Sheets for all chemicals and hazardous materials to be brought on either the ARC or DAOF site. All manufacturers' recommended precautions shall be followed during the use of any chemical and hazardous material. MSDSs must be submitted to the COTR for approval by the cognizant NASA Safety Specialist prior to the use of any chemical or hazardous substance. See also Paragraph 1.10.1 "Documents at the Jobsite" and Paragraph 1.27.1 "Chemicals and Hazardous Materials" of this section.

D.9 SAFETY COMMUNICATIONS

Quality Assurance and Safety Plan Plans, hazard analyses, and MSDSs are only effective when the workers in the field are aware of the potential hazards for that day, and take mitigation measures to work safely in that area at that time. Therefore, daily safety communications are a critical requirement. Every work day shall begin with a brief safety meeting and every work day shall include a safety inspection by the Contractor's designated Site Safety Officer, see Paragraph Titled "Daily Safety Meetings/Daily Safety Inspections".

Also, prior to beginning any new DFOW the Contractor shall conduct an Activity Hazard Analysis on that new class of work and shall conduct a thorough discussion of that Activity Hazard Analysis with the workers performing the work. The Contractor shall ensure the workers understand the hazards and how to use any special tools, unique equipment, and personal protective equipment. Only after these safety analyses and communications occur shall the new class of work be allowed to proceed.

D.9.1 Documents at the Jobsite

To help maximize safety communications, the following list of documents shall be maintained on the jobsite and made easily available for the Contractor's employees and Subcontractors' employees. These records shall also be made available for Government inspection. They include but are not limited to:

a. the approved Quality Assurance and Safety Plan,

b. all approved Activity Hazard Analysis,

c. all approved MSDSs,

d. all approved permit documents for Permit Required Operations that have been completed,

e. all records of lockout/tagout operations that have been completed,

f. the jobsite OSHA 300 log,

g. all training records, including Confined Space Entry Training Certificates, and

h. other records that are deemed appropriate due to the nature of the work, i.e. certificates, permits, licenses, etc.

These records shall be stored at a convenient centralized location on the jobsite. These records shall be organized, filed, and labeled in binders or file folders in a fashion that all persons involved with the project can obtain the information quickly and easily.

D.9.2 Posted Warnings and Prohibitions

The Contractor shall comply with procedures prescribed for control and safety of all persons visiting the project site. The contractor shall install all barricades and signs needed. All points of entry to the project site shall have a sign warning of the requirement to wear hard hats. The Contractor is responsible for familiarizing each employee and each subcontractor employee with safety requirements.

All Contractor personnel are to obey all posted prohibitions, restrictions, warnings, and traffic control signs and devices. Contractor personnel shall not enter any area in which a red light is flashing without permission of the NASA area supervisor. When alarm bells are sounded in a building, secure the equipment in use and leave the building by the nearest exit. An egress passage must be maintained at all times in the work area. The Contractor shall advise employees of these requirements.

The Contractor shall advise the COTR of any special safety restrictions the Contractor has established so that Government personnel can be notified of these restrictions.

D.9.3 Display of Safety Information

The Contractor shall erect a safety bulletin board at the job site within 2 calendar days after the COTR has approved the Quality Assurance and Safety Plan. The following information shall be displayed on the safety bulletin board in clear view of the on-site construction personnel, maintained current, and protected against the elements and unauthorized removal:

a. Map denoting the route to the nearest emergency care facility.

b. Emergency phone numbers.

c. Copy of the most up-to-date Quality Assurance and Safety Plan.

d. Current AHA(s) and MSDSs.

e. OSHA 300A Form.

f. OSHA Safety and Health Protection-On-The-Job Poster.

g. Safety and Health Warning Posters.

h. Active Permits.

   i. Excavation and Digging,

   ii. Open Flame and Hot Work,

   iii. Confined Space Entry,

   iv. Utility Outages/Facility Closures

   v. Crane Operations.

D.9.4 TRAINING

D.9.4.1 Employee Indoctrination

Employees (prime, subcontractor, vendors, and suppliers) onsite will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

D.9.4.2 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new phase, training will be provided to all affected employees to include a review of the AHA to be implemented.

D.10 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147. Specific Lockout/Tagout requirements are as follows:

a. The tags shall be the same for both lockout and tagout, and shall only be used once. The information on the tag shall be printed legibly.

b. For lockout the information shall include - name of person controlling the lock, the date the lock was put in place, telephone number of the person controlling the lock, name of the Project Inspector monitoring the work, name of the company serving as prime contractor for the work, and the name of the company for which the lock control person is employed.

c. For tagout, the above information is required plus an explanation of why a lock could not be used, and what additional safety precautions were used.

The above information shall be documented, and the record made available for inspection. Upon completion of the Lockout/Tagout Operation the documents shall be stored at the jobsite.

COTR will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout tags.

When work is to be performed on electrical circuits, the contractor shall only allow qualified personnel to perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

D.10.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

D.10.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the COTR. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the COTR.

D.11 SAFETY MEETINGS AND INSPECTIONS

D.11.1 Mutual Understanding Meeting

Before commencing the work, the Contractor shall meet with representatives of the COTR to discuss and develop a mutual understanding relative to administration of the overall safety program. Items to be discussed shall include: COE EM-385-1-1, hard hats/safety shoes, other personal protective equipment (PPE), daily safety meetings, activity hazard analysis, frequency of inspections, 911 communications, stopping of unsafe activities, permit required operations and MSDSs.

D.11.2 Contractor Daily Safety Meetings/Daily Safety Inspections

The Contractor shall conduct daily safety meetings at the beginning of each work shift with their employees. This safety meeting shall be administered by the Contractor's Project Lead, or qualified designated representatives. This safety meeting shall be attended by all of the Contractor's employees, as well as all subcontractors and their employees working at the project site for that day. If any of these persons are not present at the daily safety meeting, they shall be briefed of the issues discussed in the meeting on an individual basis by the Contractor's Project Lead or QC Manager prior to starting work at the site that day. The safety meeting format and discussion shall include, but not be limited to: the schedule of events on the site for the day; addressing hazard analyses for the day's activities; allowing employees and subcontractors to submit hazard analyses and MSDSs for upcoming activities; planning permit required operations; discussing unsafe conditions and near misses on the job site; discussing new equipment and material deliveries to the job site; discussing corrective actions to be taken and assignment of responsibilities for the implementation of those corrective actions.

The Contractor's designated Site Safety Officer shall, at least once per shift, conduct at least one walk-through site safety inspection of all site activities. This inspection shall be conducted at a random time during each shift. The Site Safety Officer's sole purpose during the walk-through shall be to ensure compliance with the approved Accident Prevention Plan, approved Activity Hazard Analysis, and approved MSDSs. Additionally the Site Safety Officer must ensure the workers receive feedback as to their safety effectiveness and compliance with safety procedures.

The Contractor shall use the attached Safety Meeting/Safety Inspection sheets and Safety Meeting Attendance sheets, or an approved equal, to report the elements described herein. These sheets shall be submitted to the COTR on a daily basis by 10:00 am on the next work day, (with the Contractor's "Daily Report to the Inspector").

D.12 CONTRACTOR VEHICLES AND EQUIPMENT

Drivers of contractor owned vehicles must have with proof of registration and insurance at all times, as well as a valid driver's license in order to drive on site.

Contractor-owned, leased, or operated equipment must be in satisfactory mechanical condition. Vehicle identification is required on both sides of all contractor vehicles, clearly identifying the contractor. While in use at the job site, rental equipment shall be kept in good working order and properly maintained. Contractor owned equipment brought on site must have copies of all operating air permits for the equipment.

Prior to a piece of rental equipment arriving on the job site, the Contractor shall present a hazard analysis for the use of the equipment. The hazard analysis shall include consideration for hazards associated with unloading, moving, and reloading the equipment. The Contractor is responsible to ensure that all employees working on or

around that equipment are properly trained to use it and made aware of its associated hazards.

Hoisting and lifting devices and cranes must bear evidence of proof loading within the preceding 12 months. Operators of hoisting and lifting devices and cranes shall be trained in proper use and safety limitations. The Contractor shall provide written proof of qualification for all operators of fork lifts and personnel lifts (i.e. boom lifts, platform lifts, scissors lifts, etc.). Outdoor hoisting operations shall not commence if winds are above 20 knots (23 mph) steady state or if gusts exceed 35 knots (40 mph) and the Contractor shall also comply with the manufacturer's recommended operating limits; the more restrictive shall govern.

Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16 and Appendix G. In addition, for mobile cranes, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or and organization that tests and qualifies crane operators). Written proof of current qualification shall be provided.

Contractor owned vehicles which will be driven on the flight line (aircraft hangars, aprons, ramps, tow-ways, and taxiways) must bear identifying signs and property damage insurance. Access to the flight line must be authorized by the cognizant Flight Operations Manager through the COTR. The Contractor shall be responsible for performing daily inspections of these vehicles and shall secure, remove, or dispose of all foreign objects, materials, and debris that can cause damage to an aircraft. Objects and debris lodged between tire treads shall be removed prior to driving on the flight line. All vehicles which are permitted on aircraft maintenance ramps, fuel storage areas, fuel servicing areas, hangars, explosive areas, and any other fire hazard areas shall be equipped with an approved spark arrestor and authorized in writing by the COTR for use in these areas.

Operators of motor vehicles shall be licensed. Only Contractor work vehicles, delivery vehicles, and debris hauling vehicles, driven by licensed operators, will be allowed at the work site. Vehicles for transportation of personnel or personal tools (commuting) must be parked in designated parking spaces.

The use of seat belts is mandatory by all operators and passengers traveling in motor vehicles on Ames Research Center or the Dryden Aircraft Operations Facility (DAOF). Passengers are prohibited from riding in or on the back or bed of any truck. The speed limit, unless otherwise posted, is 15 miles per hour. The security police use radar units.

Use of Government owned equipment, tools, supplies, or materials is prohibited unless specifically authorized by the COTR.

D.12.1 VEHICLE FOREIGN OBJECT DEBRIS (FOD) PREVENTION STEPS

In aircraft facilities at both ARC and the DAOF, Cars, trucks, trailers, and mobile service vehicles that have access to aircraft operational areas are a potential source of FOD. Prevention that should be taken includes:

a. Inspect all transport vehicles that will operate on the flight line and hangar areas for foreign objects.

b. Before a vehicle is driven onto taxiways, runways, or into aircraft parking areas, the driver will stop and check that there are no rocks or pebbles caught in the tire treads and that the load is secure. The driver will also check pickup beds for loose tools, hardware, trash, and other debris.

c. Vehicles must not be driven off the hard surface unless absolutely necessary. If it does become necessary to drive off to let an aircraft pass or for any other reason, the driver will once again check the load for security and the tires for foreign objects before re-entering the hard surfaced area. This does not apply to emergency vehicles responding to an emergency.

d. All vehicles will enter and leave the flight line at controlled access points unless an emergency vehicle is responding to an emergency.

D.13 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid treatment procedures and medical emergency contact information, including ambulance information at project site.

D.14 1.15 FIRE PREVENTION AND PROTECTION

In addition to the requirements stated below, the Contractor shall also be familiar with guidelines located in NASA STD 8719.11 NASA Safety Standard for Fire Protection.

Open-flame heating devices will not be permitted except by approval in writing from the NASA/ARC Safety Officer or the NASA/DRFC-DAOF Facility Safety Manager, depending on the site. Approval for the use of open fires and open-flame heating devices will not relieve the Contractor from the responsibility for any damage incurred because of fires.

Burning trash, brush, or wood on the project site shall not be permitted.

Any fire hazard conditions shall be immediately reported to COTR at NASA/ARC or . Any fire emergency situation shall be reported by calling 911 or the NASA/DFRC Security Post #1 at (661) 276-3256. Contractor vehicles must not block or encroach upon fire truck lanes at any time. The Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction.

All work sites shall be kept clean and orderly at all times. Combustible scrap, debris, and waste materials (oily rags, paper, packaging, scrap wood, etc.) shall be stored in covered metal receptacles and removed from the worksite daily to minimize potential hazards. Flammable and combustible materials shall be stored in a manner which minimizes the risk of fire including spontaneous combustion. "No Smoking" signs shall be posted in areas where flammable or combustible material are stored.

Only UL-approved containers and tanks shall be used for storage and handling of flammable and combustible liquid. All flammable and combustible liquids shall be kept in closed containers when not in use. Bulk drums of flammable or combustible liquids shall be grounded and bonded to containers during dispensing. The Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher placed within 20 feet where flammable/combustible liquids are stored.

The Contractor shall ensure the following are complied with when pressurized cylinders are on the jobsite:

a. Cylinder contents shall be identified with a label.

b. All cylinders shall be stored in an upright position at all times.

c. Cylinders shall be secured at all times.

d. Cylinders not in use shall have valve protector caps in place.

Smoking is not permitted in buildings or on roofs. Smoking is permitted in approved designated areas only. Smoking materials shall be disposed in an approved receptacle.

Nonspark producing tools and equipment or pneumatic type shall be utilized in fire hazardous areas such as hangars and other explosive environment areas. Burning of trash or rubbish is prohibited.

Dispensing of flammable and combustible liquids is not permitted in buildings or on roofs.

D.15 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site .

D.16 PERMIT REQUIRED OPERATIONS

The Contractor shall coordinate with the COTR and obtain written approval from the COTR on all Permit Required Operations before the operation begins. The Contractor

shall initiate coordination with the COTR by writing and submitting a Request for Permit. The Contractor shall provide, with the Request for Permit the following:

a. Relocation Plan - A written work plan describing the work to be accomplished during the Permit Required Operation including a schedule to be followed. The schedule shall include the dates and time period the Contractor contemplates performing the operation.

b. Activity Hazard Analysis - An activity hazard analysis of the proposed activities during the Permit Required Operation including the Contractor's plan to minimize or eliminate any hazards associated with the performance of the work. See paragraph 1.9.1

The permits are primarily used to identify potentially hazardous work conditions in an attempt to prevent accidents. The permits are also used to coordinate the required work with key DFRC activities and keep customer inconvenience to a minimum. The permits shall be processed just prior to the start of the operation. Permit forms will be provided and filled out by the Government. The Contractor shall post approved permits at a conspicuous location in the construction area near the permitted operation. Upon completion of the Permit Required Operation a copy of the approved permit documents shall be stored at the jobsite in accordance with Paragraph "Documents at the Jobsite" of this section. Permit required operations are:

1. Open Flame and Hot Work

2. Confined Space Entry,

3. Utility Outages/Facility Closures, and

4. Crane Operations.

D.16.1 Open Flame and Hot Work

The use of an open flame is a Permit Required Operation (see permit form in Attachment J18). Hot work such as welding, torch cutting, sawing metals, flame cutting, burning, grinding, brazing, soldering, and cad welding are all Permit Required Operations. Applying, installing, or removing building materials through the use of heat are also Permit Required Operations. Any operation that can result in the generation of hot flying debris or sparks is a Permit Required Operation. During operations involving possible fire hazard, the Contractor shall notify the COTR and not proceed until approval is obtained in writing. Open flame and hot work operations must be approved by the COTR before operations begin. The Contractor shall obtain this approval by submitting a written Request for Open Flame and Hot Work Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the

COTR three (3) calendar days prior to the start of these operations, to enable the COTR to review measures being taken to prevent hazard to employees, prevent possible fire damage to equipment and property, and prevent unnecessary activation of fire suppression/alarm systems.

The permit, a USAF WELDING, CUTTING AND BRAZING PERMIT, (AF Form 592), must be filled out by the Government and attached to the Contractor's Request for Open Flame and Hot work Permit. This package must be reviewed and approved by the Dryden Safety Office and approved by the COTR prior to start of open flame and hot work. After obtaining the approved permit package from the COTR, the Contractor shall proceed with the open flame and hot work operation in accordance with the approved permit documents. The Contractor or Subcontractor performing the operation shall sign the permit before any open flame and hot work operation is started. The Contractor shall also comply with the requirements stated below.

The Contractor shall discontinue open flame or hot work operations 30 minutes prior to the end of the normal work day. A Contractor employee shall be assigned as Fire Watchman for every open flame and hot work operation. The Watchman shall be equipped with suitable fire extinguishers and shall check all areas around and below the welding or burning operation for fires. The check shall be continued for at least 30 minutes after completion of the open flame or hot work operation to ensure no possible sources of latent combustion.

The Contractor shall provide portable fire extinguishers for fire safety during open flame and hot work operations. When conducting open flame and hot work operations on roofs, the Contractor shall provide and be equipped with one full 20 pound 20-A:120 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. For all other open flame and hot work operations the Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. The COTR may request a standby from the Edwards Fire Department; this accommodation does not relieve the Contractor of responsibility for open flame and hot work safety.

Upon completion of open flame or hot work operation (or expiration of Permit), the permit shall be returned to the government.

D.16.2 Utility Outages/Facility Closures

Turning a utility off or on is a Permit Required Operation. Closing a facility or part of a facility is a Permit Required Operation. Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the cognizant NASA Safety Specialist. Utility outages and facility closures must be approved by the cognizant Facility Specialist before outages and closures begin. The

Contractor shall obtain this approval by submitting a written Request for Utility Outage/Facility Closure Permit in accordance with Paragraph D.16 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the COTR fourteen (14) calendar days in advance of the planned outage or closure, to enable the COTR to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with ARC and DFRC-DAOF activities, and keep Center impact to a minimum.

The permit, UTILITY SYSTEM OUTAGE APPROVAL (at DAOF form DFRC-113), must be filled out by the Government and attached to the Contractor's Request for Utility Outage/Facility Closure Permit. This package must be reviewed and approved by the cognizant NASA Safety Office, the Facilities Engineering & Asset Management Office, the affected Building/Area Manager, and the COTR prior to initiation of the outage or closure. After obtaining the approved permit package from the cognizant Safety Specialist, the Contractor shall proceed with the work requiring an outage or closure in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

The shut-down and start-up of the utilities for the outage shall be performed by the government and not the Contractor.

Contractors shall not shut down, shut off, disconnect, block, or otherwise impair any fire protection sprinkler system, fire hydrant, fire alarm system, special extinguishing or other installed fire protection system without an approved Utility Outage Approval (for the DAOF form DFRC-113; for NASA ARC see attachment O).

D.16.3 Crane Operations

Operating a crane is a Permit Required Operation for NASA ARC and DFRC-DAOF. Setting up a crane is a Permit Required Operation for NASA ARC and DFRC-DAOF. Cranes shall not be operated without written permission from the cognizant NASA Safety Specialist. Crane operations must be approved by cognizant NASA Safety Specialist before crane setup begins. The Contractor shall obtain this approval by submitting a written Request for Crane Operation Permit in accordance with Section D.16 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the COTR seven (7) calendar days in advance of the planned crane operation to enable the cognizant NASA Lift Manager to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with key DFRC activities, and keep Center impact to a minimum.

The permit, a CRANE OPERATION APPROVAL, must be filled out by the Government and attached to the Contractor's Plans. The contractor shall prepare the following plans/documents:

(1) Description of Work,

List the work to be accomplished during the lifting operation

(2) Center Impact Analysis,

List the affects this activity will have on Center occupants and Center operations, i.e. evacuate portions of a building, close a fire lane, require special secure access, close a building exit/entrance, etc.

(3) Activity Hazard Analysis

Per Section D.8.1

(4) Lift Plan

(a) The exact size and weight of the load.

(b) The maximum load limits for the entire range of the lift.

(c) Height of the lift.

(d) The lift geometry and sequence of actions.

(e) The load radius.

(f) The boom length and angle, for the entire range of the lift.

(g) Ground conditions and outrigger and mats requirements.

(h) A drawing showing the location of the crane and the "from" and "to" pick points, including adjacent buildings, utilities, and other obstructions or hazards.

2) Rigging procedures and rigging hardware.

3) Proof of qualification for the crane operator, including a current physician's certificate that meets the requirements of EM 385-1-1, Appendix G (Procedures for the Examination and Qualification of Crane Operators).

4) Environmental conditions under which lift operations are to be stopped.

5) Communication and coordination requirements.

6) The Contractor shall make Personnel Assignments and clearly list by name who will be the Lift Director, Crane Operator, Signalman, Rigger, and Tag Line Persons.

7) The Contractor shall also complete the Crane Safety Checklist prior to commencing lifting operations.

8) The Contractor shall perform a practice pick without the load to verify estimated boom angle(s) required to pick, rotate, and set the load.

The lift packages must be reviewed and approved by the cognizant Lift Manager for the center at which the operation is occurring prior to initiation of the crane setup. After obtaining the approved permit package from the COTR, the Contractor shall proceed with the crane operation in accordance with the approved permit documents.

Crane Safety Checklist for Facility Lifts:

Things to check

(1) Crane certifications and documents have been checked and are current, including:
  (a) Current physician's certificate.
  (b) Insurance.
  (c) Pre-lift Safety Meeting minutes.
(2) Operator certifications have been checked and are current.
(3) Ancillary lifting equipment certifications (slings, chokers, etc.) are current.
(4) Boom angle needed to reach both pick point and set points have been checked and capacity of the crane (AT THOSE BOOM ANGLES) is sufficient to lift the intended load.
(5) Capacity of the crane at the horizontal angles required for the pick, rotation, and set have been checked against crane manual and capacity is sufficient for the intended load. (Note: Some cranes, especially crawler cranes that don't have outriggers, DO NOT have the same capacity to the side that they do to the front.)
(6) There is sufficient room for crane counterweights to miss all obstructions when the crane rotates horizontally.
(7) Clip on crane hook has sufficient spring tension.
(8) All people in area are wearing hard hats and safety shoes.
(9) Person who is signaling crane operator has been designated and everyone understands who that person is for this operation.
(10) Lift Supervisor has been designated and everyone understands who that person is for this operation.
(11) Personnel handling tag lines have been designated and they understand that they are not allowed under the load.
(12) Ground where outriggers are set has sufficient capacity to resist "punching shear" force which is generated from load and expected geometric configuration of crane.
(13) Check for overhead electrical lines within boom radius + 20 feet. Brief the Chief, Facilities Engineering & Asset Management Office on proposed mitigation procedures.

(14) Check for underground vaults, tanks, or utilities near the crane location that might collapse or shift causing the crane to shift or sink while under load.
(15) Ensure the lifting/hazardous zone is delineated clearly to public (use cones, caution tape, fencing, or other.)

Things to do

1. Practice pick shall be made prior to actual lift in order to verify estimated boom angle(s) required to pick the load, rotate the load, and set the load. (Note: This is done without the load.)

D.17 ELECTRICAL SAFETY

Contractor shall appoint an individual responsible for the electrical safety of each work team to restrict entry to dangerous locations to those authorized by him jointly with the Government. Lockout/Tagout controls will be strictly enforced.

When ever possible, all lines, circuits, and equipment to be worked on shall be deenergized before work is started. If equipment or circuits cannot be deenergized, the Contractor shall provide all necessary personal protective equipment and other protective controls to work on energized lines, circuits, and equipment. Additionally, approval from the COTR shall be obtained by the Contractor prior to performing work on energized lines, circuits, and equipment.

The Contractor shall use Ground Fault Circuit Interrupters (GFCI) in all circuits used for electric tools and equipment in the construction site. The Contractor shall use GFCIs in all circuits used for temporary lighting in the construction site. GFCIs shall be installed in accordance with the most recent edition of the National Electric Code.

D.18 PROTECTION OF EXISTING UTILITIES

Existing utilities that are indicated, or the location of which is made known to the Contractor prior to beginning of operations, and utility lines constructed during the Contractor's operation, shall be protected from damage. If the Contractor damages any of these utilities they shall be repaired by the Contractor at no additional cost to the Government. In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not known to the Contractor, report thereof shall be made immediately to the COTR. If the COTR determines that repairs shall be made by the Contractor, such repairs will be ordered under the clause of the general provisions of the contract entitled "Differing Site Conditions".

D.19 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the COTR for all specialized material and equipment that could cause fatal harm to construction personnel or to the construction project.

Workers shall be protected from radiation exposure in accordance with 10 CFR 20. Standards for Protection Against Radiation.

Loss of radioactive material shall be reported immediately to the COTR.

Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5 p.m. on weekdays.

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the COTR will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process.

Use of equipment containing radioactive isotopes or any nuclear sources such as density test, moisture detectors, radiography, etc. must be approved by the Dryden Safety Office and the COTR. If such equipment is to be used in the work, the Contractor must notify the Dryden Safety Office through the COTR no less than 14 days prior to the use of such equipment. During the use of such equipment the Dryden Safety Office is authorized to make periodic checks to insure that proper health precautions are being followed. If the Dryden Safety Office determines that these precautions are not being followed, the Dryden Safety Office will immediately notify the COTR to initiate corrective actions.

D.20 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the COTR.

D.21 PROTECTION OF WORK

Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain from the COTR the current subsurface utility drawing of the particular area to be worked on. Contractor shall stake out subsurface utilities, communication cables and pipe lines indicated within the area of work.

Contractor shall notify the COTR, 48 hours prior to the start of excavation work or surface penetration, to enable the cognizant Safety Specialist to review measures being

taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the COTR of his intention to initiate work prior to actual start of activity.

After obtaining clearance from the COTR, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor shall temporarily halt any machine excavation work or other surface penetration when approaching 10 feet 3 meters of an existing utility line until the Contractor has exposed the utility line by hand excavation.

D.22 GAS PROTECTION

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

Contractor shall have one or more employees properly trained in operation of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

When working with systems that may compromise air composition, readings shall be permanently recorded daily, indicating the concentration of gas, point of test, and time of test. Submit copies of the gas test readings to the COTR or designee at the end of each work day.

D.23 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, drill hammers, generators, tractors, saws, air compressors, and explosive activated tools, etc.) shall be scheduled for weekends and/or outside normal duty hours. Contractor operations that result in noise levels above 60 dBA in any occupied buildings (offices, laboratories, control rooms, hangars, etc.) and are disruptive to NASA/DFRC business operations shall be performed on weekends or outside normal duty hours. Use of any such equipment shall be approved in writing by

the COTR prior to commencement of work. (Normal duty hours defined in Section A.1).

D.24 SEVERE STORM PLAN

In the event of a severe storm warning, or indications of impending severe weather (e.g. dust storms, damaging wind, heavy rains, floods, tornados, hail, or lightning) the Contractor shall monitor weather conditions and take appropriate precautions including but not limited to:

a. Secure outside equipment and materials and place materials possible to damage in protected locations.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

d. Secure materials and equipment that should not be exposed to, or contaminated with, dirt and dust to protect the materials and equipment from damage. This includes mechanical, electrical, and electronic equipment to ensure their function is not compromised. This also includes materials that have aesthetic purpose to ensure appearance is not damaged.

D.25 HAZARDOUS WASTE

When working with hazardous waste and materials, Contractor personnel must wear or use personal protective articles such as protective clothing, respiratory devices, protective shields, etc., appropriate to the task being performed. Provisions are to be made by the Contractor for continuous contact with personnel working with hazardous waste/materials in remote areas.

Contractor shall identify all wastes produced and dispose of them in the following approved manners:

Identify all wastes and waste producing processes including chemicals, paints, Petroleum, Oil and Lubricant (POL) products and solvents, and their containers. All unknown wastes shall be chemically identified.

Obtain a determination of whether the waste is hazardous from the cognizant NASA Safety Specialist.

Notify the COTR prior to taking disposal action for any hazardous waste.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by contacting the COTR.

Document the waste type, quantity, location, and personnel/contractor/ agency responsible so the material can be tracked from generation through ultimate disposal as required by Environmental Protection Agency under Resource Conservation and Recovery Act.

1.27.1 Chemicals and Hazardous Materials

No chemicals and no hazardous materials such as explosives, flammables, sources of ionizing radiation, corrosives, or toxic substances may be brought onto NASA/ARC or NASA/DFRC-DAOF premises without authorization from the cognizant NASA Safety Authority. Provide the COTR with a copy of the Material Safety Data Sheets (MSDSs) for all chemicals and hazardous materials to be brought on site. All manufacturer recommended precautions shall be followed during the use of any chemicals and hazardous material. MSDSs will be required of all substances deemed to be hazardous by the COTR. MSDSs must be submitted to the COTR for approval prior to the use of any chemicals and hazardous substance per Section D.8.2 “Material Safety Data Sheets” . Explosives shall not be used or brought to the project site.

Refer to NASA NSS 1740.12 for further guidelines regarding safety with explosives, propellants and pyrotechnics.

D.25.1 Asbestos, Lead Paint, and PCBs

Any work in or around asbestos containing material (ACM) or suspect ACM, including but not limited to insulation; fire proofing; ceiling tiles; flooring materials; roofing materials; or transite, gypsum board, plaster and hollow cell walls, must be approved by the COTR prior to commencing work.

The use of any construction materials containing asbestos is prohibited.

In the event suspect ACM is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the COTR or COTR-designee.

Any work involving the disturbance of lead based paint or suspect lead based paint must be approved by the COTR prior to commencing work.

In the event suspect lead based paint is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the COTR.

The use of any paints containing lead or zinc chromate is prohibited.

Any work involving the disturbance of PCBs must be cleared through the cognizant NASA Safety Specialist.

D.26 CONFINED SPACE

The Confined space for this project refers to any tasks or inspections which must be performed inside the Mirror Coater Chamber.

Comply with the requirements in 29 CFR 1910.146. Any potential for a hazard in the confined space requires a permit system to be used. Comply with the requirements in 29 CFR 1910.146. NASA NPR 8715.3 is available on the internet at http://nodis3.gsfc.nasa.gov.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Local Authority (Cognizant Industrial Hygenist) for entry procedures prior to entering confined space).
b. All hazards pertaining to the space shall be reviewed with each employee before entry.
c. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.
d. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth.
e. Include training information for employees who will be involved as entrant attendants for the work.
f. Entry Permit is required at both NASA ARC and DRFC-DAOF. At NASA ARC, use the permit request form in Attachment N. For the DAOF, use forms DFRC-223, DFRC-224, and/or DFRC-225 or other form with the same minimum information for the Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

Entering a confined space is a Permit Required Operation at the NASA ARC and DFRC-DAOF (for ARC see Attachments J.16 and J.17). Entering a manhole, underground vault, sewage pit, vessel, tank, subfloor area, or other confined space is a permit required operation. Safety clearance from the local Industrial Hygenist is required before any Contractor personnel enter a manhole or vault or any other confined space. Entry must be assessed under Confined Space guidelines. Permit Required Confined Space regulations shall be followed during all confined space entries. Confined space operations must be approved by the COTR before operations begin. The Contractor shall obtain this approval by submitting a written Request for Confined Space Entry Permit in

accordance with Section D.16 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the COTR three (3) calendar days prior to the start of these operations, to enable the COTR to review measures being taken to prevent hazard to employees.

The permit, a CONFINED SPACE ENTRY PERMIT (forms DFRC-223, DFRC-224, and/or DFRC-225), must be filled out by the Government and attached to the Contractor's Request for Confined Space Entry Permit. This package must be reviewed and approved by the Cognizant Safety Office and approved by the COTR or designee prior to entry. After obtaining the approved permit package from the COTR, the Contractor shall proceed with the confined space operation in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

The Contractor shall have one or more confined space entry attendants/entry supervisors who are properly trained in the operation of gas monitoring equipment and formally qualified as confined space entry attendants/entry supervisors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to monitor the confined space. Gas monitoring shall be performed prior to entry and continuously when anyone is in the confined space. Readings shall be permanently recorded daily, indicating the concentration of gas, location and time the space was monitored.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A breathing hazard check by the Government is required prior to entering areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. Surveillance and monitoring shall be required in these types of workspaces by both Contractor and Government personnel.

D.27 BARRICADING WORK AREAS

Areas made hazardous to workers, project personnel, the public, or other persons by Contractor operations shall be barricaded with tape and signs indicating hazardous activity.

D.28 FALL HAZARDS

When work is performed at heights which expose workers, project personnel, the public, or other persons to falling objects, such areas shall be barricaded, restricted, or protected.

When work is performed at heights which expose workers, and inspectors to falls, the Contractor shall provide fall protection. The Contractor shall check with the cognizant NASA Safety Specialist before commencing roofing work or any activity on a roof and

shall ensure safe work conditions. When working from an aerial lift workers shall use a body harness and lanyard system appropriately attached to the boom or basket.

Each employee on a walking/working surface 4 feet or more above lower levels shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system.

D.29 PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

Any areas in which overhead work or critical lift activities are taking place are considered hard hat areas. All persons working on or visiting the project site shall wear hard hats (ANSI Z89.1 Type I or Type II) during these periods.

All Contractor employees and Subcontractors shall wear clothing suitable for the weather and work conditions. The minimum for field work shall be short sleeve shirt, long trousers, and steel-toed safety boots (ANSI Z41).

For purposes of inspecting the work under this contract, the Contractor shall provide personal protective and safety equipment to the Government inspector for use during inspections. This includes but is not limited to body harnesses, lanyards, lifelines, ladders, aerial lifts, respirators, safety glasses, face shields, shade lenses, etc. This does not include hard hats and steel-toed safety boots.

D.30 ENVIRONMENTAL PROTECTION

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract.

D.31 Air Quality

The Contractor's operations shall satisfy air quality requirements for Kern County Air Pollution Control District, including permits for all temporary, portable construction equipment with a rated engine over 50 bhp.

D.32 DUST CONTROL

The Contractor shall maintain work areas within or beyond the project site free from dust which would cause a hazard or nuisance to others. . Dust control shall be performed as the work proceeds and whenever a nuisance or hazard occurs.

The Contractor shall provide and install dust barriers to control dust movement so that dirt and dust does not migrate out of the construction site and into occupied sections of the building. Any corridors, offices, and other rooms that become contaminated by dirt and dust migrating from the Contractor's activity shall be cleaned, dusted, and vacuumed by the Contractor at no expense to the Government.

D.33 FIRST AID AND EMERGENCIES

The contractor shall maintain a 16-unit first aid kit on the job site clearly located and marked. The Contractor's Site Safety Officer shall inspect the kit every work day; see Section D.11.2 "Daily Safety Meetings/Daily Safety Inspections".

The Contractor is responsible for all medical treatment of their employees. Upon request, emergency medical treatment may be provided to construction workers who have experienced an acute injury or illness while working on ARC property at the NASA Ames Health Unit adjacent to N215 (see attachment M). Outside normal duty hours the Contractor is responsible for first aid treatment of employees and transportation to a medical facility off-site. All injuries sustained on-site must be reported to the COTR whether treated at the NASA/ARC or NASA/DFRC-DAOF facility or elsewhere. (Normal duty hours are defined in Section A.1 "Work Hours".)

Emergency telephone numbers and reporting instructions shall be conspicuously posted at the job site. Fire, rescue, and first aid are available by contacting 911 on a NASA/ARC or NASA/DFRC-DAOF telephone. If a NASA/ARC or NASA/DFRC-DAOF phone is not available in an emergency, call and clearly explain the emergency. A direct 911 contact cannot be made by use of a personal or cellular phone. To summarize, in an emergency from:

- NASA ARC
  - Government phone dial 911
  - Cell phone 650-604-5555

- NASA DAOF
  - Government Phone dial 911
  - Cell phone dial 661-276-5504

Appendix E Moving Equipment and Site Controls

E.1 General

E.1.1 Summary

Requirements of this Section apply to, and are a component of, each section of the SOW.

E.1.2 Moving Equipment List

Prior to the start of work, the Contractor shall submit a moving equipment list showing the locations and dimensions of moving equipment (including equipment and material storage area (onsite and offsite), and access and move routes, avenues of ingress/egress to the move sites). The Contractor shall indicate if the use of a supplemental or other staging area is desired. The Contractor shall show locations of safety fences, site trailers, equipment/truck entrances, and trash dumpsters.

E.2 Site Control Products

E.2.1 Temporary Signage

E.2.1.1 Project and Safety Signs

The requirements for the signs (Project Name, NASA PM Contact, Contractor PM Contact, Site 911 info, etc) are to be placed at the immediate work area. The Contractor shall erect signs within 15 days after receipt of the notice to proceed.

E.2.2 Temporary Traffic Control

E.2.2.1 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by moving activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. The Contractor shall securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

E.2.2.2 Temporary Wiring

The Contractor shall provide temporary wiring in accordance with NFPA 241 and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

E.3 Site Control Execution

E.3.1 Availability and Use of Utility Services

E.3.1.1 Temporary Utilities

The Contractor shall submit temporary utilities plan required for the move as part of the Relocation Plan. Materials may be new or used, shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

E.3.1.1.1 Electricity

The Contractor shall provide connections, sized to provide service required for power and lighting. Feeder and branch wiring with area distribution boxes shall be coordinated and located so that power is available throughout the project site by use of power cords. 120/208 and 480 electrical volt feeder service is available. Lighting shall be provided by the Contractor. Electricity used will be furnished by the Government.

E.3.1.2 Fire Protection

The Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction. The Contractor shall remove debris and flammable materials daily to minimize potential hazards.

E.3.2 Hangar Access and Traffic Provisions

E.3.2.1 Hangar Access

The Contractor shall conduct operations in a manner that will not obstruct exiting hanger operation and shall be coordinated with written permission of the COTR at least 15 calendar days prior to the proposed hanger activity.

E.3.2.2 Government Daily Safety Coordination Meetings

While at the ARC and the DAOF, the Contractor shall attend daily government safety/coordination meetings to coordinate activities for the day. For ARC, the meeting time and location will be identified at the Contract Initiation Meeting. For the DAOF, the meeting will be held in room 234, promptly at 7:30 AM. Contractor shall participate in these meetings by sharing hazardous activities planned for the given day and foreseeable future. Contractor shall work with meeting attendees' to de-conflict activities that have the potential of impacting operations at the facility. This government safety/coordination meetings are considered to be a NASA best practice and generally run no more than 10 minutes.

The Contractor shall share with their employees at their Daily Safety Meeting specific information gathered at the government safety/coordination meeting.

E.3.2.3 Maintenance of Traffic

a. The Contractor shall conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic except with written permission of the COTR at least 15 calendar days prior to the proposed traffic modification date. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. The Contractor shall provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

E.4 Contractor's Temporary Facilities

E.4.1 Safety

The Contractor shall protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the COTR. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the NASA Occupational Safety Specialist through the COTR.

E.4.2 Storage Area

Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. The Contractor shall park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

E.4.3 Security Provisions

The Contractor shall provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

E.4.4 Weather Protection of Temporary Facilities and Stored Materials

The Contractor shall take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. The Contractor shall take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. The Contractor shall ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

E.4.5 Temporary Project Safety Barriers

The Contractor shall, as soon as practicable, furnish and erect temporary project safety barriers at the work site. The Contractor shall maintain the safety barriers during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

E.4.6 Restoration of Storage Area

Upon completion of the project the Contractor shall remove the bulletin board, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the barriers area, the Contractor shall remove the barriers that will become the property of the Contractor. The Contractor shall restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use.

E.5 Environmental Management

E.5.1 General

1.1.1.1 Definitions

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Biobased content" is calculated as the weight of the biobased material divided by the total weight of the product, and is expressed as a percentage by weight.

b. "Biobased materials" include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by the Biomass R&D Act. Minimum biobased content shall be as defined in the U.S. Farm Bill.

c. "Chain-of-custody" is a process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

d. "Pollution and environmental damage" is caused by the presence of chemical, physical, or biological elements or agents. Human health or welfare is adversely affected; ecological balances are unfavorably altered; the utility of the environment for aesthetic, cultural, or historical purposes degrades.

E.5.1.1 Pre-execution Meeting

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the COTR to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental protection.

E.5.1.2 Environmental Regulatory Requirements

The Contractor shall be responsible for knowing federal, state, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. The Contractor shall comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

E.5.1.3 Environmental Requirements for Products

E.5.1.3.1 Material Safety Data Sheets (MSDS)

The Contractor shall submit an MSDS for each product specified in other sections or required by OSHA to have an MSDS. MSDS shall be prepared within the previous five years. Include information for MSDS Sections 1 through 16 in accordance with ANSI Z400.1 and as follows:

a. Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.

b. Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.

c. Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

d. Section 14: Identify hazard class for shipping.

e. Section 15: Identify federal, state, and local regulations applicable to the material.

f. Section 16: Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared.

E.5.2 Products

E.5.2.1 Environmentally Preferable Products

The Contractor shall consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of products, and provide products and materials with the least effect on the environment, determined by LCA analysis, released toxins, and other methods.

E.5.2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls.

d. Products containing chlorinated fluorocarbons.

e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.

f. Paint containing more than 0.06 percent lead.

E.5.3 Execution

E.5.3.1 Protection of Natural Resources

The Contractor shall comply with applicable regulations and these specifications. The Contractor shall preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the COTR.

E.5.3.1.1 General Disturbance

The Contractor shall confine demolition and construction activities to immediate work area. The Contractor shall remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site. The Contractor shall transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction.

E.5.3.1.2 Water Resources

The Contractor shall comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). The Contractor shall prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of

water. The Contractor shall store and service moving equipment at areas designated for collection of oil wastes.

E.5.3.1.3 Air Resources

The Contractor shall comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to absorb VOC emissions or in occupied spaces.

d. Properly maintain equipment to reduce gaseous pollutant emissions.

E.5.3.2 Field Quality Control

The Contractor shall comply with requirements of agencies having jurisdiction and as specified herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

E.6 Waste Management

E.6.1 General

E.6.1.1 Government Policy

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 35 percent by weight of total project solid waste shall be diverted from the landfill in support of EO 13423, Section 2 and NASA Procedural Requirements (NPR) 8530.1.

E.6.1.2 Records

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the COTR during construction, and a copy of the records shall be delivered to the COTR upon completion of the construction.

E.6.1.3 Salvage Materials and Equipment

All items of materials designated by the COTR to be salvaged shall remain the property of the Government. Salvage Material Records shall be made available to the COTR during the move, and a copy of the records shall be delivered to the COTR upon completion of the move. Salvage items shall be marked, segregated, itemized, delivered, and off-loaded by the Contractor at the storage area near Building 703.

The Contractor shall maintain adequate property control records for all materials or equipment designated as salvage. These records may be in accordance with the Contractor's system of property control, if approved by the COTR. The Contractor shall be responsible for adequate storage and protection of salvaged materials and equipment and shall replace, at no cost to the Government, salvage materials and equipment broken or damaged during salvage operations.

E.6.1.4 Collection

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable.

E.6.1.5 Cleanup

The Contractor shall remove move debris, waste materials, packaging material and the like from the work site daily. The Contractor shall store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable, including the 6” vacuum lines. The Contractor shall neatly stack stored materials not in trailers, whether new or salvaged.

E.6.1.6 Disposal

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the COTR and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

E.6.1.6.1 Waste

Materials with no practical use or economic benefit shall be placed in the waste management dumpster provided by the government.

E.6.1.6.2 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

Appendix F Sources for Reference Materials

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1	(2004) Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	(1999; R 2010) Sampling Chain-Of-Custody Procedures
ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2011) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Biomass R&D Act	(2000) Biomass Research and Development Act
U.S. Farm Bill	(2002) U.S. Farm Bill of May 2002

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	(1972; R 2005) National Pollutant Discharge Elimination System

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR	Protection of Environment
40 CFR 261	Identification and Listing of Hazardous Waste

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual

Appendix G Contract consequences

G.1 Repair replacement

The Contractor shall repair or replace any component or equipment damaged or lost during the disassembly, shipment, re-assembly or startup/commissioning of the Mirror Coating Facility. The repair shall be such that the component functions in its before damaged state and the replacement shall be identical to the original component.

G.2 Impact damages

G.3 Administration