STATEMENT OF WORK

12 INCH LO2 GATE VALVE
FOR THE LC-39 A/B LO2 STORAGE TANK

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ADP	Acceptance Data Package
ANSI	American National Standard Institute
ASME	American Society of Mecanical Engineers
AR	Acceptance Review
CCP	Contamination Control Plan
CDR	Critical Design Review
CGA	Compressed Gas Association
CO	Contracting Officer
COTR	Contracting Officer's Technical Representative
C_V	Valve Flow Coeficient
DC	Design Comment
FAR	Formal Acceptance Review
ISO	International Organization for Standardization
KSC	John F. Kennedy Space Center
LO2	Liquid Oxygen
MAPTIS	Materials and Processes Technical Information System
MTBF	Mean Time Between Failure
MIUL	Materials and Processes Identification and Usage List
MUA	Material Usage Agreements
NASA	National Aeronautics and Space Administration
NDE	None Destructive Evaluation
No.	Number
NVR	Non-Volatile Residue
PDF	Portable Document Format (Adobe Acrobat)
PE	Professional Engineer
SOW	Statement of Work

1.0 PURPOSE AND SCOPE

1.1 Purpose

A 12 Inch Block valve is required for the Liquid Oxygen (LO2) storage tanks and support systems at Complex 39 to support future launch programs. The valve will be continuously exposed to the commodity and must be extremely reliable.

The primary purpose of this procurement is for the design, development, fabrication, qualification and delivery of a 12 Inch Block Valve.

1.2 Scope

The 12 inch LO2 gate valve functional, performance, interface, design and construction, quality assurance, and testing requirements are provided in the attached KSC procurement specification, 732FPC00024, *VALVE, GATE, MANUAL, LIQUID OXYGEN SERVICE, SPECIFICATION FOR*.

Contractor is to provide design, develop, fabricate, perform acceptance testing and first article qualification testing and deliver the LO2 12 inch Gate valve as defined in Specification 732FPC00024. The quantity required is as follows:

12 Inch Gate Valve:

a. Quality Test Article: 1 Valve, 3 Soft Goods Kits (Basic Contract)
b. LC-39B Production: 2 Valves, 6 Soft Goods Kits (Base Contract)
c. Special maintenance tools and equipment (Base Contract)
d. LC-39A Production: 2 Valves, 6 Soft Goods Kits (Optional)

Note: The valves above shall include the required soft goods.

This Statement of Work (SOW) does not replace the requirements noted on the referenced specification.

The above options shall be documented as an optional cost and denoted separately. Any other potential options to contract are as specified in Section 3.0 of this SOW and shall also be included in the bid response.

1.2.1 Objective

The objective of this procurement is to design and develop the component, perform the supporting analyses, and perform tests on qualification units to provide auditable verification that the components are producible and meet the requirements of the procurement specification. Tasks performed shall include qualification testing as defined in the component specification. Documentation provided will include analyses supporting the design process, development of all modeling and detailed drawings required to fabricate and assemble the

component, and performance of testing on test articles to provide verification of the design for critical requirements of the component, successful completion of defined technical reviews. The detailed requirements are specified in Section 3.0 of this Statement of Work (SOW).

2.0 APPLICABLE DOCUMENTS

The following documents are applicable to this SOW:

Specification Number	Description
732FPC00024	Valve, Gate, Manual, Liquid Oxygen Service, Specification For
ANSI/ISO/ASQ 9001	American National Standard Quality Management Systems Requirements
ISO 10012	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment
CGA G-4.1	Cleaning Equipment For Oxygen Service
ASME B16.34	Valves-Flanged, Threaded and Welding End
NFS 52.246-72	Material Inspection and Receiving Report

3.0 REQUIREMENTS

The Contractor shall meet the following requirements contained in this section and the KSC, NASA procurement specification.

The component requirements for performance, interfaces, design and construction, quality assurance, and certification testing are provided in procurement specification 732FPC00024.

3.1 General

The Contractor shall provide detailed, signed/stamped Professional Engineer (PE) certified shop drawings, and analysis as required by Specification 732FPC00024.

The Contractor shall provide design, analysis, fabrication and testing for the Hardware Item.

The Contractor shall provide any analysis performed to meet all ASME B16.34 requirements.

The Contractor shall perform First Article Qualification Test as required in the applicable specification. If the component was previously qualified for another government agency and meets the requirements in Specification 732FPC00024, the Contractor shall provide the specific component information (analysis or testing) to the NASA CO (or designated representative) in detail for review when providing the bid for this contract.

The Contractor shall fabricate and perform Non Destructive Evaluation (NDE), qualification test, acceptance tests, cleaning, cryostat, certification, shipment preparation, packaging and delivery of the Hardware item to KSC site.

NASA (or its designated representative agent) reserves the right to witness and inspect any part during the construction, fabrication, assembly and test period at the Contractor or Contractor's suppliers / subcontractor's site.

The Contractor shall provide the NASA CO (or designated representative) any technical requirements and specifications for a two (2) week review prior to providing it to any Subcontractor.

3.2 Project Management and Control

If the Contractor will be subcontracting out any of the effort then the Contractor shall provide a Project Management Plan with the proposal. This plan shall provide a description of the Contractor's management concepts, practices, approaches, plans, and schedules necessary for accomplishing (managing and controlling) the project tasks described in the Statement of Work. The plan must provide NASA with accurate and timely information as to the technical and schedule requirements of the contract. In addition, the plan shall present those management systems to be utilized to define and delegate task assignments and shall define the organizational relationships of the Contractor, subcontractor, and NASA.

3.2.1 Data Management

The Contractor shall prepare, establish, implement, and maintain a Data Management Plan. This plan shall be initially submitted thirty (30) days after contract award with revision as required. The Data Management Plan shall define the scope and depth of the Contractor's efforts including management, organization, planning, and the relationship of the data management program to the Contractor's other administrative and technical organizations. The plan shall specify the Contractor's management policies and identify, by specific reference, standard practices and detailed work instructions to be used in implementing the data management program. The plan shall include the following elements: data management organization, data control procedures, data storage and retrieval procedures, subcontractor data control procedures, and special restrictions. The

plan shall include a preliminary data submittal schedule for fulfilling submission of data in the specific quantities, media, and due dates required.

All data deliverables shall be delivered electronically in common computer formats such as Word, Excel, Acrobat, etc. unless otherwise specified. All engineering records - drawings, reports, calculations, etc shall be provided to the government in root file format as well as an image file such as PDF and two clean hard copies. All Contractor detail Proprietary documents shall be appropriately marked per individual sheet.

3.2.2 Monthly Status and Final Reports

The Contractor shall provide a monthly status report. Contractor format is acceptable. The first report shall be delivered on the first calendar month following the end of the first full month after contract award. Monthly project status reports shall be delivered every ten (10) days following the end of each month. This report shall provide data for the assessment of monthly cost, technical and schedule progress and summarize the results of the entire contract work. The monthly status report shall include:

a. Work accomplished for current reporting period, including a report of overall cost, technical and schedule performance.
b. Work planned for next reporting period.
c. Current problems which impede performance or impact program schedule or cost, and proposed corrective action.
d. Other information that assists NASA in evaluating the Contractor's cost, technical and schedule performance.

3.2.3 Project Schedule

The Contractor shall develop, maintain, and track a project schedule. The program schedule shall illustrate the schedule that the Contractor intends to follow over the period of performance. The schedule shall be of sufficient detail to ensure that slips to events and product deliveries shall be projected in a timely manner. The program schedule shall be expanded if notified by NASA that the level of detail is insufficient. The Contractor shall provide a logic linked project schedule in Microsoft Project 2003, 2007 or 2010. Schedule baseline shall be established thirty (30) days after contract award. Schedule of progress after baseline will be required at monthly status updates, coincident with telecon status meetings. The Program/Project Schedule shall include tasks necessary to accomplish the total scope of work. The schedule shall also include all logical relationships (interdependencies) between tasks, including major subcontract and supplier delivery dates. Schedules shall contain the approved baseline schedule as well as current forecasted dates. Program/Project Schedules shall be reported in four sections. The following deliverables shall be extractions from the detailed schedule. All data contained in the sections shall be consistent, statused monthly and based on the same cutoff date.

a. Summary Schedule – One page, top level, Gantt-type summary document that reflects all contract and controlled milestones, major program/project phases (i.e., design, fabrication, integration, assembly, etc.) and all end item deliveries.
b. Detailed Schedule – The entire scope of work shall be broken into schedule tasks and milestones at a consistent level of detail to allow discrete progress measurement and visibility into the overall development, fabrication, integration, assembly, test, and delivery phase of each end item deliverable. Additionally, all schedule tasks/milestones shall be integrated with the appropriate sequence relationships to provide a total end-to-end item delivery. This schedule shall contain all contract and controlled milestones, key subcontractor milestones, end item delivery dates, and key data delivery dates. The detailed schedule serves as the basis for identification of program/project critical paths.
c. Critical Path Report – This report shall be an extract from the Detailed Schedule and include all tasks and milestones with 10 workdays or less of total slack (float). The report shall be submitted in a waterfall format and organized in manner such that the path with the least amount of slack is delineated first and followed by each successive path according to total slack values.
d. Contractor Schedule Assessment Report – The report shall contain narrative explanations for contract milestones and significant project milestones that have moved more than thirty (30) calendar days into the future from their baseline dates. Program/Project milestones shall be identified and negotiated with the project office. These narratives shall include a proposed work-around schedule detailing how the Contractor plans to recover the lost schedule time.

3.2.4 Meetings

The Contractor shall provide manpower, facilities, and data to support the meetings and reviews defined in this SOW, and will document and provide NASA the meeting minutes for review, within two (2) working days after the meeting.

3.2.4.1 Monthly Teleconference

The Contractor shall support a monthly teleconference for schedule and technical status with the NASA COTR (or designated representative), NASA CO (or designated representative) and cognizant engineers. The Contractor shall include, at a minimum, a review of the program schedule, document status, design, development hardware fabrication and test status, problem identification, and efforts undertaken for corrective action.

3.2.4.2 Design Reviews

Manpower, facilities, and data shall be prepared to support the submittals required within this scope of work. NASA shall track Design Comments (DC) associated with the submittal reviews. The Contractor shall perform all work

necessary to prepare recommended technical options, solutions and dispositions to close each DC. Formal DC closure requires NASA COTR concurrence. No review milestone shall be considered completed until all DC's deemed critical by the NASA COTR (or designated representative) are closed. The Contractor shall provide the following for each submittal:

a. Review materials – all design drawings, analysis, inspect / test plans; etc., must be dropped in a common viewable electronic format (along with root file format) to NASA technical representative twelve (12) workdays prior to start of review period.
b. DCs - Design Comments showing disposition (accept, accept intent, study, reject, withdrawal, etc) change summary description when applicable, action items, actionees, suspense dates and closure status shall be submitted. Initial disposition shall be within seven (7) work days after closure of comment period.

3.2.4.2.1 Initial Submittal

The Contractor shall provide the following data as an initial submittal for NASA review within 120 calendar days of contract award. NASA will review the items and either 1) approve the design for production of the Qualification article or 2) request additional information via the Request For Information (RFI) process or 3) request a formal review meeting with the Contractor.
The initial submittal shall include the following items, at a minimum:

1. Component description – A written narrative description of the valve functions
2. Final Specification Tree and Drawing Tree
3. Design / Shop fabrication drawings
4. Procurement specifications for any procured items
5. Preliminary Parts List
6. Recommended Spare Parts List
7. An updated detailed fabrication and test schedule.
8. Acceptance Test Procedures
9. Qualification test procedures– Identify near term testing of sub-components and qualification testing to be performed on qualification unit(s)
10. Verification plan– Identify verification approach to tech specification requirements and auditable methods of analysis, test, demo, or inspection
11. Handling requirements/design
12. Provide MTBF and basis for determination
13. Any design analysis performed
14. Provide C_v and method of determination.
15. Materials Identification and Usage List
16. Cleaning Procedure
17. Development and Production Plan with Long Lead time parts/components identified

18. Operations and Maintenance Manual (disassembly and assembly instructions, trouble-shooting instruction, recommended maintenance tools and materials)
19. Final Shop production process procedures for such items but not limited to weld procedures / qualification records, NDE processes / individual certifications, cleaning processes / procedures, etc.
20. Packaging protection and transportation plans to KSC of Production and the Qualification Test units.

After successful completion of this review and disposition of comments incorporated to final fabrication test drawings and specifications work may proceed to start fabrication of test articles.

3.2.4.2.2 Qualification Article ADP Submittal

The Contractor shall submit an Acceptance Data Package (ADP) for the Qualification Test Article within 30 calendar days after completion of the Qualification Testing. package A certification of compliance to the SOW and procurement specification shall be submitted. The ADP may be submitted in Contractor format.

NASA will review the items and either 1) approve the design for production of the Qualification article or 2) request additional information via the Request For Information (RFI) process or 3) request a formal review meeting with the Contractor.

The Acceptance Data Package for the qualification valve shall include data described in the SOW Section 3.5 (Acceptance Data Package)
After successful completion of this review, and disposition of comments, the Contractor may proceed to move forward with manufacturing of the production units.

The Acceptance Data Package for each valve shall include data described in the SOW Section 3.5 (Acceptance Data Package), including the qualification data from the first article testing. NASA final acceptance will take place after shipment to Kennedy Space Center, Florida. Refer to NFS 52.246-72 to be used for means for shipment and NASA acceptance.

3.3 Document Control

The Contractor shall implement a Document Control Process as defined by their Quality Management System.
All documents and records - Drawings, reports, calculations, etc shall be provided to the government in an electronic format, root file format as well as an

image file such as PDF and two clean hard copies. All Contractor detail Proprietary documents shall be appropriately marked per individual sheet.

3.3.1 Request for Information

All Contractor requests for information or to deviate from the technical requirements in Specification 732FPC00022 or this SOW, shall present requests using the Request for Information (RFI) process. The RFI form shall be submitted to NASA and a response will be made within ten (10) working days. Questions to the Contractor from NASA will also use the RFI form and the Contractor shall respond within ten (10) working days as well.

After qualification no changes to the valve design, material composition, or processes are authorized without the written direction from the NASA contracting officer or NASA Design Engineering.

3.3.2 Change Management

The Contractor change process shall ensure that all design changes that affect development, fabrication, assembly, inspection, or testing shall go through a controlled process to ensure that the quality of the component and associated documents are not compromised.

3.4 Product Assurance

3.4.1 Quality System

The contractor's quality system shall be certified to ANSI/ISO Q9001. If Contractor subsequently changes registrars, loses its registration status, or is put on notice of losing its registration status, it shall notify the NASA's CO within three (3) days of receiving such notice from its registrar.

3.4.2 Pre or Post-Award Survey

Prior to starting work on this order and at the discretion of NASA Quality Assurance Representative, a pre or post award survey of the supplier may be conducted by customer representatives consisting of representatives from Engineering, Procurement, and Quality Assurance. This survey will be conducted at a time mutually agreeable to by all parties.

3.4.3 Contamination Control

The Contractor shall develop and implement a Cleaning Procedure that meets the requirements in Specification 732FPC00024. The Procedure shall be provided to the NASA CO (or designated representative) with the Initial Submittal. The procedure shall address as a minimum the following:

1. Materials Selection - Materials shall be selected to preclude a source of contamination in both natural and induced environments. All fluids shall be procured to specifications listed in the Contamination Control Plan (CCP). Acceptable fluid cleanliness levels shall be defined in the specifications and provided in the plan.
2. Cleaning and Surface Cleanliness - All materials shall be cleaned to meet CGA G-4.1 requirements for the end item use. The cleaning method shall not degrade the material properties, subsequent processing or quality of the part. The Cleaning methods shall include required solvents and method, shall also be forwarded to the NASA CO (or designated representative) for review and approval.
3. Protection methodology, e.g., bagging and packaging criteria and materials.
4. Storage controls and monitoring.
5. Contamination controls and methods of implementation.

3.4.4 Calibration System

The Contractor shall have a documented calibration system that meets the requirements of ISO 10012, or equivalent standards.

3.5 Acceptance Data Package (ADP)

The Contractor shall develop, maintain and deliver, for each component end item assembly, an Acceptance Data Package. Receipt of electronic copies of the data package must be fourteen (14) days prior to shipment of the first unit. A hard copy of the data must be shipped with the unit. Any units shipped without ADP will not be considered acceptable for receipt acceptance at customer site. The Acceptance Package shall include the following as a minimum:

1. Test history log, including post manufacturing checkout and final verification tests of the component, with the following data (may refer to the Component Data Log for details):
   a. Actual measurements identified to specified tests. Reference can be made to applicable test reports are satisfactory provided that copies of the reports are provided.
   b. Brief test summary.
   c. List of actual and recommended retest.
   d. Special test instructions, investigations, warnings, and problems encountered during test.
   e. Failure and corrective actions data for all failures during all testing.
2. Each component will have a data log which shall include the following:
   a. Weld Related Data:
      (1) Inspection records for all NDE inspections, such as radiograph and dye penetrant, including weld traceable maps of welder and procedure number at each joint.
      (2) Welder and Weld inspector certifications.
      (3) Weld procedures

b. Records for all metallic materials and shall include for all wetted components:
   (1) Mechanical properties and chemical composition for every heat number used
   (2) Traceability of heat numbers to the applicable part
   (3) Testing certificates
c. Records for non-metallic materials for all wetted components and pressure bearing parts:
   (1) Material certifications
   (2) Test data
d. First Article Qualification Test Data (applicable to Qualification Unit only)
   (1) Final Test Plan & Procedure
   (2) Test Reports
e. Acceptance Test Data:
   (1) Final Test Plan & Procedure
   (2) Test Reports
f. Contamination:
   (1) Finalized cleaning procedure
   (2) Results
g. Dimensional check to verify critical dimensions that includes measurements of the outside dimensions to check conformity with drawings.
h. Records showing any identified defects during inspection / testing with correction data. – Applicable to all the above tests and inspections.

3. Analysis
4. Component Qualification
   a. A certificate of qualification shall be provided for each component after successful testing has been completed.
5. Photographs and video of qualification/ acceptance testing shall be provided to NASA.
6. Complete copies of drawings reflecting AS-BUILT configuration to the level necessary to perform repair, maintenance and operation of the component.
7. Configuration Records:
   a. Parts and drawing list identifying all parts and incorporated or pending changes to each.
   b. List and copies of approved and pending deviations and waivers.
   c. Complete list of hardware items shipped loose or separately.
8. A Verification Matrix which shall include an auditable method (analysis, test, demonstration or inspection) of meeting the requirements in the procurement specification.

3.6 Design and Development

The Contractor shall design and develop the component such that it meets the requirements as described in the SOW and the component specification.

Qualification testing shall be performed as part of the design/development phase to assure compliance with the above specification. Data deliverables and analyses to be performed include the following:

3.6.1 Component Specifications

A detail technical specification for any subcontract piece part of the component fabrication is required for NASA review. All associated data deliverables are due with the Initial Submittal and with final acceptance data package following acceptance testing of prototype units of each size.

3.6.2 Drawings and Associated Lists

The Contractor shall provide four (4) copies of the as-built assembly cross section drawing of each component / assembly in a part breakdown format, part information, part breakdown list with part numbers, and maintenance manuals. Maintenance manuals shall have disassembly and assembly instructions and trouble-shooting instruction for the component for use in maintaining the component. The Maintenance Manual shall also include recommended maintenance tools and materials. One each electronic version of each of these documents shall be provided on a disc or other transferable electronic media with source program specified.

3.6.3 Materials and Processes

The Contractor shall ensure the adequacy of the component through proper selection, material certification records, treatment, and tracking/traceability of all materials.

3.6.3.1 Materials and Processes Selection, Implementation, and Control Plan

The Contractor shall submit a Materials and Processes Selection, Implementation, and Control Plan.

3.6.3.2 Materials and Processes Identification and Usage List (MIUL)

The Contractor shall deliver a Materials and Processes Identification and Usage List (MIUL) for the component design.

3.6.3.3 Non Compliant Materials and Processes

Materials and processes usage which do not comply with contractual specifications and requirements, shall require approval from NASA. If they do not meet NASA requirements, NASA reserves the right to reject the material. Technical rationale to justify usage shall be submitted describing the material or processes application.

3.6.4 Test Planning, Procedures, and Reporting

The Acceptance and First Article Qualification Test data shall be documented by the Contractor in separate documents per the following:

3.6.4.1 Test planning information shall include the following as a minimum:

1. Complete description of article under evaluation, including the description of the interface requirements between the article and the test facility (or apparatus) and differences between the article under evaluation and the fully configured flight article.
2. The overall philosophy, approach, and objective for each item, including any special tailoring or interpretation of design and testing requirements.
3. The allocation of requirements to appropriate verification levels of assembly. Usually this is a reference to a requirements trace-ability matrix listing all design requirements and indicating a cross-reference to a verification method and to the applicable assembly level.
4. Detail descriptions of all test activities (i.e., tests, analyses, inspections) to be performed based on the identified requirements. Identify any prerequisites, constraints, and objectives for all the test activities.
5. Detail time correlated sequence of test activities.
6. Description and planned usage of the support equipment, software, facilities, and tooling necessary to execute the test activities, and required tools, test beds, etc.

3.6.4.2 Test procedures shall contain the following as a minimum:

1. Identification of item/article being subjected to test, inspection, or demonstration.
2. Identification of objectives established for the particular test, inspection, or demonstration.
3. Description of steps and operations, in sequence, to be taken.
4. Identification of measuring and recording equipment to be used, specifying range, accuracy, and type and any special instructions for operating such equipment.
5. Layouts, schematics, or diagrams showing identification, location, and interconnection of item/article, support equipment, and measuring equipment.
6. Identification of hazardous situations or operations.
7. Precautions and safety instructions to ensure safety of personnel.
8. Environmental and/or other conditions to be maintained with tolerances.
9. Constraints on test, inspection, or demonstration.
10. Pass-fail criteria for evaluating results.
11. Instructions for handling non-conformances and anomalous occurrences during activity.
12. Confirmation that required support equipment has been calibrated and certification of the calibration is still valid.

13. Identify requirements verification points (NASA, Contractor)

3.6.4.3 Test Reports shall include the following as a minimum:

1. Conclusions and recommendations relative to success of the test activity.
2. Description of deviations from nominal results, failures, approved corrective actions and procedures, and retest.
3. Trace-ability back to the requirement.
4. Copy of as-run procedure (as appropriate).
5. Identification of test configuration.
6. Specific results of each procedure including automated test segments and associated analyses.

3.6.5 Fabrication and Assembly

The Contractor shall be responsible for maintaining and conducting all fabrication and assembly activities (equipment, processes, and procedures) in a manner which is consistent with and supports the requirements of this contract and the associated technical specification.

3.7 Submittals

Section	Deliverables	Due at
1.2	Basic Valve Bid	Proposal
1.2	Optional Valve Bid	Proposal
3.1	Component Qualification information from previous government qualification	Proposal
3.1	Subcontractor Technical Specifications / Requirements	2 weeks prior to providing to Subcontractor
3.2	Project Management Plan	Proposal
3.2.1	Data Management Plan	30 days after Contract Award
3.2.2	Monthly Status Report	10 days after the end of the Month
3.2.3	Project Schedule	30 days after Contract Award
3.2.4	Meeting Minutes	2 workdays after the meeting
3.2.4.1	Monthly Teleconference	Monthly (at a mutually agreed time)
3.2.4.2	Design Review Materials	With the Initial Submittal
3.2.4.2	Review Design Comments	7 workdays after closure of comment period
3.2.4.2.1	Initial Submittal	120 days after Contract Award
3.2.4.2.2	Qualification Article ADP Submittal	20 days after successful Qualification Test.
3.4.1	Notice of ISO status change	Within 3 days of notice
3.4.2	Cleaning Procedure	With the Initial Submittal
3.5	Acceptance Data Package	14 days before component is delivered (PDF).
3.5	Acceptance Data Package	Hardcopy with delivered component.
3.6.1	Component Specifications	With the Initial Submittal
3.6.2	Drawings and Associated Lists	With the Initial Submittal
3.6.3	Component Specifications	With the Initial Submittal
3.6.3.1	Materials and Processes Selection, Implementation and Control Plan	With the Initial Submittal
3.6.3.2	Materials and Processes Identification and Usage List	With the Initial Submittal
3.6.4.1-2	Acceptance Test Plans & Procedures	With the Initial Submittal
3.6.4.1-2	Qualification Test Plans & Procedures	With the Initial Submittal
3.6.4.3	Acceptance Test Reports	With the Initial Submittal
3.6.4.3	Qualification Test Reports	With the Qualification Article ADP Submittal

Note – Days are defined as Calendar days unless specified.