GTI ENERGY

REQUEST FOR PROPOSAL (RFP)
PART 1 OF 3:

PRIMARY SPECIFICATIONS

REVISION: 0

ISSUED: AUGUST 15, 2025

BID DUE DATE: SEPTEMBER 12, 2025,
7 PM CENTRAL TIME

RFP to Support Engineering-Scale ROTA-CAP™ System for CO_2 Capture

Detailed Design, Procurement, Fabrication, Installation, Commissioning, & Start-up Support

In support of DOE Contract Number:
DE-FE0032466

GTI ENERGY

Project Title:
ROTA-CAP™: Engineering -Scale Testing of Carbon Capture Technology in Iron and Steel Production

GTI Energy Project Number:
23654

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1.0 BACKGROUND INFORMATION

1.1 Project Background and Objective

The U.S. Department of Energy (DOE) and National Energy Technology Laboratory (NETL) have awarded GTI Energy (GTI) a contract (DOE contract number DE-FE0032466) as the lead partner to oversee the design, fabrication, installation, and testing of an engineering-scale, post-combustion CO_2 capture system based on GTI's transformational ROTA-CAP™ technology. The overall objective of the project is to design and build the engineering-scale system, and then test the system with real flue gas at U. S. Steel's Edgar Thomson industrial iron and steel production facility in Braddock, Allegheny County, PA. Specific performance objectives consist of the following:

1. Design and fabricate an engineering-scale ROTA-CAP™ system, which refers to a system capable of capturing 10 metric tonnes of CO_2/day (MTPD).
2. Develop rigorous, first principles, multi-scale, validated process models that are used to guide pilot scale test conditions through statistical design of experiments and robust optimization methodologies.
3. Install and commission the system at the Host Site and test the system using real flue gas from the Host Site.
4. Perform parametric testing to establish the operating conditions at which a carbon capture efficiency of 95% or greater can be achieved (mass CO_2 out / mass CO_2 in), with a CO_2 purity of 95% or greater (% vol.).
5. Achieve continuous, steady-state operation for a minimum of two months with a carbon capture efficiency of 95% or greater (mass CO_2 out / mass CO_2 in) and a CO_2 purity of 95% or greater (% vol.).
6. Collect and report inlet and outlet criteria pollutant emissions data (e.g., NO_X, SO_X, and particulate matter) during parametric and continuous testing.
7. Collect and report technology-related emissions data (e.g. amine slip, nitrosamines, solvent degradation, etc.) to assess the non-CO_2 co-benefit emissions reduction of utilizing carbon capture technology.
8. Validate a reduction of carbon capture cost of at least 30% compared to the DOE baseline technology.
9. Attain a Technology Readiness Level (TRL) of 6 and demonstrate the readiness of this technology for further scale-up.

The purpose of this Request for Proposal (RFP) package is to solicit proposals from qualified Bidders to complete the detailed design and engineering of the ROTA-CAP™ system, the equipment procurement, and construction of the equipment skid required to meet the objectives of the project.

1.2 Project Team

GTI Energy is the primary contact with the DOE and NETL, and is the lead partner on the project. GTI is partnered with U. S. Steel, the Host Site for the system demonstration, as well as other stakeholders including Low Emissions Technology Australia (LETA), Amrize (formerly Holcim US), and Enbridge. Figure 1 below shows the project organization chart for the project.

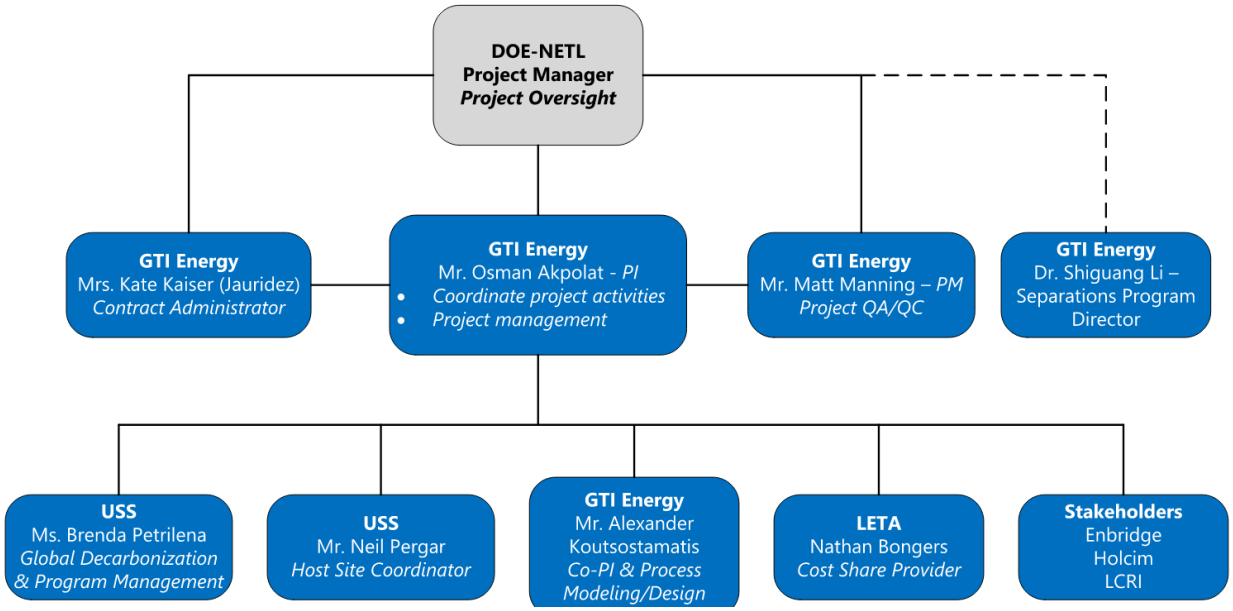

Figure 1: Project Organizational Structure.

1.3 Project Structure

The overall project is divided into three DOE budget periods (BP) as defined below in Table 1. The project is currently in BP1, and this RFP has been developed in accordance with the bid package development task (BP1: Task 4 in the table below). The detailed design, procurement, fabrication, quality assurance (QA)/quality control (QC) testing, performance of a factory acceptance test (FAT), and installation of the Engineering-Scale ROTA-CAP™ system, as specified in this RFP, are scheduled to occur during BP2. Commissioning and testing of the system are scheduled to occur during BP3.

Table 1: Budget Period and Task Structure

Budget Period	Task	Activity Description	Start Date	End Date
BP1	Task 2.0	Develop an initial, detailed techno-economic analysis (TEA).	8/01/2024	11/30/2024
		Perform initial engineering review and coordinate host site integration.		2/28/2025
	Task 3.0	Develop a rigorous, validated process model.	8/01/2024	8/31/2025
	Task 4.0	Design the engineering-scale system and develop a bid package.	9/01/2024	8/31/2025
	Task 5.0	Perform engineering associated with site preparation.	12/1/2024	8/31/2025
BP2	Task 6.0	Fabricate and construct rotating packed beds (RPBs), perform QA/QC testing.	9/01/2025	6/30/2026
	Task 7.0	Finalize design of engineering-scale system and complete construction of the test skid.	9/01/2025	8/31/2026
	Task 8.0	Complete test site preparation.	9/01/2025	8/31/2026
	Task 9.0	Ship the completed skid to the host site and install the skid.	9/01/2026	11/30/2026
		Conduct a Facility Readiness Review (FRR) to verify that installation is complete and that commissioning of the system can begin.	9/01/2026	
		Develop a commissioning plan.	9/01/2026	
		Develop a test plan for parametric and steady-state testing.	9/01/2025	
BP3	Task 10.0	Complete commissioning of test skid.	12/1/2026	2/28/2027
		Conduct a Test Readiness Review (TRR) to verify that commissioning is complete and system operations can begin.		
	Task 11.0	Conduct parametric testing at Host Site with real flue gas.	3/01/2027	5/31/2027
	Task 12.0	Conduct continuous, steady-state testing.	6/01/2027	11/30/2027
	Task 13.0	Remove skid from the Host Site.	12/1/2027	1/31/2028
	Task 14.0	Update and validate the process model using data collected during testing.	4/01/2027	11/30/2027
		Complete a final, detailed TEA.		
		Perform final engineering review & reporting.		

2.0 GENERAL

2.1 Definitions

The following terms used herein and in the accompanying Contract Documents are defined as:

- **Owner:** GTI Energy (GTI), an Illinois, USA, not for profit organization.
- **ROTA-CAP™:** GTI's rotating packed bed (RPB) gas-liquid contacting technology.
- **Host Site:** U. S. Steel Edgar Thomson industrial iron and steel production facility
- **Project Sponsor:** Department of Energy (DOE) – National Energy Technology Laboratory (NETL)
- **GTI Representative:** During the procurement, equipment manufacturing, and delivery phase of the work, the Owner shall be represented by an individual identified as the GTI Representative.
- **Host Site Representative:** During the facility preparation work, the Host Site shall be represented by an individual identified as the Host Site Representative.
- **Project Stakeholder Representative(s):** During the design, procurement, installation, commissioning, and operation phases of the project, GTI will communicate with Project Stakeholders who will provide input as needed that GTI will provide to the Selected Bidder, if necessary, to support the project.
- **Bidder:** A person, company, or supplier responding to this RFP.
- **Selected Bidder:** The person, company, or supplier contracted by the Owner to execute the Work outlined in the Contract Documents and who is subject to the terms thereof. The designated representative for the Selected Bidder shall be named in the Contract Documents.
- **Subcontractor:** Any external entity to the Selected Bidder, which contracts with the Selected Bidder to perform labor, furnish materials, or provide equipment in support of the Selected Bidder's Work scope.
- **Host Site Contractor Crew:** The local contractor selected by the Host Site to complete site preparation, equipment unloading, and other field work required by the Host Site.
- **Contract Documents:** The contract between the Owner and the Selected Bidder detailing the agreed upon Work scope to be completed under the contract, and other relevant Terms and Conditions of the contract.
- **Work:** The tasks and work scope to be performed by the Selected Bidder, as defined by the Contract Documents, including deliverables to be generated, milestones to be met, and other relevant activities.
- **Skid:** The term "Skid" is a shorthand reference that is used to refer to the collection of multiple process modules, containers, or individual skids that comprise the overall ROTA-CAP™ system.

3.0 BIDDING INFORMATION

3.1 Bid Opportunity

A competitive proposal is the official response by a Bidder to a RFP solicitation where competitive negotiation procedures will be used to evaluate and select the proposal judged to be the most highly rated based on merit, price, and price-related factors. In the competitive proposal process, price will not necessarily be the predominant factor in the award decision. Because competitive negotiation procedures will be used to select the winning proposal, the terms "competitive proposal," "Request for Proposals," and "competitive negotiation" are often used interchangeably.

3.2 Bid Evaluation Criteria

The bid evaluation criteria for this RFP are described below and are also shown in Table 2.

- Project Costs (overall expected cost and the cost breakdowns)
- Approach to Quality Control
- Project Management Team, Experience, References (demonstrated ability to deliver similar equipment that worked, project references)
- Ability to Manage the Project (ability to meet GTI's overall project schedule, maintain the project within the cost estimate, change order control, etc.)
- Ability to Provide Expected Deliverables (compliance with GTI's statement of work (SOW), number and type of exceptions)
- Intangibles (GTI perception, safety, responsiveness, workload, etc.)

GTI will conduct a comprehensive, fair, and impartial evaluation of all proposals. Each proposal will first be analyzed to determine overall responsiveness and completeness. A proposal that does not comply with the bid instructions and/or does not satisfy the bid requirements will be deemed non-responsive and may, at the discretion of GTI, be eliminated from further consideration. The proposal evaluation and selection process will be based upon the evaluation matrix: Ratings will be applied to each category to produce a score for each criterion. The sum of these scores will provide an overall rating to be compared against other Bidders. Each Bidder should provide detailed responses including reference to any existing "in house" procedures, policies, etc. as they reference all requirements of this RFP.

GTI will determine whether the proposal attempts to modify any mandatory contract provision applicable to the RFP. Proposers are cautioned that by submitting a proposal, they are agreeing to the general requirement provisions of the RFP which relate to their proposal. GTI will verify insurance coverage. In determining whether current coverage is matched or exceeded, it is acknowledged by the Bidder that current insurance coverage shall be matched or exceeded even if the cost to match or exceed coverages has increased when compared to the cost for coverage in effect at the time of issuance of the RFP.

Table 2: Bid Evaluation Matrix

CRITERIA BEING RANKED	WEIGHTING	RATING SCALE FOR BIDDERS 0 = POOR, 5 = EXCELLENT	
		Rating	Weighted Score
Project Costs	30%		**0.00**
Approach to Quality Control	15%		**0.00**
Project Management Team, Experience, References	15%		**0.00**
Project Schedule & Ability to Manage	20%		**0.00**
Ability to Provide Expected Deliverables	10%		**0.00**
Intangibles (GTI perception, safety, responsiveness, workload, etc.)	10%		**0.00**
TOTAL BIDDER SCORE	**100%**	----------	**0.00**

The evaluation matrix is used to define the bid requirements and score the bids according to the specified requirements. The evaluation matrix supports GTI's ability to measure the best valued bid. Bidders shall have the opportunity to participate in a debrief with GTI following evaluations.

Failure to provide information to the above criteria may deem a proposal non-responsive and may, at GTI's discretion, result in the proposal being eliminated from further consideration. GTI reserves the right to conduct other evaluations and measurements of the Bidder's responses as may be required to make an informed decision.

3.3 Bid Content

The Bidders shall provide the following information as part of their proposal:

1. Completed bid form as shown in Table 3
2. Summary of proposed subcontracted work
3. Proposed project manager resume
4. Experience list detailing the Bidder's prior work on systems of similar scale
    a. Scale shall be based on the liquid and gas flows detailed in the Heat and Material Balances (H&MB) provided in Part 2 of this RFP (Appendix 1)
5. Project organizational chart showing key personnel
6. Project schedule with key deliverables, including:
    a. Estimated completion date of detailed engineering
    b. Other key completion dates (weeks after receipt of purchase order/subcontract award)
7. Travel and reimbursable expenses at cost for site support
    a. Required site support is detailed in Sections 5.0 and 6.0 of this RFP

8. Hourly rates for work done outside of proposal
9. Confirmation of acceptance of this scope or list exceptions
10. Company Employer Identification Number (EIN)
11. Certificate of Insurance meeting all liability limits (per terms and conditions)
12. Risk identification and approaches to mitigate those risks

3.4 Bid Form

GTI developed the bid-form below to breakout costs and necessary information for submitted proposals. Bidders shall complete the bid form and submit this as part of the proposal.

Table 3: Bid Form

ROTA-CAP™: Engineering-Scale Testing of Carbon Capture Technology in Iron and Steel Production BID FORM			
COST ELEMENT DESCRIPTION	**COST ELEMENT - PROPOSAL ESTIMATE**		**TOTAL ESTIMATED COST**
	LABOR COSTS	**NON-LABOR COSTS**	
Detailed Engineering & Design Work			
Equipment Costs (Per the Equipment List & Datasheets)			
Pumps			
Blowers			
Heat Exchangers			
Vessels, Drums, Tanks			
Columns			
Filters			
Equipment Costs with Optional Considerations Detailed in RFP			
Blowers - Modification of GTI's Existing Blower			
Scrubber Column & Caustic System - Impact of Reduced SO_2 Concentration Target			
Valves (Per the Manual Valve List)			
Instrumentation Costs (Per the Instrument List)			
Control Valves and Transmitters			
Pressure Relief Valves			
Flow Instruments			
Level Instruments			
Pressure Instruments			
Temperature Instruments			
Analyzers (Gas & Liquid Analyzers - Per Instrument List & Scope of Supply)			
Electrical and Control Costs			
Fabrication and Assembly of the Skid			
Shipment of Skid to Host Site			
Commissioning/Testing Support			
Subcontractor Costs, (if applicable)			
Project Management (Weekly Teleconferences, Documentation, Administrative)			
TOTAL PROPOSAL COST			

The equipment considered in the bid shall be in accordance with all the documents included with this RFP. The Bidder shall note in the quotation any exceptions to the technical requirements given in these documents. Any variation in design, which the Bidder thinks will provide a superior product or operation, shall be noted in the quotation as an option and will be considered during the evaluation.

Additional items that can be considered for the bid form, or detailed in a supporting narrative, include the following:

- Estimated manhours by Cost Element (for applicable Cost Elements)
- Definition of expected Project Management (PM) activities (meetings, reporting, invoicing, status updates, travel to Host Site, etc.)

3.5 Bid Submittal instructions

The Bidder shall submit one hard copy of their proposal and an electronic version to GTI by the bid due date specified on the cover page of this RFP. Hard copies can be delivered via mail, and shall be postmarked by the specified submittal deadline. Electronic copies can be emailed to Mark Stevens at MStevens@gti.energy. GTI recommends that Bidders request a delivery receipt upon email submission as a record of bid submission.

Submitted bids shall be signed by an authorized officer of the company, or equivalent.

3.6 Exceptions & Clarifications

The Bidder shall identify any exceptions to the scope of work as defined in this RFP. Please identify the specific section and item number for the item that the exception applies, or that needs to be further clarified.

GTI Energy will clarify bids received and request additional information as needed with each individual Bidder, and will issue Addendums, as needed,

4.0 TECHNICAL DESIGN DATA

The technical design data and documents for the engineering-scale ROTA-CAP™ system, including the Basis of Design, are provided in Appendix 1 – Technical Design Package Documents. Appendix 1 is provided in Part 2 of this RFP, which is a separate document. This appendix also includes an index of all the documents included in the Technical Design Package.

5.0 SCOPE OF SUPPLY & TECHNICAL REQUIREMENTS

Under this section, a detailed description of the Scope of Supply and Technical Requirements is provided. The Selected Bidder for the Engineering-scale ROTA-CAP™ system will be responsible for detailed engineering, purchase of equipment/instrumentation/materials, fabrication of the modular skid(s), performing a FAT, transportation of the Skid (which may consist of multiple modules) to the Host Site, developing foundation specifications, developing a lift plan and associated diagrams, developing unloading and installation procedures, coordination with the Host Site Contractor Crew to facilitate the unloading of the Skid at the Host Site by said crew, and assisting with the assembling and commissioning of the Skid at the Host Site.

5.1 Documentation Provided by GTI

As part of the detailed bid package for the system, the documentation detailed below has been provided by GTI in Appendix 1 – Technical Design Package Documents. Appendix 1 is provided in Part 2 of this RFP, which is a separate document.

Process:

- Process Description
- Block Flow Diagram (BFD)
- Process Flow Diagram (PFD)
- Process and Instrumentation Diagrams (P&IDs)
- Heat and Material Balance (H&MB)
- Equipment List
- Line List
- Manual Valve & Specialty Item List
- Tie-Point List
- Utility List
- Effluent & Emissions List
- Operations Philosophy

Mechanical

- Preliminary Equipment Datasheets
- Preliminary Piping Specifications

Control System

- Control Philosophy
- Preliminary Instrument List & I/O Count
- Control Narrative & Control System Description
- Preliminary Alarm List
- Interlock List
- Cause & Effect Diagram

Safety

- Preliminary Hazard and Operability Study (HAZOP) Study Topical Report
- HAZOP Recommendation Tracker
    - This document contains recommendations captured during a preliminary HAZOP that will need to be revisited and addressed in detailed design.

5.2 Documentation & Deliverable Requirements for Selected Bidder

The Selected Bidder shall provide the following deliverables as part of the detailed design of the system (Table 1 - BP 2: Task 7.0). Documents and calculations shall be subject to review and approval by GTI prior to procurement or fabrication of the associated piece of equipment.

Process

- Detailed PFDs & P&IDs based on the drawings provided by GTI
- As-built P&IDs
- Over-pressure Protection Evaluation and PSV Sizing Calculations
    - System overpressure scenarios for Selected Bidder's Skid are to be evaluated during the detailed design phase. This evaluation should be completed by a competent engineer in the design, sizing, and selection of pressure relief devices, as outlined in API 521.
    - A vessel can be exempt from the installation of a mechanical overpressure device only if the exemption criteria outlined in UG-140 of the BPVC are followed.
- Equipment Process Design Calculations
- Hydraulic Calculations & Pressure Profile
    - Finalize Line Sizing
    - Should include estimates of pressure drops for major pieces of equipment.
    - Shall specify the maximum allowable pressure drop and/or required pressure drop, as applicable.
- A detailed HAZOP shall be performed during detailed design of the system, and the findings and recommendations captured in the detailed HAZOP shall be documented.
    - Recommendations captured in the HAZOP that require modifications to the system scope shall be covered via a change order.

Mechanical

- Final Equipment Datasheets & Equipment List
    - Verify and/or complete designs for all equipment, based on the Preliminary Equipment List provided in document 23654-0000-LST-0003 in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP). Complete and/or formulate Datasheets and Specifications that are sufficiently detailed for procurement of equipment, including:
        - Vessels, Tanks, and Totes
        - Pumps

        - Blowers
        - Heat Exchangers and Boilers
        - Columns (Excluding the Rotating Packed Beds)
        - Filters
        - Specialty Items defined in the Equipment List
    - Pressure vessels must comply with ASME Section VIII Boiler and Pressure Vessel Code
- Equipment Drawings
- Final Piping & Insulation Specifications
    - All piping within the Skid must be designed, fabricated, installed, tested, and inspected in accordance with the requirements of ASME B31.3
    - Insulation specifications shall be included on the detailed P&IDs and should specify if it is for heat conservation or personnel protection
- Heat Tracing Specifications (if required)
- Fabrication Drawings
- General Arrangement Drawings
- Piping Drawings (Isometric Drawings)
- Layout Drawings (elevation/plan view) and 3D Model to fit the Skid within the site constraints
- Pipe Support Calculations
- Material Specifications
- Welding Procedures
- Shipping Plan (Lifting, Transport, and Installation)

<u>Electrical</u>

- Electrical Load List
- As-built Electrical Diagrams, Including:
    - Wiring Diagrams
    - Single Line Diagrams
    - 480 VAC Distribution Diagram
    - 120 VAC Distribution Diagram; including uninterruptible power supply (UPS) system
    - Heat Tracing Installation Details (if applicable)
- Arc Flash Study/Certification
- Grounding Plan

<u>Control System</u>

- Final Instrument List
- Instrument Datasheets
- Final I/O List
- Final Alarm List
- Final Control Narrative
- Final Cause & Effect Diagram
- Sequence Logic Diagram

- Sizing Calculations for Control Valves and Orifice Plates
- Copies of Control Logic and Human Machine Interface (HMI) Displays.
- As-built set of drawings including but not limited to:
    - Instrument Air Distribution
    - Instrumentation Layout
    - Circuit Schedules for power services
    - Hookup drawing (instrument installation drawing)
- List of "Shipped Loose" Items
- Control System Enclosure Documentation:
    - Panel Wiring Diagrams
    - Dimensional Drawings of Panel
    - List of Cards and Components
    - Terminal Strip Diagrams
    - Identification of all Terminals
    - Rack Identification
    - Card Positions
    - Instrument Tags
    - Cable Identification and Core Numbering
    - Power Supply Identification
    - Grounding and Screening Details
    - Details of Resistor Installation
    - Recommended Spare Parts List

<u>General</u>

- Bill of Materials
- Operating Procedures (developed in conjunction with GTI)
- Operation & Maintenance (O&M) Manuals for all applicable equipment and instrumentation
- Installation Instructions
- Field Assembly Instructions and Drawings
- Testing Procedures for Factory Acceptance Test (FAT) and Site Acceptance Test (SAT)
- Commissioning Plan
- Shipped Loose Item Packing List
- Priced Spare Parts List
- Weight of Delivered Skid (broken down by module or individual skid)
    - Weights and sizes shall be specified in the Bill of Lading, the Packing List, and other associated documents
- Foundation Drawings / Concrete Specifications
- Anchor Bolt Layout & Loading Details
- Lifting Plan, including adequate lifting lugs, fork-lift access, etc.
    - The plan shall include diagrams detailing lift points, handling details, and the center of gravity of the modules or equipment to be lifted
- Shipping Plan

- Provide updates for any other preliminary documents provided with this RFP within Appendix 1 – Technical Design Package Documents (Part 2 of this RFP).
- Review GTI deliverables and identify any modifications or additional equipment required
- Electronic copies of all drawings in native format (AutoCAD or equivalent)
- Safety Data Sheets (SDS)

5.3 Review & Approvals

The required reviews and approvals that shall take place between GTI and the Selected Bidder are detailed in Figure 4.

The required review points include a HAZOP that shall take place during the detailed design phase. For any substantial design changes that are implemented after the HAZOP has been conducted, a follow-up HAZOP review for such changes must be conducted and incorporated into the initial HAZOP documentation. As part of the FAT, the compliance with the HAZOP recommendations will be confirmed.

Table 4: Review & Approval Matrix

Description	Timing					Review Required	Review Method	Hold Point	Hold Description
	With Proposal	After Contract Award	Detailed Design	Procurement /Fabrication	Testing/ Commissioning				
Bidder Proposed Document and Drawing Lists	X					X	Proposal Review		
QA/QC Procedures and Certificaitons (Per RFP)	X					X	Proposal Review		
Estimated Total Weight and Sizes	X					X	Proposal Review		
Requirements & Configuration Review		X				X	Meeting	X	Initial Review prior to start of Detailed Design.
Engineering Design Calculations & Documents			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
Equipment Vendor Data			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
Instrument Vendor Data			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
Complete Equipment & Instrumentation Datasheets			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
Finalized Design Drawings			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
Bill of Materials			X			X	Document Review	X	Approval required before release for Procurement/Fabrication.
HAZOP Review			X			X	Meeting		
Detailed Design Review & Approval			X			X	Meeting	X	Approval to proceed with fabrication based on acceptance of the design deliverables.
Equipment Performance & NDE Records/Reports				X		X	Document Review		
Instrument Calibration Records				X		X	Document Review		
As-Built Drawings				X		X	Document Review	X	Approval required before FAT can be considered complete.
Operating Procedures				X	X	X	Document Review	X	Approval required before release to begin FAT.
Operation and Maintenance (O&M) Manuals				X	X	X	Document Review	X	Approval required before release to begin FAT.
Installation Instructions				X		X	Document Review	X	Approval required before release for shipment to Host Site.
Field Assembly Instructions and Drawings				X		X	Document Review	X	Approval required before release for shipment to Host Site.
Testing Procedures (For FAT & SAT)				X		X	Document Review	X	Approval required before release to begin FAT.
Commissioning Plan				X	X	X	Document Review	X	Approval required before release to initiate commissioning.
Shipped Loose Item Packing List				X		X	Document Review		
Finalized Total Weight and Sizes				X		X	Document Review		
Priced Spare Parts List				X		X	Document Review		
Shipping Plan					X	X	Document Review	X	Approval required before release for shipment to Host Site.
Factory Acceptance Testing (FAT) of Skid					X	X	Witness	X	Approval required before release for shipment to Host Site.
Site Preparation Review w/ Host Site					X	X	Witness	X	Confirmation that Host Site is ready to accept system. Required before release for shipment.
Site Acceptance Test (SAT) / Facility Readiness Review (FRR)					X	X	Witness	X	Approval required to confirm installation is complete before starting commissioning.
Test Readiness Review (TRR)					X	X	Witness	X	Approval required to confirm commissioning is complete and system is operational.

5.4 Equipment and Instrumentation Scope

5.4.1 Equipment

The Bidder's scope shall include the procurement of all equipment detailed in the Preliminary Equipment List provided in document 23654-0000-LST-0003 in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), with the exception of the RPBs. The Absorber and Regenerator RPBs, tagged as D-0102A/B and D-0301, respectively, shall be supplied by a separate vendor as specialty Packaged Units, and delivered to the Selected Bidder for installation and integration into the overall Skid. The scope of the RPBs and the integration points with the overall system are defined in the P&IDs and technical documents provided in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP).

The Bidder's scope of supply with respect to equipment also includes, but is not limited to, the following:

- Equipment drawings, design, and calculations should be submitted to GTI for review prior to procurement or fabrication of the equipment, in accordance with Sections 5.2 and Section 5.3.
- For the fabrication of pressure vessels, the Selected Bidder is also required to solicit a fabricator who is experienced in the fabrication of pressure vessels; the fabricator's name and credentials must be supplied prior to fabrication.
- Fabrication of frames / skid(s):
    - Procurement and fabrication of structural steel
    - Grating suitable for 100 lbs / Square Foot
    - Protective Painting or Coating
    - Ladders, Stairs, and Platforms with Hot-Dipped Grating
        - For any ladders greater than 6' tall, a barrel or cage must be included.
    - Pipe Racks and Bridges
    - Grounding and Bonding
    - Lighting
- Supply and installation of all motors for equipment.
- Mounting/installation of equipment on skids. This shall include the RPBs, which are to be supplied as Packaged Units.
    - The Selected Bidder shall design the Skid to accommodate the installation of the Absorber and Regenerator RPB units once supplied by the specialty vendor. Preliminary dimensions to be accommodated are as follows:
        - Absorber Preliminary Frame Dimensions: 120" X 70" X 80" (L x W x H)
        - Regenerator Preliminary Frame Dimensions: 120" X 60" X 80" (L x W x H)

- Supply and installation of piping and tubing between equipment, including piping and tubing required for the installation of instrumentation.
    - The Selected Bidder shall route piping and tubing such that walkways and areas requiring personnel access are free of hazards and obstructions.
- Supply and installation of piping and tubing between the Skid equipment and the interface points with the Host Site at the Skid battery limits.
    - The Selected Bidder shall route piping and tubing such that walkways and areas requiring personnel access are free of hazards and obstructions.
- Supply and installation of insulation for equipment and piping, as defined on the P&IDs, preliminary Equipment Datasheets, and other documents in the Technical Design Package.
    - The Regenerator RPB shall be supplied with insulation supports, insulation specifications, and installation instructions for the insulation required on the unit. Based on the instructions provided, the Selected Bidder shall procure and install the insulation on the Regenerator RPB.
- Labeling of process equipment, including but not limited to hand valves, control valves, instrumentation, vessels, tanks, totes, pumps, blowers, heat exchangers, boilers, filters, specialty items, flow direction, and piping contents.
    - Nomenclature and naming conventions have been defined in the Basis of Design provided in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), and the conventions are reflected in the PFD, P&IDs, and other documents within the Technical Design Package.

As part of the detailed design and procurement/fabrication of the system, the Selected Bidder shall also account for the following considerations:

- The number of skid sections shall be minimized to limit field interconnection work.
    - It is GTI's preference for the system to be modularized, to facilitate transport of the system modules/skids and installation of the system at the Host Site. This can involve the use of shipping containers or similar enclosure types to house the individual skids/modules.
- Units shall be designed for outdoor duty as dictated by the modularization/enclosure strategy employed by the Selected Bidder, consistent with ambient conditions at the Host Site.
    - The need for freeze protection and winterization of equipment shall be addressed by the Selected bidder, as required by the modularization/enclosure strategy employed.
- All construction material shall always be protected and at completion all equipment shall be thoroughly cleaned.

- All materials shall be new and in accordance with the latest applicable codes and shall have a U.L. listing mark, except where U.L. is not available, and conform to other recognized industry standards.
- The inclusion of safety showers and eye wash stations shall be evaluated as part of the detailed design of the Skid.

Any other equipment not explicitly included in the Preliminary Equipment List that is deemed necessary by the Bidder shall also be identified as part of the Bidder's response to this RFP.

5.4.2 Instrumentation & Electrical Components

The Bidder's scope shall include the procurement of all instrumentation detailed in the preliminary Instrument List provided in document 23654-0000-LST-0006 in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), with the exception of the temperature elements and vibration sensors included in the scope of the RPBs as defined on the P&IDs and in the Instrument List.

The Bidder's scope of supply with respect to instrumentation and electrical components also includes, but is not limited to, the following:

- Supply and install liquid analysis equipment for analysis of the composition of the amine solvent utilized in the system.
    - The analyzers shall be capable of determining the concentration of the amine component of the solvent, as well as the carbon dioxide loading of the solvent.
    - The drawings in the Technical Design Package documents show manual sample locations for solvent sampling. Bidders shall also consider the implementation of solvent sampling header with selector valves as an option, to streamline the sampling process and minimize the amount of manual sampling required.
- Installation of a Fourier-Transform Infrared Spectrometer for gas analysis. This instrument shall be purchased by GTI and supplied to the Selected Bidder for installation into the Skid.
    - GTI shall coordinate with the Selected Bidder during detailed design to communicate the dimensions of the unit to be accommodated in the equipment layout as well as the desired installation location.
    - The gas analysis locations and sampling points are defined on the P&IDs.
- Installation and wiring of all instruments in the Bidder's scope.
- Installation material like manifolds, tubes, fittings, instrument air tubing, mounting and supports, junction boxes, and glands.
- Supply and installation of wiring, conduit, trays, and associated hardware as required for installation and control of instrumentation, in accordance with the National Electric Code (NEC) and electrical classifications.

    - The Selected Bidder shall route wiring, conduit, trays, and other electrical connections such that walkways and areas requiring personnel access are free of hazards and obstructions
- Supply and installation of wiring, conduit, trays, and other electrical connections between the Skid and the interface points with the Host Site at the Skid battery limits.
    - The Selected Bidder shall route wiring, conduit, trays, and other electrical connections such that walkways and areas requiring personnel access are free of hazards and obstructions
- Supply and installation of switches, starters, and control panels.
- Enclosures for field mounted analyzers and equipment.
- Heat tracing circuits and sizing for freeze protection, if deemed necessary based on the modularization/enclosure strategy employed by the Bidder.
- Motor starters with local disconnects, integrated hand-off-auto switches, and local indicator panel lights.
- 480 VAC, 3phase power distribution panel.
    - Breakers and motor/control panel power wiring to be included as needed.
- 120VAC, 1phase control power distribution panel.
    - Wiring and breakers to be included as needed.
- Lighting and 120 VAC electrical outlets (minimum of 1 per floor) for the Skid, including transformers and lighting panels.
    - Lighting shall be considered for both the inside and outside of modules/containers.
- Lightning Protection
    - The Selected Bidder shall design and construct supplied equipment in accordance with good lightning practices and to the strike potential data for the local area surrounding the Host Site. Lightning arrestors shall be designed and installed in accordance with the supplier's standards and shall be reviewed and approved by the Host Site.
- Supply and installation of the Control System, including the following:
    - Supply of panel and wiring diagrams.
    - Control system engineering and programming, including control loops, alarms, data historization, interlocks, operator displays, and control logic diagram.
- Terminate power, control conductors, and twisted pair cables at all electrical panels and equipment as needed.
- Provide earth grounds for all equipment and as needed for safety.
- Labeling of instrumentation and control valves.

- Nomenclature and tagging conventions have been defined within the documents in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), and the conventions are reflected in the P&IDs and other documents within the Technical Design Package.

As part of the detailed design and procurement/fabrication of the system, the Selected Bidder shall also account for the following considerations:

- All electrical equipment shall be compliant with general area classification, rated for outdoor usage. All work shall conform to the latest edition of the NEC, the Occupational Safety and Health Act (OSHA), State of Pennsylvania, and local codes.
- All instruments shall be outdoor rated, and materials shall be specified in accordance with the piping material specifications for the project and International Society of Automation (ISA) standards.
- All materials shall be new and in accordance with the latest applicable codes and shall have a U.L. listing mark, except where U.L. is not available, and conform to other recognized industry standards
- After wiring is complete, the Selected Bidder shall conduct tests to verify insulation resistance where applicable; system is free of short circuits and other faults; motors rotate properly, and all equipment operate correctly.

Any other instrumentation or electrical components that are not explicitly mentioned in the Scope of Supply or in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), but that are deemed necessary by the Bidder, shall also be identified as part of the Bidder's response to this RFP.

5.4.3 Communications

Bidders shall account for the following considerations in their response to this RFP:

- The preference of the Host Site is that only Host Site personnel access the plant's control room on a regular basis. Therefore, the Selected Bidder shall consider the inclusion of an appropriate enclosure and control room for the ROTA-CAP™ system's electronics, such as a system Personal Computer (PC) or HMI, in the design of the system.
- The Data Acquisition System (DAS) and control system shall be designed such that GTI's home office personnel have real-time, remote access to pertinent data, alarms, and HMI screens.
- The Host Site's cybersecurity requirements do not easily facilitate network access by external parties. Therefore, the use of a personal cell network exclusive to GTI shall be considered as a means for connecting to the system, monitoring operations, collecting data, and transmitting data to GTI's home office.

5.4.4 Additional Considerations

Modification of an Existing Blower:

As an option in the Bidder's proposed quote, the Bidder shall evaluate the option of re-using and modifying an existing blower package that GTI has available for use as the Liquid Ring Blower package (K-0102) defined in the Technical Design Package Documents instead of procuring a new blower package. The potential impact on cost and schedule shall be noted in the Bidder's response.

The specifications of the existing unit are supplied in Appendix 2 – Existing Blower Specifications (Part 3 of this RFP).

Performance of SO_2 Removal System (Caustic Scrubber):

The system specifications provided in the Technical Design Package Documents target a residual SO_2 concentration in the scrubbed flue gas leaving the Caustic Scrubber (D-0101) of 10 parts per million by volume (ppmv) or less. As an option in the Bidder's proposed quote, the Bidder shall evaluate the impact of targeting a residual SO_2 concentration of 5 ppmv or less. The potential impact on cost and schedule shall be noted in the Bidder's response.

Alternative Solvents:

The system specifications provided in the Technical Design Package Documents are based on the use of 50% by weight monoethanolamine (MEA) as the baseline solvent for the carbon capture system. GTI is also considering the use of CESAR-1 solvent as an alternate, which is comprised of ~27% 2-Amino-2-methyl-1-propanol by weight, 13% piperazine by weight, and 60% water by weight.

As an option in the Bidder's proposed quote, the Bidder shall evaluate the impact of the use of CESAR-1 solvent on the required material selection for the units within the Skid (metals and gaskets/elastomers), as well as any potential design impact on equipment (pumps, heat exchangers, etc.). The expected impact on material selection, equipment design, cost, and schedule shall be noted in the Bidder's response.

5.5 Quality Assurance (QA)/ Quality Control (QC) Requirements

As part of GTI's quality assurance (QA) and quality control (QC) metrics, GTI requires Bidders to have the following plans in place prior to construction and provide a copy of the plans as part of their bid response.

- Training requirements for construction team
- Welding Procedure(s)
- Welding Certification Requirements

- Welding Quality Check and Assurance
- Pressure Test Procedures for equipment, piping, and instrumentation
- Checkout and Commissioning Procedures and/or Plans

As part of GTI's QA/QC requirements, GTI will require the Selected Bidder to provide the following documentation throughout the Skid fabrication process:

- Preliminary design and/or specification datasheets
- Datasheets provided from instrumentation and equipment vendor(s)
- Weld Inspection Records
- Pressure Check/Test Records
- Certification/Records of Equipment Performance Tests
- Certification/Records of Non-Destructive Examination (NDE)
- Calibration Certification/Records for Instrumentation

5.6 Inspection & Testing

The Selected Bidder's testing and verification of the completed system shall include:

- Pressure testing of equipment and piping, including pressure and vacuum sections.
- Continuity checking for instrumentation wiring.
- Bump-checking of all electric motors.
    - Bidders should consider a rental generator to conduct testing of blower motors if necessary.

As part of the documentation of the completed inspections and testing, as well as the document requirements specified in Sections 5.1, 5.2, 5.3, and 5.5 of this RFP, the Selected Bidder shall provide a Design Book which includes:

- An Inspection Test Plan with general manufacturing steps, inspections and tests performed, procedures, QA/QC, hold points, etc. Vendor should finalize this plan during detailed engineering phase.
- Finalized (As-built) Drawings and Specifications, which includes design pressures and temperatures for equipment / piping
- Equipment / Instrument / Material Specifications
- Piping Stress Calculations, Weld Maps, and NDE Maps
- Piping Material Take-off (MTO)
- Welding Procedure Specifications (WPS)

- If a vessel is determined to be exempt from mechanical overpressure device requirements, a full set of code calculations shall be performed by an engineer who is experienced in pressure vessel design, and copies of the vessel code calculation and U-1 report shall be provided.

For any work that is to be executed in the field after equipment has been delivered to the Host Site, all drawings and calculations must be stamped by an Engineer of Record in the State of Pennsylvania.

GTI reserves the right to witness the tests and inspections defined in this RFP, and/or inspect fabrication progress throughout the agreement period. GTI shall be notified of planned testing/ inspections a minimum of 1 week in advance to provide GTI personnel the opportunity to witness a specific inspection or test if desired. Any desired inspections of fabrication progress shall be coordinated between GTI and the Selected Bidder.

5.6.1 Factory Acceptance Test (FAT)

Prior to the FAT, the Selected Bidder shall perform and record the inspection of steelwork finish, equipment, wiring, nameplates, etc., as well as functional testing of power sources, power distribution circuits, alarm circuits, and instrument loops in the commissioning report. This documentation shall be submitted to GTI.

In addition to Selected Bidder's standard test procedures, a FAT shall also be carried out at the Selected Bidder's facility in the presence of GTI and relevant Host Site personnel. The Selected Bidder shall submit a detailed test procedure to GTI for approval and comments one month prior to the FAT. All hardware and software documentation shall be completed and available for the test.

The FAT is intended to demonstrate that the system has been fabricated correctly and completely in accordance with the project, manufacturing assembly specifications and software configurations, and that the system's performance complies with the system specifications. The satisfactory completion of the FAT shall be a prerequisite to system shipment to the Host Site.

The FAT shall include:

1. Visual inspection for check of good workmanship and compliance with specifications.
2. System recovery from power failures.
3. Operation of all peripherals.
4. Check of system redundancy, failure of controller, power supply, etc.
5. Complete functional check after all system equipment has been connected and inputs/outputs fully simulated to demonstrate that the system operates in manner defined in this specification and other documents (to the extent possible prior to shipment to the Host Site). The functional description shall be a guideline defining how the equipment operates.
6. Verification that any recommendations identified in the HAZOP review that pertain to fabrication, installation, and/or inspection/testing have been adequately addressed.

5.6.2 Site Acceptance Test (SAT) / Facility Readiness Review (FRR)

After the system has been installed at the Host Site, the SAT (also referred to as an FRR) will be conducted on site to ascertain that no damage occurred to the system during shipment, that the system is correctly installed, and that the system requirements are satisfactory when connected to "live" field inputs/outputs. The Selected Bidder shall provide personnel to witness and assist in the SAT/FRR.

The completion of the SAT/FRR shall be used as the verification that the system installation has been adequately completed, and that commissioning of the system can begin.

6.0 ADDITIONAL REQUIREMENTS

6.1 High-Level Project Schedule

Provided below is a high-level summary of the project schedule to be completed under this project.

Table 5: High-Level Project Schedule

Description	Start Date	End Date
Bid Package Release, Review, and Bid Submission	08/15/2025	9/12/2025
Bidder Selection and Contract Negotiation	9/12/2025	TBD
Detailed Engineering Design of System	TBD	TBD by Bidder
Procurement, Construction, & Factory Acceptance of System	TBD by Bidder	8/31/2026
Skid Delivery, Installation, and Commissioning (no later than)	9/01/2026	2/28/2027

6.2 Project Management Requirements

As part of this project, the Selected Bidder will need to ensure the project meets the specified requirements, cost under the contract, and project schedule defined under this RFP. To ensure this, GTI is requesting that the Selected Bidder participate, conduct, and/or be a part of the following:

- Kick-off meeting
- Host and conduct bi-weekly review meeting
- Participate in supplemental hazard review(s)
- Participate in review meetings with Department of Energy, as required
- Participate in periodic inspections by GTI Personnel
- Participate in review and coordination meetings with the RPB Supplier
- Lead review with Host Site on delivery, installation, and foundation requirements

6.3 Shipping, Delivery, and Installation Requirements

When the system is ready to be shipped, the Selected Bidder shall schedule a trucking crew to pick up system modules and components at the Selected Bidder's facility and deliver the system to the Host Site. All shipped loose items must be tagged, match marked, and documented on a packing list for traceability and proper field installation. A list of accompanying equipment, shipped loose items, and one copy of applicable installation, operation, and service manuals shall be included with the equipment shipment. All equipment shall be adequately supported to withstand adverse shipping conditions and to prevent damage during shipment.

The Selected Bidder shall be responsible for any permitting required for shipment of the Skid and shall assume any responsibility during Skid shipment. Contractual language regarding ownership, warranties, etc. to be determined and finalized prior to contract agreement with the Selected Bidder.

The Selected Bidder shall also coordinate with the Host Site's selected Contractor Crew as follows:

- Provide mechanical installation packet to Host Site Contractor Crew.
    - The packet shall provide details on tie point connection locations, field fabrication, spool piece reattachment between skids, and equipment setting details.
- Provide electrical installation packet to Host Site Contractor Crew.
    - The packet shall provide details on field termination requirements and locations, location of power termination points, and any other electrical field work requirements.
- Review lifting plan with Host Site Contractor Crew.
- Selected Bidder is expected to be onsite once the power and utility connections have been completed.
    - Selected Bidder should plan for 2 personnel to be onsite for a 2-week (10 day) period.
    - Selected Bidder will need to verify equipment rotation, Skid communication with HMI, and overall system operability as part of commissioning.
    - A detailed commissioning checklist will be generated by GTI and the Selected Bidder, and then reviewed with the selected Host Site Contractor Crew to ensure the checklist items are appropriately addressed.
- Testing / verification of the completed system installation shall be performed at the Host Site, including:
    - Rotating equipment direction and operation verification.
    - Continuity checking for instrumentation wiring.
    - Bump-checking of all electric motors.
    - Completion of SAT per Section 5.6.2.
    - Align and level all motors, compressors, and other rotating equipment.

6.4 Commissioning & Start-up Support

The selected supplier shall provide the necessary personnel to oversee and direct the commissioning activities to ensure all installed components work properly, communicate with each other and the Distributed Control System (DCS) system, and that the system supplied operates as specified in this RFP.

The selected supplier shall provide the necessary personnel to work with the GTI project team to oversee and support the initial operation of the equipment and any troubleshooting during the initial startup. For bidding purposes, please assume support staff will be on site for two weeks and then on standby as needed, which will be charged at the hourly rates submitted in the proposal. A minimum of two support staff shall be considered in the bid, however Bidders may propose to provide a larger number of support staff if deemed necessary. The number of support staff proposed shall be identified by the Bidder as part of the bid.

6.5 Environmental, Health, and Safety (EH&S) Requirements

Equipment should be designed and manufactured to meet all applicable codes and standards, identified in the Basis of Design provided in Appendix 1 – Technical Design Package Documents (Part 2 of this RFP), to be operated in a safe manner. This includes having the necessary barriers around any exposed moving parts, insulation on hot surfaces and other safety related items to ensure safe installation and operations.

Safety requirements for the Host Site are provided in Appendix 3 – Host Site Requirements & Documentation (Part 3 of this RFP).

6.6 Host Site Requirements

U. S. Steel's Edgar Thomson industrial iron and steel production facility in Braddock, PA has been identified as the Host Site for this project. This is an existing facility that can provide real flue gas for testing of the Engineering-Scale ROTA-CAP™ system.

Requirements of the Host Site, including the site plan detailing the proposed system location, are provided in Appendix 3 – Host Site Requirements & Documentation (Part 3 of this RFP).

6.7 Legal Requirements

Any agreement resulting from this RFP shall be a subcontract under the Cooperative Agreement Number DE-FE0032466 between GTI and DOE/NETL, and therefore certain contract provisions from the Cooperative Agreement and Service Agreement must be flowed down to the Selected Bidder. The required flowdown provisions will become a part of this Agreement and are referenced in Appendix 4 – Flow Through Requirements from DOE Sponsor (Part 3 of this RFP).

Selected Bidder represents that the goods and/or services furnished under this Agreement are commercially available goods and/or services that are offered for sale in the Selected Bidder's regular course of business. Selected Bidder further represent that the goods and/or services provided do not involve the development of intellectual property, the creation of new goods, or research and development activities.

6.8 Buy America Requirements

This project is subject to Buy American Requirements. The applicable requirements for this project are provided in Appendix 5 - Buy America Requirements (Part 3 of this RFP).

7.0 COMMERCIAL TERMS & CONDITIONS

7.1 Contract Details

Contract type will be a **fixed bid**. The Bidder should provide a detailed cost and time estimate to design, procure, construct, deliver, install, and manage this project with the details laid out in this document.

7.2 Procurement Terms and Conditions

After the Selected Bidder is chosen, GTI will provide the terms and conditions for the contract between GTI and the Selected Bidder.

8.0 GLOSSARY

The following list of acronyms, abbreviations, and terms are applicable for this report:

Acronym or Term	Definition
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASME BPVC	ASME Boiler and Pressure Vessel Code
BFD	Block Flow Diagram
BP	Budget Period
DAS	Data Acquisition System
DCS	Distributed Control System
DOE	U.S. Department of Energy
EH&S	Environmental, Health & Safety
EIN	Employer Identification Number
FAT	Factory Acceptance Test
FRR	Facility Readiness Review
GTI	GTI Energy
HAZOP	Hazard and Operability Study
HMI	Human Machine Interface
H&MB	Heat and Material Balance
I/O	Inputs and Outputs
ISA	International Society of Automation
LETA	Low Emissions Technology Australia
MEA	Monoethanolamine
MTO	Material Take-Off
MTPD	Metric Tonne Per Day
NDE	Non-Destructive Examination
NEC	National Electric Code
NETL	National Energy Technology Laboratory
OSHA	Occupational Safety & Health Act
O&M	Operation & Maintenance
PC	Personal Computer
PFD	Process Flow Diagram
PI	Principal Investigator
PM	Project Management
ppmv	Parts Per Million, by Volume
P&ID	Piping and Instrumentation Diagram
QA	Quality Assurance
QC	Quality Control
RFP	Request for Proposal

Acronym or Term	Definition
RPB	Rotating Packed Bed
SAT	Site Acceptance Test
SDS	Safety Data Sheets
SOW	Statement of Work
TBD	To be Determined
TEA	Techno-economic Analysis
TRL	Technology Readiness Level
TRR	Test Readiness Review
UG	General Requirements of the ASME BPVC
UL	Underwriters' Laboratories
UPS	Uninterruptible Power Supply
VAC	Voltage Alternating Current
WPS	Welding Procedure Specifications

9.0 LIST OF TABLES AND FIGURES

9.1 TABLES

9.2 FIGURES

GTI ENERGY

End of RFP Part 1