Attachment B2: Technical Performance Metrics and Desired System Characteristics
Topic 2 NextSTEP-3 Appendix A

Requirements
1.1 Oxygen Production Throughput
1.2 Pilot-Scale Demonstration
1.3 Integrated Process Flow
1.4 System Performance Metrics
1.5 Oxygen Production Measurement
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1.10 Regolith Feed System
1.11 Thermal Management

Requirement ID	Requirement Type	Requirement
1.1.1	Oxygen Production Throughput	The demonstrated system shall operate at a throughput that is scalable to a production capacity of 10 metric tons (mT) of oxygen per year without requiring significant modifications to the underlying technology architecture or process.
1.2.1	Pilot-Scale Demonstration	Offerors are encouraged to demonstrate a pilot-scale system capable of producing 1 mT of oxygen per year, equivalent to approximately 0.2 kg O_2/hr, assuming 200 continuous 24-hour Earth days of operation per year.
1.3.1	Integrated Process Flow	The system shall demonstrate an integrated process flow in which the product stream from each component is transferred directly to the next downstream component. The process flow cannot be interrupted to remove or inject any material (solid, gas, or fluid).
1.4.1	System Performance Metrics	The following key system performance metrics shall be recorded and reported: a) total oxygen produced (kg), b) production rate (kg O2/hr), c) production per energy input (e.g. kg O2/KWh), d) extraction efficiency (kg O2/kg regolith), e) and composition of output stream (e.g. molecular abundance of contaminant per molecules of O2).
1.5.1	Oxygen Production Measurement	The system shall measure and quantify oxygen yield/production at the system output to show it meets production rates and the cleanliness requirements for an oxygen liquification system for propellant use.
1.5.2	Oxygen Production Measurement	The oxygen product stream shall be characterized to demonstrate compliance with the cleanliness requirements applicable to downstream oxygen liquefaction for propellant production.
1.6.1	Flight Demonstration-Forward Readiness	Offerors shall identify all modifications required to transition the ground demonstrated system to a flight-ready implementation and shall assess the expected impact of those modification to system performance. The modifications required to make the system flight ready must be defined along with any impact on performance.

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		Note: As neither flight qualification nor TRL6 testing is required in the scope of this effort, hardware materials, power draw, etc. do not need to meet flight requirements. However, key Decision Points will consider the viability of a future flight system.
1.7.1	Continuous Operations Demonstration	The test program shall demonstrate full, integrated system operation at a minimum of 48 hours of continuous operations. Any consumables or repairs incurred must be reported and be accounted for in the metrics.
1.8.1	Waste Handling	The system shall continuously discharge waste stream (spent regolith simulant or unwanted gaseous by-products) without disrupting system operations.
1.8.2	Waste Handling	The method used to expel processed regolith from the reactor shall be representative of the intended lunar operating concept.
1.8.3	Waste Handling	Collection, transport, or disposal of tailings after discharge from the system boundary is not required.
1.9.1	Product Stream Characterization	The composition and mass of the product stream shall be measured and quantified at the system output. System by-products that are separated to produce the clean, dry O2 stream are encouraged to be measured but not required. Capture and storage of products is not required. However, proposers are encouraged to address the upstream and downstream systems to the extent possible.
1.10.1	Regolith Feed System	The system shall include a regolith handling system to feed the regolith simulant into the reactor. This is assumed to include a regolith hopper in addition to any required feed/metering device. The regolith hopper can be replenished manually. However, Offerors are encouraged to address the upstream and downstream systems to the extent possible.
1.11.1	Regolith Simulant	The Offeror shall identify within the proposal the regolith simulant to be used in the system test. Offerors shall be responsible for the procurement, acquisition, and associated costs of the selected regolith simulant. The selected simulant shall represent lunar highlands regolith and be relevant to conditions expected in the lunar south polar region. The selected particle size distribution shall be appropriate for the proposed extraction process. Note: NASA acknowledges that the reaction and products of a regolith simulant may not be fully representative of lunar regolith. Expected limitations of the simulant chosen shall be identified.
1.12.1	Thermal Management	The System design and test program shall generate the thermal performance data necessary to support future Thermal Vacuum (TVAC) test planning.
1.12.2	Thermal Management	The system shall be instrumented to measure temperatures, thermal interfaces, and thermal management

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		performance sufficient to characterize component-level and system-level thermal behavior.
	Thermal Management	The test program shall collect and report data necessary to evaluate thermal interactions between major system components and interfaces relevant to future TVAC testing.

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