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TECHNOLOGY READINESS LEVEL (TRL) SCORING QUESTIONNAIRE

The TRL questionnaire was adapted and modified from the TRL assessment developed by Pacific Northwest National Laboratory and is intended to measure the extent to which a technology is suited for deployment in a real operational environment.

Instructions:

Beginning with TRL 1, please respond “yes” or “no” to each question by marking your response in the left-hand column. If you answer “yes” to all questions at level 1, please move forward to level 2 and so forth. For the highest level at which you can respond “yes” to all questions, please report that level as your TRL score at the bottom of this questionnaire and submit the entire document as part of your proposal submission under Section D.4.3 Project Description and Specifications.

Technology Readiness Level (TRL)	
9	Commercial operation in relevant environment
8	Commercial demonstration, full scale deployment in final form
7	System prototype in an operational environment
6	Fully integrated pilot (prototype) tested in a relevant environment
5	Component validation in relevant environment (coal plant)
4	Component validation tests in laboratory environment
3	Analytical and experimental critical function proof-of- concept
2	Formulation of application
1	Basic principles

+EPRI 2011 (Freeman and Bhowan) & GAO 2010

TRL 1: Have basic principles been observed and reported?

Yes/No		Comments
	Has a reasonable process concept been proposed?	
	Do basic principles (physical and chemical) support the concept?	
	Have scientific observations been reported?	
	Have mathematical formulations of concepts been developed?	
	Do rough calculations support the concept?	

TRL 2: Has a concept or application been formulated?

Yes/No		Comments
	Have functional requirements been determined?	
	Have results of analytical studies been reported in peer-reviewed papers?	
	Have potential design solutions been identified?	
	Have the basic components of the technology been identified and partially characterized?	
	Have performance predictions been documented for each component?	

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	Have paper studies (studies done without laboratory work) confirmed the feasibility of simple process simulations?	
	Does preliminary analysis confirm basic scientific principles?	
	Have experiments validating the concept been designed with synthetic data?	
	Has preliminary qualitative risk analysis been documented?	

TRL 3: Has analytical and experimental proof-of-concept been demonstrated in a laboratory environment?

Yes/No		Comments
	Have experiments validated the predicted capability of technology components?	
	Have analytical studies verified performance predictions and produced algorithms?	
	Are the technology or system performance metrics established?	
	Can science relevant to developing the technology be modeled or simulated?	
	Have technology or system performance characteristics been confirmed and documented with representative data sets?	
	Do experiments or modeling and simulation (M&S) validate performance predictions of technology capability?	
	Do the results of technical application experiments verify the feasibility of such applications?	
	Does published research provide evidence for successful integration of technology and system components?	
	Have design techniques been identified and/or developed?	
	Have scaling studies been initiated?	
	Has analysis of alternatives been completed?	
	Have programmatic risks been identified and mitigation strategies been documented?	

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TRL 4: Has prototype-scale testing of equipment been completed in a laboratory environment?

Yes/No		Comments
	Have system requirements been finalized and documented?	
	Have design requirements been derived from system requirements?	
	Have system performance metrics been updated?	
	Have scalable technology prototypes been produced?	
	Has the performance of components been demonstrated at lab-scale?	
	Has a draft process design been completed?	
	Have performance characteristics of a 1 kW lab-scale prototype been demonstrated?	
	Have low-fidelity assessments of system integration and engineering been completed?	
	Are most system components available (laboratory surrogates in some cases)?	
	Have integration studies been started?	
	Have initial cost drivers been identified?	
	Are scaling studies and architecture diagrams completed?	
	Has a formal risk management program been initiated and integrated with project	

TRL 5: Has pilot-scale testing been demonstrated in a relevant environment?

Yes/No		Comments
	Have system interface (internal and external) requirements been documented?	
	Can unavailable system components be simulated using modeling and simulation (M&S)?	
	Has a pilot plant been developed at this scale?	
	Are process measurements high fidelity?	
	Does the pilot plant operate under realistic conditions?	
	Have individual plant components been verified and validated through testing?	
	Can all process specifications be simulated and validated in pilot plant?	
	Has acceptance testing of individual components been performed?	
	Has integration of modules/functions been demonstrated in a laboratory environment?	
	Have quality and reliability issues been identified and documented (target levels may not yet be set)?	
	Has system process design been finalized?	
	Has systems engineering begun?	
	Is the programmatic risk management plan documented?	
	Has a configuration management plan been documented and implemented?	

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	Has formal review of all documentation been completed?	
	Are materials, processes, methods, and design techniques at least moderately developed and verified?	

TRL 6: Has prototype (semi-works pilot) engineering scale testing been demonstrated in a relevant environment?

Yes/No		Comments
	Have system integration issues been addressed?	
	Is the operational environment fully known and documented?	
	Has prototype been tested in a simulated operational environment?	
	Have performance characteristics been verified and validated in a simulated operational environment?	
	Has prototype been tested in real operating environment?	
	Has an inventory of external interfaces (e.g. material, solvent, supply chain) been completed?	
	Are the components of the pilot plant functionally compatible in realistic problem-solving tests?	
	Have control systems been verified and validated in pilot plant?	
	Has engineering feasibility been fully demonstrated?	
	Have engineering drawings and piping and instrumentation diagrams been finalized?	
	Has collection of maintainability, reliability, and supportability data started?	
	Have design to cost (DTC) goals been identified?	
	Has system requirements specification document been completed?	
	Are all changes controlled/documentated using configuration management?	
	Has the final technical report been completed?	

TRL 7: Has equipment/process successfully operated in the relevant operational environment?

Yes/No		Comments
	Has process equipment been tested individually under stressed and anomalous conditions?	
	Are modeled components representative of production components?	
	Has operational testing of the process in relevant environment been completed?	
	Is data for Reliability, Maintainability, and Supportability analysis available?	
	Are process equipment and materials available?	
	Do prototypes represent actual form, fit, and function?	
	Have software algorithms been verified and validated with existing systems?	
	Is scaling completed?	

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TRL 8: Has the actual unit successfully operated in a limited operational environment

Yes/No		Comments
	Are all technology/system components form, fit, and function compatible?	
	Is technology/system form, fit, and function compatible with operational environment?	
	Has technology/system form, fit, and function been demonstrated in operational environment?	
	Has technical Developmental Test and Evaluation (DT&E) documentation been completed?	
	Are all materials in production and readily available?	
	Has maintainability, reliability, and supportability data collection been completed?	
	Is maintenance documentation completed and under configuration control?	
	Have final architecture diagrams been completed?	
	Have software algorithms been verified and validated with existing systems?	

TRL 9: Has the actual unit successfully operated in the full operational environment (hot operations)?

Yes/No		Comments
	Does technology/system function as defined in Operational Concept document?	
	Has technology/system been deployed in intended operational environment?	
	Has technology/system been fully demonstrated?	
	Has Operational Test and Evaluation (OT&E) been successfully completed and documented?	
	Have design to cost (DTC) goals been met?	
	Have safety/adverse effects issues been identified and mitigated?	
	Has all programmatic documentation been completed?	

Highest TRL: _____

Offeror's Name: _____

Date: _____