TECHNOLOGY READINESS LEVELS

UNIVERSITY TECHNOLOGY RESEARCH LAB AND CENTER

Dr Kingsley Abhulimen Research Lab and Center registered as a Limited Liability Company is a program and initiative jointly developed with the University. University Technology System Limited funds and supports early stage technology innovations often partnering with startups to accelerate their development. The Technology Readiness Level (TRL) is a 1-9 scale that measures a technology maturity with TRL2 through 7 representing a transition from initial concept formulation to a prototype validated in a simulated or relevant operational environment.

DR KINGSLEY ABHULIMEN RESEARCH CENTER AND LAB

What it is:

An initiative by Syntechsys and University Technology System Limited to partner with researchers and inventors to identify and support unproven, early stage ideas that have the potential to impact the future of energy aligning with its “Powering Innovators and Inventors to progress novel ideas and inventions incorporating syntechsys

technology in that effort for a transition to powering progress strategy for transition into our Client's Business

How it works:

The Program collaborates with researchers and startups and small/medium sized enterprises to help develop and advanced their concepts and ideas leveraging on Syntechsys technologies. Dr Kingsley Abhulimen Research Lab and Center often use a network of partners in Syntechsys Novel Catalysts Programs to provide funding, technical expertise and commercialization support

Focus: The program supports inventions and projects that can integrate with Syntechsys Novel Catalysts technologies programs for transition into Syntechsys technologies portfolios and those that can support broader energy transition

Technology Readiness Levels (TRL) 2-7

TRL 2: Technology Concept and Formulation

- Basic Principles are observed and applied to a new technology concept
- The technology potential applications are outlined
- At this stage, nothing has been proven and it bridges basic research and practical development

TRL3: Experimental Proof of Concept

- Active research and analytical and laboratory studies are conducted to see if technology is viable
- A proof of concept is demonstrated in a laboratory setting

TRL4: Technology Validated in a Laboratory

- Components are integrated and tested together at a laboratory level
- The technology is validated in a lab setting, often using laboratory scale-prototypes or models

TRL 5: Technology validated in a relevant environment

- The technology is validated in an industrially relevant environment often through a more integrated system

TRL6: Prototype demonstrated in a relevant environment

- A functional prototype or model is created and demonstrated in a relevant environment
- The Prototype is a more representative of the final system than a lab scale version

TRL7: Integrated Pilot System demonstrated in an operational environment

- The prototype system is demonstrated in a planned operational environment
- This is a critical step that shows the system can work under realistic conditions before a full commercial deployment

Technology Readiness Levels (TRLS)

TRL is a system for assessing the maturity of a technology ranging from 1(basic research) to 9(fully operational system)

TRL2: Technology Concept is applied and a Patent is Filed

TRL3: Analytical and experimental critical function and/or characteristic prove that it works

TRL4: Basic Technological components are integrated and tested in a laboratory environment

TRL5: Components are integrated and tested in a relevant environment

TRL6: A system/prototype model is demonstrated in a relevant environment

TRL7: A system/prototype is demonstrated in an operational environment

DR KINGSLEY ABHULIMEN RESEARCH LAB AND CENTER WITH THE SHELL GAMECHANGER PROGRAM is a shell initiative that provides funding and support to early-stage startups and businesses with innovative, unproven ideas in the energy sector. The goal is to help de-risk and advance technologies with the potential to have significant impact on the future of energy

Technology Readiness Levels (TRL) 2-7

The TRL scale measures the maturity of a technology as it progresses from fundamental research to operational use. The levels from 2 to 7 are:

TRL 2: Technology Concept Formulation: At this stage, the potential applications of the basic principles (established in TR1) is defined. The concept is still primarily theoretical and there is little or no experimental validation

TRL3: Analytical and Experimental Proof of Concept. Active research and Design begin. Laboratory studies and measurements are used to validate the individual elements of the technology demonstrating technical feasibility

TRL4: Technology Validation in a Laboratory environment. Components are integrated and tested in a controlled lab setting to ensure they work together. The result is low fidelity prototype

TRL5: **Technology validation in a relevant environment**. The integrated components are tested as a more realistic, large scale prototype in an environment that closely simulates the actual conditions

TRL6: **Prototype Demonstration in a Relevant Environment:** A fully functional prototype is demonstrated in a high -fidelity lab setting or simulated operational environment

TRL7: **System prototype demonstration in an operational environment**. The prototype is tested in its intended real-world operating environment. The system is at near full scale for this pilot demonstration

TRL of Dr Kingsley Abhulimen's Patented Technology

Based on the information from search results, Dr Kingsley Abhulimen's "Real Time Computer Assisted Leak Detection/Location and Inventory Monitoring System" is most likely at TRL7 or higher, potentially even TRL8 based on the following indicators:

Patent Details: Google Patent shows that Dr Abhulimen filed a patent application for this invention and that the patent was issued (US6970808B2). Patent Applications are typically filed when the technology has moved past the

earliest conceptual stages (TRL2-3) and has a functioning proof of concept and often a working prototype

Context of the Invention: The patent describes a system that compares real time measurements from supervisory control and data acquisition (SCADA) system with a simulated flow model. The Patent abstract describes the invention as a real time method and system for leak and inventory monitoring

Evidence of Operational Testing: Dr Abhulimen worked with SIEP, Shell USA and Shell Oil Company, SNEPCO, Shell Nigeria to develop a Patented Application of Risk and Safety Management System. This suggests the technology was at least demonstrated or tested with industry partners in an operational and relevant environment (TRL 6-7)

Public Recognition: The Nigeria Prizes websites lists Dr Abhulimen as a co-winner of the 2004 prize for science with this work. This level of recognition indicates a technology that has proven to work and has been assessed for its impact, placing it far beyond early development stages.

The TRL scale measures the maturity of technology itself, not just its intellectual property status.

The Patent for Dr Abhulimen invention contains diagrams illustrating the application of his system to a typical pipeline network system and a typical pilot test model and it mentions collaborations with Shell. This evidence of testing in a relevant or operational environment suggests a high TRL. The patent protects the intellectual property, while TRL assesses the operational maturity and readiness for commercialization of the technology