

### Abstract

Containment/Surveillance (C/S) measures are critical to any verification regime in order to maintain Continuity of Knowledge (CoK). The Ceramic Seal project is research into the next generation technologies to advance C/S, in particular advancing security and improving efficiency. The Ceramic Seal is a small form factor loop seal with advanced tamper-indication including a frangible seal body, tamper planes, external coatings, and electronic monitoring of the seal body integrity. It improves efficiency through a self-securing wire and in-situ verification with a handheld reader. Sandia National Laboratories (SNL) and Savannah River National Laboratory (SRNL), under sponsorship from the U.S. National Nuclear Security Administration (NNSA) Office of Defense Nuclear Nonproliferation Research and Development (DNN R&D), have previously designed and are now fabricating and testing Ceramic Seals. Tests are underway at both SNL and SRNL, with different types of tests occurring at each facility. This paper will describe the Ceramic Seal prototype, the design and development of a handheld standalone reader and an interface to a data acquisition system, fabrication of the seals, and results of initial testing.

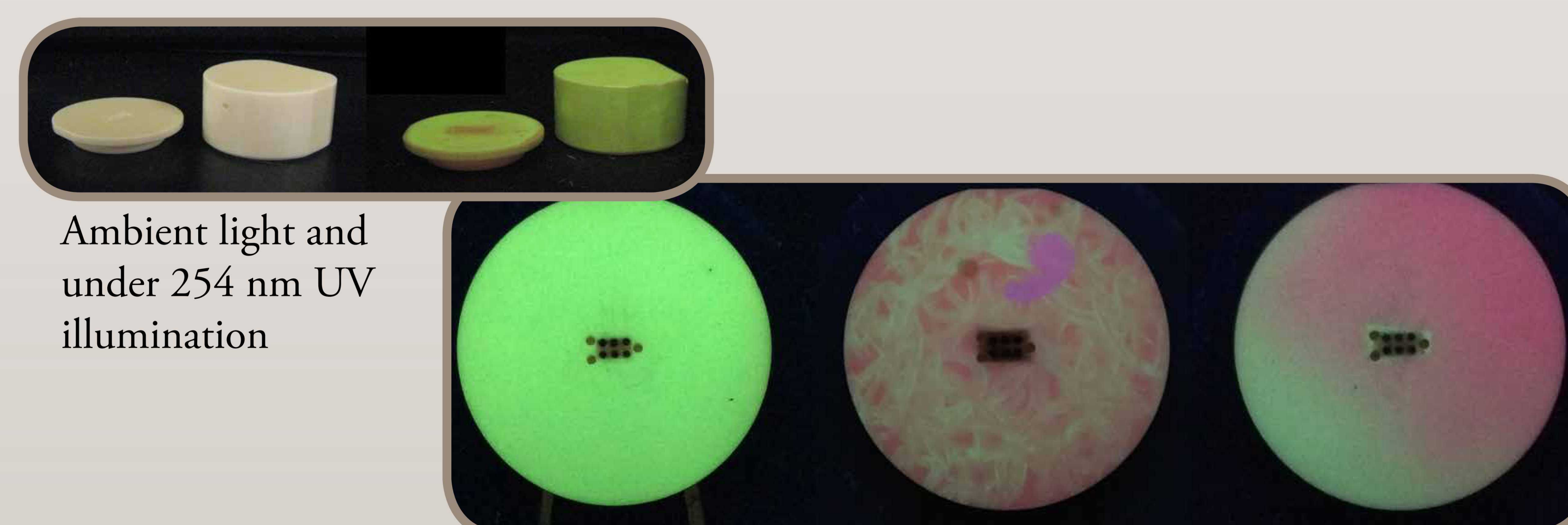
## IMPROVED SECURITY

### Electronic monitoring of seal body integrity



Spiral-pattern tamper plane

### Tamper-indicating external fluorescent coatings



Ambient light and under 254 nm UV illumination

Solid green, chaotic, and gradient under 254 nm UV illumination

### Passive identification via Laser Surface Authentication

Frangible alumina seal body – tamper attempt is prone to result in fragments that are difficult to reassemble without evidence of tampering

## IN-SITU VERIFICATION

Coatings reader – iPod/iPhone obtains images of seal illuminated by commercial UV lamp. Seal, lamp and imager held by additively manufactured frame.



### Reader for stand-alone applications:

- Personality Programming
- State-of-health
- Tamper events
- Verify authenticity
- Includes microprocessor-based crypto-token for secure key management



### Tablet interface:

- Personality Programming
- State-of-health
- Tamper events
- Verify authenticity

## EASE OF APPLICATION



Wire is threaded through a tortuous path

### AUTHORS:

Heidi A. Smartt

Juan A. Romero

Joyce Custer

Ross Hymel

Sandia National Laboratories  
Albuquerque, NM, USA

Dan Kremetz

Derek Gobin

Larry Harpring

Michael Martinez-Rodriguez

Don Varble

Savannah River National Laboratory  
Aiken, SC, USA

Jeff DiMaio

Stephen Hudson

Michael Schreuder

Margaret Shaughnessy

Tetramer Technologies  
Pendleton, SC, USA

Data acquisition system:  
collects and manages data from  
various sensors