



Contribution ID: 278

Type: poster

## An Integrated Passive (Battery-Free) Seals-and-Tag for International Safeguards

*Wednesday, 22 October 2014 16:50 (30 minutes)*

The ability to reliably and securely automate the monitoring of SNM is an important goal in Safeguards. Although item level monitoring of SNM requires both seal and tag technologies, the two technologies thus far have been developed more or less independently, and had been a lack of an integrated compact system. An integrated seal-and-tag approach not only aids inspectors to perform their tasks effectively, this approach also allows real-time inspection in large scale facilities. A typical facility could be the size of a large warehouse with hundreds or thousands of items that need to be sealed and monitored in real-time.

Previously we reported on advanced secure RF passive (battery-less) tags with special features including, long-range interrogation of passive tags, communicating with passive tags with strong encryption and dynamic authentication features, and the ability to place the tags directly on metal objects. In this paper, we report on a novel secure passive tag integrated with fiber optics seal that allows real-time monitoring of items through secure wireless communications that employs AES encryption and dynamic authentication. Furthermore, the devices can be networked for large scale operations.

The proposed passive seal has the same capabilities as active seals in that it allows real-time monitoring. However, the battery lifetimes of conventional active seals are limited or unpredictable. As the long-term storage of SNM might last for several years, these passive seals having been integrated with passive RF tags, extends the lifetime of the physical seals and tags indefinitely, while getting the same performance of active seals and tags. The integrated seal-and-tag is transformational in addressing a critical need in Safeguards area for long-term real-time monitoring.

### Country or International Organization

United States of America

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**Session Classification:** Advanced Technologies for Safeguards Communications: E-Posters