



**PASSPORT**  
SYSTEMS INC

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## Company Profile

Passport Systems, Inc. (Passport) was founded in December 2002 to develop and commercialize nuclear resonance fluorescence (NRF), a technology invented by MIT Professor and Passport founder William Bertozzi, as well as other technologies, to address the threats facing the world after the terrorist attacks on September 11, 2001. Passport's technologies are applied to automatically identify sea, air and land cargo contents in a fraction of the time required by other systems. The company, under the Department of Homeland Security's Domestic Nuclear Detection Office's Nuclear and Radiological Imaging Platform Advanced Technology Demonstration (NRIP ATD) Program has completed the design of a full scale cargo scanner incorporating all of Passport's advanced primary and secondary screening technologies which is being constructed and will be tested by DNDO at the port of Boston in the coming months. The purpose of the ATD is to detect the presence of concealed nuclear weapons, nuclear materials and other contraband as well as automatically clear or confirm alarms while differentiating nuclear and non-nuclear contraband from all other materials. To aid in the development and commercialization of its products, Passport has received more than \$85 million in government (\$50M) and private funding (\$36M).

### 1.1 Company History

The following is a compilation of major milestones in the development of the SmartScan 3D™ System.

- **September 2007** - Passport Systems, Inc. received a contract from DNDO to build and test a proof of concept scanner to detect shielded nuclear materials and shielding material in cargo containers. A follow on to two earlier contracts managed by DHS, the contract objective was to demonstrate the full functionality of Passport's NRF technology in combination with its Effective Z in 3 Dimensions (EZ-3D™) technology in an integrated system.
- **October 2008** - Passport Systems, Inc. received a contract to develop prototype modules based on its Prompt Neutrons from Photo-fission (PNPF) and NRF technologies for DNDO's Advanced Technology Demonstration (ATD) for Shielded Nuclear Alarm Resolution (SNAR) Program. The purpose of these modules is to detect the presence of concealed nuclear weapons and nuclear materials.
- **July 2011** - Passport Systems, Inc. completed the Characterization Readiness Review phase of their ATD for the SNAR Program under its current contract with DHS/DNDO. Under the SNAR ATD program, Passport Systems developed a prototype scanner for DHS/DNDO based on its EZ-3D™, PNPF, and NRF technologies. The purpose of these modules is to detect the presence of concealed nuclear weapons and nuclear materials as well as automatically clear or confirm alarms while differentiating shielded Special Nuclear Material (SNM) from all other material.
- **September 2012** - Passport Systems, Inc. received a contract from DHS/DNDO under the Nuclear and Radiological Imaging Platform Advanced Technology Demonstration (NRIP) ATD for the design, construction and testing of a non-intrusive cargo inspection system. Passport proposed to conduct this

ATD at The Massachusetts Port Authority (Massport), where it will utilize Passport Systems' EZ-3D™, PNPf, and NRF technologies. The purpose of these technologies is to detect the presence of concealed nuclear weapons, nuclear materials and other contraband as well as automatically clear or confirm alarms while differentiating nuclear and non-nuclear contraband from all other material.

### **Recognition Award**

- **July 2012** -- Passport Systems, Inc. was recognized by the DHS/DNDO on May 14 at the [2012 IEEE Symposium on Radiation Measurements and Applications \(SORMA\) West 2012 Conference](#). The certificate of appreciation was presented to Dr. Robert Ledoux, president, CEO and director of [Passport Systems, Inc.](#), and the ATD Teams of Passport Systems, Inc., for superior achievements in the Intelligent Radiation Sensor System (IRSS) and SNAR programs.

## **2 SmartScan 3D™ Automated Cargo Inspection System**

### **2.1 System Overview**

Passport Systems, Inc.'s fixed cargo scanner, SmartScan 3D™, offers significant increases in capability over existing deployed technologies for automated, rapid clearing of non-threat cargo/vehicles, the detection of threats in heterogeneous cargo, manifest verification and/or investigation, and the detection of heavily shielded nuclear materials. SmartScan 3D™ integrates Passport's proprietary EZ-3D™ anomaly detection, PNPf, and NRF technologies with conventional high-resolution imaging and intelligent passive radiation detection to automatically clear or detect threat objects in a primary scan mode in less than 2 minutes. In secondary, or alarm resolution mode, the system differentiates specific isotopes and performs material identification to rapidly clear or confirm suspected threats or manifest anomalies, typically in less than 5 minutes. The scanner supports multiple operational configurations, with the capability to be used as either as a primary scanner with integrated alarm resolution, or in secondary mode to resolve suspicious or difficult cargos. A rendering of the system is shown below.



## 2.2 Advantages

Passport's SmartScan 3D™ technologies enable a number of advantages over other scanners, including:

### **Automated threat detection with 3D localization**

In less than two minutes, system automatically detects and locates many types of contraband and anomalies present in the cargo

### **Automated alarm resolution**

Quickly resolve potential contraband with high confidence through rapid material identification and discrimination

### **Highly penetrating x-rays for inspecting the densest cargos**

The 9 MeV X-rays can readily penetrate more than 400 mm (16") of steel for the interrogation of the densest cargos

### **Dose optimization**

Using SmartScan 3D™ Radiography, the system constantly monitors and adjusts the x-ray beam intensity to deliver only as much radiation as is required to detect and clear threats

### **Material identification for cargo manifest verification and duties collection**

The system's broad material identification and discrimination capabilities can be used to support tariff collection activities

## 2.3 Advanced Technologies

### **SmartScan 3D™**

The system uses Passport's SmartScan 3D™ technology to provide a high resolution conventional top-down image similar to the image seen on typical baggage x-ray systems, scaled up for cargo. The system automatically adjusts the beam intensity to maintain the highest quality image while using as little dose as possible in less dense areas of the cargo, lowering the overall inspection dose while maintaining the capability of inspecting very dense areas.

### **EZ-3D™**

During the initial inspection, Passport Systems prime technology for contraband detection is called EZ-3D™, which stands for *Effective Atomic Number (Z) in Three Dimensions*. It determines the weighted average of the atomic numbers (effective Z) and the density of materials present in each voxel (3D pixel) of the cargo. EZ-3D™ does this by analyzing the interactions of the x-ray beam with the matter in the cargo, since these interactions are dependent on the atomic number and the density of the matter being scanned

Materials of interest are instantaneously and automatically detected, alerting the operator to the presence of the targeted contraband, while supplying a three-dimensional location of the alarm. EZ-3D™ provides an image of the complete cargo container free of the confusing geometric distortion typically found in other scanners.

## ***PNPF***

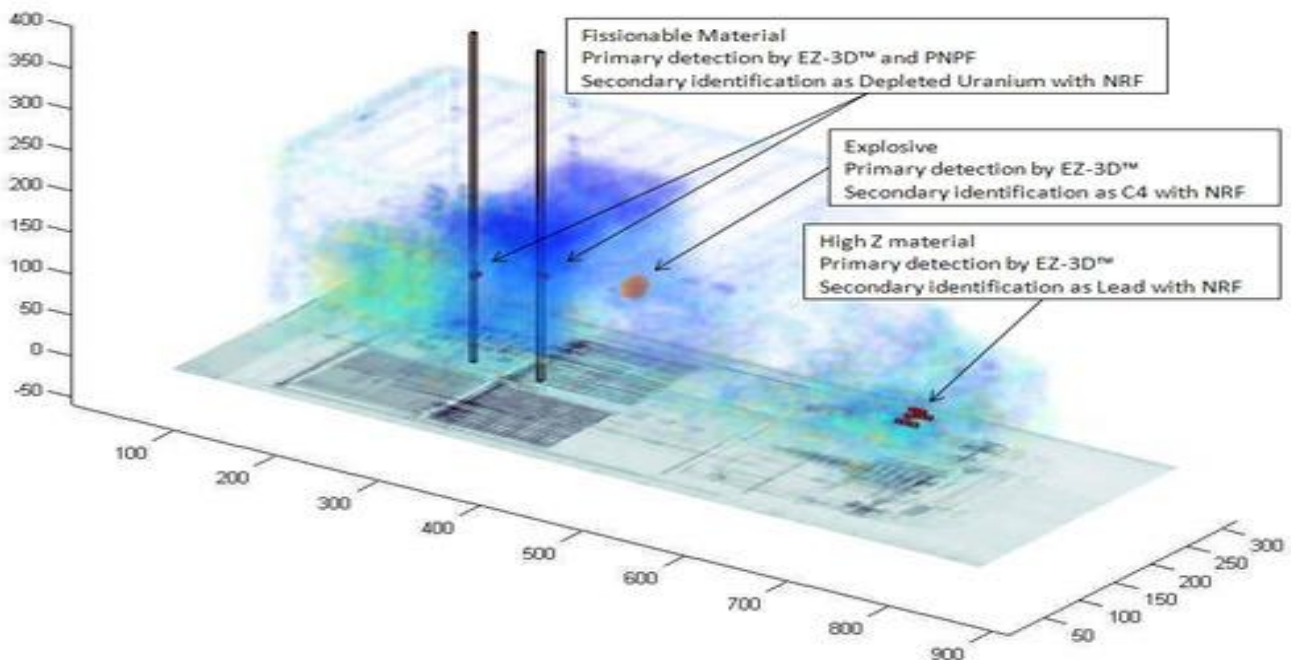
Another materials discrimination technology used in the primary scan is called PNPf, which stands for *Prompt Neutrons from Photo-induced Fission*. This technology provides rapid, automated 2D detection of fissionable material in real time by capitalizing on the fact that the beam used to initially scan the cargo will produce a unique signature when it comes into contact with any fissionable material. This technology is one of the most sensitive and rapid techniques currently available.

## ***Resonance Fluorescence***

If any regions of interest are found during the primary scan, Passport's scanner performs a secondary scan of each of those regions using a third patented technology – *Resonance Fluorescence*. This technology precisely and automatically identifies the contents of cargo, resolving the alarms that may have been raised in the primary scan with detection times from seconds to a few minutes in average cargo. It does this by capitalizing on the fact that when the beam passes through the cargo, it excites the cargo's matter to emit photons with unique signatures. These signatures are compared against a fully customizable library. The material identification library contains nuclear material, explosives, drugs, nerve agents, and firearms components, but can be easily expanded and customized as needed for changing threats. The module can also be used for cargo verification, for example differentiating water from alcohol or marble from granite.

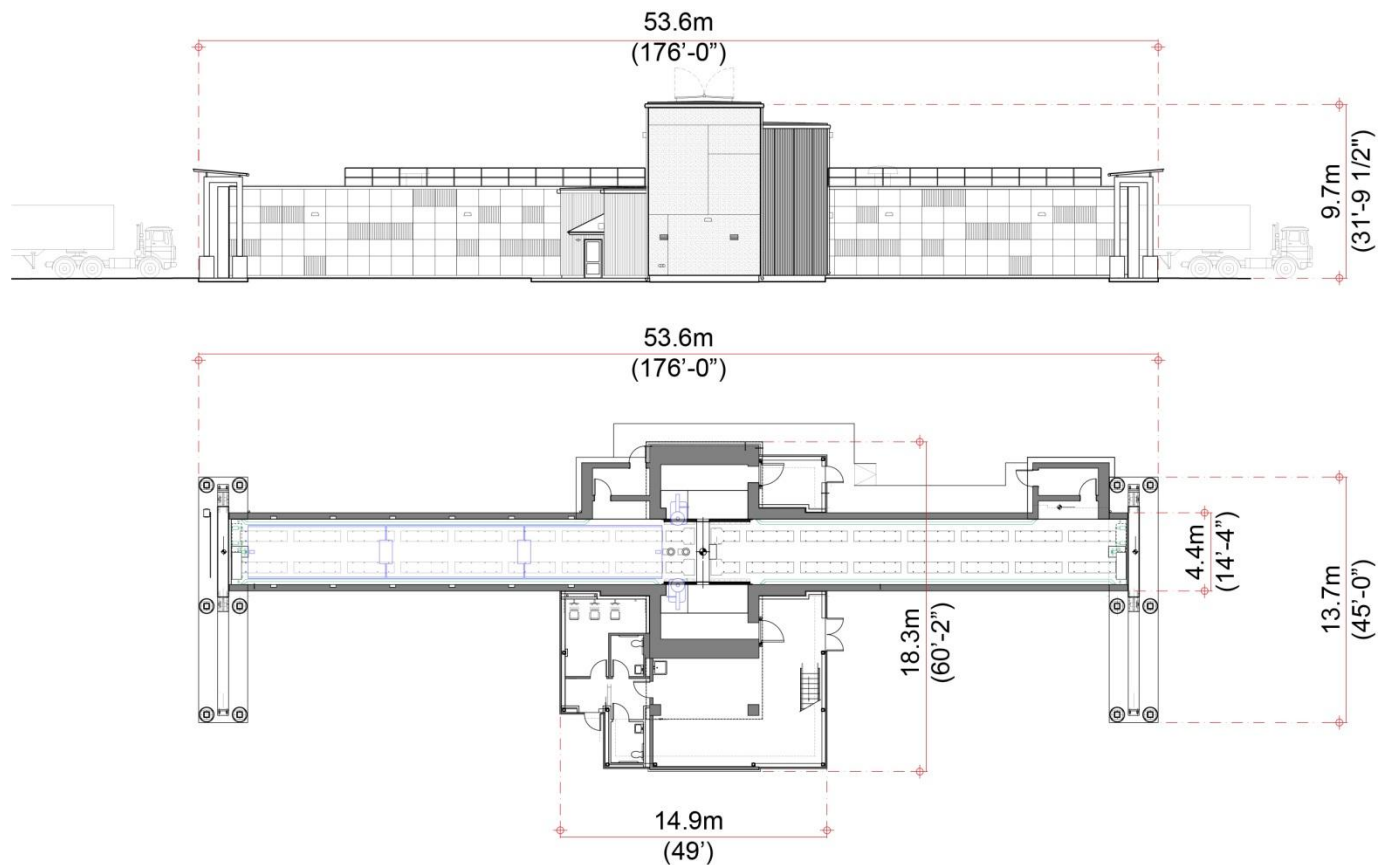
## ***Integrated Passive Radiation Detection***

Just prior to the primary scan the system also functions as a highly sensitive passive radioactive material detection system with an integrated set of detectors dedicated to the detection of radioactive materials. A precise secondary high resolution scan may be used to further inspect any suspect areas in order to identify and quantify the alarm.



**3D Image of Cargo Truck Scanned Using EZ-3D™, NRF, and PNPf Technologies. The red objects are fissionable material, which are identified as 238U (depleted uranium). The red/purple is high atomic number material, which are identified as lead (in the battery). The orange is high explosives which are identified as C4.**

The performance of the three main technologies (EZ-3D™, PNPf and NRF) have been demonstrated and characterized under the DHS-DNDO SNAR program (<http://www.dhs.gov/shielded-nuclear-alarm-resolution-snar>), resulting in DHS-DNDO recognizing Passport for its efforts under this (and another) program (<http://passportsystems.com/pr/072512.html>).



**Elevation and Plan view of the SmartScan 3D™ Cargo Scanner**