Challenges In Air Cargo Screening

August 22, 2016
Summary

1. Recap of Air Cargo Screening
2. Air Cargo Screening Regime
3. Consolidated Air Cargo Screening – FINDEX Air Cargo Scanner
4. Break Bulk Air Cargo Screening – CT Based Inspection System
Recap of Air Cargo Screening
Air Cargo Screening as part of Aircraft Security

Passenger & Luggage Security

Checked Luggage Security

Air Cargo Security
Current Concerns of Air Cargo Screening

- Air Cargo constitutes 30% of international trade
- Only a small fraction of global air cargo is actually screened
- Screening practices vary widely
- Highly variable: non-homogenous, cluttered contents and differing shipment size
The Threats in Air Cargo Screening

- Explosives
- Flammable Substances
- Arms and Ammunitions
- Nuclear Materials
- Narcotics
- Tobacco
- Alcohol
- Quarantine items

<1 Litre/ 1 m³
<1 kg/ 1 ton

Air Cargo
Air Cargo Screening Considerations

• The screening technology and methodology need to be:
  – Safe and Reliable
  – Capable of detecting desired threats
  – Easy to operate and maintain
  – Compatible with current and future operation
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2 Air Cargo Screening Regime

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Air Cargo Security Screening

1. Break Bulk Cargo
2. Consolidated Cargo
3. Vehicles
Break Bulk Cargo Screening

Primary Inspection

CT Inspection System

X-ray Inspection System

Secondary Inspection

Radioactive Monitoring

Raman

CT Liquid Scanner

ETD
Break Bulk Cargo Screening

1. CT Inspection System
2. X-ray Inspection System
3. Control Center
4. Raman/CT Technology Liquid Scanner
   Other recheck methods: ETD, Radioactive Monitoring System, etc.
Consolidated Cargo Screening

Air Container

FINDEX Air Cargo Scanner

Palletized Cargo

Conventional Large Pallet X-ray Inspection System
Vehicle Screening

PB Series Cargo/Vehicle Inspection System

Multifunction Fast-Scan System

MT Series Mobile System
Challenges in Air Cargo Security

- Consolidated cargo is hard to screen
- Break Bulk cargo screening is time consuming and laborious
- Time pressure - must not impede logistic flow and airplane schedule
- Existing technologies face limitations – high cost, low speed, cannot distinguish within clutter
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3 Consolidated Air Cargo Screening – FINDEX Air Cargo Scanner

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FINDEX Air Cargo Scanner
Consolidated Cargo Screening

- Screening of built-up ULD/Pallet
- High energy X-ray scanner is used
- Scan before loading onto aircraft
- Time efficiency: cargo already consolidated
- Lower labour cost
**FINDEX Technology and Its Benefits**

- Fast Interlaced Neutron and Dual-Energy X-ray imaging technology
  - Utilizes high resolution X-ray radiographic image
  - X-ray data provides information about density of material
  - Neutron/X-ray interaction cross-section ratio provides information about the average composition of the material
  - More sensitive than dual-energy X-ray technology
FINDEX Technology and Its Benefits

Transmission

\[
\frac{I^x}{I^x_0} = e^{-\mu_x \rho x}, \quad \frac{I^n}{I^n_0} = e^{-\mu_n \rho x}
\]

Composition

\[
R = \frac{\mu_n}{\mu_x} = \frac{\ln(I^n / I^n_0)}{\ln(I^x / I^x_0)}
\]
**FINDEX Technology and Its Benefits**

- More precise material discrimination capability based on material composition and density
- Particularly high sensitivity to organic materials, such as concealed explosives and narcotics

![Graph showing R values for various materials](image)
FINDEX Air Cargo Scanner

- 14 MeV D-T neutron generator and 6/3 MeV dual energy X-ray accelerator
- Plastic scintillator X-ray and neutron detector
- Compact design - patented fast neutron shielding technology
- No on-site construction work
- Easy maintenance
## Specifications of AC6015XN

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>X-ray: Interlaced Dual-energy Electron Linear Accelerator</td>
</tr>
<tr>
<td>Neutron: 14MeV Thermo Fisher generator</td>
<td></td>
</tr>
<tr>
<td>Penetration</td>
<td>320mm steel</td>
</tr>
<tr>
<td>Max Size of Scanned Object</td>
<td>2.44m (Width) × 3.0m(Height)</td>
</tr>
<tr>
<td>Max Weight of scanned object</td>
<td>7000kg</td>
</tr>
<tr>
<td>Throughput</td>
<td>40 units of standard AKE/LD3 per hour</td>
</tr>
<tr>
<td>Material Discrimination</td>
<td>256 color-coded image</td>
</tr>
</tbody>
</table>
Installations

Abu Dhabi International Airport
Installations

Beijing Capital International Airport
Imported car
Images

Smuggled sculpture

Smuggled porcelain
Images

Explosive & Ammunitons

- Grenade
- Pistol
- Rifle
- Explosive
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Break Bulk Air Cargo Screening – CT Based Inspection System
Air Cargo Inspection by CT Scanners

- Automated detection for explosives/narcotics, quarantine items etc.
- Higher supervision efficiency
- Up to 1800 parcels per hour
- Real-time On-screen Resolution
- High resolution images display
- Dual-energy material discrimination
- Improve resolution efficiency
- Secondary inspection with secondary inspection Raman, CT liquid scanner, ETD, etc.
CT Reconstruction Principle
3D Images – Clear View of Inner Structure
**Dual-Energy Material Discrimination**

- High-resolution dual-energy 3D image & CT slice image

Material discrimination in 3D image to improve the image analysis efficiency.
Dual-Energy Material Discrimination

- Dual-energy CT technology – Improves recognition accuracy

![Graph showing material discrimination based on density and effective atomic number (Z_eff).]
Automatic Detection Ability

Automatic Detection of Explosives
ECAC EDS Standard 3 approved

High-resolution DR image
CT slice image
High-resolution 3D image

The ECAC EDS Std. 3 approved models:
XT2080, XT2080AD, XT2100
Installations

Australian Customs
Installations

China Customs
Extension of Automatic Detection

For narcotics

For quarantine contraband

For other specific threats
CT Product Series

**XT2080AD**
- Tunnel Width: 750mm
- Conveyor Speed: 0.24m/s
- Throughput: 860BPH
- Certification: CAAC, ECAC EDS Std. 3

**XT2100**
- Tunnel Width: 1004mm
- Conveyor Speed: 0.3m/s
- Throughput: 1080BPH
- High-resolution, dual-energy CT slice images and 3-D images
- Certification: CAAC, ECAC EDS Std. 3

**XT2100HS**
- Tunnel Width: 1004mm
- Conveyor Speed: 0.5m/s
- Throughput: 1800BPH
- Dual-view DR images
- High-resolution, dual-energy CT slice images and 3-D images
**Consolidated vs Break Bulk (FINDEX vs CT)**

**Consolidated (FINDEX)**
- Time efficiency
- Lower labour cost
- Combo technology – Neutron + X-ray
- More detailed material discrimination

**Break Bulk (CT)**
- High Throughput
- Automatic threat detection
- 3D reconstruction improves image analysis
- Smaller operating area required