For Airport Safety and Capacity

FODetect®

Automatic FOD Detection System

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Proprietary and Confidential

The Vision

To provide airport operators with absolute control and monitoring of their main source of revenue - the runways, and enhance safety of operations and capacity.

Since 2001 !






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The FOD Problem

FODetect in News Broadcasts Worldwide

New York Times with the FAA

TF1 news – France

Channel 5 News - Boston

Videos can be viewed on the Xsight website,

www.xsightsys.com/newsbroadcasts.htm

The FOD Problem: Tire Incident examples

- July 24, 2003 – B747 returned to Tel Aviv's Ben-Gurion A/P shortly after takeoff due to damaged landing gear
- August 11, 2005 – B747 tire punctured on landing at Tokyo's Narita A/P. R/W closed for 24 minutes.
- December 19, 2005 – B747-400, four tires blew during takeoff from LAX. FODs were scattered across airport runways and taxiways.
- March 2, 2007, Newport News, Va. Bombardier Learjet 36A, FOD caused a burst tire during takeoff. Aborting the takeoff, crew tried to control the "fishtailing" and activate the drag chute unsuccessfully, the aircraft ran off the runway.
- October 1, 2008 Columbia (S.C.) Metro Airport, Learjet 60SE. Tire blow-out during takeoff, pilot aborts at 80 knots overrunning runway and perimeter fence and crossing a road.
  4 fatalities, 2 survivors burned by post crash fire.
  NTSB currently investigating cause.

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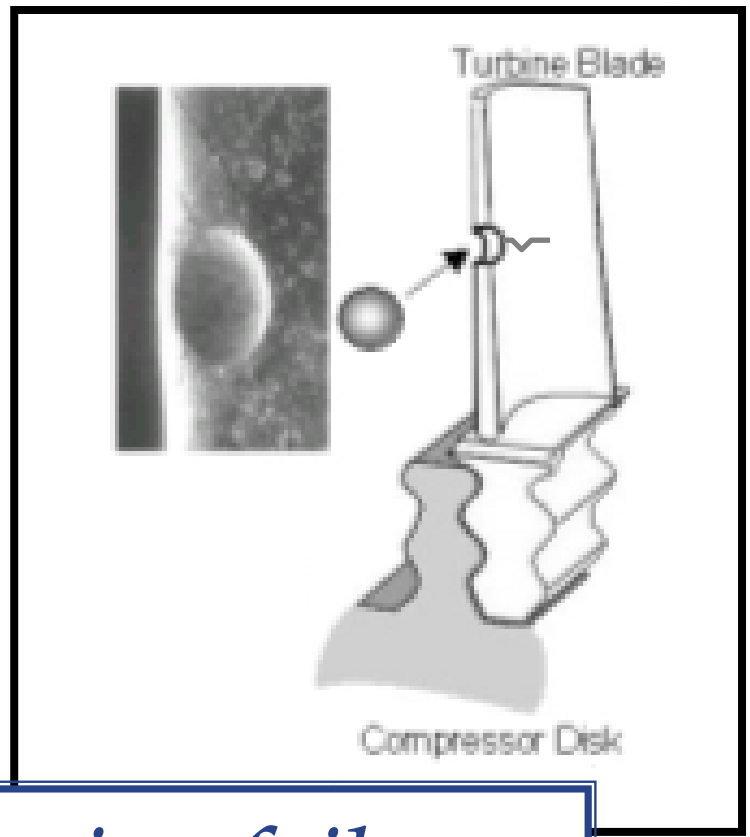
The FOD Problem: Turbine Blades

- Aircraft turbine engines routinely experience ingestion of debris resulting in FOD.
- Such damage can dramatically reduce the lifetime of engines.



FOD can cause engine failure

The FOD Problem: Annual Damage

- $4b direct damage for entire industry[1]

- Analysis of 300 largest airports:[2]
  - 70,000 FOD incidents
  - $1.1Bn direct damage (maintenance)
  - $12Bn inclusive damage (delays, inefficiencies fuel, etc)

- Direct cost to airlines
  - $6-20M per airport
  - $263K per 10K movements

[1] U.S. Air Force Research Lab at Wright Patterson AFB (Squadron Leader Richard Friend)

[2] "The cost of FOD" Research study by Insight SRI, UK

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The impact of FOD on airports

- **Awareness**: Many airports are not always aware of the extent of the problem
  - DGAC study reveals 8 severe runway FOD findings a month at Paris CDG
- **Safety and potential accidents**:
  - Damage to reputation
  - Subject to liability
- **Delays and lost capacity**:
  - FODs cause monthly delays of over 200 minutes in the large airports
  - Damage to reputation and passenger dissatisfaction
- **Insurance**: Increased insurance rates for airports and airlines due to risk and damage
- **Financial:** Damage to aircraft are borne by airlines, MROs and equipment leasing companies (increased rates)

FAA Advisory Circular, issued 09/09

US Department of Transportation / FAA Advisory Circular, AC number 150/5220-24 Airport Foreign Object Debris/Damage (FOD) Detection Equipment

- Concludes 3 years of joint activity between the FAA and Xsight.
- Sets the standards for FOD detection equipment, and eligibility for Federal Funding (AIP and PFC)
- FODetect **is fully compliant** with the AC and **meets or exceeds** the highest level of performance requirements in every parameter

Evaluation commenced January 2008:

FAA extensive evaluation of FODetect at Boston's Logan International Airport extending over two winters with heavy snow conditions, consistently yielded outstanding performance results throughout FAA assessment.

Evaluation of four technologies:

Stationary radar, stationary electro-optic, hybrid radar and electro-optic, and mobile radar. **Of all systems evaluated, only FODetect meets or exceeds the AC's highest performance levels.**

Further FAA AC information
http://www.xsightsys.com/faacertification.htm

FOD Detection Systems

Key Requirements

FOD – Key Requirements

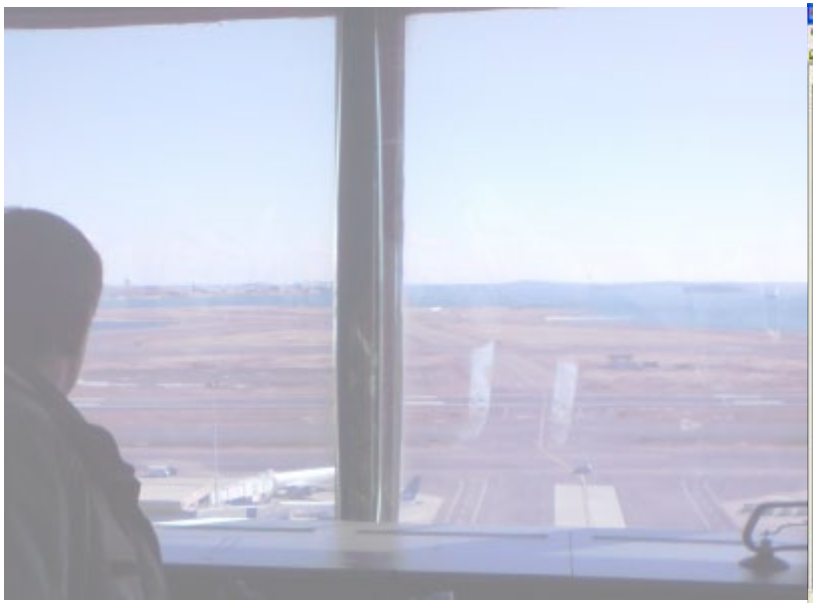
- Detection capability

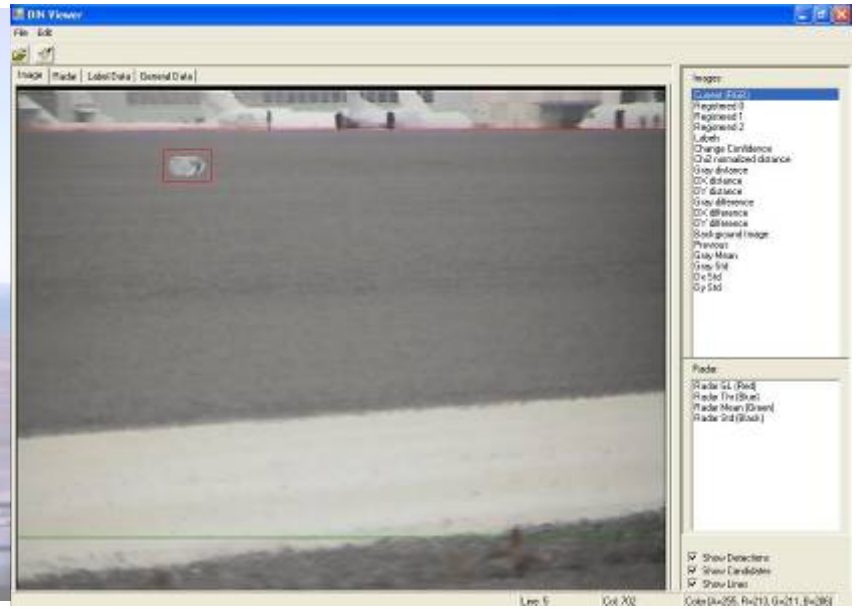
  To detect objects of all sizes and materials, with high probability, in all weather conditions in which an airport is operational

Objective: P_d > 95%

FOD – Key Requirements

- Visualization and interrogation





Objective: Allow remote FOD decision for Zero Runway False alarms and to support capacity/availability growth

FOD – Key Requirements

- Fast detection and action cycle

Objective:

Between-movements detection and decision

FOD – Key Requirements

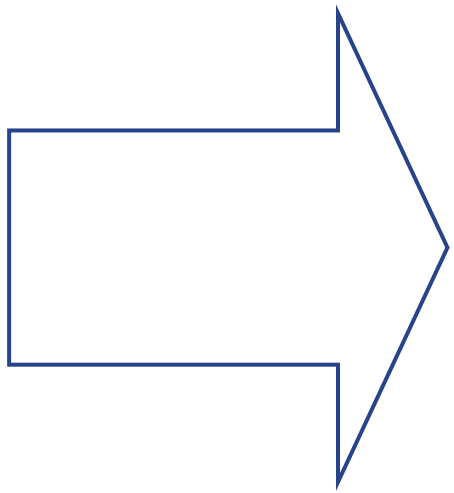
- Ascription – Ability to associate detected FODs with the cause
  - Part dropped by aircraft
  - Tool or fastener dropped by maintenance, service

Objectives:

- **Alert aircrafts for danger**
- **Identify FOD sources for preventive action**

Key Requirements - Conclusions

- Performance
- Visualization
- Ascription
- Scan time
- Affordable



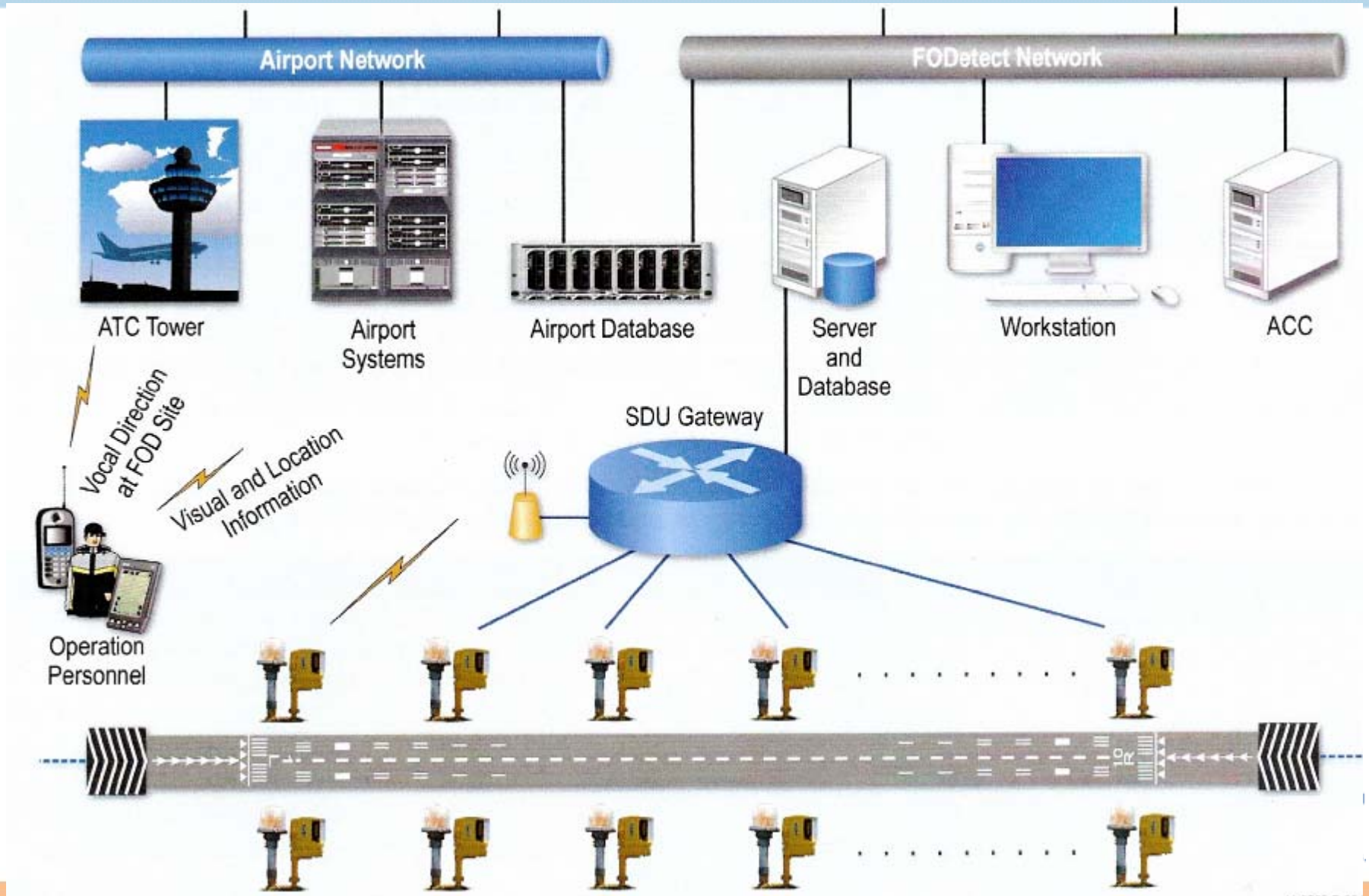
- ☑ Closest to the scene
- ☑ Vision/radar fusion
- ☑ Distributed COTS networked system

Distributed system solution

Sensors placed on the edge lights infrastructure.

The edge light becomes a *smart edge light*

System block diagram



The FODetect Process

1 Scan and Detect

Each SDU continuously scans a section of the runway using radar and advanced image processing technologies.

2 Alert

Upon detection of a FOD, an audio visual alarm is raised at the operator console showing the FOD location.

3 Interrogate & Classify

Operator views high resolution image and receives FOD physical data (size, location) from the SDU, supporting a decision for action to be taken.

4 Remove

An operations vehicle is sent to clear the FOD. GPS coordinates and laser pointer assist in efficient removal.

5 Document and Tag

FOD data and actual images are archived and FOD is tagged.

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SDU - Surface Detection Unit Components

CCD camera with NIR
Tilt, zoom & focus control

77GHz Radar

Pan motion axis

Frangible coupler & quick disconnect cable

Local CPU & Line Series Power Supply

LAN / optic fiber communication

FODetect® milestones

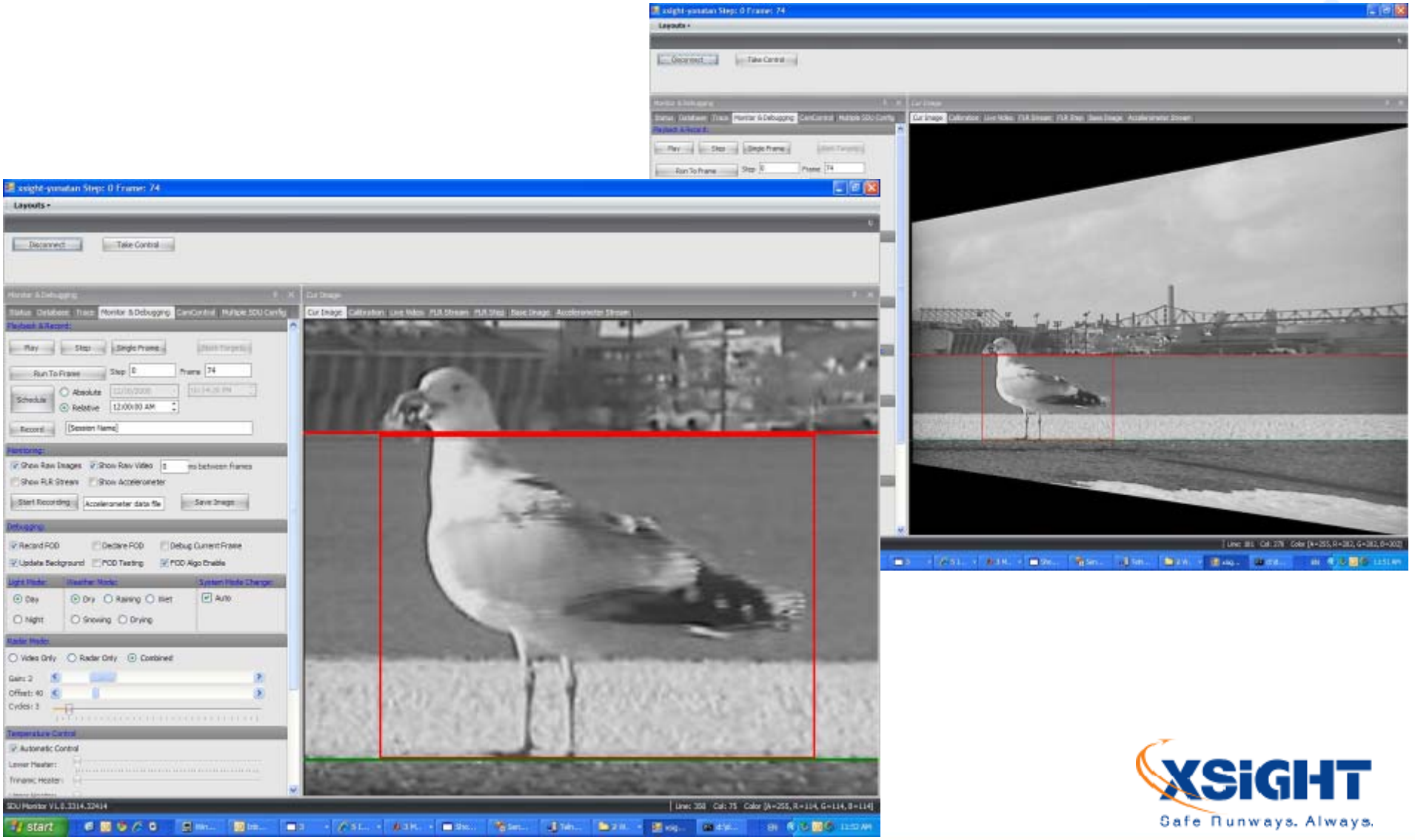
- August 2007 - FAA selects FODetect for evaluation at Logan airport, (BOS) towards issuing Advisory Circular (AC)
- March 2009 - FODetect receives ATC Global 2009 emerging technology award
- September 2009 – FAA issues FOD AC based on evaluation results. FODetect eligible for FAA funding.
- May 2010 – FODetect selected by Logan airport Boston following competitive bid and analysis of all 4 technologies evaluated by FAA, for installation on all runways
- June 2010 – Leading European airport purchases FODetect for installation on busy intersections
- September 2010 – Ben-Gurion (TLV) selects FODetect as sole source supplier for both main runways

Installation at Logan

Operator console in Control Tower - 16th Floor

Runway 15R installation

Seagull Detection



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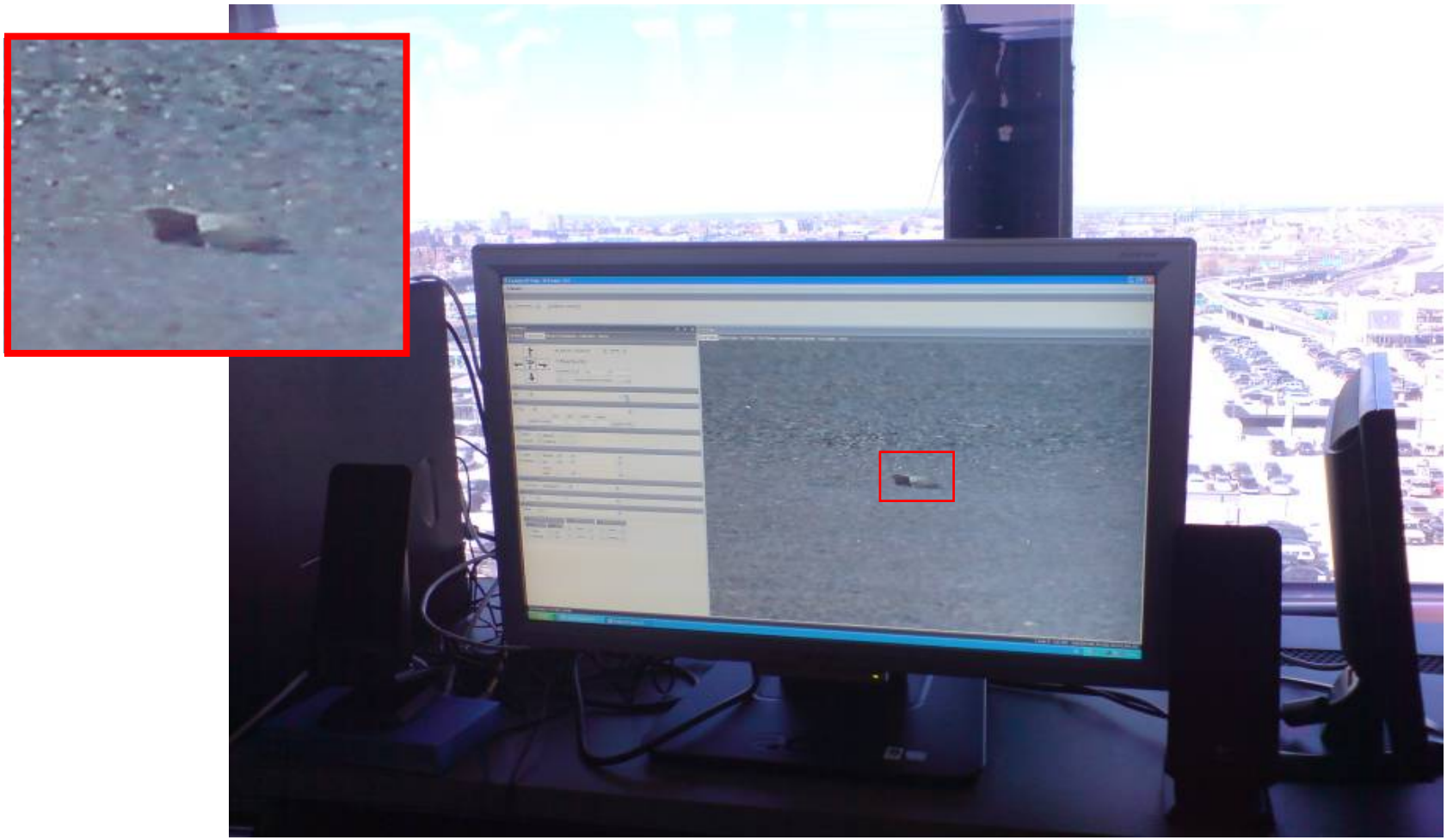
Clam-shell FOD Detection



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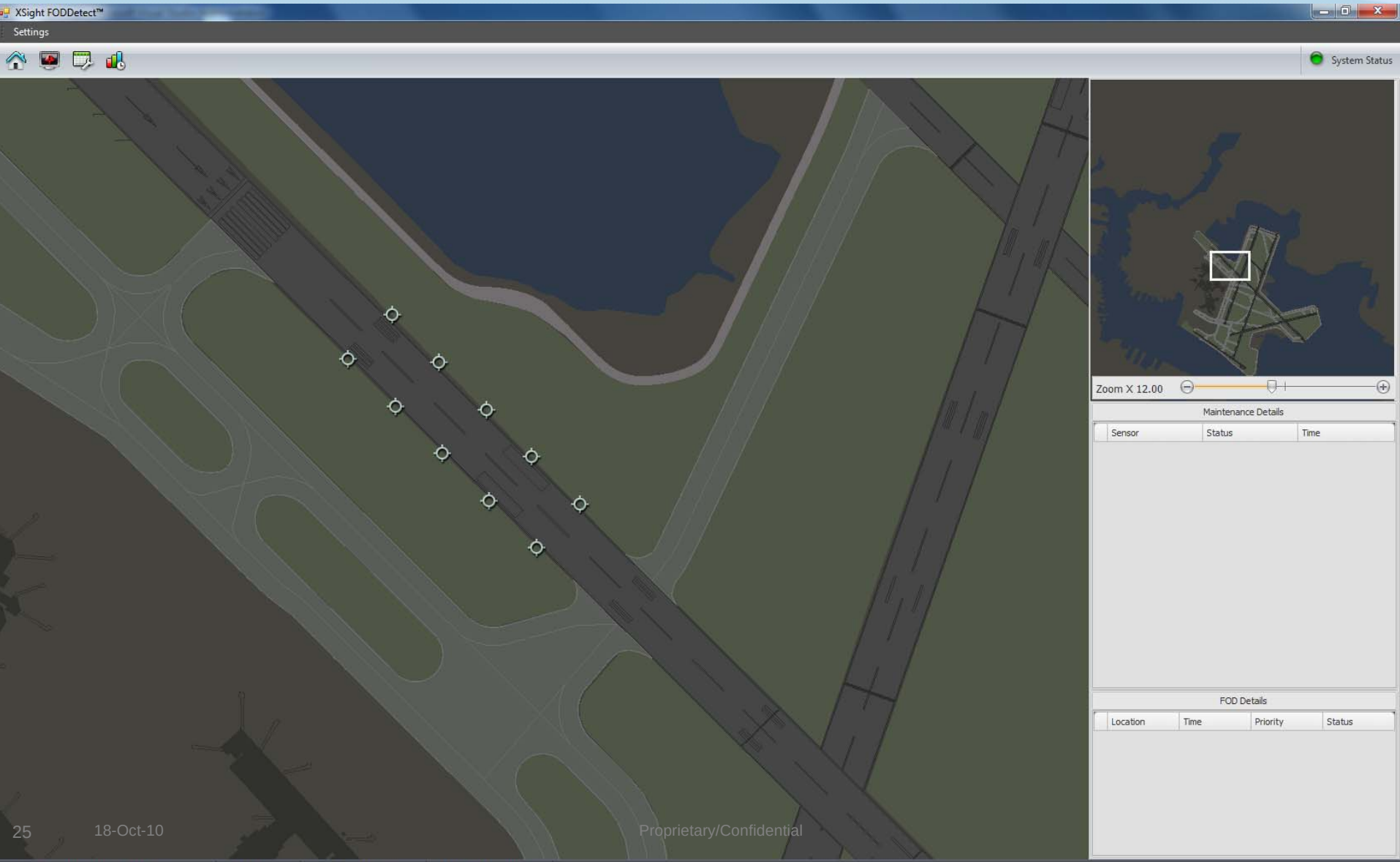
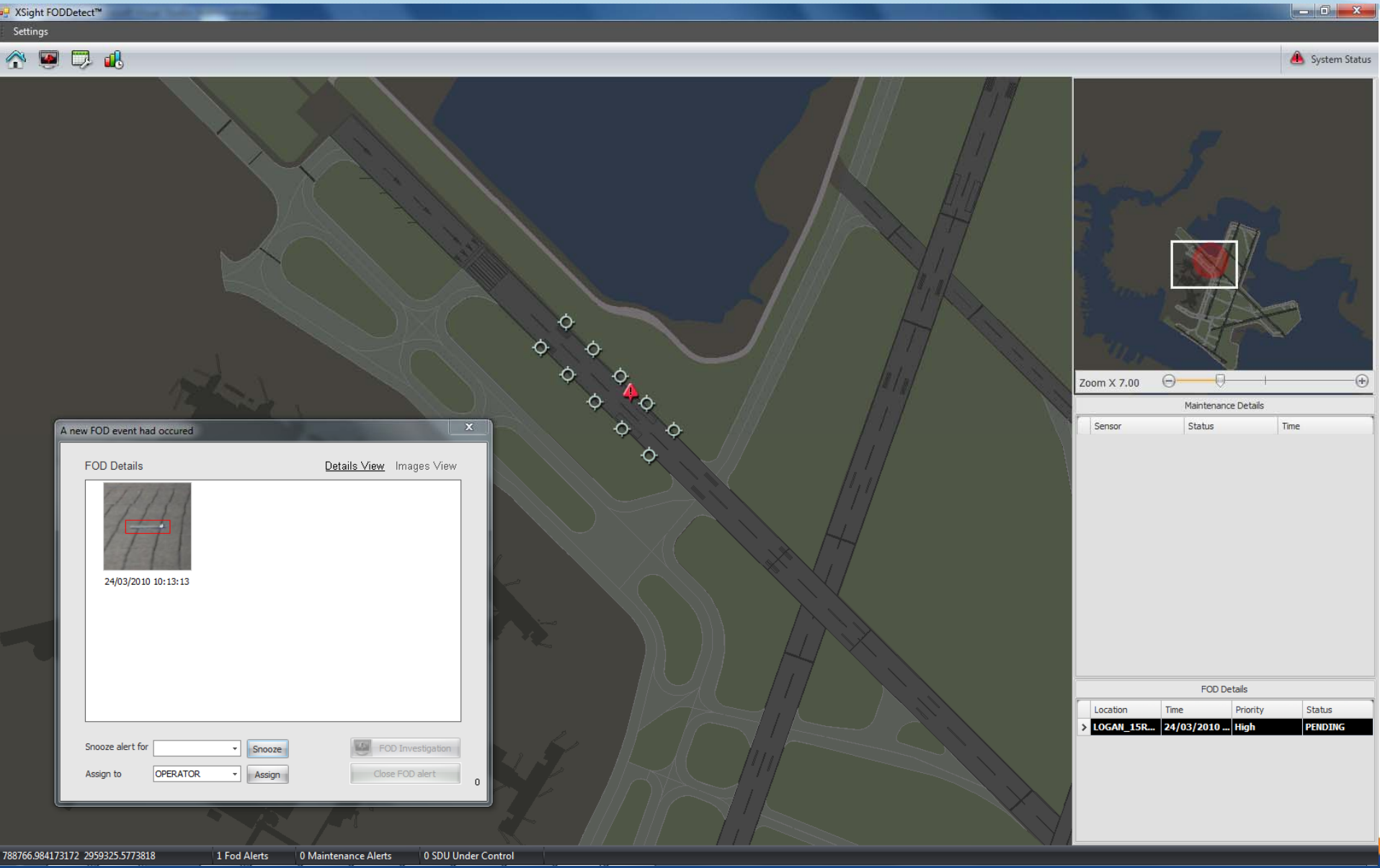
FODetect System
Operator console

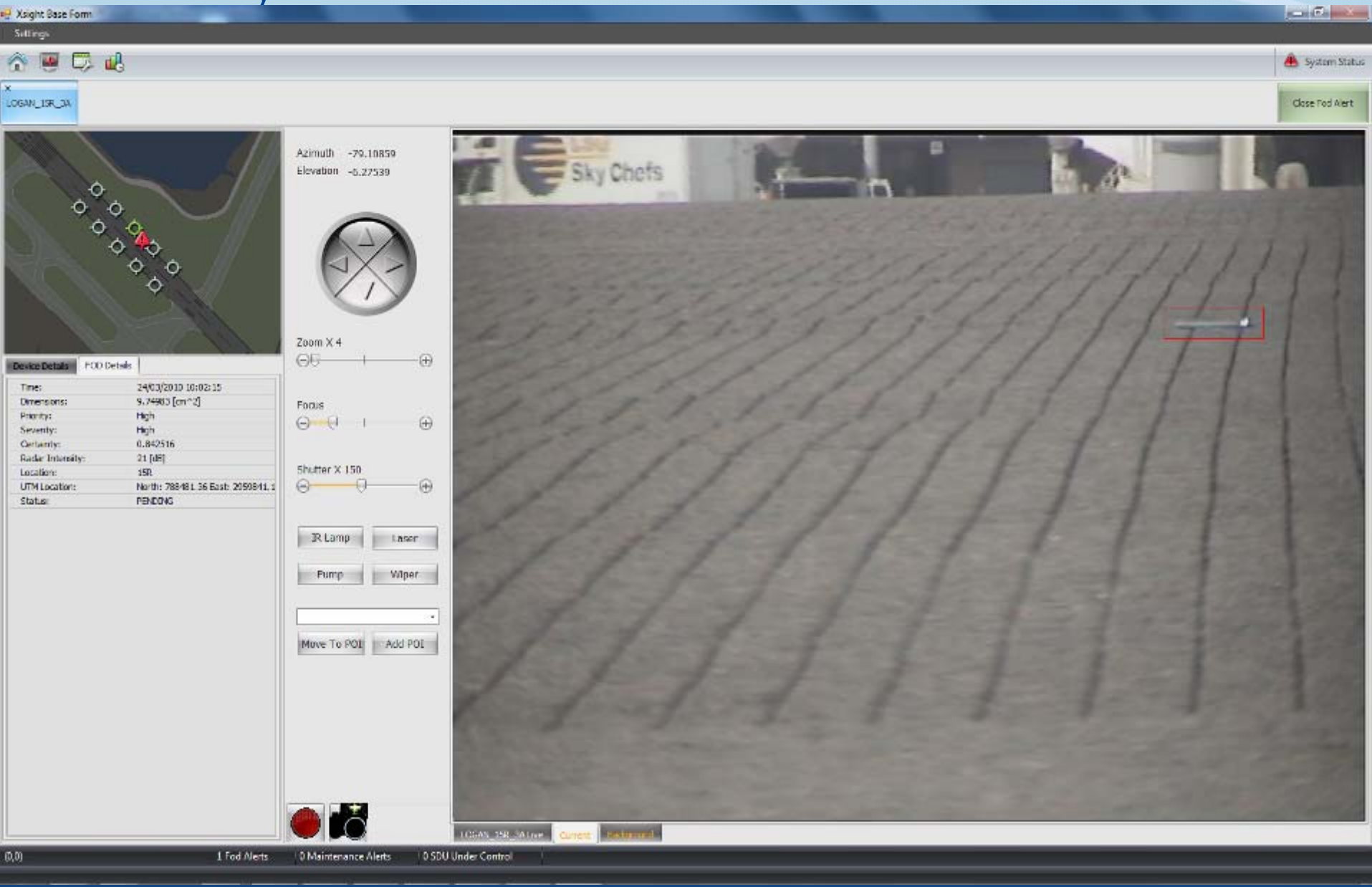
Main Screen – showing SDU locations



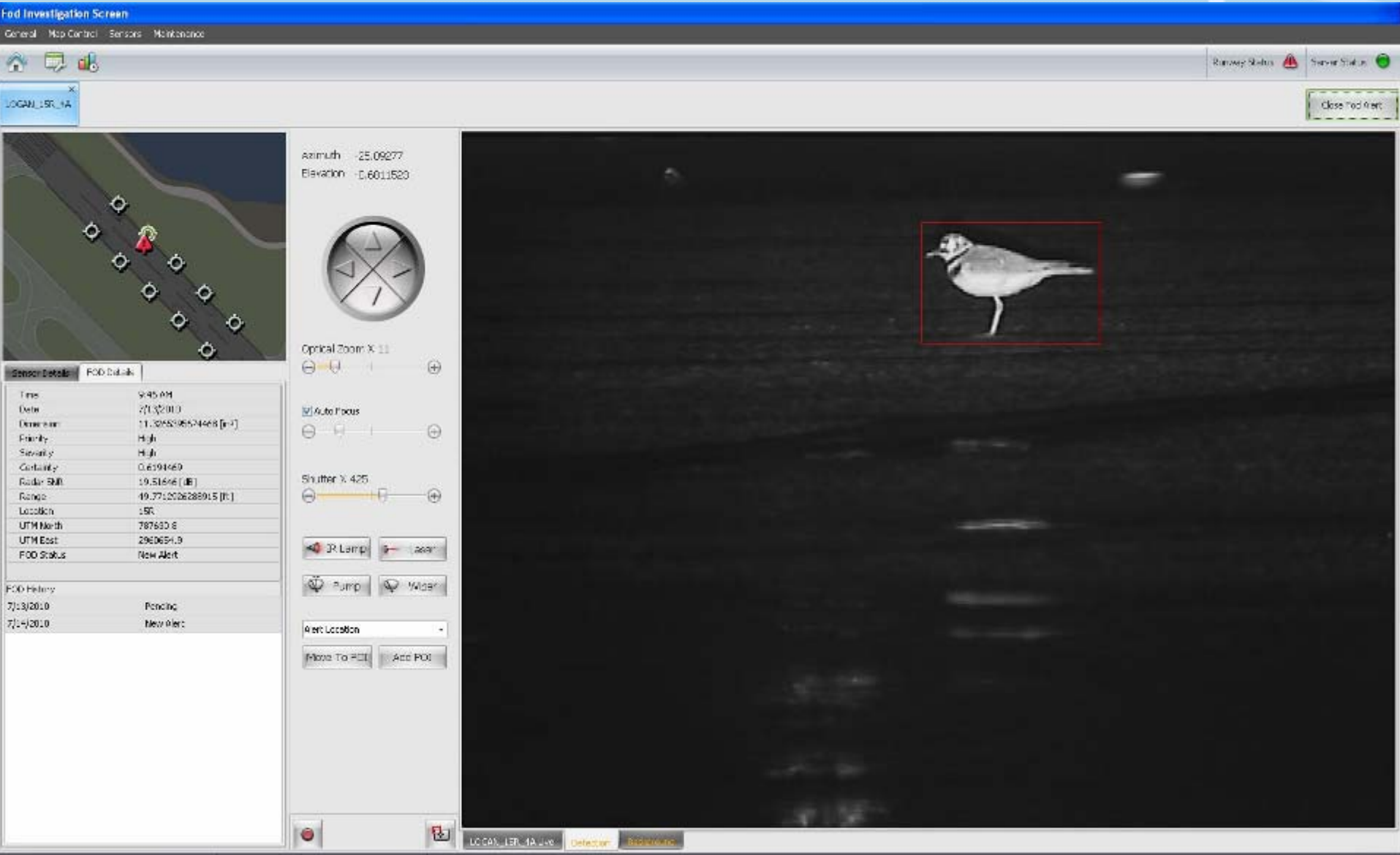
FOD detected – audio and visual alerts (see below) are issued



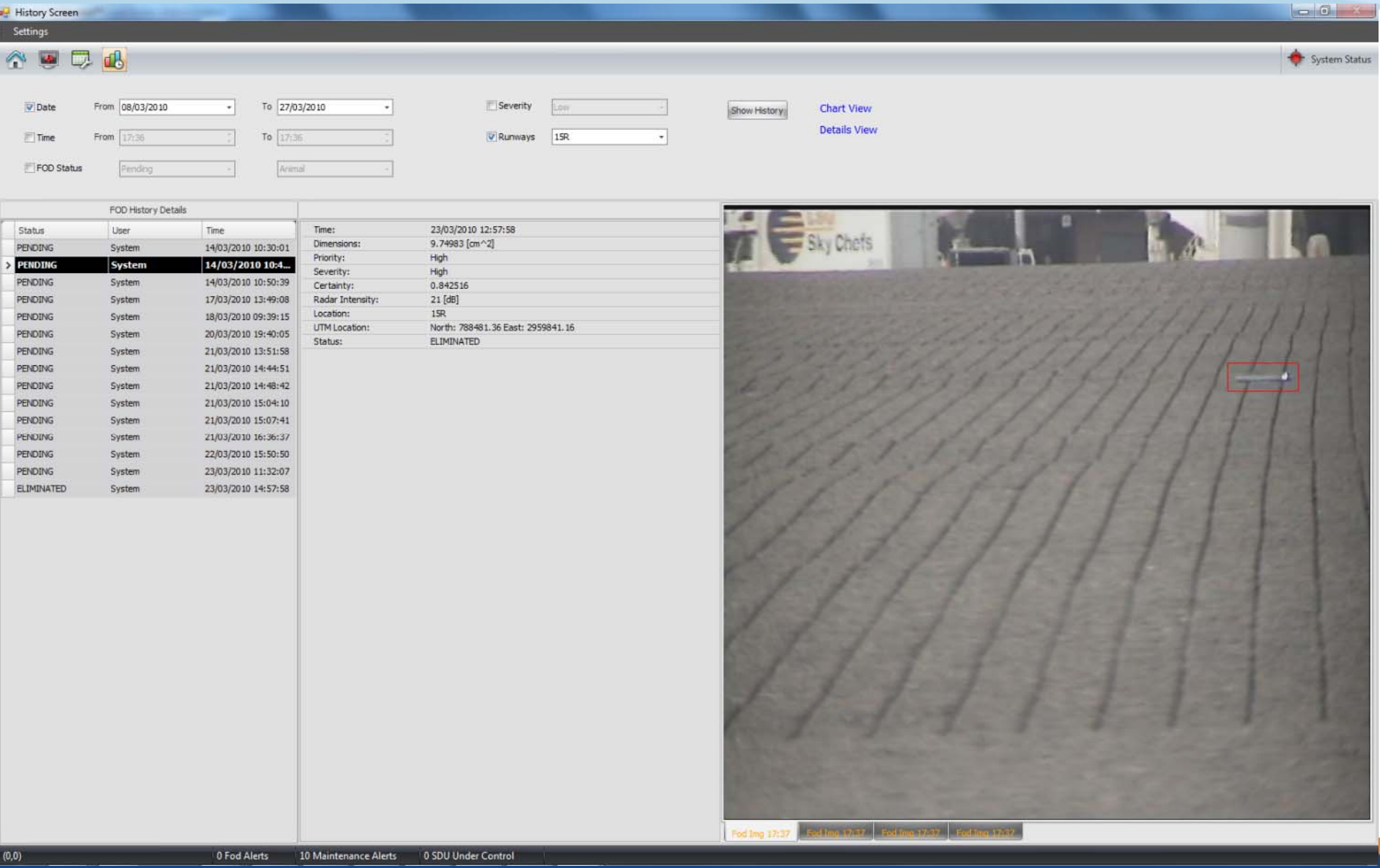
FOD Investigation – operator can zoom in and identify the FOD



Bird detection at night



FOD History - database



Control Tower visibility limitations

- Runway viewed from the SDU camera in heavy fog -
The system cameras provide the control tower a clear view of the runways even in extreme low visibility conditions

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FOD Ascription

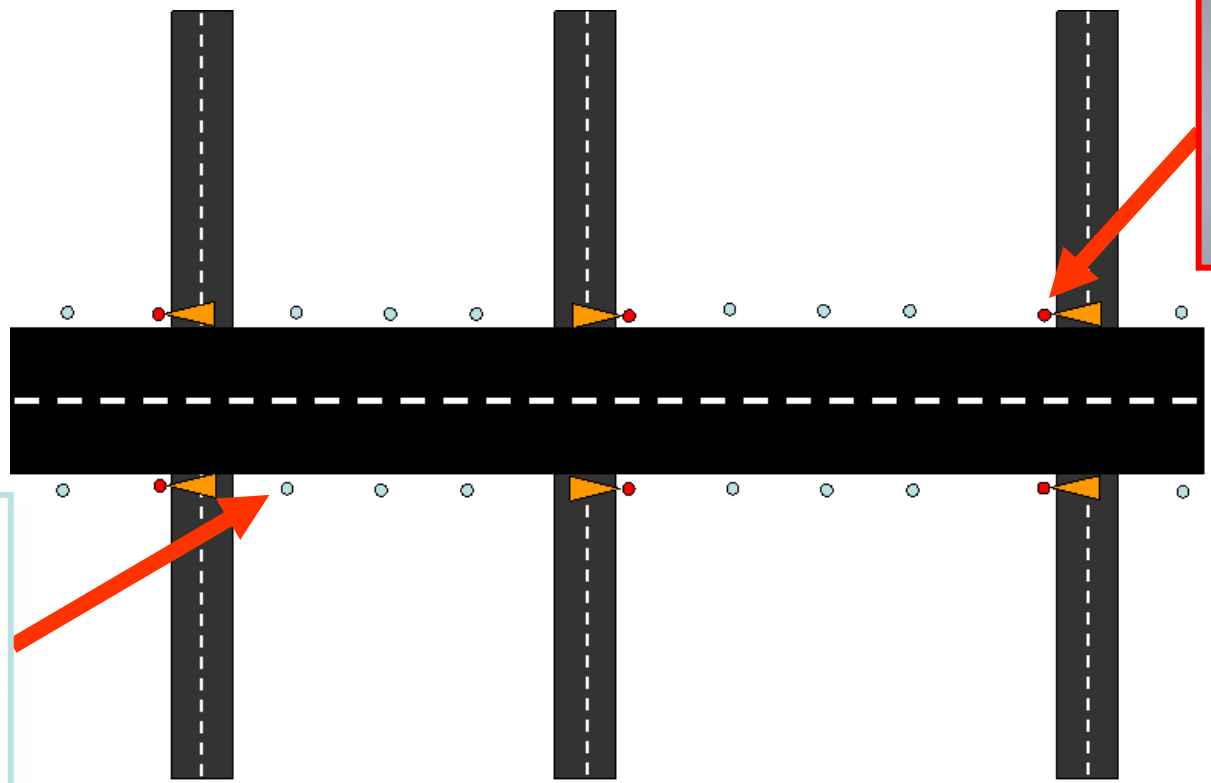
FOD-ID – Video Recording Unit

- Identifies sources of airport FOD
- Provides photographic evidence of FOD sources
- Uses existing lighting infrastructure
- Monitoring of intersection traffic
- Recording of runway incidents

FOD Ascription System Overview

Objective – associate the responsible vehicle/aircraft with detected FOD

- SDU – Surface Detection units - Scan RW and detect FODs
- VRU – Vehicle Recording units - Monitor RW entrances\exits and save images of every motion in and out of the RW



VRU

SDU

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FOD Ascription – FOD Alert Flow Chart

Vehicle recording unit

Server (MMI)

FOD Alert

Fetch image of vehicle, corresponding to the FOD detection time and place

Display image of the suspected FOD source

FOD Alert & FOD Image

FOD source image

video clip

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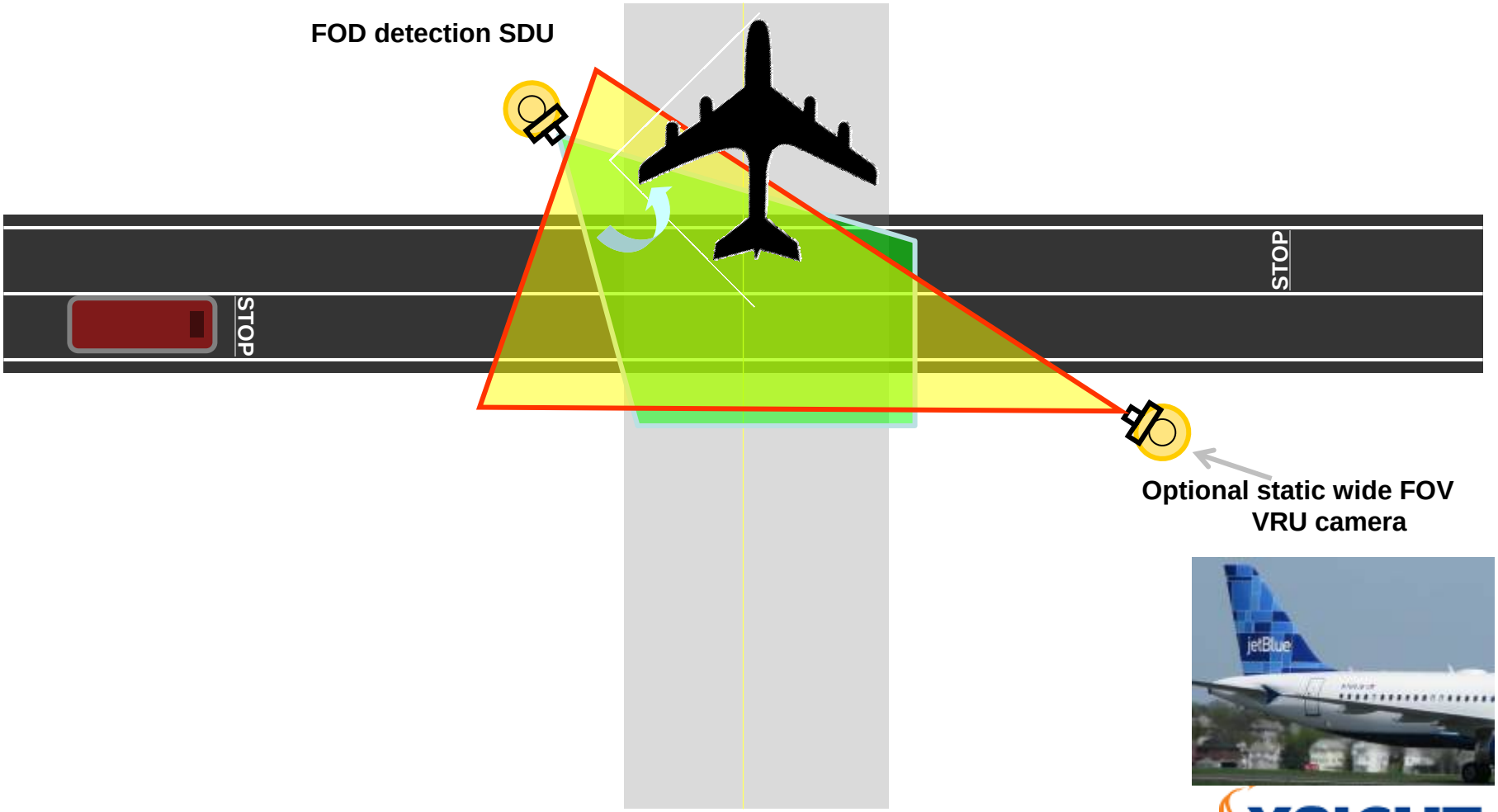
FODspot™ for Intersections and hot spots

- FODetect is a scalable solution can be installed on specific intersections or other hot spots
- Intersections are prone to higher incident rates of FOD due to increased traffic and nature of vehicles traversing the runway
- A number of different parties (service vehicles, aircrafts, etc) may be responsible for the FODs
- The responsibility often falls on the operations, due to lack of ability to identify the responsible party

Intersections and Hot-Spots Solution



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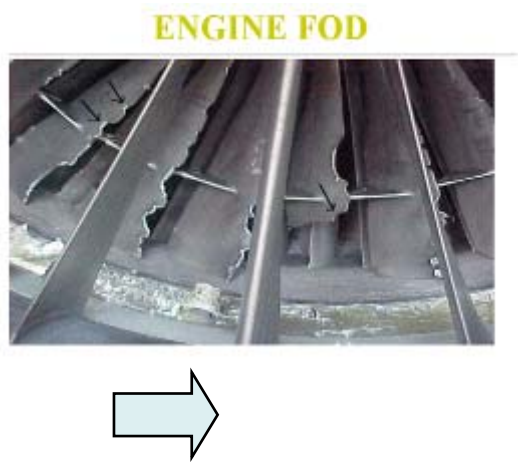
Safety Requirements

- **The SDU is designed to meet FAA/ICAO edge light safety requirements:**
  - **14” Height limitation**
  - **Frangible Coupler** – Use a frangible coupler according to AC150-5345-46.
  - **Quick-Release Connector** – use a quick-release connector according to AC150-5345-26.
  - **Wind** - designed and tested to meet AC150-5345-46b.

Runway Situational Awareness Additional Applications

- Wildlife detection and tracking
- Runway surface condition
- Runway lighting status and ILC
- Runway Security and Surveillance



✓ Runway Command & Control

✓ Runway Command & Control

✓ Security

Summary - FODetect Benefits for Airports

- Safety
- Early detection of runway FODs - Eliminate FOD damages
- FOD detection during operations
- Efficient pinpointing and removal of FODs – increase capacity and availability
- Reduce need for manual patrols which consume human resources and runway time
- Documentation of FOD incidents (time, location, images) – create much needed statistics
- Ability to correlate FODs to their sources, support incident investigation and preventive actions

Integrate runway sensing technology and achieve absolute control and monitoring of the runway; safety, capacity and operation continuity.