

The Satellite Imagery Analysis Unit (SIAU)

- Provide analytical services related to the exploitation of satellite imagery in support of inspection and verification activities
- Collect, process, analyze, and disseminate imagery-derived products to Safeguards
- Provide geospatial information - identifying the "what" and "where" of a feature or object on the Earth's surface



Role of Satellite Imagery Analysis

- Monitor Nuclear Sites & Activities
(baseline, updates, change detection)
- Verify Additional Protocol (AP) Declarations
- Verify Design Information (DIV)
- Support/Drive Complementary Access (CA)
- Investigate Alleged Undeclared Activities
(based on Open Source & Third Party information)



Satellite Imagery: Change Detection

Natanz Uranium
Enrichment
Plant

20 SEP 2002



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Satellite Imagery: Change Detection

Natanz Uranium Enrichment Plant

29 FEB 2004



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Satellite Imagery: Change Detection



Image: DigitalGlobe/ISIS

Lavizan-Shian Site, Iran -- August 11, 2003



IRAN: Lavizan Site

Published by ISIS on 18 June 2004

Satellite Imagery: Change Detection



Image: DigitalGlobe/ISIS

Lavizan-Shian, Iran -- March 22, 2004



IRAN: Lavizan Site

Published by ISIS on 18 June 2004

Satellite Imagery: Historical Information

1962
KH-4
7.5m

1986
KVR 1000
2m

2003
QuickBird
0.6m

IAEA

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Satellite Imagery: Additional Protocol Verification

Satellite imagery provides a description of features by their size, shape, location and any deviations from the State's declaration. It also aids in the identification of locations for CA.

Identified Site Perimeter with Security Wall

Declared Site Perimeter

Main Entrance

Second Entrance for Transport Vehicles

Switchyard

- Declared Site Perimeter
- Identified Site Perimeter
- Quarry
- Not shown on the Site Diagram
- Under Construction
- Storage Area

IAEA

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An Example of Different Imaging Sensors

Nyongbyon as an example

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Formosat (Taiwan, China)
2m

WorldView-1 (US)
0.5m

The SIAU is using high-resolution imagery from 2.5m to the best commercially available sensor 0.5m

An Example of Different Imaging Sensors Mine Example

Spot-5
2.5m



Contains Spot Image copyrighted materials

Satellite Imagery: A Radar Example

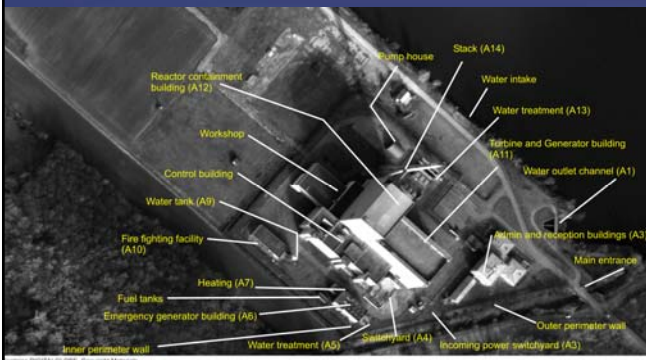
SAR Provides Complementary & Additional Info

- Cloud Penetration
- All-Weather
- Day/Night
- Sensitivity to Metal Objects



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Satellite Imagery: The Optical Counterpart



Natural Color, High Interpretability, Clear/Direct Representation

Imagery Analysis

VIDEO
The Satellite Imagery
Analysis Unit
Supporting IAEA
Verification Activities



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Geographic Information System

A GIS links various information & data types spatially to one single information system

Satellite Images



Open Source



Vector Data



Cartographic Maps



3D Information



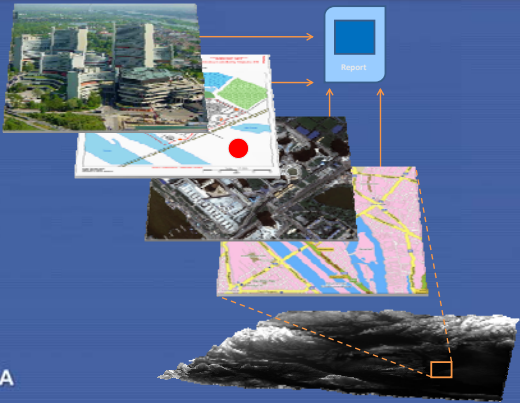
Image Products



Geographic Information System



1:5000



**Improving the Efficiency
& Effectiveness of Satellite Imagery**
GeoEye-1, 0.5m resolution, 2009-01-20



Contains GeoEye copyrighted materials



Member State Support Programme

MSSP R&D is essential in maintaining and growing a strong analytical capability

- HW/SW
- R&D for enhancing analytical methods
- Training
- Expertise



Diversification of Sources

- Enhances our ability to assess the extent and status of nuclear activities of States
- Ensures the integrity and authenticity of satellite imagery



Diversification of Sources

Available high-resolution commercial sensors

- Spot 5, 2.5m (France)
- Formosat-2, 2m (Taiwan, China)
- KVR-1000, 2m (Russia)
- TerraSAR-X, 1m SAR (Germany)
- Cosmo-Skymed, 1m SAR (Italy)
- Kompsat-2, 1m (Korea)
- DK-1, 1m (Russia)
- Ikonos-2, 1m (USA)
- Eros B, 0.7m (Israel)
- QuickBird, 0.6m (USA)
- WorldView-1, 0.5m (USA)



Diversification of Sources

Future high-resolution commercial sensors

- 2009: GeoEye-1, 0.5m resolution (USA)
WorldView-2, 0.5m resolution (USA)
- 2010: Pléiades, 0.7m resolution (France)
- 2012: Göktürk, 0.7m resolution (Turkey)
- ...Cartosat-2, <1m resolution (India)



Conclusions

- Commercial satellite imagery is an integral part of Safeguards – operationally and routinely used
- Imagery analysis has proven to be a powerful safeguards tool:
 - Supporting inspection & verification of declared activities
 - Identifying, characterizing & monitoring undeclared sites
- SIAU analysts have unique knowledge/expertise in imagery-based NFC signatures and observables
- Commercial satellite imagery is expected to play an increasing role in verification (20/20)