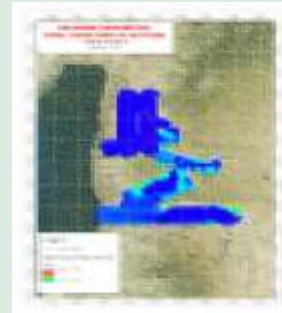




OSI radiation mapping techniques used during the Integrated Field Exercise IFE14

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1

Outline

- PART 1: CTBTO components
 - Network of IMS stations
 - International Data Centre
 - On-site inspections
- PART 2: Radiation mapping techniques
 - handheld and car-borne systems
 - Air-borne equipment



Backpack, 3"x3" NaI(Tl)



Car borne 4L NaI(Tl)



Air-borne equipment on board Super Puma

On-site Inspection: Integrated Field Exercise in 2014



The 2014 Integrated Field Exercise (IFE14)

took place from November 7th to December 5th in the Hashemite Kingdom of Jordan.

IFE14 involved :

- more than 150 tons of equipment
- ca 250 participants
(Inspection Team -40-, Inspected State Party, Evaluation Team, VIP visitors, Observers, Scenario Team)



Base of Operations at IFE14,
On the shore of the Dead Sea, Jordan.

The main objectives of the IFE14 were:

- ✓ To demonstrate the CTBTO/OSI level of readiness to deploy an inspection team with equipment for an inspection. *Comparison baseline: previous IFE in Kazakhstan, 2008.*
- ✓ To collect lessons for continued development and improvement required in all areas during the preparations and conduct of the inspection exercise
(Equipment, Documentation, Training, Mission planning, Scenario, Exercise management)
- ✓ To provide inputs to next OSI Action Plan for further developing the OSI operational capabilities

Radiation monitoring mapping at IFE14



Goals and strategy for gamma radiation monitoring:

To survey the Inspection Area (along roads, in fields, etc) and narrow-down the search areas of interest to trigger further sampling activities

samples are then analysed in the RN-NG Field Laboratory

Products are maps of radiation background or detected anomalies

both background and OSI relevant fission or activation products

Equipment deployed for mapping anomalies during IFE14:

Handheld (5x) and car borne (1x) gamma radiation monitoring

Low resolution NaI(Tl) <0,3ℓ to 4ℓ (car borne) were available

Air-borne gamma-ray spectrometry monitoring:

Powerful Contribution-in-kind from Canada, 2013

60 ℓ sodium iodine detectors (3x RSX-5 packs from Radiation Solutions Inc.)

On-board acquisition, monitoring, and ancillary sensors

Radar and laser altimetry, GPS, Navigation system

Radiation mapping: Equipment used 1/2



Deployed equipment for mapping anomalies during IFE14:

Handheld (5x) and car-borne (1x) gamma radiation monitoring scanners

Low resolution NaI(Tl) from 0,2ℓ (handheld) to 4ℓ (car-borne) were available at IFE14

ATOMTEX AT6101C
Spectrometric Portable
Radiation Scanner



5 such units
Deployed during
IFE14

ATOMTEX PDA Display
For real-time monitoring



ATOMTEX AT6103/2
Vehicle borne Scanner



<http://www.atomtex.com>

Radiation mapping: Equipment used 2/2



Deployed air-borne equipment for mapping radiation anomalies during IFE14:

Canadian contribution: Gamma-ray spectrometry monitoring from Radiation Solutions Inc.

60 ℓ sodium iodine detectors (3x RSX-5 detector packs)

On-board acquisition and monitoring,



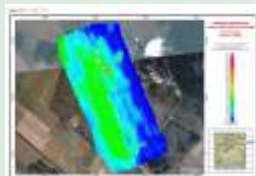
One of three RSX-5 pack:
5 detectors of 4L each.
Total 110 kg / RSX-5 pack.

and ancillary sensors:

Radar and laser altimetry, P&T sensors,



GPS and Navigation panel for the pilots



Training and calibration exercise, Hungary.
Two point sources above 30 MBq are clearly detected



Aircraft: Super Puma from the Royal Jordanian Air Force,
Marka Air Base, Amman, Jordan.

Mapping RN anomalies: Handheld / car-borne systems



Overview of CPS survey maps:

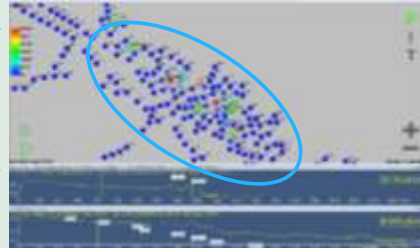
Left: Map of the Inspection Area (1000 km²) with backpack and car-borne survey results (green dots) and flight results (dark brown areas, see also specific slide)

Bottom left: Backpack survey around a Restricted Area (RAS)

Bottom right: Zoom on backpack survey inside the RAS



First gamma backpack survey of Polygon 29.
Restricted Access Site (RAS) dashed red was declared.
Samples taken in washouts on the sides of the RAS revealed very low concentrations of Iodine 131.
Detailed survey inside the RAS: Zoom, right plot



Counts per second (upper graph) during the survey inside the Restricted Access Site (RAS) of polygon 29. Gamma lines of Co-60 (surrogate nuclide for I-131) are visible in the individual spectrum (middle plot). About 10 local hot spots were found.

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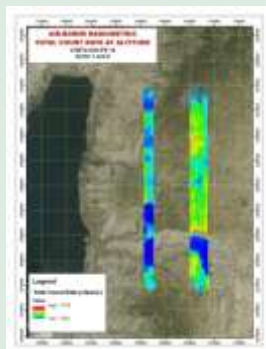
7

Mapping radiation anomalies: Air-borne system



Result maps from 6 sorties during the IFE14

also presented at the CTBTO Science and Technology Conference in June 2015 [1]



Total Count Rate map at altitude for IFE14 sorties 1 and 2. Anomalous areas in red are due to low altitude over topographic highs, examination of spectra shows no anthropogenic content.

[1] Design and Operational Experience with an Aerial Gamma Radiation Survey System for On Site Inspection. Seywerd *et al* Poster T2.1-P7 at CTBT: 2015 Science and Technology Conference (2015) <http://www.ctbto.org/specials/sn2015/>



Total Count Rate map at altitude for IFE14 sorties 3 - 6. Focus was on specific polygons of interest to evaluate whether anthropogenic materials were present. Flight paths planned and conducted as much as possible along the valleys to optimise the limit of detection for the challenging topography.

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8

Conclusions

The Integrated Field Exercise 2014 in Jordan was a successful event that demonstrated much improvements over the previous IFE08.

Challenging IFE14 Exercise that provided many good lessons for further improving OSI operational capabilities:

- Periodic Training including refresher sessions is necessary for inspectors to maintain skills and fluency with complex equipment (e.g. air-borne gamma-ray spectrometry) and procedures including data interpretation ;
- Automated post-processing of data acquired, and reporting procedures, to allow surrogate inspectors to focus on the interpretation of relevant anomalies

Thank you !



IFE14 Group picture at the Base of Operations, Dead Sea, Jordan

Blue: Inspection Team, Red: Inspected State Party, Black: Control Team, Green: Evaluators,
Dark Blue: Scenario Team

Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect the views of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) Preparatory Commission. The Commission itself takes no responsibility for the content of this Technical Presentation.

