IAEA Department of Nuclear Sciences and Applications
Environment Laboratories

The emergency response capabilities of the network of Analytical Laboratories for the Measurement of Environmental Radioactivity

ALMERA

IEM9

Assessment and Prognosis

in Response to a Nuclear or Radiological Emergency

IAEA Action Plan on Nuclear Safety

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Network of Analytical Laboratories for the Measurement of Environmental Radioactivity

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IAEA Department of Nuclear Sciences and Applications
Environment Laboratories

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Summary

- Rationale
- Brief introduction of ALMERA
- ALMERA activities
- ALMERA capabilities relevant to rapid response capacity
- Future plans

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The ALMERA network

- Established in 1995
- Objective: to maintain a worldwide network of laboratories capable of providing reliable and timely analysis of environmental samples in the event of an accidental or intentional release of radioactivity to the environment
- Formal member nomination process

Aim of network was diversified in time, as Member States requested membership for laboratories with many different profiles (different profiles of monitoring, research, academic/training, metrological, etc)

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Rationale for increased IAEA support for development of emergency response capabilities

Following the Fukushima Daiichi NPP accident member laboratories expressed interest in increased focus on methodological and analytical quality support for emergency preparedness.

Demands from member laboratories for validated analytical procedures for routine and emergency monitoring have increased.

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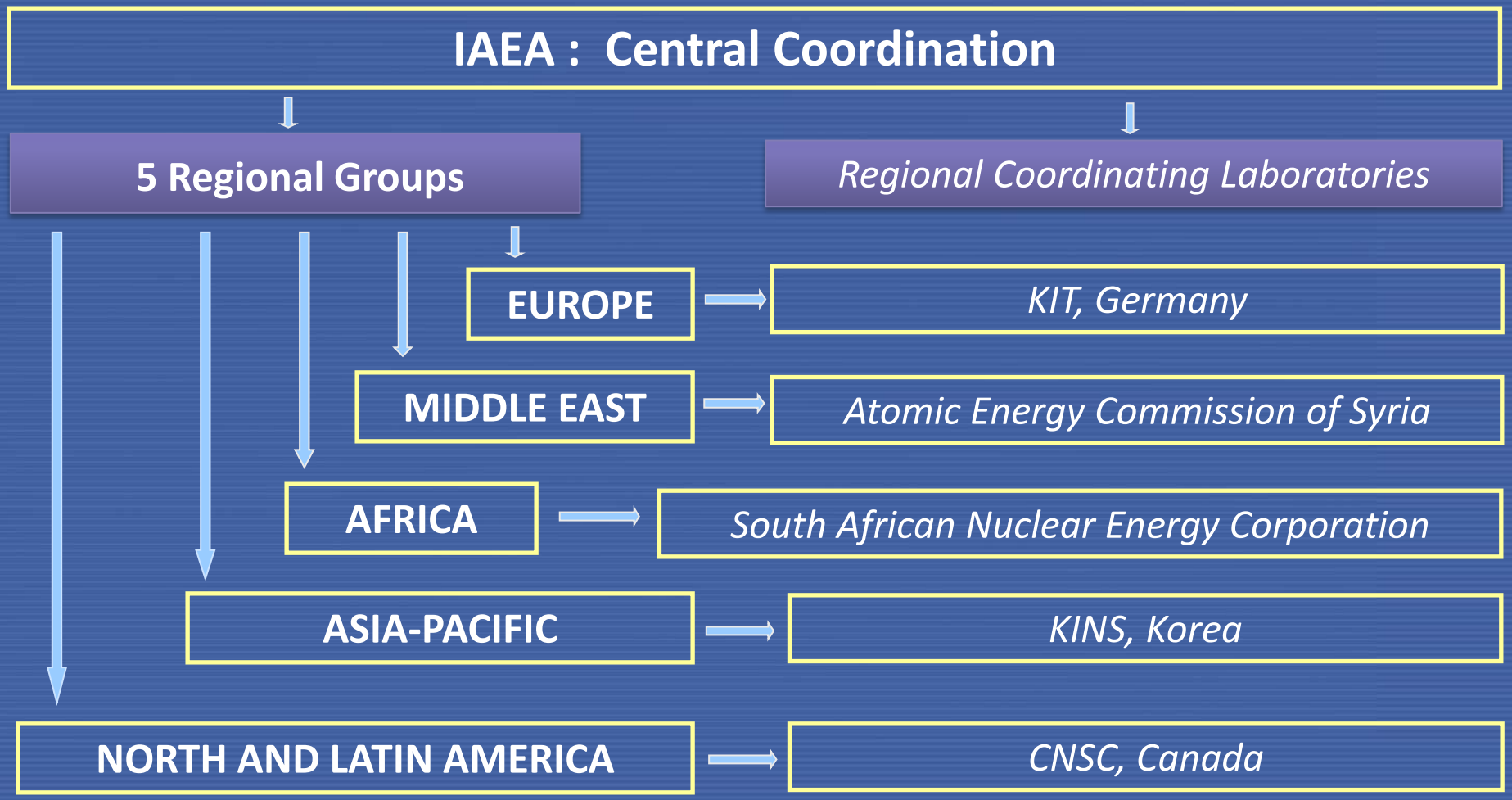
Increased support for development of emergency response capabilities

Strategy:

- Added focus for methodological developments of rapid methods
- New Reference Materials relevant for emergency situations (e.g. food, biological samples, aerosol filters)

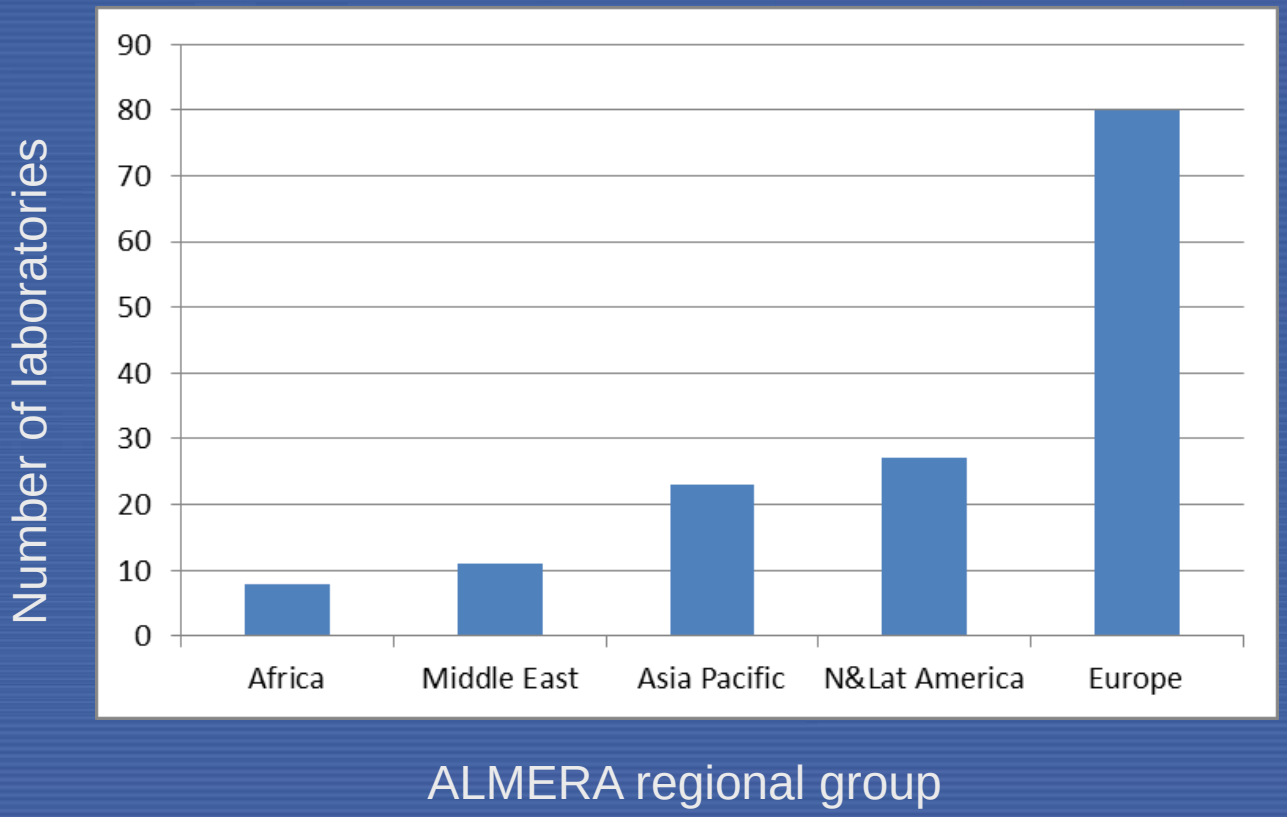
- Proficiency Tests
  - Short reporting time in addition to normal reporting
  - Adapted evaluation criteria
- Increased collaboration with RANET

Network structure and organization



Member laboratories in March 2015

150 laboratories in 84 countries



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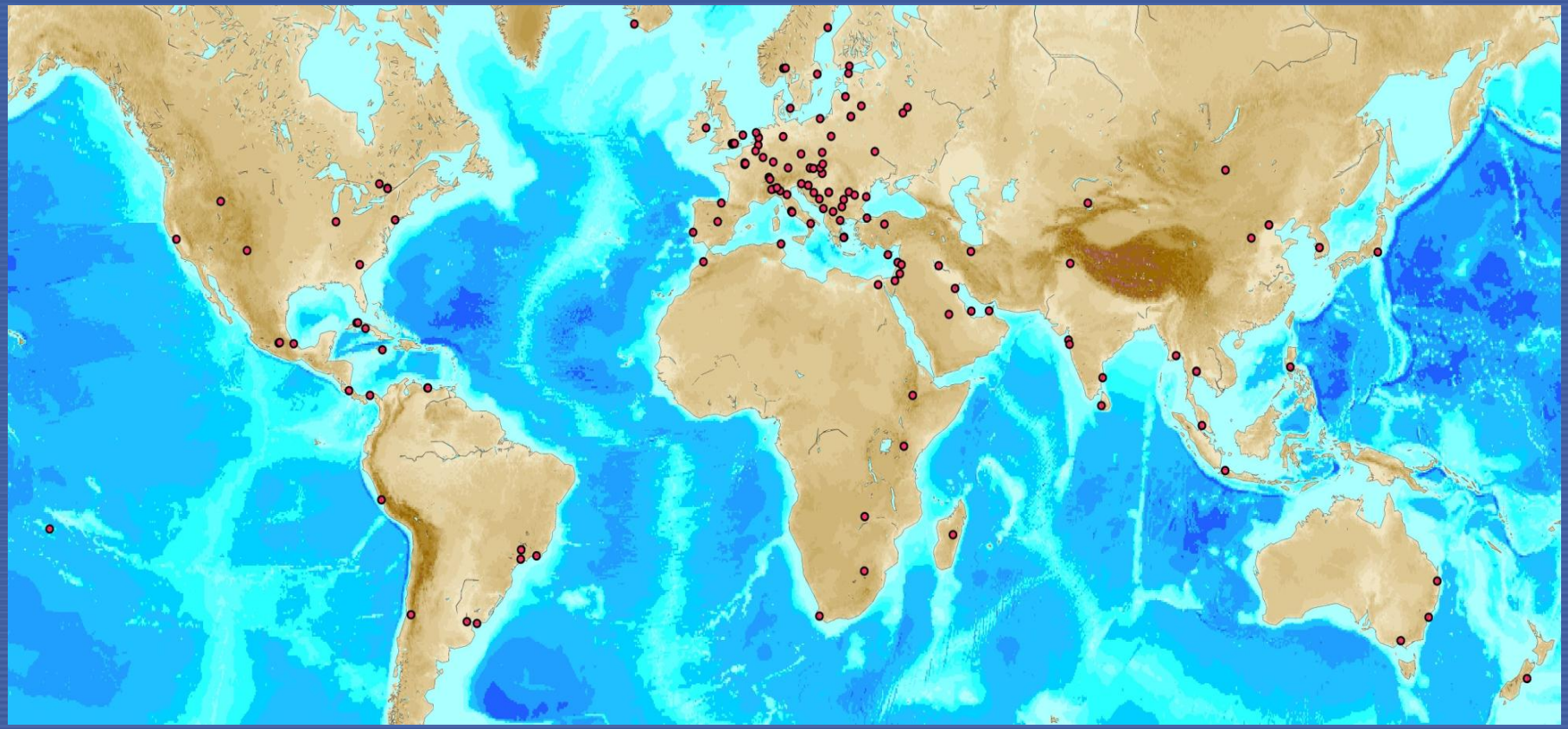

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Korea Institute of Nuclear Safety (KINS, Korea)

- Development of IAEA procedures for radionuclides determination in environmental samples

KINS

IAEA Collaborating Centre/ ALMERA member laboratory

National Food Chain Safety Office, Budapest, Hungary

- Production and characterization of matrix reference materials

IAEA Collaborating Centre/
ALMERA Regional coordinating laboratory

Atomic Energy Commission of Syria

- Characterisation of reference materials and radioecology of NORM

ALMERA: pool of knowledge and expertise

- ✓ Documented technical competence of ALMERA laboratories through participation in proficiency tests
- ✓ Wider application of recommended validated methods and methodological harmonization, leading to enhanced world-wide comparability of environmental radioactivity measurement results
- ✓ Shared information on available analytical capabilities and expertise, which facilitates the identification of laboratories with competence in specific areas of interest, particularly in emergency situations.

IAEA: coordination and technical support role

The IAEA is committed to assist the ALMERA network of laboratories to maintain their readiness by coordination activities:

- Organization of coordination meetings
- Organization of proficiency tests as a tool for external quality control
- Development of validated analytical methods for routine and emergency monitoring
- Organization of workshops and training courses
- Coordination with other relevant networks and activities

ALMERA coordination meetings

Year	Meeting No.	Location	Participants	MS
1997	1st	IAEA, Vienna, Austria	38	15
2005	2nd	ICTP, Trieste, Italy	45	29
2006	3rd	KINS, Daejon, Republic of Korea	36	17
2007	4th	ICTP, Trieste, Italy	61	34
2008	5th	CNEN-IRD, Rio de Janeiro, Brazil	27	17
2009	6th	Food & Feed Safety Directorate, Budapest, Hungary	51	22
2010	7th	ERPA, Addis-Ababa, Ethiopia	60	22
2011	8th	IAEA, Vienna, Austria	79	48
2012	9th	TAEK, Ankara, Turkey	40	27
2013	10th	CNSC, Ottawa, Canada	40	23
2014	11th	IAEA, Vienna, Austria	84	50
2015	12th	IAEA, Monaco		

ALMERA proficiency tests

Year	ALMERA proficiency test / interlaboratory comparison	Participants	MS
2005	ALMERA proficiency test	**53**	**37**
2005	Soil sampling interlaboratory comparison	**10**	**10**
2006	Gamma emitting RNs in water, soil and grass	**38**	**29**
2007	Artificial and natural RNs in water, soil and spinach	**58**	**46**
2007	Po-210 determination in water	**36**	**30**
2008	Naturally occurring RNs in phosphogypsum	**49**	**40**
2009	Gamma emitting RN in simulated air filters	**69**	**46**
2010	Ra-226 in soil and natural radionuclides in water	**46**	**36**
2011	Natural and artificial RNs in soil and water	**57**	**41**
2012	Natural and artificial RNs in water, hay and soil	**58**	**54**
2013	Man-made and natural RNs in water and flour	80	**77**
2014	RNs in water, seaweed and sediment; gamma spectra	75/109	**51/49**
2015	RNs in water, brown rice and soil		

Samples

- **Water (1-2)**
  - Spiked tap water for
    - anthropogenic and natural gamma-emitters (Cs-134, Cs-137, Ra-226…)
    - Beta- emitters (H-3, Sr-90)
    - Alpha-emitters (natural U, Am-241, Pu-isotopes)
- **Water 3 (QC sample)**
  - Spiked water, the radionuclides and their massic activity are listed in the cover letter of the PT **(to check the calibration only)**
- **Biota samples (spiked or naturally contaminated)**
  - Hay (2012), Flour (2013), Seaweed (2014), Brown rice (2015)
  - Radionuclides: Cs-134, Cs-137
- **Mineral matrix (natural)**
  - Soil, sediment

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Preparation of spiked seaweed sample (80 kg)

Steps

- Planning the process
- Study the physical properties of the seaweed
- Homogenisation of the blank
- Radiochemical analysis of the blank (gamma-sp)
- Checking the ampoules (Cs-134, Cs-137)
  - Control weight
  - By point source measurement
- Preparation of the master spike solution (by gravimetric method)
- Spiking a small aliquot (4 kg)
- Homogenisation (intensive blender)
- Dilution with 76 kg blank
- Homogenisation
- Bulk homogeneity test
- Bottling
- Final homogeneity test
- Assigning the target value and uncertainty

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Co-production by Korea, Jamaica, Hungary and IAEA!

PT evaluation method

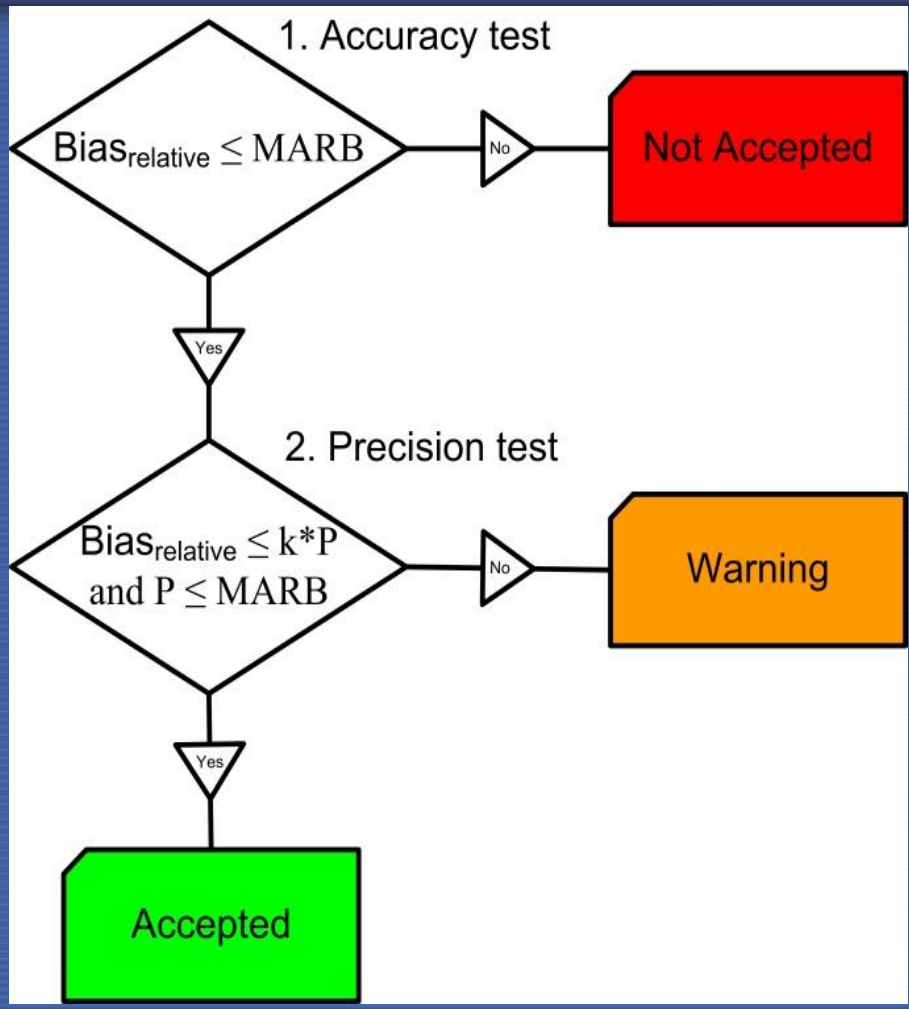
MARB

Maximum **A**cceptable **R**elative **B**ias (%)

$$P = \sqrt{\left(\frac{u_{target}}{A_{target}}\right)^2 + \left(\frac{u_{reported}}{A_{reported}}\right)^2} \times 100$$

$$Bias_{relative} \leq k * P$$

k = 2.56



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Data presentation and interpretation

- **S-curve**
- **Pie chart**
- **Overall performance**
- **Bias trend analysis**
  - Master sample, master analytes (Cs-134, Cs-137)
    - „Master sample”: water
    - „Slave samples”: biota, soil
  - Rules
  - Same radio-analytical method
  - Similar activity level
  - The activity should be five times higher than the MDA value (supposing average user laboratory circumstances), ISO 17043
  - Data presentation on the X-Y chart: slave sample versus master sample

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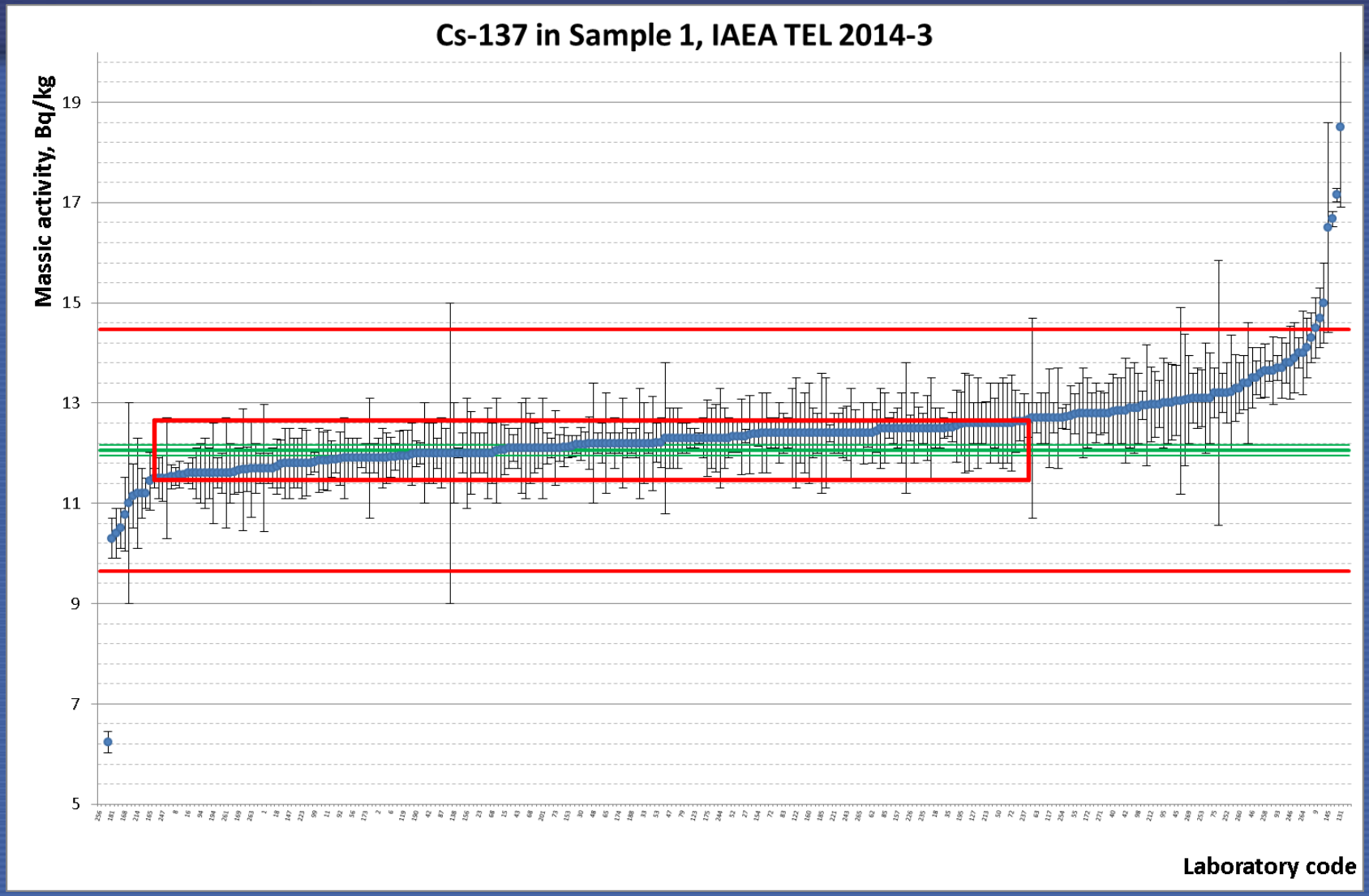
Cs-137 in water, 2014



From 297 reported results 208 (70%) are within ± 5%!

ALMERA vs World-Wide PT performance

Cs-137 in drinking water, 2014 IAEA TEL Pt			
	No. of reported values	Within 5%	%
All participants	297	208	70.0
World-wide group	236	162	68.6
ALMERA	62	46	74.2

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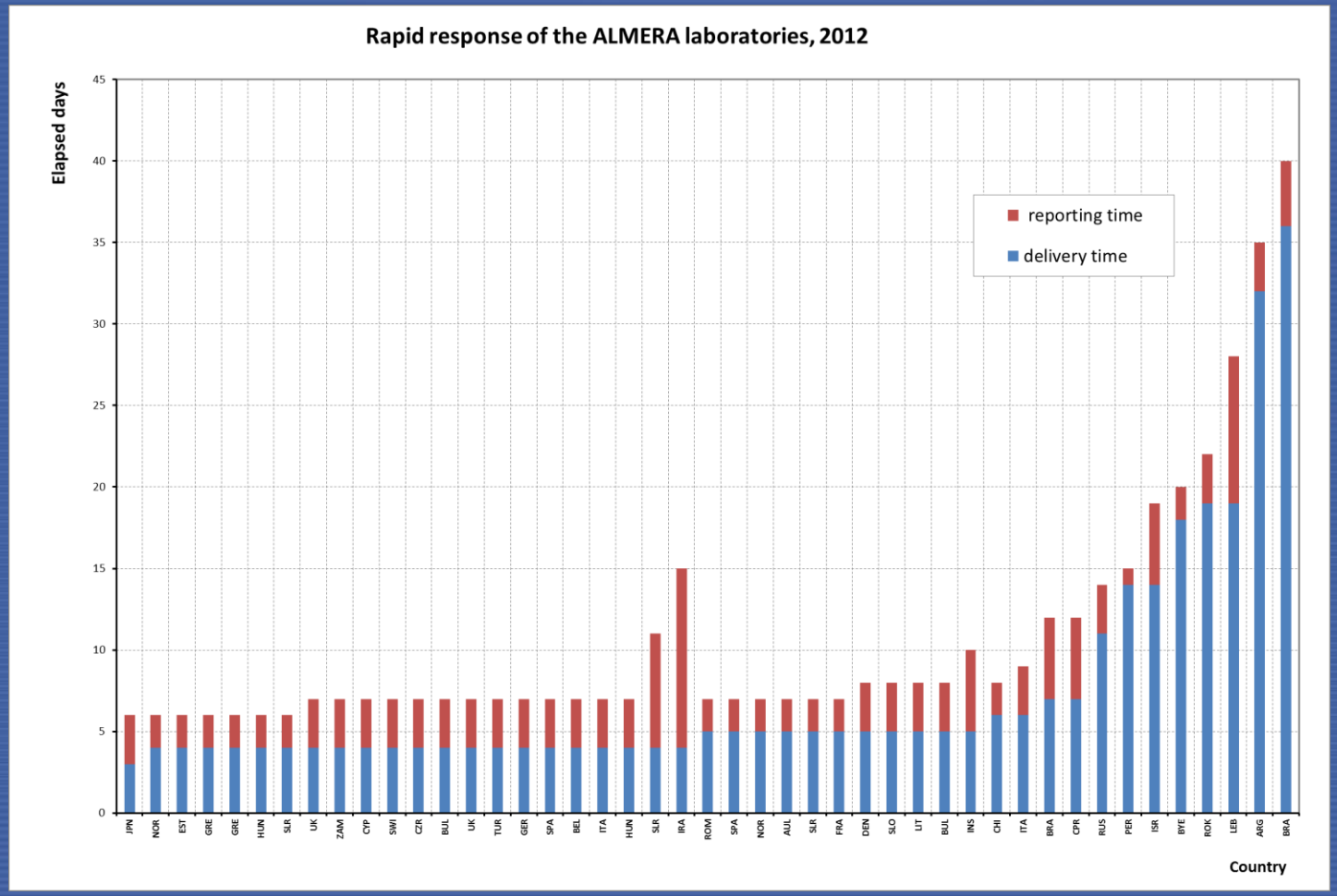
Reporting time for rapid response

ALMERA mandate: "reliable and timely analysis of the samples and data reporting"



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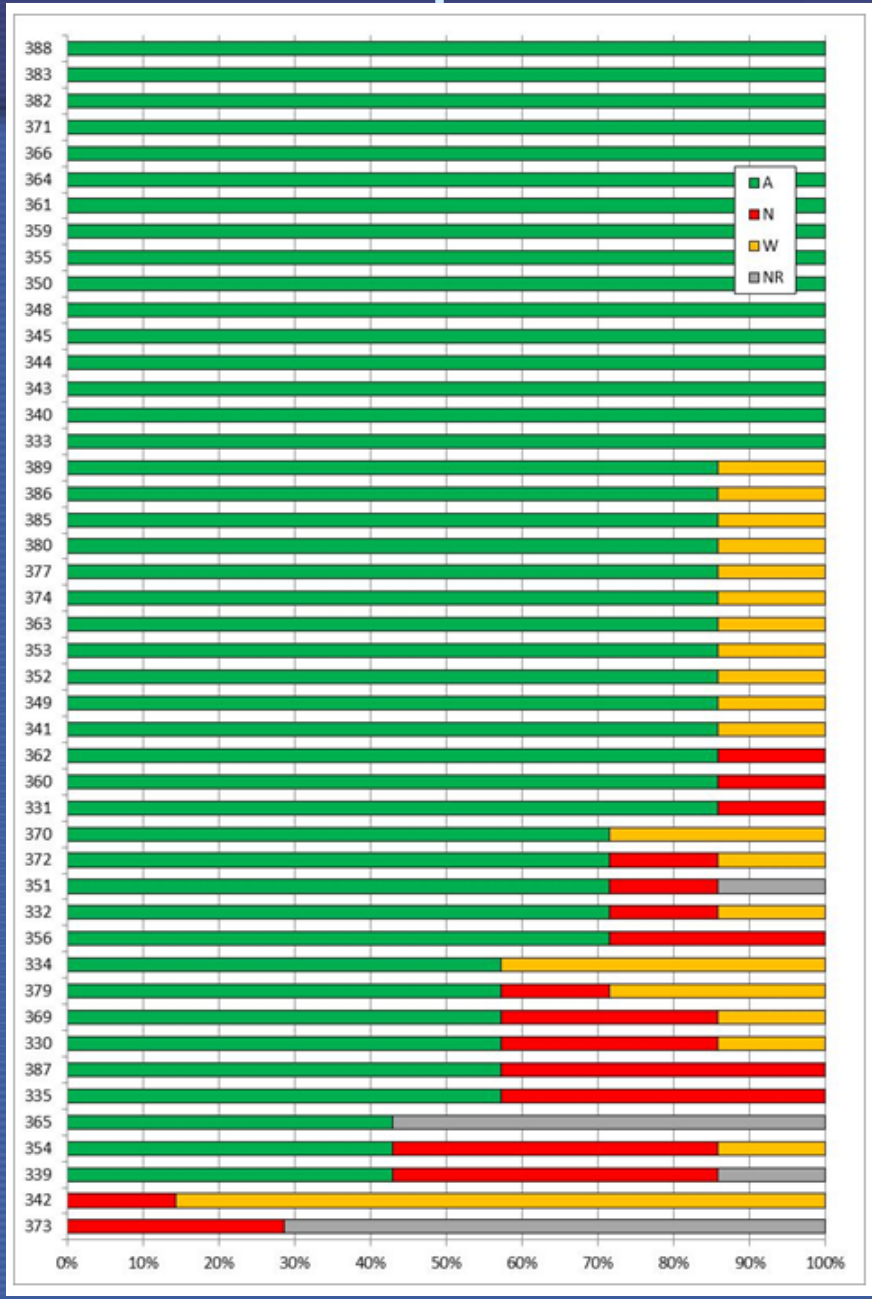
Performance of the labs for rapid response

REPORTING STATISTICS

Action	Number of sample sets
Sample sets sent	60
Received by the participants	97 %
Reported within short term	77 %
Reported until the long term deadline	90 %



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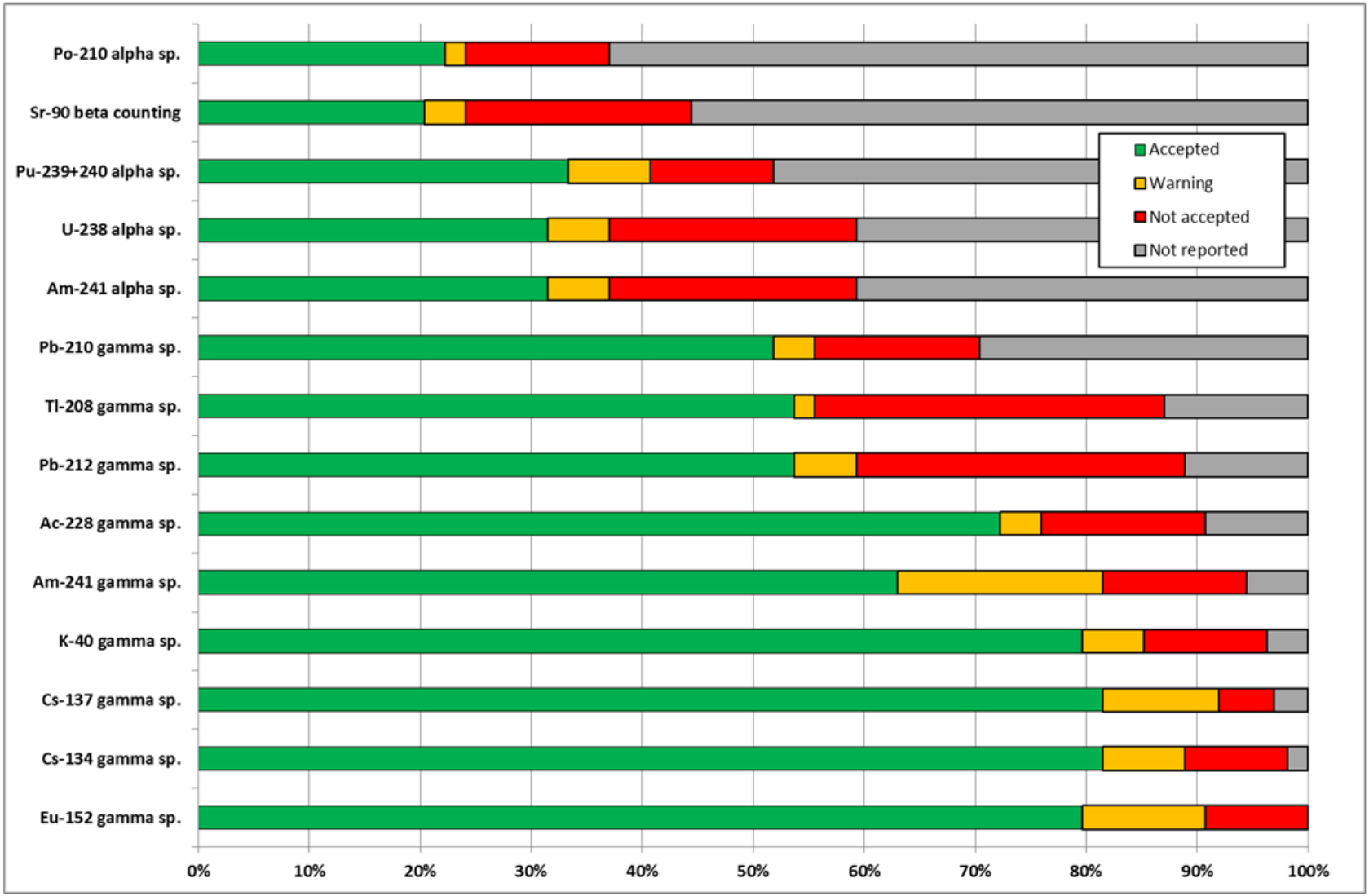
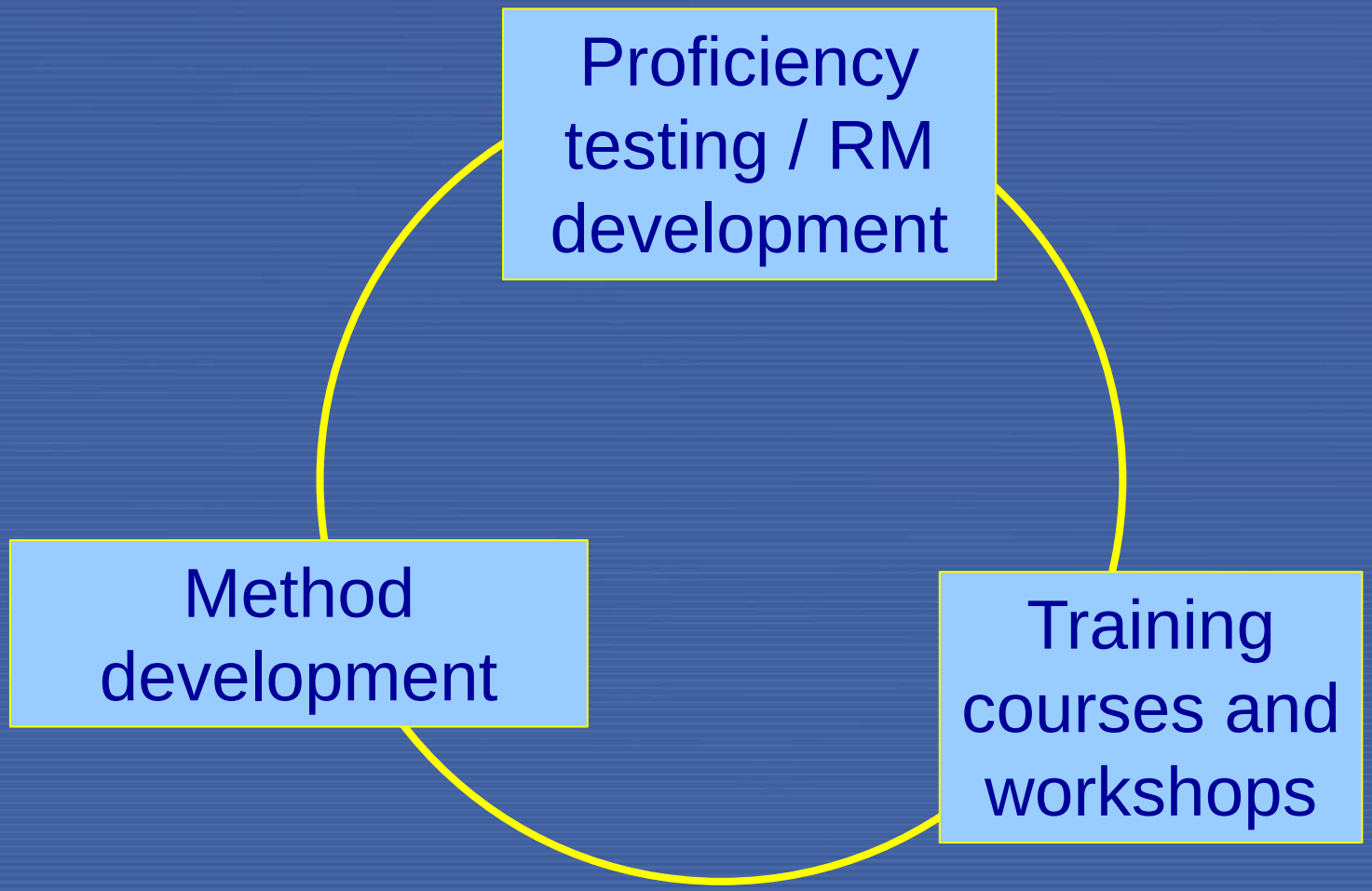
WW PT performance for different analytes: gap analysis



ALMERA capacity building



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Validated analytical methods

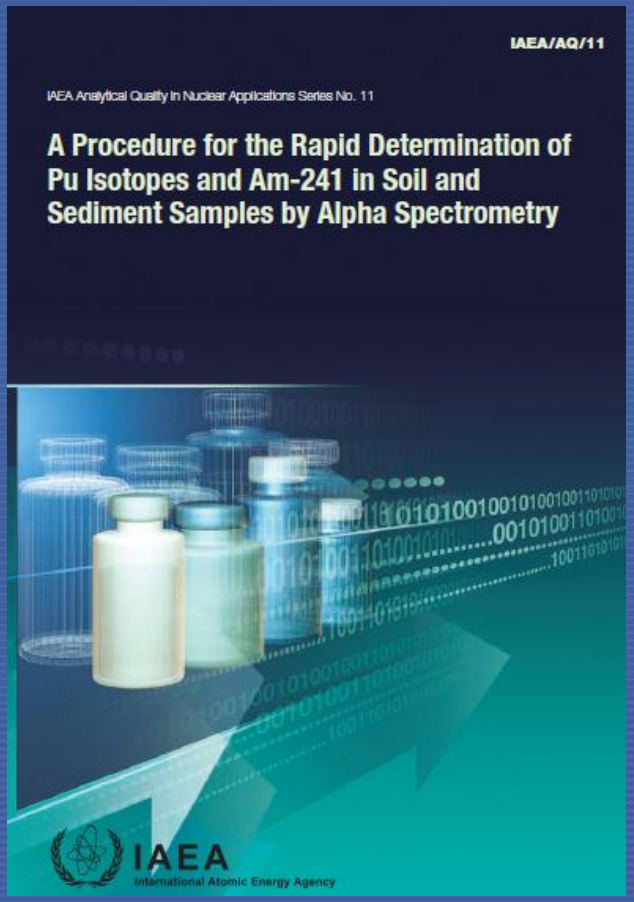
Sample matrix	Nuclides							
	Pu isot.	^{241}Am	^{90}Sr	^{210}Po	^{210}Pb	$^{226+228}$Ra	U	Th
Aerosol	O	O	O					
Soil/sediment	O/O	O/O	O/O					
Terrestrial surface water				O		O		
Milk			O					
Phosphogypsum				O	O	O	O	O

O: Routine procedure

O: Rapid method for emergency monitoring

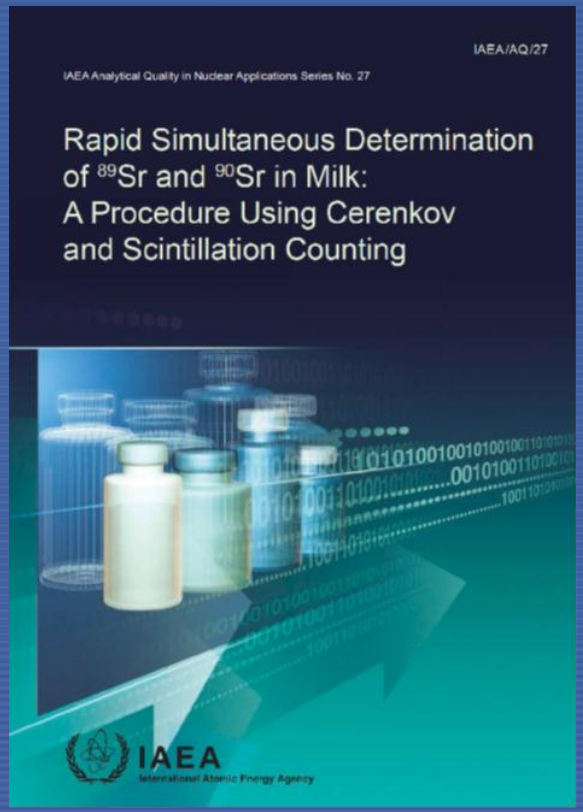
Rapid method for Pu and Am-241 in soil

A procedure for the rapid determination of Pu isotopes and Am-241 in soil and sediment samples by alpha spectrometry, IAEA Analytical Quality in Nuclear Applications Series No. 11, 2009



Rapid method for Sr-89 and Sr-90 in milk

Rapid Simultaneous Determination of Sr-89 and Sr-90 in Milk: A Procedure Using Cerenkov and Scintillation Counting, IAEA Analytical Quality in Nuclear Applications Series, No. 27, 2013



Analytical methods under development

- Proficiency test results show analytical difficulties for the ALMERA laboratories to measure Sr-90 in soil
- Recently, especially after the FDNPP accident, determination of radiostrontium in seawater became an issue of interest.
- Methods under development:
  - Rapid method for the determination of radiostrontium in soil
  - Rapid method for the determination of radiostrontium in seawater

ALMERA workshops and training courses

Year	Title of the IAEA workshop/training course	Trainees	MS
2007	Understanding and evaluating radioanalytical measurement uncertainty	61	34
2009	Uptake of radionuclides into staple crops in the Asian region	17	10
2009	In-situ X-ray fluorescence and gamma ray spectrometry	44	28
2010	Coincidence summing and geometry corrections in gamma spectrometry	32	20
2011	Measurement of natural radionuclides in environmental samples and NORMs and TENORMs by gamma spectrometry: experimental challenges and methodologies	35	27
2012	Alpha spectrometry and radioanalytical techniques	12	12
2012	Measurement results uncertainty estimation and method validation	33	22
2014	Rapid assessment methods for environmental radioactivity	24	21
2014	Rapid determination of Sr-89+90 in milk	12	12
2015	Rapid assessment (ANL) + In-situ gamma (Labor Spiez)		

ALMERA training courses 2014

Rapid Assessment Methods for Environmental Radioactivity,

10 to 21 November 2014 in Argonne National Laboratory, Chicago, USA

- 'Hands-on' training on the validated rapid method for the determination of Pu isotopes and Am-241 in soil and sediment samples using alpha spectrometry
- Field training
- RESRAD assessment codes

'Hands-on' radiochemistry training course, 3-7 November 2014 at KINS, Republic of Korea

- 'Hands-on' training course on the validated rapid method for the determination of Sr-89 and Sr-90 in milk using Cerenkov and scintillation counting

ALMERA training course 2014

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March 2014

IAEA and Argonne National Laboratory Train Scientists on State-of-the-Art Methods for Rapid Environmental Radioactivity Assessment

Scientists representing laboratories in 21 countries learned state-of-the-art methods for precise and quick assessment of radionuclides in the environment at a training course on rapid assessment methods for environmental radioactivity, held between 10 and 21 March 2014 at the Argonne National Laboratory (ANL) in the US. (Photo: I. Osvath/IAEA)

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For two weeks in March, 24 scientists representing laboratories in 21 countries learned state-of-the-art methods for precise and quick assessment of radionuclides in the environment. The venue was a training course on rapid assessment methods for environmental radioactivity, held between 10 and 21 March 2014 at the Argonne National Laboratory (ANL) in the US. It was organized by the Environment Laboratories Division in the IAEA Department of Nuclear Sciences and Applications in cooperation with the ANL to particularly benefit scientists working in laboratories belonging to the ALMERA network.

ALMERA is the acronym for Analytical Laboratories for the Measurement of Environmental Radioactivity, a world-wide network of analytical laboratories capable of providing reliable and timely determination of radionuclides in samples used for both routine and emergency environmental monitoring. p>

"The ALMERA network is a valuable resource for the IAEA for ensuring reliable and timely determination of radionuclides in the environment," said Mr. David Osborn, Director of the IAEA Environment Laboratories. "Such a training course is important to reinforce the analytical skills of the personnel in the ALMERA

Practical Training Course on Rapid Determination of Radiostrontium in Milk Using Cerenkov and Scintillation Counting, KINS, Korea, 3-7.11.2014

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Checking for Radionuclides in Dairy Food Products

ALMERA Training Course Demonstrates State-of-the-art Method for Detecting Radiostrontium in Milk

By Aurelien Pitois, , IAEA Environment Laboratories

07
November 2014

Experts from the IAEA and Korea Institute of Nuclear Safety train scientists on a rapid analytical method to be used for food monitoring in emergency situations at a training course held in Daejon from 3 to 7 November 2014. (Photo Credit: A. Pitois/IAEA)

Related Resources

- ALMERA Network - Providing Accurate Measurements for Monitoring Radioactivity in the Environment
- The ALMERA Network
- IAEA Environment Laboratories

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ALMERA training courses 2015

Rapid Assessment Methods for Environmental Radioactivity, 4-15 May 2015 in Argonne National Laboratory, Chicago, USA

In-situ gamma-ray spectrometry training course,

2-6 November 2015 at Spiez Laboratory, Switzerland

Developments

- Capacity building in the network supported through Technical Cooperation projects
- ALMERA labs joined IAEA's Response and Assistance network (RANET)
- RANET labs/environmental capabilities participated in ww PTs
- Short reporting deadline PTs
  - PT for aerosol filters planned
- Development and validation of rapid methods
  - Sr-90 in soil and seawater
- Training
  - Rapid assessment, in-situ gamma, Sr in milk

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ALMERA website

ALMERA inside ->

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http://nucleus.iaea.org/rpst/ReferenceProducts/ALMERA/index.htm