WORKSHOP

The second radon-in-field international intercomparison for passive measurement devices: dwellings and workplaces

COST Action "NORM4Building": products and results of a multidisciplinary project

R. Trevisi*, F. Leonardi*, C.Nuccetelli^

*INAIL Settore Ricerca e Certificazione

^Istituto Superiore di Sanità

COST Action “NORM4Building”: products and results of a multidisciplinary project: main objective

A new European network for reuse of NORM residues in innovative building materials

Exchange of multidisciplinary knowledge and experiences (radiological, technical, economical, legislative, ecological, …)

Stimulate the

reuse of NORM residues in new tailor-made sustainable building materials

while

considering exposure to external gamma radiation and the resulting indoor air quality

Fly ash

Phosphogypsum

Metal slag

Red mud

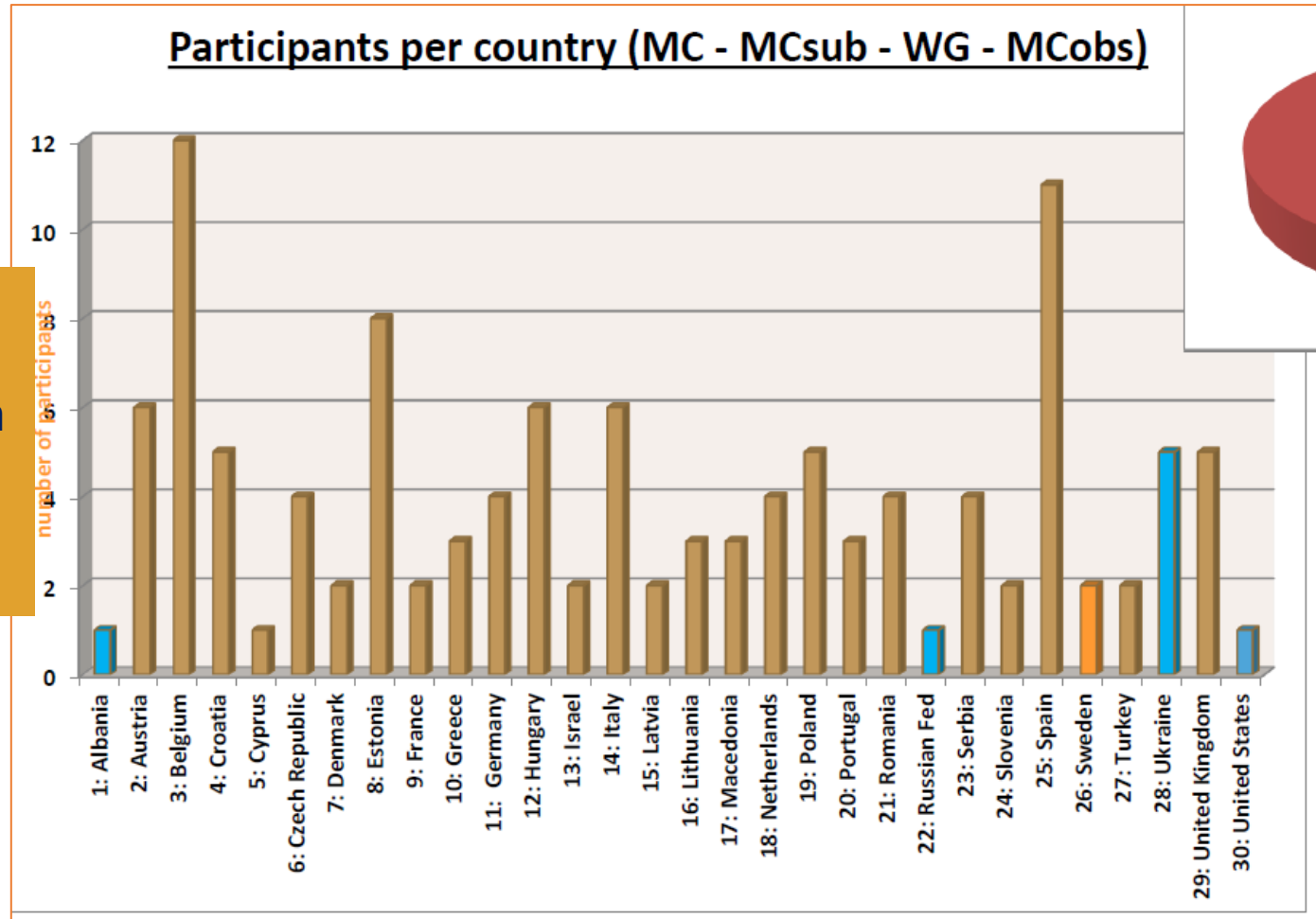
Ceramics

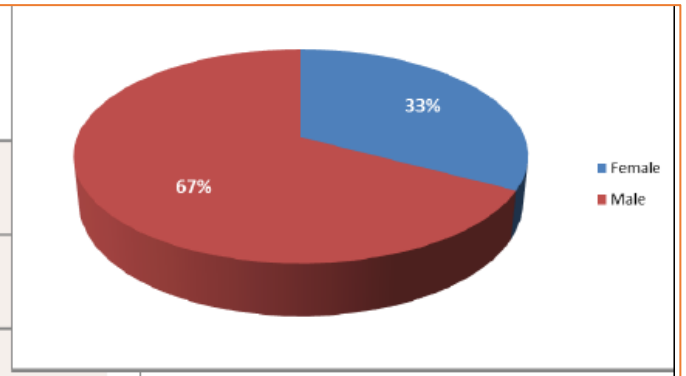
Concrete

Cement

COST Action "NORM4Building": products and results of a multidisciplinary project - Participants

Italy has participated with people coming from 3 public research institutions with different regulatory roles





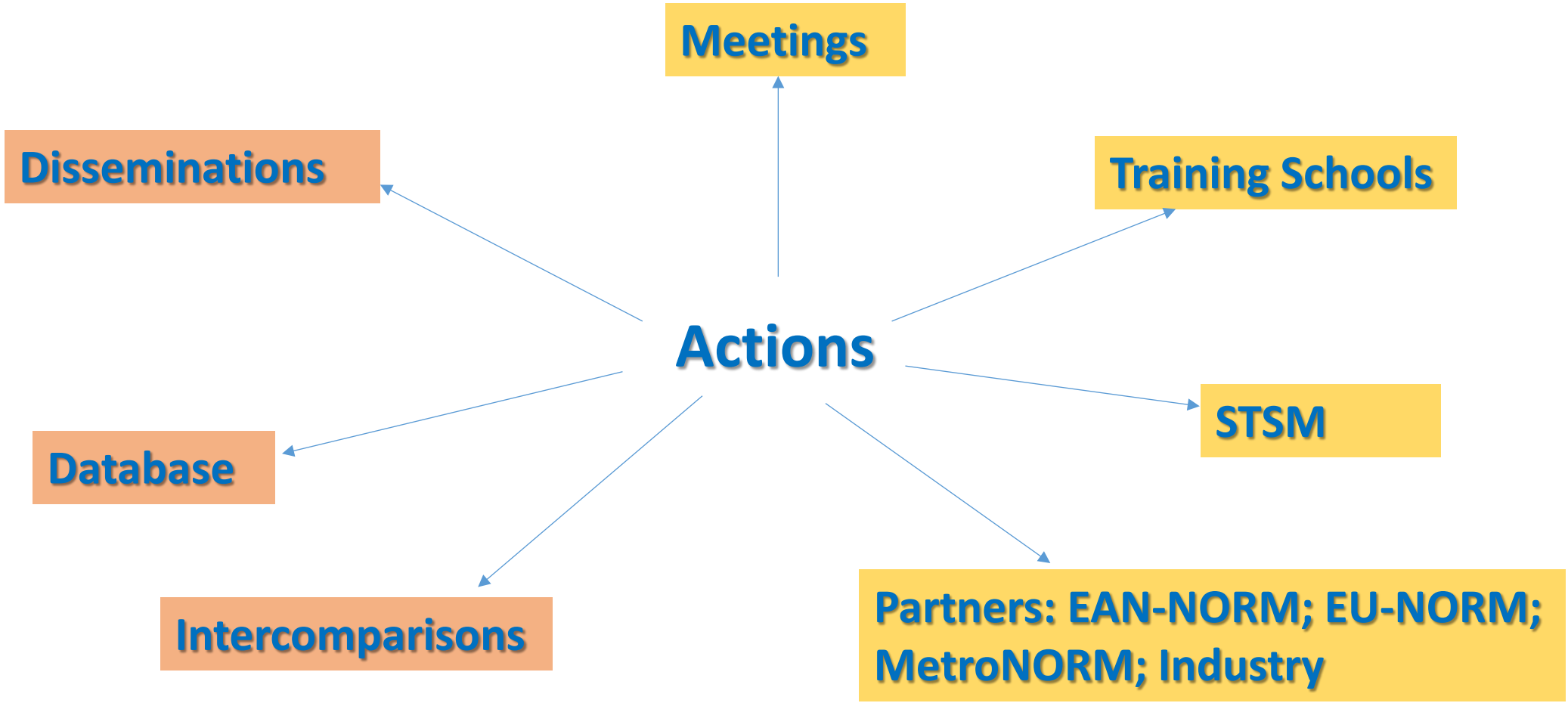
New participant:

Russian Federation
Andrei Tsapalov

- 119 experts from 30 countries

From W.Schroeyers 23/08/2016 Lyngby Meeting

Scientific and Collaborative Actions



COST Action "NORM4Building": products and results of a multidisciplinary project – Meetings and Round tables

year	venue	Linked with
2013	Madrid (Spain): Kick off meeting	-
2014	Dead Sea (Israel) Veszprém (Hungary)* Prague (Czech Republic) Sheffield (England) Hasselt (Belgium)*	*Conference of the Nuclear Societies in Israel* - *EU-NORM Conference* *Workshop on Waste Cementation* -
2015	Leuven (Belgium) Vienna (Austria)	*Bauxite residue valorization and best practices Conference* *ICRM Symposium*
2016	Zagreb (Croatia)* Veszprem (Hungary) Lyngby (Denmark)* Stockholm (Sweden)	- *Terrestrial Radionuclides in Environment Symposium* - *EAN_NORM 8° Workshop*
2017	Rome (Italy)	Final Symposium of COST NETWORK "NORM4Building" *Use of by-products in construction: dealing with natural radioactivity*

Training Schools

The aim of the Training Schools are to widening, broadening and sharing knowledge relevant to the Action’s objectives through the delivery of intensive training on a new and emerging subject

Date	Venue	Title
31 Aug-4 Sept, 2015	Hasselt (Belgium)	NORM in building materials
15-19 Aug, 2016	Rilems (Denmark)	Concrete and radiological aspects
12-16 Sept, 2016	Athens (Greece)	Training school on NORM in Building Materials
24-28 July, 2017	Katowice (Poland)	Measurement on NORM in Building Materials

COST Action “NORM4Building”: products and results of a multidisciplinary project – STSM (Short Term Scientific Mission)

A Short Term Scientific Mission (STSM) gives the opportunity for a research visit to the institution in another country in order to foster the collaboration or to learn new technique.

NORM4Building supported several STSM’s each year by means of travel grants. This action supported particularly, but not exclusively, the **Early Career Investigators (ECI)** (PhDs who have no longer than 8 years of experience after receiving their Ph)

COST Action "NORM4Building": products and results of a multidisciplinary project – STSM (Short Term Scientific Mission)

Year	Realized STSM	ESR	Woman	Man
2014	5	3	3	2
2015	11	9	4	7
2016	15	9	6	9
2017	7 +2	4	3	4+2
Total	38+2= 40	25	16	22+2 24

Eight calls for STSM

COST Action "NORM4Building": products and results of a multidisciplinary project – STSM (Short Term Scientific Mission)

Country	Host	Home country
Italy	9	1
Belgium	3	5
Hungary	3	8
Slovenia	4	1
Serbia	2	5
Estonia	2	4+1
Macedonia	2	6
Cyprus	1	1
Greece	2	
Turkey	1	
Latvia		2
Spain	1	1
Israel	2+1	
Ukraine		2
Russian Federation		2+1
Poland	1	
Portugal	2	
Sweden	1	
United Kingdom	2+1	1

NORM4 BUILDING

Dissemination

- Web site — **http://norm4building.org/**
- Special issues — **n. 2 Special Issues of J. Environ. Radioact.**
  n. 1 Special Issue of Constr. Build. Mat.
- Papers submitted mentioning the COST Action — **In a dedicated page of the web site papers are collected and the .pdf file are available**
- NORM4 Building Book — **Naturally Occurring Radioactive Materials in Construction - Integrating Radiation Protection in Reuse (COST Action Tu1301 NORM4BUILDING)**
  Editors: Wouter Schroeyers

Special Issue – J. of Environmental Radioactivity (1)

Order in Special Issue	Submission No.	Title	Corresponding author
Editorial paper		Special issue: Natural Radioactivity in Construction	Konstantin Kovler, Wouter Schroeyers
1	JENVRAD-D-15-00759	FIRST INTERCOMPARISON AMONG LABORATORIES INVOLVED IN COST ACTION-TU1301 "NORM4BUILDING": DETERMINATION OF NATURAL RADIONUCLIDES IN CERAMICS	Gerti Xhixha
2	JENVRAD-D-15-00755	CONCENTRATIONS OF 226RA, 232TH AND 40K IN INDUSTRIAL KAOLINIZED GRANITE	Natasa Todorovic
3	JENVRAD-D-15-00781	RADON EXHALATION STUDY OF MANGANESE CLAY RESIDUE AND USABILITY IN BRICK PRODUCTION	Tibor Kovacs
4	JENVRAD-D-16-00278	RADIOLOGICAL CHARACTERIZATION AND EVALUATION OF HIGH VOLUME BAUXITE RESIDUE ALKALI ACTIVATED CONCRETES	Wouter Schroeyers
5	JENVRAD-D-16-00367	ALKALI-ACTIVATED CONCRETE WITH SERBIAN FLY ASH AND ITS RADIOLOGICAL IMPACT	Ivan S Ignjatovic
6	JENVRAD-D-15-00763	RADIOLOGICAL AND MATERIAL CHARACTERIZATION OF HIGH VOLUME FLY ASH CONCRETE	Ivan S Ignjatovic
7	JENVRAD-D-16-00004	THE NATIONAL SURVEY OF NATURAL RADIOACTIVITY IN CONCRETE PRODUCED IN ISRAEL	Konstantin Kovler
8	JENVRAD-D-15-00766	RADIOLOGICAL CHARACTERIZATION OF THE ANCIENT ROMAN TUFF-POZZOLANA CAVE IN ORVIETO (ITALY)	Rosabianca Trevisi

Special Issue - Construction and Building Materials

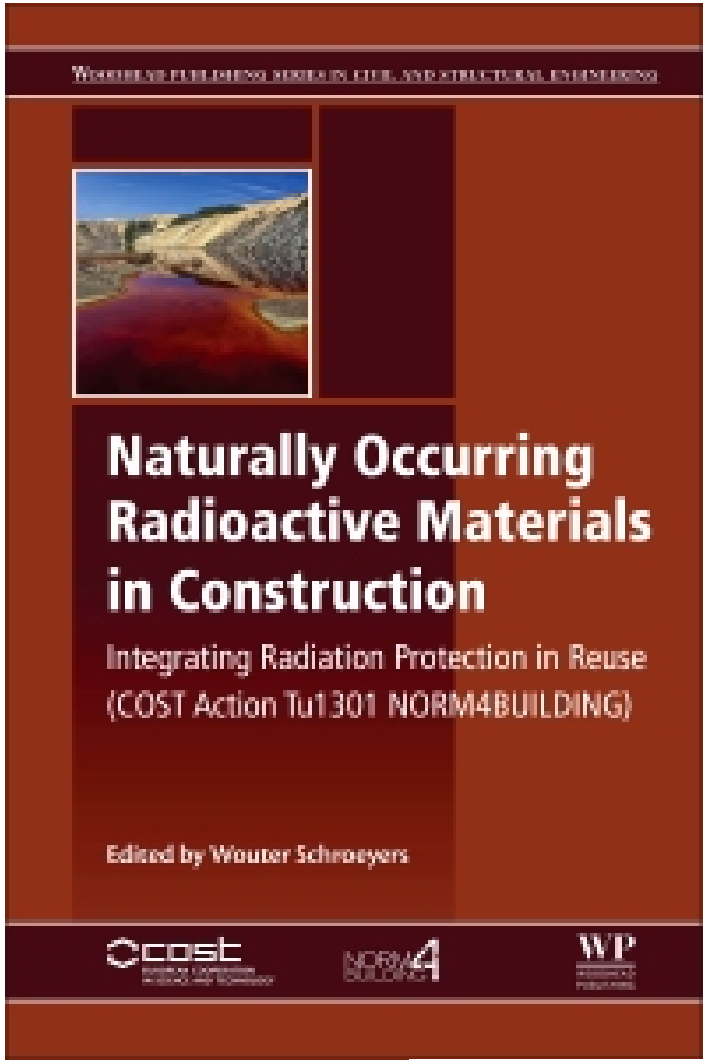
- Papers presented in Rome (**June 6-8 June**, 2017)
- Dedicated issue for CBM (Construction and Building Materials)
- Elsevier peer-refereed journal, impact factor 2.296: https://www.journals.elsevier.com/construction-and-building-materials
- CBM special issues: https://www.journals.elsevier.com/construction-and-building-materials/special-issues
- The tentative title of the Special Issue as to appear on Science Direct / in print: **Use of NORM-containing products in construction**
- Short title: **NORM in Construction**
- The number of expected papers to be published in this Special Issue (subject to approval from the publisher): **10-20**

Naturally Occurring Radioactive Materials in Construction
Integrating Radiation Protection in Reuse (COST Action Tu1301 NORM4BUILDING)

Editors: Wouter Schroeyers

eBook ISBN: 9780081020081
Hardcover ISBN: 9780081020098
Imprint: Woodhead Publishing
Published Date: 29th May 2017

The book "Naturally Occurring Radioactive Materials in Construction" with the final results of our COST Action TU1301 can be bought via this link:
https://www.elsevier.com/books/naturally-occurring-radioactive-materials-in-construction/schroeyers/978-0-08-102009-8



Naturally Occurring Radioactive Materials in Construction
Integrating Radiation Protection in Reuse (COST Action Tu1301 NORM4BUILDING)

Editors: Wouter Schroeyers

Contents

Editors: Wouter Schroeyers

- Chapter 3
  - 3.1 Radioactivity
  - 3.2 NORMs
  - 3.3 Radiation physics
    - 3.3.1 Interaction of radiation with matter
    - 3.3.2 Radiation doses and units
  - 3.4 Radiation exposure
    - 3.4.1 Structure of radiation dose
    - 3.4.2 External radiation
    - 3.4.3 Internal radiation
  - 3.5 Principal radiation characteristics of NORM
    - 3.5.1 Activity concentration of natural radionuclides
    - 3.5.2 Radon emanation and exhalation
  - 3.6 Conclusions

Scientific actions

1 Core Group + 4 Working Groups:

WG1 Data base with best practices.

WG2 Options for new tailor-made building materials.

WG3 Improve measurement capacity and standardization: optimized (in-situ) measurement protocols, calibration procedure and development of standard materials, Organization of intercomparisons, etc.

WG4 Improving radiological impact assessment models: end-of-Life considerations for building materials with a particular focus on the leachability, evaluation of the practical implementation of the newly developed building materials on the market, investigating the influence of different legislative radioprotection scenarios.

Intercomparisons and other technical activities

- In order to assess the reliability of labs and to evaluate the gamma spectrometry as technique for determining BM activity concentrations to calculate the index I, an intercomparison exercise has been organised.
- methodologies and instruments for radiological characterisation of NORM containing building materials
- Collaboration with MetroNORM Network
- Preparation of input for:

- CEN/TC351/WG3: draft standard on gamma spectrometry of Building Material
- CEN Technical Report “Radiation from construction products- Dose assessment of emitted gamma radiation”

1st Intercomparison of natural radionuclides in ceramics

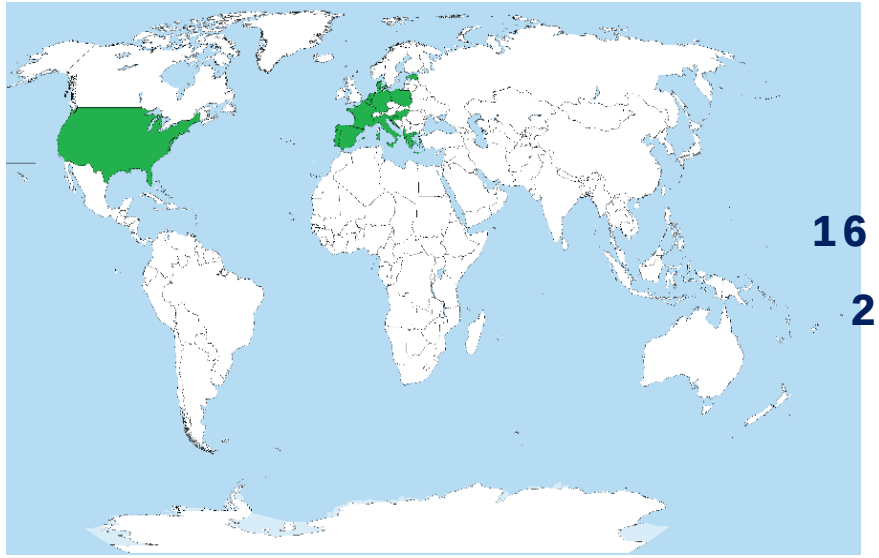
Determination of natural radionuclides of ^{40}K, ^{226}Ra and ^{232}Th in building materials to comply with the ***Council Directive EU BSS (2013)****.*

Country	Organization/Institute
Albania	Institute of Applied Nuclear Physics, University of Tirana
Belgium	Nuclear Technology - Faculty of Engineering Technology, University of Hasselt
Belgium	SCK CEN Belgian Nuclear Research Centre
Croatia	Institute for Medical research and occupational Health Radiation Protection Unit
Denmark	DTU Nutech, Technical University of Denmark
Estonia	Institute of Physics, University of Tartu
France	IRSN Institut de Radioprotection et de Sureté Nucléaire
Germany	IAF - Radioökologie GmbH
Greece	National Technical University of Athens
Hungary	Institute of Radiochemistry and Radioecology, University of Pannonia
Hungary	Social Organization for Radio-ecological Cleanliness
Italy	**University of Ferrara, Department of Physics and Earth Science**
Italy	Instituto Superiore di Santà
Netherlands	NRG
Poland	Silesian Centre for Environmental Radioactivity, GIG
Portugal	Instituto Superior Técnico (IST), Campus Tecnologico e Nuclear (CTN), Universidade de Lisboa
Slovenia	ZVD Zavod za varstvo pri delu d.o.o.
Spain	CIEMAT-Servicio de Protección Radiológica
Spain	**CIEMAT-Unidad de Radiactividad Ambiental y Vigilancia Radiólogica**
Spain	University of Huelva
Spain	University of Salamanca
Spain	University Autonoma de Barcelona
USA	Nuclear Engineering Teaching Lab, University of Texas

BSS introduced the index I as a conservative screening tool to identify building materials as being of concern from a radiation protection point of view

$$I = C_{Ra\text{-}226} / 300 \text{ Bq kg}^{-1} + C_{Th\text{-}232} / 200 \text{ Bq kg}^{-1} + C_{K\text{-}40} / 3000 \text{ Bq kg}^{-1}$$

participation



16 Countries

23 Labs

From C.Nuccetelli 2015 Salerno Conference

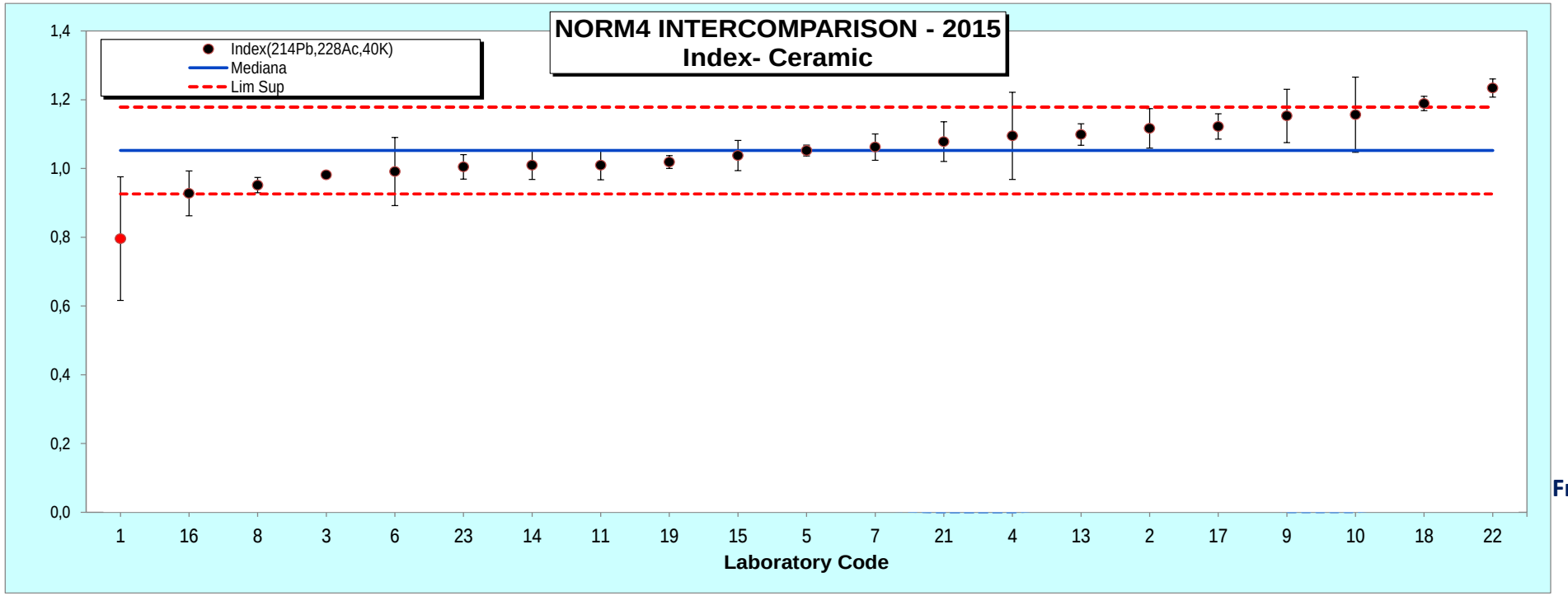
Results: calculation of the Activity Concentration Index

Lab participation

91%

- The determination of index based on the gamma spectrometry results of ^{214}Pb (^{226}Ra), ^{228}Ac(^{232}Th) and ^{40}K has been done showing a good concordance of Labs.

- Gamma spectrometry has been the better technique for determining BM activity concentrations to calculate the index I, the representativeness is better than that obtained with radiochemical methods.



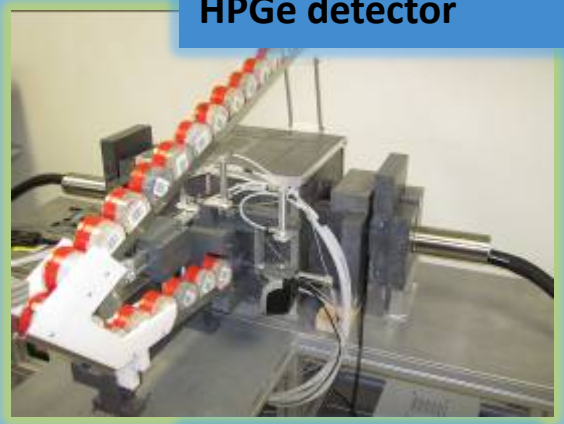
From C.Nuccetelli 2015 Salerno Conference

Techniques and methods for radioactivity measurement

INAIL provider ECM

in lab

HPGe detector



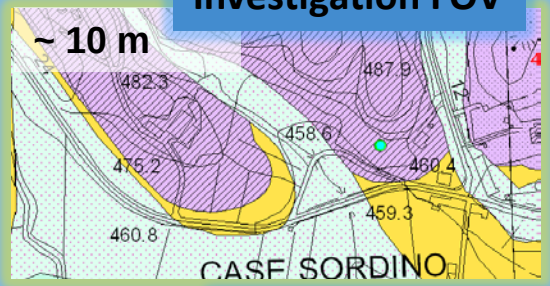
Investigation FOV

R&D technology

in situ

NaI(Tl) detector

Investigation FOV

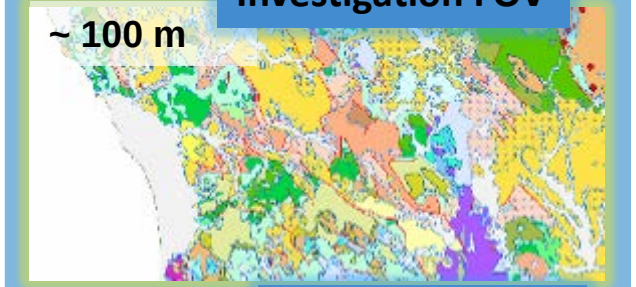


R&D technology

airborne

NaI(Tl) detector

Investigation FOV



R&D technology

From C.Nuccetelli 2015
Salerno Conference

Database NORM4Building

Database where each residue stream is listed and sorted per process that generates it but also per application where they are employed.

This database is enriched over the years with measurements of residue streams, also per country, and a substantial wealth of data with statistical gravity will become available.

The database combines research information towards industrial practices incorporating NORM residues in building materials.

A merged database from 3 current databases:

- The Italian database, developed by ISS and INAIL
- A brand new collection with national data on NORM provided by partipants
- Datamining, which constantly updates the database

Please go to **http://norm4building.org/db/**

COST Action "NORM4Building": products and results of a multidisciplinary project – CONCLUSIONS

NORM4Building with MetroNORM, EAN-NORM and EU-NORM are working towards the **European NORM Association (ENA)** whose creation was announced in the Final Conference, held in Rome.

The European NORM Association (ENA) will be the platform bridging several networks and aligning the collaboration between networks.

Thank you for your kind attention