

LOW-LEVEL RADIOACTIVITY MEASUREMENTS

Background

The Low-level radioactivity measurements service performs measurements of alpha or beta emitters on various types of low-radioactivity biological samples and environmental samples from internal and external clients.

Objectives

- ✎ to maintain and develop techniques concerning the measurements of low-level radioactivity of alpha and beta emitting radionuclides in environmental and biological samples;
- ✎ to measure these samples by means of low-background counters (liquid scintillators, proportional counters, ZnS counters and alpha-spectrometers);
- ✎ to support and advise the nuclear and non-nuclear industry on problems of radioactive contamination and or low-level radioactivity measurement;
- ✎ to maintain the quality assurance (QA) system according to the EN45001 / ISO17025 standard for which we obtained the Beltest accreditation in 1998 and to expand this QA system to all our routine measurements;
- ✎ to assess the internal dose from occupational intakes of radionuclides for workers of the nuclear industry.

Programme

Our laboratories propose low-level radioactivity measurements of

- ✎ total alpha and beta activity with proportional and ZnS counters;
- ✎ ^3H , ^{14}C and other low energy beta emitters by liquid scintillation;
- ✎ $^{90/89}\text{Sr}$ and ^{131}I activity measurements with proportional counters;
- ✎ ^{226}Ra and ^{222}Rn by the emanation method;
- ✎ natural uranium by fluorimetry;
- ✎ polonium, thorium, uranium, plutonium americium and curium by alpha spectrometry.

These measurement are performed on biological and environment samples.

Achievements

In 2000, the Low-level Radioactivity laboratories have measured more than 9800 samples. These ser-

vices were provided for half to SCK•CEN and half to external firms.

Our laboratories analysed some 5140 biologic samples (381 nose-blow, 12 faeces and 4747 urine). These analyses were requested for 91% by Health Physics of external firms for the control of workers handling radioactive materials. The main elements measured in these samples are plutonium, uranium, americium and tritium. A special feature in the urine sample analysis are the 3236 samples measured for uranium in urine from the Belgian military contingent on their return from Kosovo. Until now, we have not found any positive results in these samples showing that no significant contamination has occurred for the Belgian military contingent during their sojourn in Kosovo.

Within the framework of Radiological survey of nuclear installations, our laboratories have measured numerous environmental samples. We measured daily airborne dust samples collected on SCK•CEN's site at Mol, for total alpha and beta activities. Weekly rainwater samples collected at SCK•CEN were also measured for alpha and beta activities. The results obtained in 2000 were similar to those measured previously. Our laboratories measured environmental samples collected at or around SCK•CEN or nuclear facilities such as Doel, for alpha and beta global activity and for tritium, ^{90}Sr , ^{131}I , ^{226}Ra , uranium, plutonium and americium. These samples consisted of surface water, river water, soil, sediment, fish and milk.

We made our measurement capabilities also available to researcher's groups of our institution. In particular for the division Radioactive Waste & Site restoration, measurements have been performed for the research on waste package, migration studies and the technical liability.

At the request of the Health Physics Department, we performed numerous measurements for the control of SCK•CEN installations such as the reactors BR1 and BR2 and the chemistry building and for the control of the environment around our institute.

As part of the QA system, to control the quality of our analyses, our laboratories participate successfully to the yearly intercomparison exercises organised by PROCORAD. These exercises involved bioassay measurements of tritium, Sr, Cs, U, Np, Pu, Am and Cm.

Scientific Staff

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Perspectives

Our laboratory will set-up a new analytical procedure for the analysis of uranium using a KPA (Kinetic Phosphorescence Analyser). This will allow us to improve the limit of detection for the measurement of uranium in aqueous samples.

As an ongoing process, we will continue documenting our routine analysis methods according to EN45001 / ISO17025 regulation and the overall SCK•CEN's QA procedures in view to expand our accreditation to all our analytical procedures. In 1998 our laboratory obtained the accreditation for the global alpha and beta measurement procedure and for the liquid scintillation measurement procedure. In 1999, our accreditation was confirmed and expanded to the ⁹⁰Sr analytical procedure. For 2001 we will extend our accreditation to the ¹³¹I and Nose-blow analytical procedure.

In the 5th Frame Work Programme of the European Commission, our laboratory will take part in the project OMINEX Optimisation of Monitoring for Internal Exposure. This project aims to develop practical methods that could be used by monitoring laboratories to optimise the design and implementation of internal exposure monitoring programmes for specific exposure situations. The outcome of the project should be a common, harmonised approach to the design and implementation of internal dose monitoring programmes throughout the EU.

Partners

PROCORAD	Association pour la Promotion du Contrôle de qualité des analyses de biologie médicale en radiotoxicologie. (in 1999 57 laboratories from 17 different countries).
ULg	Université de Liège (Liège, Belgium).

Partners

AWW	Antwerpse Waterwerken (Antwerp, Belgium).
BP	Belgoprocess (Dessel, Belgium).
BN	BELGONUCLEAIRE (Dessel, Belgium).
-	DSM Research BV (Geleen The Netherlands).
KCD	Electrabel Doel (Doel, Belgium).

CNT	Electrabel Tihange (Tihange, Belgium).
-	FBFC International (Dessel, Belgium).
IDEWE	Interdisciplinaire Dienst voor het Welzijn (Heverlee, Belgium)
IRMM	Institute for Reference Materials and Measurements (Geel, Belgium).
MHKA	Militair Hospitaal Koningin Astrid (Brussels, Belgium).
PIDPA	Provinciale en Intercommunale Drinkwatermaatschappij der Provincie Antwerpen (Antwerp, Belgium).
-	Prayon Rupel-Engis (Engis, Belgium).
UM	Union Minière (Olen, Belgium).
Ulg	Université de Liège (Liège, Belgium).
VITO	Vlaamse Instelling voor Technologisch Onderzoek (Mol, Belgium).

Scientific output

Conferences

- C. Hurtgen, "Uranium measurements in human biosample.", Mini-Symposium on Depleted Uranium. VUB Brussels, October 26, 2000
- C. Hurtgen, "Natural radioactivity in bioassay by alpha spectrometry measurements.", 5th International conference on methods and applications of radioanalytical Chemistry. - MARC V. Kailua-Kona, Hawaii, USA, April 9 - 14, 2000

Publications

- P. Vermaercke, F. Verzezen, S. Boden, "Implementing quality assurance in an R&D environment at the Belgian Nuclear Research Centre - SCK•CEN", Accred. Qual. Assur. 5, pp. 21-27, 2000
- C. Hurtgen, S. Jerome, M. Woods, "Revisiting Currie - How low can you go?", Applied Radiation and Isotopes, 53, pp. 45-50, 2000
- F. Verzezen, C. Hurtgen, "A multiple window deconvolution technique for measuring low-energy beta activity in samples contaminated with high-energy beta impurities using liquid scintillation spectrometry.", Applied Radiation and Isotopes, 53, pp. 289-296, 2000
- E. Holm, S. Jerome, C. Hurtgen, "Proceedings of the ICRM Low-Level Radioactivity measurements Techniques

Conference.", Applied Radiation and Isotopes, Volume 53, Number 1-2, 2000

C. Hurtgen, "Natural radioactivity found in bioassay measurements.", Kerntechnik, 65, pp. 40-44, 2000

C. Hurtgen, "Extraction Chromatography: Application in Radiobioassay.", Int. Workshop on the application of extraction chromatography in Radionuclide measurement, November 9-10, 1998, IRMM, Geel, Belgium., 2000

Reports

H. Doerfel, A. Andradi A., M. Bailey, C.-M. Castellani, C. Hurtgen, N. Jarvis, L. Johansson, B. Leguen, G. Tarroni, "Third European Intercomparison Exercise on Internal Dose Assessment.", FZKA 6457, Forschungszentrum Karlsruhe, 2000

C. Hurtgen, A. Andradi, A. Birchall, C.-M. Castellani, H. Doerfel, L. Johansson, B. LeGuen, G. Tarroni, "Database on Radionuclides in Workplaces.", BLG-839, SCK•CEN, 2000

Thesis

Jan A. A. Cornelis "Alfabus32: Integratie van ZnS tellers in een bestaand QA-systeem") - Hogeschool voor Wetenschap en Kunst (De Nayer Instituut)