Ref. Ares(2022)1067924 - 14/02/2022

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D – Nuclear energy, safety and ITER
D.3 – Radiation protection and nuclear safety

Verification under the terms of Article 35 of the Euratom Treaty

Technical Report

BELGIUM

Radioactivity monitoring arrangements of radiologically contaminated areas

Molse-Nete river and riverbanks

12 - 16 July 2021

Reference: BE 21-05

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES	Radioactivity monitoring arrangements of radiologically contaminated water catchment areas (Molse-Nete river and riverbanks)
LOCATIONS	Brussels and Mol, Belgium
DATES	12 - 16 July 2021
REFERENCE	BE 21-05
TEAM MEMBERS	Mr V. Tanner (team leader) Ms E. Diaconu
REPORT DATE	3 February 2022
SIGNATURES	

V. Tanner E. Diaconu

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Abbreviations

EC	European Commission
FANC	Belgian Federal Agency for Nuclear Control
GM	Geiger-Müller
HPGe	High-purity Germanium
IAEA	International Atomic Energy Agency
LIMS	Laboratory Information Management System
LRM	Low Level Radioactivity Measurements
REM	EC Radioactivity Environment Monitoring database
SCK CEN	Belgian Nuclear Research Centre
TLD	Thermal Luminescent Dosimeter
ZnS	Zinc Sulfide

TECHNICAL REPORT

1 INTRODUCTION

Under Article 35 of the Euratom Treaty, all Member States must establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with basic safety standards[1]. Article 35 also gives the European Commission the right of access to such facilities to verify their operation and efficiency. The radiation protection and nuclear safety unit of the European Commission's Directorate-General for Energy is responsible for undertaking these verifications. The Joint Research Centre Directorate-General provides technical support during the verification visits and in drawing up the reports.

The main purpose of the verifications under Article 35 of the Euratom Treaty is to provide an independent assessment of the efficiency and adequacy of monitoring facilities for:

- liquid and airborne discharges of radioactivity from a site into the environment;
- levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant pathways;
- levels of environmental radioactivity on the territory of the Member State.

Taking into account previous bilateral protocols, a Commission Communication[2] describing practical arrangements for Article 35 verification visits in Member States was published in the *Official Journal of the European Union* on 4 July 2006.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The Commission notified Belgium of its decision to conduct an Article 35 verification in a letter addressed to the Belgium Permanent Representation to the European Union. The Federal Agency for Nuclear Control (FANC) was designated to lead the preparations for the visit.

2.2 DOCUMENTS

To assist the verification team in its work, the national authorities supplied an information package in advance[3]. Additional documentation was provided during and after the verification visit. The information provided was used as a source during drawing up the descriptive sections of the current report.

2.3 PROGRAMME OF THE VISIT

The Commission and FANC discussed and agreed on a programme of verification activities in line with the Commission Communication of 4 July 2006.

[1] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OJ L 13, 17.1.2014)

[2] Commission Communication *Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty — Practical arrangements for the conduct of verification visits in Member States* (OJ C 155, 4.7.2006)

[3] Replies to the preliminary information questionnaire addressed to the national competent authority, received on 24 November 2020

During the opening meeting, presentations were given by FANC on the national monitoring programme and their activities, whilst the verification team presented the Article 35 and the programme for the verification.

The verification team notes the quality and comprehensiveness of all presentations made and documentation provided.

Verifications were combined with verifications of the Brussels city radiation monitoring arrangements (verification BE 21-04) on 12-16 July 2021. The verification team met the following representatives of the national authorities and other parties involved:

Federal Agency for Nuclear Control (FANC)

- Frank HARDEMAN, Director-General
- Jurgen CLAES, Environmental Radioactivity Expert, Nuclear Inspector
- Oliver ZEMB, Director Department Health and Environment
- David RASQUIN, Nuclear Emergency Plan Expert, Nuclear Inspector
- Sylvain NOOTENS, Environmental Radioactivity Expert, Nuclear Inspector
- Geert BIERMANS, Head of unit Surveillance of the Territory and Natural Radiation

SCK-CEN

- Michel BRUGGEMAN, Head of Expert Group LRM
- Freddy VERREZEN, Technical Manager Radio-Analytical Laboratories (RAL): LRM
- Liesel SNEYERS, Technical Manager Sampling and Environmental Monitoring (SEM) and project leader Radiological Surveillance project at SCK CEN: LRM

3 BODIES HAVING COMPETENCE IN MONITORING ENVIRONMENTAL CONTAMINATION

3.1 FEDERAL AGENCY FOR NUCLEAR CONTROL

The Belgian Federal Agency for Nuclear Control (FANC) is the authority on the protection of the population and the environment against the dangers resulting from ionizing radiation. It comprises five departments and employs some 160 members of staff.

FANC was established by law of April 15th 1994 and according to its position, it has a great independency, which is necessary to take up its responsibility to the society in an impartial way. It is led by a board of directors and the daily management is observed by a General-Director. The law attributes to the FANC the objectives of "protection of the population, workers and the environment against the dangers of ionising radiation", which consist of the following:

- propose, apply and improve laws and regulations;
- control human (and non-human) activities responsible for exposure of man to radioactivity;
- ensure the surveillance of radioactivity on the Belgian territory (Telerad automatic network and Radiological Surveillance Monitoring programmes);
- co-operation on nuclear emergency plans;
- distribute neutral and objective information.

FANC, in cooperation with Bel V, operates environmental monitoring facilities (Telerad network, aerosol and water samplers, etc.), but it does not have a radioanalytical laboratory. Therefore, the analytical work of the environmental radiation surveillance programmes in Belgium is outsourced via a public tendering process. Typical duration of these contracts is four years.

3.2 BEL V

Bel V is a subsidiary of FANC and has since April 14th 2008 taken over the regulatory controls in class I/IIA nuclear installations formerly carried out by the Authorized Inspection Organization (AVN). FANC relies on the technical expertise of Bel V for carrying out inspections in nuclear power plants and other nuclear installations in Belgium (hospitals, universities and radionuclide production facilities). Bel V acts as an expert for the safety assessments of nuclear projects, participates in meetings and working groups that are organized in the framework of international organizations (EC, OECD, IAEA), exchanges information and experience feedback with Belgian and foreign colleagues and contributes to the emergency plans for nuclear accidents.

4 ASSOCIATED LABORATORIES

4.1 BELGIAN NUCLEAR RESEARCH CENTRE

4.1.1 Introduction

The Belgian Nuclear Research Centre (SCK CEN) is a public institution working on nuclear and radiation research, located in Mol. It is a foundation of public utility with a legal status according to private law, under the guidance of the Belgian Federal Ministry in charge of energy. SCK CEN has more than 800 employees. It holds accreditation by BELAC. The radio-analytical work on the monitoring of the contaminated areas in Belgium is mostly done by the SCK CEN laboratory[4].

[4] SCK CEN takes part in public tendering for the four-year environmental monitoring contracts of the Belgian government (FANC). At the time of the verification, it was responsible for the environmental monitoring of the Molse-Nete water catchment areas.

4.1.2 Sample reception

Samples get a unique identification prior to sampling (sampling site, sample type and period). All samples are registered in the central LIMS system when they arrive in the SCK CEN laboratory. The registration involves the use of a set of predefined registration scripts set up following sample types and requested radioactivity analysis. All involved laboratories are then informed about the analyses to perform.

4.1.3 Sample preparation

The sample preparations for each type of matrices (e.g. surface water, dry/wet deposition, milk, soil…) are described in internal procedures and available at the workplaces. Sample treatments (filtrations, evaporation, grinding, sieving, calcination…) are performed on equipment maintained and managed in accordance with the equipment management procedures of each laboratory in compliance with the ISO 17025 standard. Sample preparation consists of various techniques; all aiming to get a representative sub portion of a sample that is in a stable condition so the analysis can be performed. Techniques used are:

- Drying (freeze drying or oven drying) following appropriate drying conditions (e.g. temperature, drying time protocol);
- Milling and sieving chosen to guarantee an appropriate degree of homogenisation for a selected sample size and analysis technique;
- Acidifying to guarantee that radionuclides do not precipitate or adhere to walls of recipients, or that solids in suspension are unwillingly dissolved;
- Filtration following the instructions for different sample types;
- Calcination with predefined calcination protocols for temperature and timing program;
- Microwave destruction with predefined destruction protocols for temperature and timing program;
- Combustion (Pyrolizer system) performed in a controlled atmosphere (oxygen/air) and using predefined protocols for temperature and timing program;
- Fusion (Catanax system) using sodium and lithium borate media to dissolve solid samples (such as concrete and soil).

Equipment used for sample preparation is cleaned after treatment of each individual sample and periodic checks are made by running blank sample material through the installations and by analysing the blank control samples for possible contamination. Additionally, where possible, equipment is subdivided and used for the treatment of predefined classes of samples (e.g. distinction between samples with a higher and lower activity concentration).

All sample preparations are executed according to procedures for which laboratory personnel has been qualified. All critical equipment is registered and subject to periodic maintenance and/or calibration. Most of the laboratory equipment exists in multiple pieces of a same type of equipment to avoid stand still of certain preparation steps in the event of failure of a piece of equipment.

4.1.4 Gamma spectroscopy

The SCK CEN laboratory has several HPGe-detectors in lead shieldings (currently 18 in use). All detectors are connected to a LYNX multi-channel analyser (Mirion). The detectors are operated in a dedicated counting room with controlled environmental conditions. Detectors are calibrated for various counting geometries using a combination of experimentally set up calibrations with standard multi-gamma sources (traceable to national standard) and computational techniques (using the EFFTRAN efficiency transfer code). The computational techniques are used to correct for sample filling height, sample density and sample composition for each individual sample deviating from the reference.

Each detector is subject to a quality control program (weekly and monthly checks of various parameters). SCK CEN has in-house knowledge for many maintenance tasks, such as restoring the vacuum of the detector, testing and resolving electronic issues.

Standards used for calibration purposes are made using reference solutions of certified radioactivity of radionuclides. Standards are obtained from different providers (NPL, PTB, Echert & Ziegler) from which a certificate is requested. Using dilutions of the reference activity different volume sources are prepared in-house to set up the reference calibrations for a water matrix. Calibrations for solid sample materials and samples of other materials and compositions are based on the principles of efficiency transfer.

Genie 2000 software is used to analyse the spectra, to identify the radionuclides and to compute their activity or activity concentration. The reference efficiency calibrations used by Genie 2000 are corrected for each individual sample using efficiency transfer principles. Efficiency transfer corrects systematically for, sample filling height, sample density (and composition) for each of the predefined reference calibrations. Next to efficiency transfer, also background corrections, decay corrections and true summing corrections are systematically applied. The results obtained in Genie 2000 are directly transferred from the analysis software to the LIMS including raw data of peak areas. Detection limits are computed according to ISO 11929 (involving all the relevant uncertainty components).

4.1.5 Alpha spectroscopy

SCK CEN carries out alpha-spectrometry using PIPS detectors in vacuum chamber (64 in use). The alpha spectrometry systems (Mirion and Ortec) consist of several alpha counting chambers combined in modules/analysers connected to a manifold with vacuum pumps to create the vacuum in the counting chambers. The analysers are grouped and connected to two separate networks and computers, which control the spectrum acquisition. All alpha spectrometry instruments are operated in a dedicated counting room with controlled environmental conditions.

Detectors are calibrated using counting planchets containing known quantities of specified actinides. The actual total efficiency (chemical yield + detection efficiency) is obtained in each separate measurement based on the counts in the tracer peak. A specific tracer is added to the sample material prior to chemical separation. Tracer solutions are obtained from standard solutions with certificate. Since analyses are always relative to the tracer activity the method is robust and not influenced by slight deterioration of the counting efficiency of the detector. The tracers are selected according to the actinide to analyse.

Each detector is annually controlled for its counting efficiency. Tracer activity is chosen in quantities in line with the expected activity in a sample. Standards are used to produce the solutions to spike samples prior to the chemical separations. The spike is added by measuring the volume of the spike solution.

Microwave digestion and fusion techniques are used to dissolve solid samples. Chemical separations are made with different chromatographic techniques selected according to the actinide that is to be isolated. Electrodeposition is used to deposit the radionuclides on the counting planchet.

Genie 2000 software is used to analyse the spectra and to determine the counts in the different regions of interest (ROI). The counts of the ROIs are then entered in a spreadsheet in which the radioactivity is computed (including the chemical yield of the separation). Detection limits are computed according to ISO 11929. The results obtained in the spreadsheet are then transferred to the LIMS from which reporting is made.

4.1.6 Liquid scintillation counting

SCK CEN laboratory has five Liquid Scintillation Counters (LSC). They are operated in a dedicated counting room with controlled environmental conditions. LSCs are calibrated using unquenched scintillation vials containing known quantities of specified radionuclides. Given the large spread in energy of beta spectra there is generally no possibility to deconvolute spectra and to determine several radionuclides from a single spectrum. Hence chemical separation techniques are required to isolate the element and the targeted radionuclide prior to its counting. As a consequence, LSC is generally used to determine a known radionuclide. Several techniques are currently used for this separation.

The chemical yield of the separation is either determined for each analyses by other means (e.g. gravimetrically by the addition of a stable element, by mass spectrometry, or by determination of chemical yield by experiment to fix an average value). Using the method of internal standardisation (where a second measurement is used with a spike added to the sample material); a robust method is obtained that copes with possible quenching effects.

Each LSC is periodically controlled for its counting efficiency and background signal. Certified reference materials (CRM) are used to produce the different spike solutions for internal standardisation. Detection limits are computed according to ISO 11929. The results obtained in the spreadsheet are then transferred to the LIMS from which reporting is made.

4.1.7 Gross alpha/beta counting

SCK CEN laboratory operates eight Mirion Gross alpha/beta proportional counters. Counters are used to count 11 cm diameter counting trays. Four of these counters are equipped with a sample changer; one module is used for ultra-low level radio-activity measurements and has four separate trays and requires manual loading of the samples.

The proportional counters are efficiency calibrated with Pu-239 for gross alpha counting and Sr-90/Y-90 (in equilibrium) for gross beta counting. Therefore, the gross counting does not yield a true radioactivity measurement (in Bq) since different radionuclides (alpha or beta emitters) emit alpha or beta particles at an energy different from the calibration nuclide. This will result in a different counting efficiency. The thin source method is used for the analyses. For gross alpha counting an absorption correction is applied to correct for the alpha particles lost in the counting due to absorption in the sample layer on the counting tray.

The proportional counters are periodically controlled for their counting efficiency (alpha and beta) and for background. Standards are used to produce the calibration counting trays. Calculation of results is made by spreadsheets in which the counts of the samples are introduced. Detection limits are computed according to ISO 11929. The results obtained in the spreadsheet are then transferred to the LIMS from which reporting is made.

4.1.8 Gross alpha counting

20 gross alpha counters are in use. The counters are homemade using ZnS detectors produced by a special deposition process of the ZnS on a plexiglass disk. The counters are used for gross alpha counting with well-known good alpha-beta discrimination. The detectors are connected to a dedicated set of counters controlled by homemade software that subdivides the counting time in a sub set of time frames for which counts are compared for checking the stability of the count (e.g. to detect decay during the counting process).

The ZnS counters are efficiency calibrated with Pu-239. As a consequence, the gross counting does not yield a true radioactivity measurement since different alpha emitters emitting alpha emitters at slightly different energies slightly different counting efficiency may result. The thin source method is used for analyses. For gross alpha counting an absorption correction is applied to correct for the alpha particles lost in the counting due to absorption in sample layer on the counting tray.

The ZnS counters are periodically controlled for their counting efficiency and for background. Standards are used to produce the calibration counting tray.

4.1.9 Measurement results

All results are stored in the database of the laboratory LIMS that resides on a SCK CEN network server. Detection limits and decision threshold are evaluated as outlined in ISO 11929. Results are archived at least once every month and stored on a network server. Proper back-up procedures are in place to safeguard the data. All data are kept for a period of at least 10 years. This includes the raw data of the measurements, as well as all data related to sampling and sample preparation.

4.1.10 Reporting

The results of the radiological monitoring program are reported to the authorities each quarter (unless results deviate from the normal expected routine measurement values, than they are reported to the authorities as soon as possible, in general within 24 hours). The results are extracted from the LIMS and transferred in an excel file provided and updated by the authorities. Each report contains the results of the samples for which all analyses were performed. In the event that a result already submitted is modified, it will be notified to the authorities and highlighted in the report

4.1.11 Sample storage

Residual sample material and testing portions are preserved for least 1 month after the results have been reported. Preservation is in accordance with the ISO norms that are applicable or following good laboratory principles. Sample preparation is performed on all samples received for analysis in order to homogenize them and to prevent degradation of the samples during the storage time (e.g. adding acid to prevent loss of analyte due to precipitation or adsorption). Samples are stored according to the appropriate ISO norms and kept in dedicated storage facilities, which are controlled for all relevant parameters (humidity, temperature, light). There are facilities for dry storage at room temperature, cooling rooms and refrigerators, freezers and freezing rooms. All relevant parameters in these rooms are constantly monitored and alarms are raised if any of the parameters fall outside the designated working limits. Alarm messages are sent by e-mail or by SMS text messages to the responsible(s) of the room, or audible and/or visual alarms at the entrance of the rooms are activated.

4.1.12 Quality management

SCK CEN is ISO 17025 accredited (BELAC). It participates in the IAEA ALMERA and in national/international comparison exercises and proficiency tests (IAEA, EC, OSPAR). In addition the SCK CEN participates yearly in other proficiency tests organised by international organisations (NPL, BfS, ISPRA, PROCORAD, AquaCheck). The head of the laboratory evaluates all results obtained by the different laboratories as soon as they become available. Results that are deviating from the expected value are registered and initiate an investigation to determine the reason of the deviation, or the source of the error made, with the intent to improve the overall process.

5 RADIOACTIVITY MONITORING OF THE NETE BASIN AREA

5.1 INTRODUCTION

The Nete basin area consists of rivers Molse Nete and Grote Laak. These rivers are fairly small; they merge together to the Grote Nete and finally meet the large Scheldt river on the south side of Antwerp. The environmental contamination in the area is complex, since it involves several rivers, which in the past received liquid discharges of the phosphate industry (Ra-226) and discharges of the nuclear waste processing (Cs-137, Co-60, Pu, Am). Radioactivity is not found only in the aquatic environment (river sediments), but due to natural flooding or dredging activities some of it has moved to the soil on the riverbanks. In addition, there is non-radiological contamination by heavy metals. The observed radiological contamination with Ra-226 correlates well with chemical contamination by heavy metals, co-precipitating with radium.

Figure 1 illustrates the existing exposure situation areas and figure 2 presents the landscape. Molse Nete receives the historical and current releases from nuclear industry at the Mol-Dessel area. Grote Laak was affected by historical releases of the phosphate industry (company Tessenderlo Chemie). The Grote Nete – Rupel – Scheldt area receives water and sediment from both rivers.

The phosphate production facility responsible for most of the historical discharges was closed in 2014. Today discharges are minimal compared to pre-1990 levels, which could reach 30 Bq/l of Ra-226. The current management of the legacy contamination involves monitoring, dose assessments and avoiding construction of new buildings on the riverbanks due to radon risk.

Despite the end of phosphate production and its associated discharges, the radiological contamination in the Grote Laak valley is still being transported by the river – albeit in concentrations which are significantly lower than those during the discharge period. The “legacy” on the banks of the Grote Laak is yet to be remediated; remediation of the Winterbeek valley is ongoing.

Figure 1. Existing exposure situations at Molse Nete, Grote Laak and Grote Nete areas

Figure 2. Landscape overview pictures

5.2 MONITORING PROGRAMMES

5.2.1 Radioactivity in river waters and sediments

Radiological analyses are performed on samples collected on annual or on ad-hoc basis in cooperation with regional governments or institutions of public interest. Several rivers are concerned:

- Molse Nete is a watercourse which receives the discharges of Belgoprocess 2 and the liquid radioactive effluent treatment plant of the Mol-Dessel site;
- Grote Laak and Winterbeek, which received the discharges of the manufacturing of feed phosphates at Kwaad-Mechelen and Tessenderlo (Ra-226);
- Grote Nete, into which the Molse Nete and Grote Laak flow;
- Ruppel, into which the Grote Nete flows and also receives the water of the Winterbeek (via the Demer which flows into the Dijle which ends into the Ruppel);
- Scheldt, which drains the entire Nete basin. It receives the discharges from the Doel nuclear power station, as well as the radioactive discharges of the Antwerp hospitals and laboratories. The Scheldt ends in an estuary area before flowing into the North Sea.

The more detailed radiological characterization of riverbanks and riverbeds has focused on the rivers, which directly received discharges: Molse Nete, Winterbeek and Grote Laak. Studies from the early 2000 by the Flemish Region show that the riverbanks of the Grote Nete – which receives the water of both Molse Nete and Grote Laak – also show a Ra-226 contamination in flooding zones, comparable to that present on the banks of the Grote Laak. This shows that part of the radium present in the discharges was deposited by the river several dozens of kilometres downstream from the mouth of the Grote Laak. These identified zones are largely inaccessible and therefore the radiological risk is negligible. A more detailed characterization was neither feasible nor justified at that time.

Recently, the presence of radium and heavy metals in the Grote Nete valley has come to the forefront again, due to planned projects by the Flemish Region to reorganize the riverbanks and flooding zones. FANC is involved in the preparation of these projects in order to assure the correct management of the NORM residues.

In the Molse Nete the analysis includes also transuranic nuclides (U-234,235,238; Pu-239,240; Am-241) in addition to the usual array of gamma emitters (fission and activation products including radiocaesiums) by virtue of this watercourse receiving liquid discharges from the nuclear installations of the Mol-Dessel site via the liquid waste treatment installations of Belgoprocess 2.

In the Nete and Demer basin, the analysis concentrates on the Ra-226 by virtue of these streams draining the waters of the Grote Laak and Winterbeek where the Tessenderlo facility have produced feed phosphates (NORM-industry) and discharged its process water enriched with radium.

Table I summaries the water monitoring programmes at Scheldt – Nete basin. Figure 1 presents the monitoring areas. Figures 3-7 illustrate some of the monitoring results.

Table I. Radiological monitoring programme for the Scheldt – Nete basin

Zone		Location of sampling points		Type of measurement	Frequency of sampling
		Scheldt	Nete		
River	water	near Doel	Molse Nete	Gamma Spectrometry: ^{7}Be, $^{134-137}Cs$, $^{141-144}Ce$, $^{103-106}Ru$, ^{95}Zr, ^{95}Nb, ^{226}Ra Spectrometry beta total, alpha total a, ^{3}H, ^{40}K	every 2 weeks

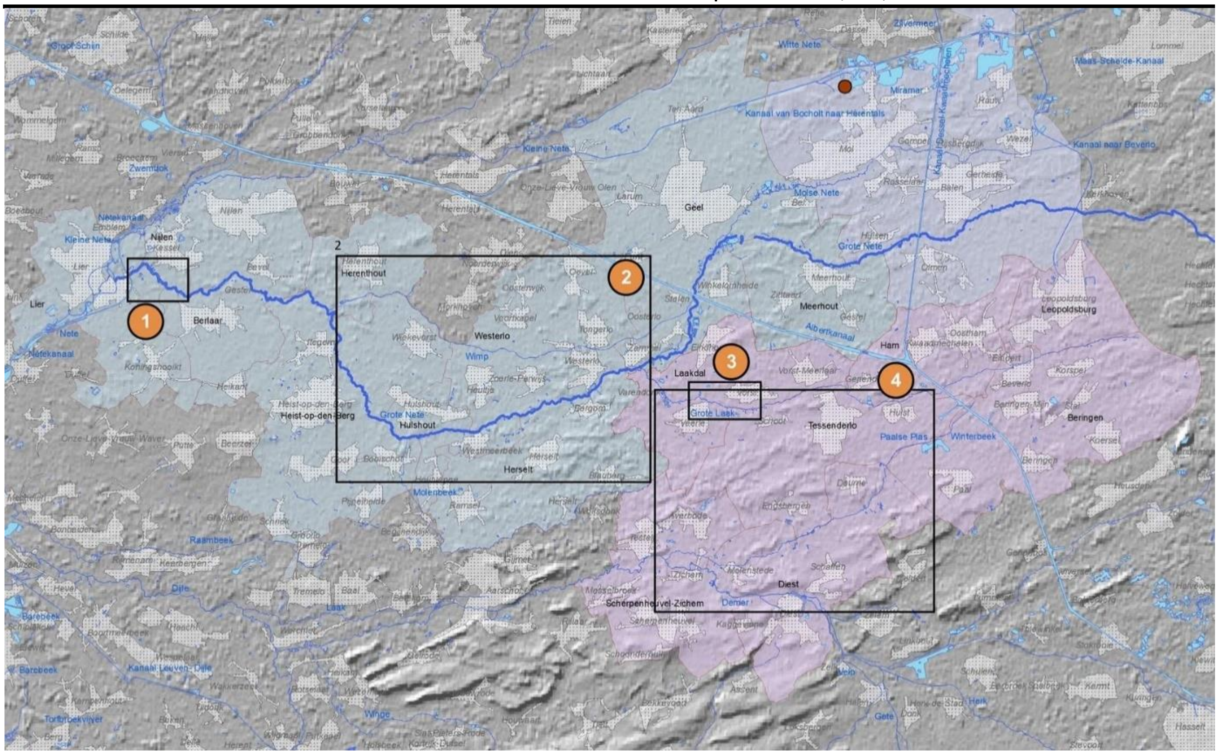

Figure 3. Monitoring of surface water (and sediments) in rivers Grote Laak, Winterbeek, Grote Nete, Rupel and Molse Nete. (1) Estuary zone of the Grote Nete into the Nete (municipality Lier), (2) Grote Nete around municipality Westerlo, (3) Grote Laak, (4) Winterbeek

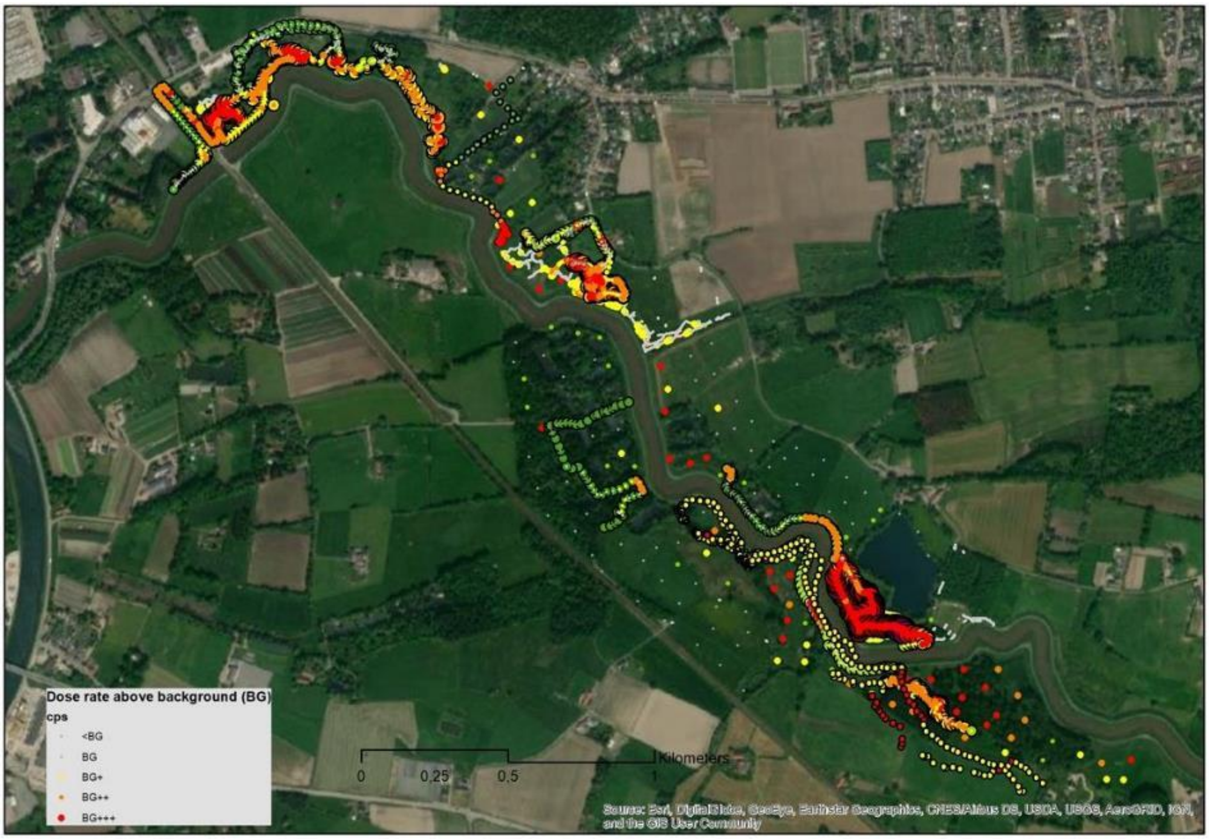

Figure 4. Estuary Zone of the Grote Nete into the Nete (municipality Lier)

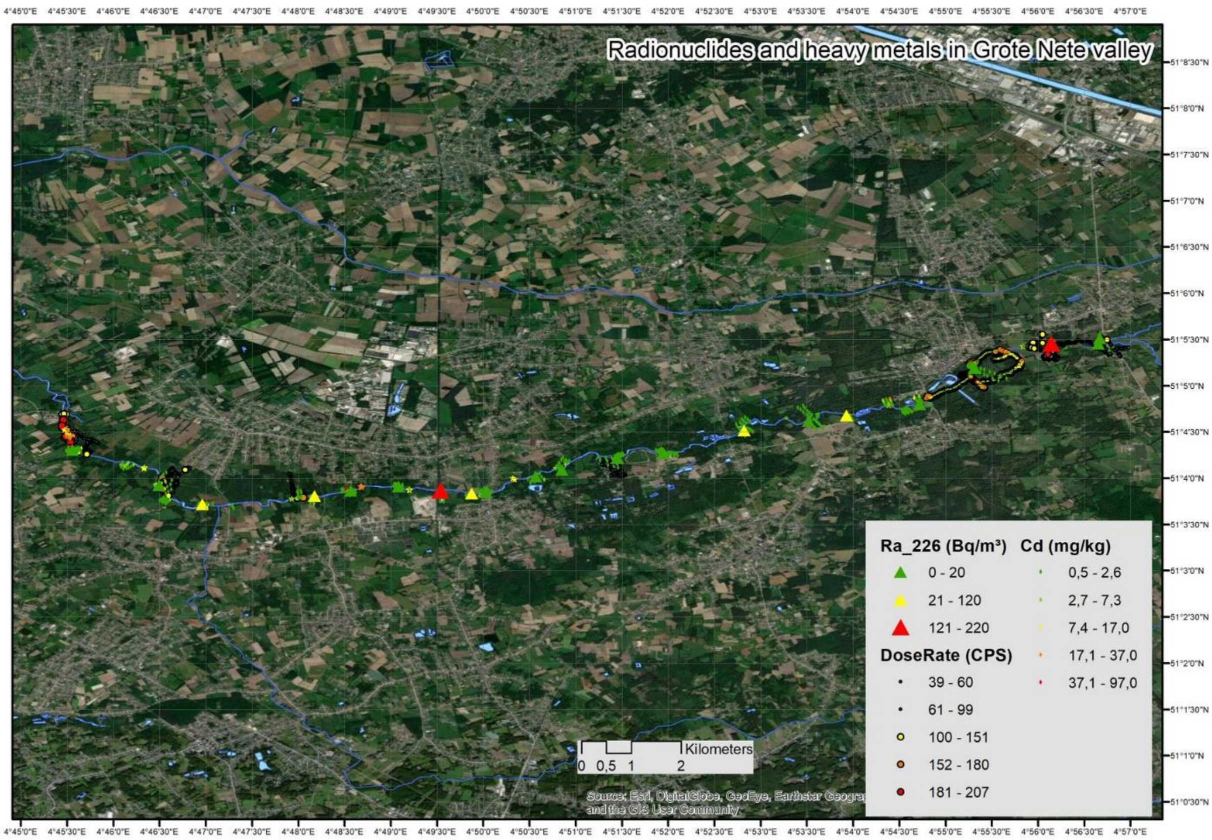

Figure 5. Grote Nete around municipality Westerlo

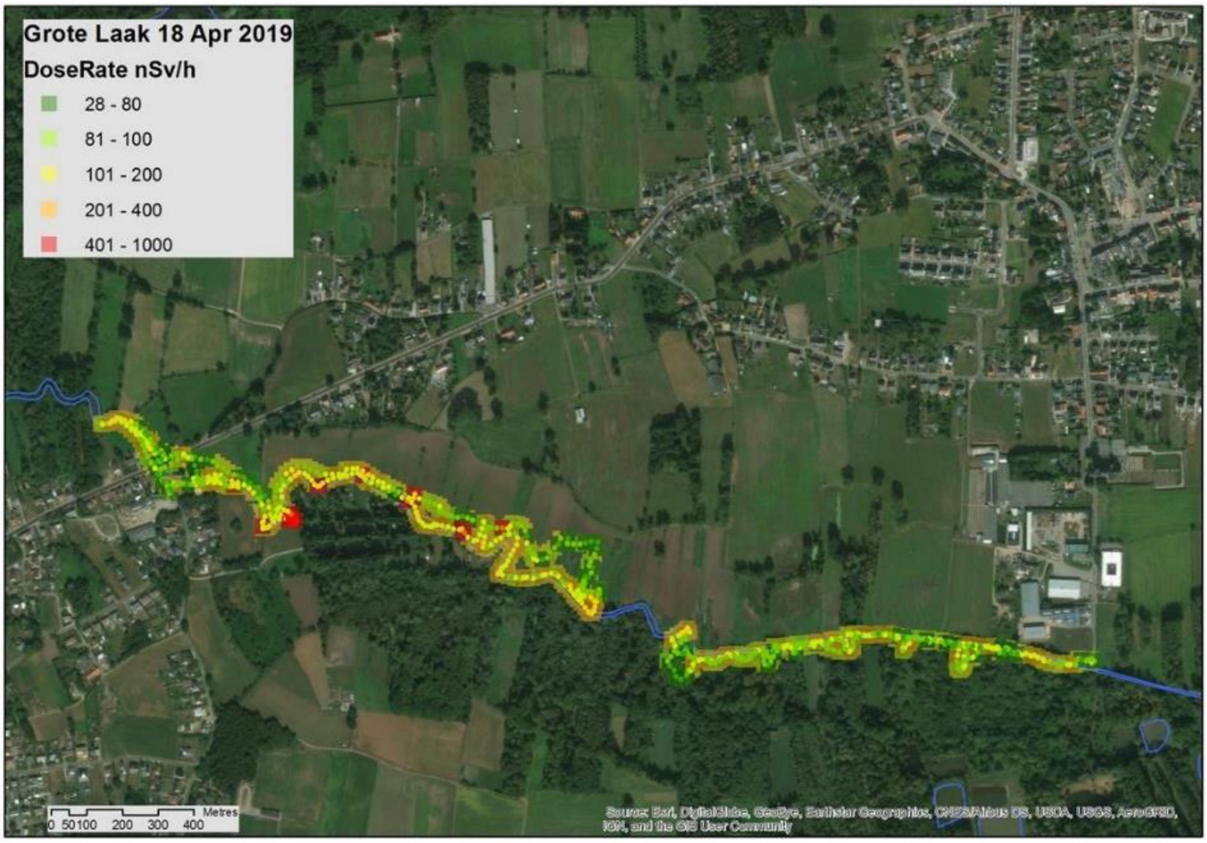

Figure 6. Grote Laak

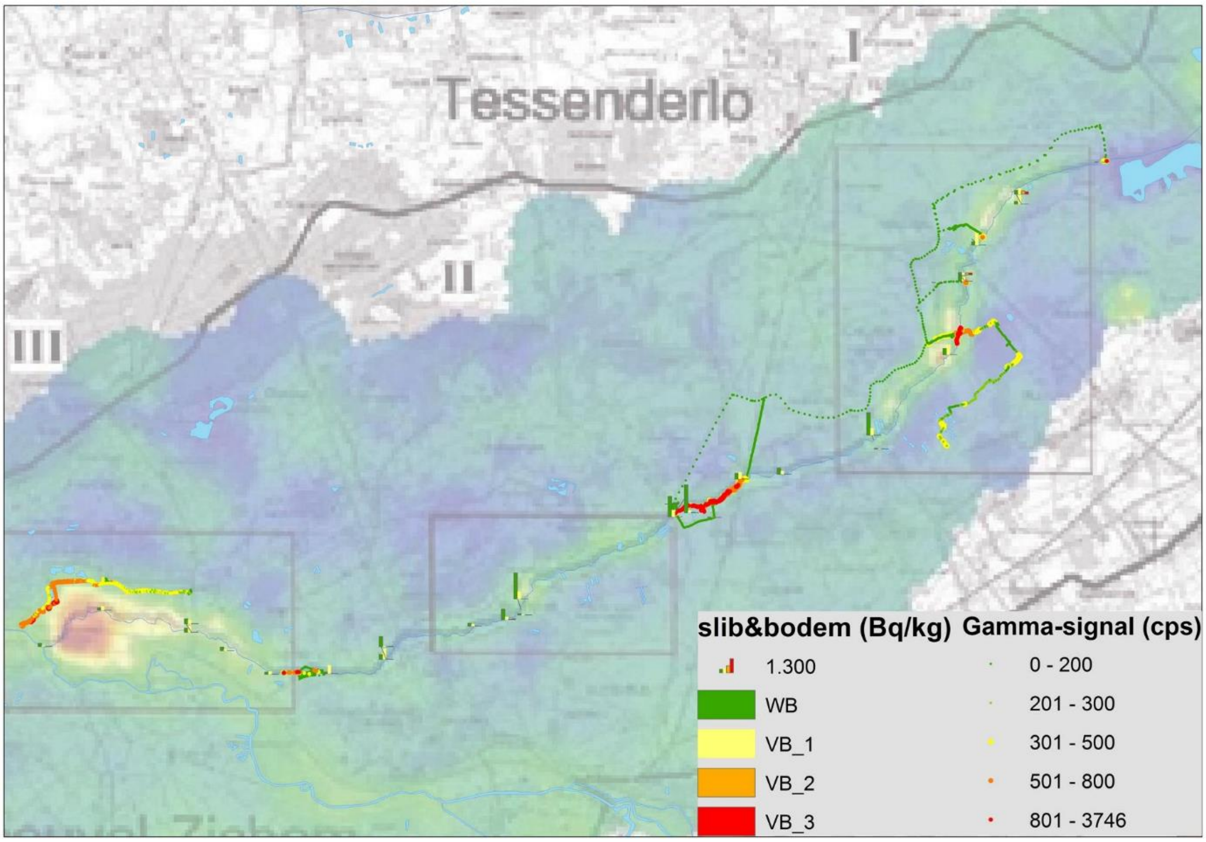

Figure 7. Winterbeek

5.2.2 Total ambient radiation dose

TLDs are used to monitor the total ambient radiation dose on the Molse-Nete riverbanks (12 locations). Until 2018 this was carried out by SCK CEN, but since then it has been a part of the Belgoprocess environmental monitoring programme. Table II below shows the monitoring locations.

Table II. TLD geographical coordinates

88	Molse Nete zuiveringsstation	51,1767000	5,1041333
95	Molse Nete - 120m na lozingspunt	51,1718833	5,0643000
97	Molse Nete - 2400m na lozingspunt	51,1705330	5,0578333
90	Molse Nete stroomafwaarts lozingspunt	51,1706167	5,0553500
89	Molse Nete stroomafwaarts lozingspunt	51,1705333	5,0543167
98	Molse Nete - 3100m na lozingspunt	51,1681667	5,0349000
91	Molse Nete achter garage Lavrijsen	51,1662167	5,0317000
93	Molse Nete - Watermolen Geel	51,1649500	5,0286333
92	Molse Nete - Watermolen Geel	51,1681667	5,0349000
99	Molse Nete - 4040m na lozingspunt	51,1633667	5,0274667
94	Grote Nete - Winkelomheide	51,1380167	4,9962833
96	Grote Nete - PIDPA Westerlo	51,0828333	4,9171833

5.2.3 Information for the public

In Belgium, all the information from the radiological monitoring programmes is made available to the public. The data from the online monitoring is published in real-time by the nuclear regulator through a dedicated website[5], while an overview of the results of the offline programmes, together with interpretation and conclusions, are published in the form of a yearly reports on the FANC website[6].

The raw data of the offline monitoring programme is currently not made available to the public, but it can be obtained on a specific request. However, an online database to make these raw data available to the public is foreseen in the near future.

Besides the communications by the nuclear regulatory authority mentioned above, the nuclear operators also have responsibilities to communicate with the public both during routine and emergency situations for all matters that relate to their installations.

In case of emergency situations, overall communication with the public is the responsibility of the governmental crisis management team.

5 https://www.telerad.be

6 https://afcn.fgov.be/fr/publications/rapports-de-surveillance-radiologique-de-la-belgique

6 VERIFICATIONS

6.1 INTRODUCTION

Verification activities were carried out in accordance with the agreed programme. This chapter summarises the verifications carried out the by the verification team. The team has assessed the monitoring arrangements based on their own expertise and comparison with similar arrangements in other Member States.

The outcome of the verification is expressed as follows:

- A '*Recommendation*' is made when there is a clear need for improvement in implementing Art. 35. These are included in the main conclusions of the verification. The Commission requests a report on the implementation of the recommendations – lacking implementation of a recommendation can lead to a reverification.
- A '*Suggestion*' is made when the verification team identifies an action, which would further improve the quality of the monitoring.

In addition, the team may '*commend'* particularly good arrangements, which could serve as a best practice indicator for the other EU Member States.

6.2 MONITORING OF THE MOLSE-NETE RIVER AREA CONTAMINATION

6.2.1 Monitoring programmes

The verification team visited the Belgian Federal Agency for Nuclear Control (FANC)[7]. The team was introduced on the history of the radiological contamination issues in Belgium and received a summary of the current monitoring programmes at the Molse-Nete area.

The radiological contamination of the Molse-Nete water catchment areas are due to historical releases; the releases today are minor when compared to past discharges. The radiological situation of the Molse-Nete river and riverbanks has been well characterised in several monitoring projects (some of which are still ongoing) to determine the possible radiation exposure of the general public.

The natural flow of water and possible dredging operations may relocate the contamination, so there is a need for further monitoring of these processes. FANC is prepared to carry out further studies to characterise the radiological situation if the future use of these areas so require.

The monitoring programme consists of several hundred water and sediment samples annually. These are taken in collaboration with routine monitoring programmes of regional environmental authorities (river sediments, groundwater), or in collaboration on projects on characterisation and remediation of historical contamination. In addition, a long-term TLD programme is in place for monitoring the total ambient radiation dose on the riverbanks.

FANC makes the results of the monitoring available to the public via regular reporting or dedicated websites.

No remarks.

[7] Markiesstreet 1 bus 6A, 1000 Brussels, Belgium

6.2.2 SCK CEN laboratory

The verification team visited the SCK CEN radiological laboratory in Mol[8]. The laboratory is very well equipped, sufficiently staffed and has excellent working facilities. The team verified the following equipment and facilities:

- Sample receipt process (sample documentation, LIMS, barcoding)
- Sample preparation and storage rooms (scales, mills, dryers, freezing room and refrigerators)
- Oven room (3 drying ovens, 2 microwave furnaces and 3 furnaces)
- Dry sample storage room (sample sealing with paraffin)
- Gamma spectrometry room (18 HPGe detectors)
- Alpha spectrometry room
- Alpha counter room (60 Canberra Alpha Analyst PIPS detectors)
- Alpha/beta total counter room (including automatic evaporation system BUCHI)
- Radon water laboratory
- Alpha total counting room (20 ZnS detector units)
- Beta counting room (4 Canberra Series 5 alpha/beta counters with automatic sampler changer and 1 Canberra LB4200 proportional counter)
- Liquid Scintillation Counting room (3 Quantulus LSC, 1 Tricarb 2900TR LSC, 1 HIDEX LSC)

The verification team was informed of the procedures and documentation associated with the analytical workflow.

SCK CEN radiological laboratory is ISO 17025 accredited. It regularly participates in several national and international comparison exercises and proficiency tests.

The verification team commends the excellent equipment, facilities and the detailed attention to quality assurance at the SCK CEN radiological laboratory.

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7 CONCLUSIONS

All planned verification activities were completed successfully. The information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, proved very useful.

The information provided and the verification findings gave rise to the following observations:

(1) The verification activities found that the facilities needed to carry out monitoring of levels of radioactivity at the radiologically contaminated water catchment areas (Molse-Nete river and riverbanks) are adequate. The Commission ascertained that these facilities are in operation and running efficiently.

(2) The team's conclusions are set out in the 'Main Conclusions' document addressed to the Belgian competent authority through the Belgium Permanent Representative to the European Union.

(3) The Commission services kindly request the Belgian authorities to inform the Commission about any significant changes in the set-up of the monitoring programme, or associated facilities.

(4) The verification team acknowledges the excellent cooperation it received from all people involved in the activities it undertook during its visit.