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

THE NETHERLANDS

Routine and emergency radioactivity monitoring arrangements
Monitoring of radioactivity in drinking water and foodstuffs

4-6 July 2017

Reference: NL 17-01

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	Routine and emergency radioactivity monitoring arrangements Monitoring of radioactivity in drinking water and foodstuffs
LOCATIONS:	Bilthoven, Lelystad, Wageningen
DATES:	4 - 6 July 2017
REFERENCE:	NL 17-01
TEAM MEMBERS:	Mr V. Tanner (team leader) Mr S. McAllister
REPORT DATE:	13 November 2017
SIGNATURES:	

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S. McAllister

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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 the basic safety standards[1]. Article 35 also gives the European Commission (EC) 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 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 exposure 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 the Netherlands of its decision to conduct an Article 35 verification in a letter addressed to the Netherlands Permanent Representation to the European Union. The Netherlands Government subsequently designated the National Institute of Public Health and the Environment (RIVM) to lead the preparations for this 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 visit. The information thus provided was used extensively in drawing up the descriptive sections of the report.

2.3 PROGRAMME OF THE VISIT

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

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1 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L 159 of 29.6.1996) and 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; repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom with effect from 6 February 2018. (OJ L 13 of 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, pp. 2-5).

3 Replies to the preliminary information questionnaire addressed to the national competent authority, received on 28 June 2017.

The opening meeting included presentations on the Netherlands's automatic monitoring network, other environmental monitoring arrangements and emergency monitoring arrangements. The verification team pointed to the quality and comprehensiveness of all the presentations and documentation.

The team carried out the verifications in accordance with the programme in Appendix 1. It met the following representatives of the national authorities and other parties involved:

Ms. Barbara Godthelp	ANVS	Senior policy advisor
Mr. Lars Roobol	RIVM	Manager RIVM radionuclide lab
Mr. Gert-Jan Knetsch	RIVM	Co-ordinator environmental monitoring
Mr. Pieter Kwakman	RIVM	Co-ordinator radiochemical analyses
Mr. Rick Tax	RIVM	Co-ordinator gamma measuring grid
Mr. Siebren van Tuinen	RIKILT	Manager RIKILT radionuclide lab
Mr. Carlo Engeler	RWS	Co-ordinator radiochemical analyses
Mr. Bernard Bajema	Vitens	Project leader
Ms. Emile Laurensse	NVWA	Food scientist

3 LEGAL FRAMEWORK FOR RADIOACTIVITY MONITORING

3.1 LEGISLATIVE ACTS REGULATING ENVIRONMENTAL AND FOOD RADIOACTIVITY MONITORING

According to Article 35 of the Euratom Treaty each Member State shall establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and to ensure compliance with the basic standards. At the moment this is not laid down in legislation in the Netherlands. The requirement is fulfilled by the national environmental monitoring program that is conducted by the National Institute for Public Health and the Environment (RIVM) commissioned by the competent authority in the Netherlands, the Authority for Nuclear Safety and Radiation Protection (ANVS). RIVM only carries out part of the program: the rest is carried out by RWS, RIKILT, NVWA and the water companies. These parties act independently, i.e. not commissioned by the ANVS, and voluntarily share their results with RIVM, who compiles the integral report for the Netherlands. The results from the combined monitoring program are reported to the European Commission to fulfil Article 36 of the Euratom treaty. The Netherlands also complies with Recommendation 2000/473/Euratom on reporting requirements and Recommendation 2004/2/Euratom on standardized information for the reporting of the data.

The Dutch monitoring program for radioactivity in the environment - including air, water (surface water, seawater and drinking water), soil, food, grass, milk and feed - is carried out according to the national requirements. The results of these measurements are reported in an annual RIVM report on the environmental radioactivity; in addition the required data is reported to the European Commission (less than in the full RIVM report).

Implementation of the new European Basic Safety Standards (2013/59/Euratom) will result in incorporation of the environmental measuring program into the Dutch new basic safety standards radiation protection decree, which will come into force from the 6th of February 2018. Article 6.24 of this new Dutch decree designates the Minister of Infrastructure and Environment to ensure that there will be an appropriate monitoring program. The minister can appoint a service that can coordinate and conduct the program. Additional administrative ordinances may be required with respect to design, content, task division and execution of the monitoring program.

3.2 LEGISLATIVE ACTS REGULATING RADIOLOGICAL SURVEILLANCE OF DRINKING WATER

In 2016, the Netherlands informed the Commission that it has transposed Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption. The list below identifies the transposing legislation.

- Order No V-1278 of the Minister for health of the Republic of the Netherlands of 11 November 2015 amending Order No V-455 of 23 July 2003 approving the Netherlands hygiene standard HN 24:2003, 'Safety and quality requirements for drinking water'
- Decree of 4 June 2015 amending the Commodities Act Decree on the preparation and processing of foodstuffs, the Commodities Act Decree on administrative fines and the Commodities Act Decree on packaged waters in the light of Directive 2013/51/Euratom
- Decree of 27 August 2015 amending the Drinking Water Decree [Drinkwaterbesluit] for the purpose of implementing Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption
- Order of the Minister for Infrastructure and the Environment of 11 September 2015, No IENM/BSK-2015/56274, amending the Drinking Water Order [Drinkwaterregeling] for the purpose of implementing Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption

3.3 International legislation and guidance documents

The list below includes the main international legislation and guidance documents issued by the European Union (EU), the International Atomic Energy Agency (IAEA), and the World Health Organisation (WHO) that form the basis for environmental radioactivity monitoring and the radiological surveillance of foodstuffs, drinking water and radioactive discharges.

The European Union

- The Euratom Treaty (1957)
- Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L 159 of 29.6.1996)
- 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; repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom with effect from 6 February 2018. (OJ L 13 of 17.1.2014)
- Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption (OJ L 296 of 7.11.2013)
- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole (OJ L191 of 27.7.2000)
- Commission Recommendation 2004/2/Euratom of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation (OJ L36 of 6.1.2004)

International bodies, in particular the International Atomic Energy Agency (IAEA)

- *Radiation Protection and Safety of radiation Sources: International Basic Safety Standards*, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna, 2014
- *Clearance of materials resulting from the use of radionuclides in medicine, industry and research*, IAEA-TECDOC-1000, IAEA, Vienna, 1998
- *Generic models for use in assessing the impact of discharges of radioactive substances to the environment*, Safety Reports Series No 19, IAEA, Vienna, 2001
- *Handbook of parameter values for the prediction of radionuclide transfer in temperate environments*, Technical Reports Series No 364, IAEA, Vienna, 1994

- *International basic safety standards for protection against ionizing radiation and for the safety of radiation sources*, Safety Series No 115, IAEA, Vienna, 1996
- *Management of radioactive waste from the use of radionuclides in medicine*, IAEA-TECDOC-1183, IAEA, Vienna, 2000
- *Regulatory control of radioactive discharges to the environment: Safety Guide*, Safety Standards Series No. WS-G-2.3, IAEA, Vienna, 2000
- World Health Organisation (WHO), *Guidelines on the quality of drinking water (Guidelines for drinking-water quality, 4th ed. 2011)*

International conventions

- The Convention on Nuclear Safety
- The Convention on Early Notification of a Nuclear Accident
- The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency

4 BODIES HAVING COMPETENCE IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY MONITORING IN THE NETHERLANDS

4.1 Authority for Nuclear Safety and Radiation Protection

The competent authority in the Netherlands is the Authority for Nuclear Safety and Radiation Protection (ANVS). It is an independent body, while the Minister of Infrastructure and the Environment[4] is politically responsible.

ANVS is responsible both for the environmental monitoring in the Netherlands and for the organisation of the crisis response. Measurements during emergencies are co-ordinated by the RIVM. During crises, partners of the RIVM are the fire departments, the Ministry of Defence, RWS, RIKILT, drinking water companies, and a network of universities and industrial facilities.

4.2 National Institute of Public Health and the Environment

The National Institute of Public Health and the Environment (RIVM), part of the Ministry of Health, Welfare and Sports, is co-ordinating the annual report on environmental radioactivity in the Netherlands, for the ANVS. It also measures air particulates, atmospheric deposition, ambient dose rate and some aspects of drinking water.

4.3 Rijkswaterstaat

Rijkswaterstaat (RWS) is responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. This includes the main road network, the main waterway network and water management systems. RWS analyses the quality of surface water, drinking water and seawater, including sediments, biota and suspended matter. The institute is part of the Ministry of Infrastructure and the Environment.

4.4 Institute of Food Safety

Institute of Food Safety (RIKILT), part of the University of Wageningen, monitors the quality of food and feed. RIKILT is reporting to the Netherlands Food and Consumer Product Safety Authority (NVWA), which is a part of the Ministry of Economic Affairs.

[4] After the verification visit the name of the ministry was changed to 'Ministry of Infrastructure, Public Works and Water Management'.

4.5 Elektriciteits Produktiemaatschappij Zuid-Nederland

Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ) is the owner of the nuclear power plant in Borssele. EPZ is responsible for taking and analysing environmental samples around the plant. Sampling and analysis is done for EPZ by NRG, Nuclear consultancy and Research Group, based in Petten.

5 ENVIRONMENTAL RADIOACTIVITY MONITORING IN THE NETHERLANDS

5.1 Introduction

The table below presents a general overview of the environment and food radioactivity monitoring in the Netherlands. Monitoring tasks are divided between RIVM, RWS, RIKILT and NRG. Results of the environmental radioactivity monitoring programme compiled by the RIVM are published on annual reports by the Ministry of Health, Welfare and Sport.

Programme	Executive organisation	Client
Air dust & deposition	RIVM	ANVS
Ambient dose rate	RIVM	ANVS
Surface water (fresh and sea)	RWS	Ministry of Infrastructure and the Environment (I&M)
Drinking water	Drinking water companies, RWS, RIVM	I&M
Milk	RIKILT	Ministry of Economic Affairs (EZ)[5]
Food	RIKILT, Netherlands Food and Consumer Product Safety Authority	EZ
Grass & feed	RIKILT	EZ
Environmental monitoring in the vicinity of the Borssele NPP	Nuclear Research Group (NRG)	Elektriciteits-Produktiemaatschappij Zuid-Nederland (EPZ)

[5] After the verification visit the client ministry was changed to 'Ministry of Agriculture, Nature and Food Quality'.

5.2 MONITORING CARRIED OUT BY THE RIVM

5.2.1 Automatic monitoring of gamma radiation dose rate and alpha/beta aerosol activity

Radiation dose rate is measured continuously. The Netherlands has an automatic radiation monitoring network covering its territory, consisting of 167 stations. The small symbols in Fig. 1 indicate the 153 locations which are equipped with gamma dose rate monitors and the large symbols indicate the 14 locations which are equipped with a gamma dose rate monitor and an alpha/beta aerosol monitor.

For gamma monitoring, a Saphymo XL-2-3 ambient dose equivalent monitor is used. Its measurement range is from 10 nSv/h to 10 Sv/h. Every 10 minutes data are gathered by the central control system. If the alarm level of 200 nSv/h is exceeded, a message is automatically sent, which is then investigated by the RIVM. The system and its components are designed for high availability.

A central server, database and the software system, which gather data from the measuring stations, are connected to a high availability private data communication network, mostly via fixed communication lines. Redundant central servers are available at a different location as a back-up system.

Figure 1. Locations of the telemetric network for monitoring radiation dose rate (small symbols) and alpha/beta aerosol activity (large symbols)

5.2.2 Monitoring of radioactivity concentration in air

Air samplers

Radioactivity concentration in air is monitored by filtering large amounts of air and by measuring the radioactivity content of the filter either in a laboratory or by a radiation detector directly on the filter assembly. The following equipment are available:

- A high volume sampler (Snow White, Senya Ltd) situated at the premises of the RIVM in Bilthoven. The air flow rate through a large fiberglass filter is approximately 780 m^3/h (normalised to STP conditions). Continuous operation is ensured by an emergency power supply. The flow rate (actually the pressure difference related to the flow rate) is monitored by a software tool every minute and a notification is sent periodically in case a threshold of 760 m^3/h (STP) is passed for more than 5 minutes. In the event of a prolonged reduced flow rate the filter is prematurely exchanged, resulting in two filters for a sampling period of one week. Also, special events reported by other countries may trigger premature exchange of the filter, such as the nuclear accident in Fukushima, or the recent report about ruthenium-106 in the air above parts of Europe.
- 14 alpha/beta aerosol monitors of the national radioactivity network (Figure 1). Berthold BAI9128 alpha/beta aerosol monitors of the national radioactivity network also report natural alpha activity concentration. For emergency purposes artificial alpha and beta is reported. The system uses a Passivated Implanted Planar Silicon (PIPS) -detector. Integration time of the 10-minute value is an hour average.
- An on-line gamma aerosol monitor (for emergency purposes) is located in Bilthoven (the so-called Nuclide Specific Monitor (NSM Canberra FHT59), using an HPGe detector). Every two hours after spectrum analysis the activities of gamma nuclides are reported. The spectrum is measured during sampling. It is not used for early warning. The typical detection limit of ^{137}Cs is about a few tenths of mBq/m^3. Gross alpha, gross beta and 78 gamma emitters (amongst which ^{7}Be, ^{131}I, ^{137}Cs and ^{210}Pb) are reported. The nuclide library of the NSM consists of about 30 nuclides.

Dry/wet deposition collectors

Atmospheric deposition is monitored by collecting rain water and dust deposition on containers and by analysing the samples in the laboratory. Four deposition collectors are situated at the premises of the RIVM in Bilthoven. The collection area of the weekly collector is 5000 cm^2 and the collection area of the three monthly collectors 961 cm^2. The collectors and the sample containers are made of plastic and positioned within a steel frame (see Fig. 2).

Samples are collected weekly for γ emitters and monthly for gross α, gross β, ^{3}H and ^{210}Po according to standard NEN 5628[6]. The sampling height is 1 m. To prevent adsorption on the container wall, an acidic carrier solution is added to the containers for γ emitters (weekly) and gross α/β (monthly) and a small amount of hydrochloric acid is added to the container for ^{210}Po. ^{210}Po is monitored for two reasons: (1) to maintain the expertise in alpha spectrometry by performing this analysis on a regular basis; and (2) to determine the background level of ^{210}Po in the environment, so it will be possible to determine ^{210}Po emissions by non-nuclear industries like cement, phosphorous and steel factories.

[6] Radioactivity measurements – Sampling of the deposition, NEN, 2009, Delft, the Netherlands

Figure 2. RIVM Dry/wet deposition collectors

5.3 MONITORING CARRIED OUT BY THE RWS

5.3.1 Monitoring of radioactivity in surface waters, sediments, biota and suspended matter

RWS carries out a sampling programme for collecting samples of surface water, sediments, biota and suspended matter (the North Sea, lakes and rivers). There are about 20 sampling locations on inland waterways and coastal waters. Figure 3 presents the sampling locations. The table below presents the sampling methodologies. Analysis includes gross-α, gross-β, residual-β, α–emitters (^{210}Po, ^{226}Ra), β-emitters (^{3}H, ^{90}Sr) and γ-emitters (^{40}K, ^{60}Co, ^{131}I, ^{137}Cs, ^{210}Pb).

RWS carries out on-line gamma radiation measurements directly on the water of the river Rhine and the river Meuse at the border crossings with Germany and Belgium (Gross-α, Residual-β, ^{226}Ra, ^{228}Ra, ^{210}Po, ^{90}Sr, ^{99}Tc, ^{3}H and all gamma nuclides with energies 40 – 2000 keV).

5.3.2 Monitoring of radioactivity in ground water and drinking water

Drinking water in the Netherlands is purified ground water or surface water from the rivers. Regional drinking water production companies monitor untreated water and treated water for radionuclides. The monitoring frequency per location ranges from 1 to 26 times per year, depending on the volume of water produced. Monitoring includes ^{3}H, gross α, gross β and residual β (yearly). Typically a 2 litre sample is taken once a year from the drinking water supply and transported to one of the analytical laboratories. Sporadically, at a few locations, RIVM measures ^{222}Rn and ^{226}Ra (in 1995 and 2015)**.**

Radon content of the drinking water in the Netherlands has been studied in 2016[7].

[7] RIVM Letter report 2016-0048, P.J.M Kwakman, J.F.M. Versteegh, Radon-222 in ground water and finished drinking water in the Dutch provinces Overijssel and Limburg, Measuring campaign 2015.

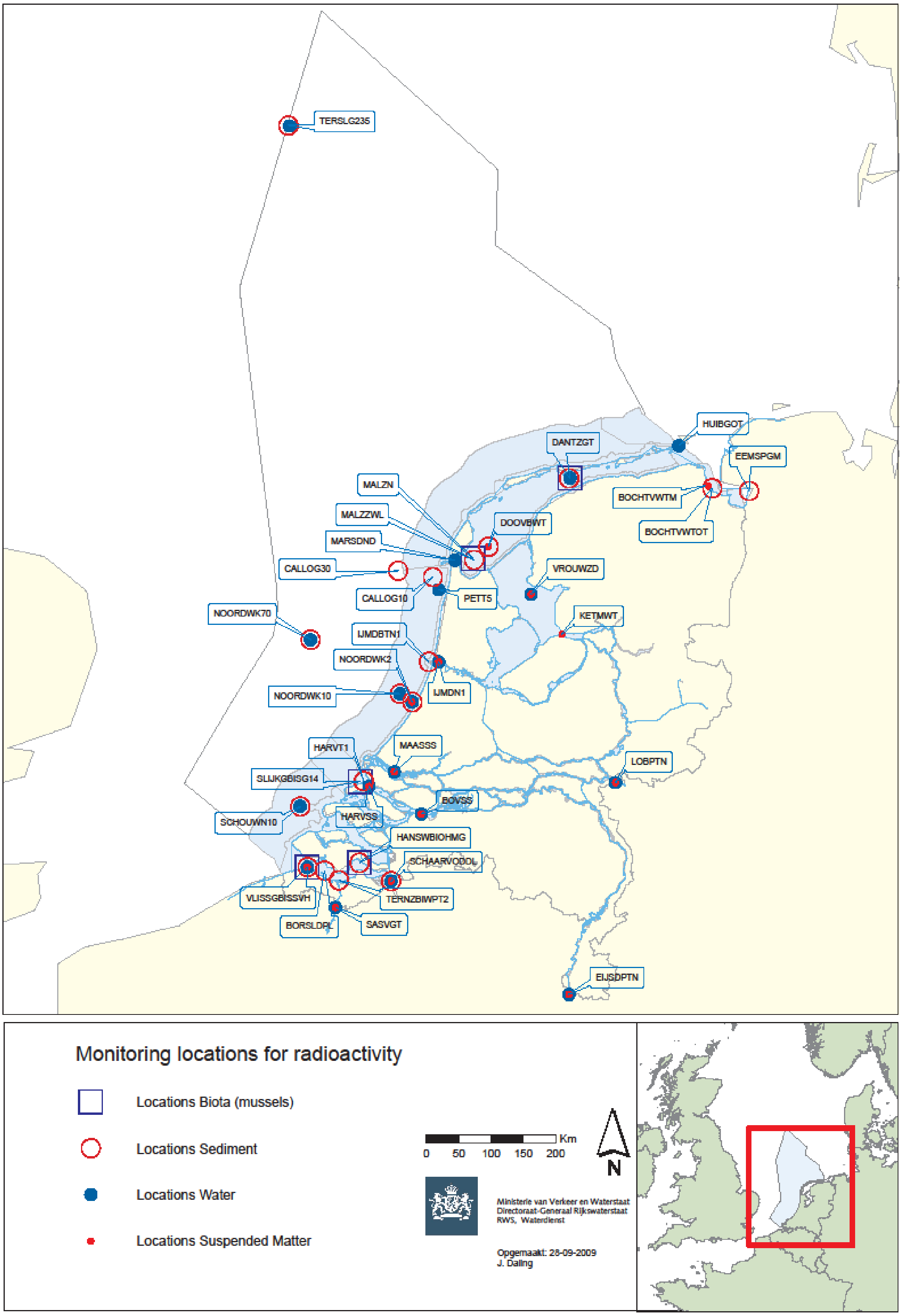

Figure 3. Sampling locations for marine and surface water, sediments and aquatic biota

Marine and surface water sampling programme[8]

Location		Parameter	Matrix	Monitoring frequency (per year)
IJsselmeer		Gross α	Water	13
(Vrouwezand)		Residual β	Water	12
		^{3}H	Water	7
		Gamma	Suspended solids	13
Noordzeekanaal		Gross α	Water	13
(IJmuiden)		Residual β	Water	13
		^{3}H	Water	13
		Gamma	Suspended solids	7
Nieuwe Waterweg		Gross α	Water	13
(Maassluis)		Residual β	Water	13
		^{3}H	Water	6
		^{90}Sr	Water	6
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	6
		Gamma	Suspended solids	13
Rhine		Gross α	Water	13
(Lobith)		Residual β	Water	13
		^{3}H	Water	13
		^{90}Sr	Water	7
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	7
		Gamma	Suspended solids	26
Scheldt		Gross α	Water	14
(Schaar van Ouden Doel)		Residual β	Water	14
		^{3}H	Water	6
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	6
		Gamma	Suspended solids	14
Meuse		Gross α	Water	13
(Eijsden)		Residual β	Water	13
		^{3}H	Water	13
		^{90}Sr	Water	7
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	7
		Gamma	Suspended solids	52
Kanaal Gent Terneuzen		Gross α	Water	13
(Sas van Gent)		Residual β	Water	13
		^{3}H	Water	6
		Gamma	Suspended solids	4
Haringvliet		Gross α	Water	13
(Haringvlietsluis)		Residual β	Water	13
		^{3}H	Water	7
		Gamma	Suspended solids	11
Coastal Area	Noordwijk 2 (1)	Gross α	Water	4
(KZ)		Residual β	Water	4
		^{3}H	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
		^{99}Tc	Water	4
Coastal Area	Petten 5 (1)	Gross α	Water	4
		Residual β	Water	4
		^{3}H	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
		^{99}Tc	Water	4
		Gamma	Water	4
Southern North Sea	Noordwijk 70 (1)	Gross α	Water	4

[8] As presented in the yearly RIVM report. The RWS programme encompasses more than is reported in this report.

Location		Parameter	Matrix	Monitoring frequency (per year)
(ZN)		Residual β	Water	4
		^{3}H	Water	4
		^{90}Sr	Water	4
Central North Sea	Terschelling 235 (1)	Gross α	Water	4
(CN)		Residual β	Water	4
		^{3}H	Water	4
		^{90}Sr	Water	4
Delta Coastal Waters	Schouwen 10 (1)	Gross α	Water	12
(VD)		Residual β	Water	12
		^{3}H	Water	12
		^{90}Sr	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
Westerscheldt	Vlissingen Boei	Gross α	Water	13
(WS)		Residual β	Water	13
		^{3}H	Water	13
		^{90}Sr	Water	13
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	13
		Gamma	Suspended solids	4
Eems-Dollard	Huibergat Oost	Gross α	Water	4
(ED)		Residual β	Water	4
		^{3}H	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
	Bocht van Watum	Gamma	Sediment	4
Wadden Sea West	Marsdiep Noord	Gross α	Water	4
(WW)		Residual β	Water	4
		^{3}H	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
	Doove Balg West	^{137}Cs	Sediment	4
Wadden Sea East	Dantziggat	Gross α	Water	4
(WO)		Residual β	Water	4
		^{3}H	Water	4
		$^{226}Ra/^{228}Ra/^{210}Po$	Water	4
(1) Number indicates distance from shore. For example, 'Noordwijk 2' means Noordwijk 2 km offshore.				

5.4 MONITORING CARRIED OUT BY THE RIKILT

5.4.1 Fixed monitoring stations for radioactivity in food and feed

RIKILT operates the national monitoring network for radioactivity in food (Landelijk Meetnet Radioactiviteit in Voedsel, LMRV). The LMRV consists of about 50 measuring stations equipped with low resolution gamma spectrometers (NaI-detectors) placed throughout the Netherlands. 23 of these stations are positioned at dairy factories (Figure 4). The results of the weekly samples of cow and goat milk from all dairy locations are combined into a monthly average for the whole country.

The monitoring stations consist of a stainless steel housing of about 700 kg, in which a computer, a NaI-detector, a monitor and a printer are placed (Figure 5). Samples, collected in a 1 litre Marinelli beaker, can be placed into the lead castle above the NaI-detector. Standard geometry measurements can be performed varying from 10 minutes to 1 hour, depending on the expected activity in the samples. In Wageningen, a central communication infrastructure including a central database is operated. This system collects data from all measuring stations every day.

The LMRV network is also an important monitoring network used in the event of a nuclear or radiological emergency, as described in the National Crisis Management Plan Radiation Incidents (Nationaal Crisisplan Stralingsongevallen, NCS).

Figure 4. Network of fixed monitoring stations for radioactivity in food and feed

Figure 5. Fixed monitoring station for radioactivity in food and feed

5.4.2 Monitoring of radioactivity in milk

In addition to the LMRV samples, raw milk samples are analysed for a range of gamma emitters on a high resolution gamma spectrometer at the RIKILT laboratory in Wageningen. The samples are collected across the Netherlands. The samples are analysed also on the beta emitter ^{90}Sr using low level liquid scintillation counting (LSC). RIKILT also monitors raw milk specifically for export certification. For this, samples are analysed for ^{137}Cs and ^{90}Sr.

5.4.3 Monitoring of radioactivity in foodstuffs

RIKILT analyses radioactivity in food products as part of the national monitoring programme. Samples are taken throughout the year and measurements carried out according to standard procedures. Of these food samples, about 10% are additionally analysed for ^{90}Sr content. RIKILT also monitors food and feed specifically for export certification (^{137}Cs and ^{90}Sr). In addition, monitoring of food imported from countries affected by the Chernobyl fallout is carried out (^{137}Cs in mushrooms, berries, etc.).

The following samples are regularly taken as a representative cross-section of the human food package:

- Vegetables and fruits
- Meat and meat products
- Game and poultry
- Eggs
- Fish and fishing products
- Ready meals

5.4.4 Monitoring of radioactivity in grass and feeding stuffs

In addition to measuring radioactivity levels in milk and food samples, the LMRV network is used to measure radioactivity levels in grass samples. For this purpose, reference pastures and fields have been designated across the Netherlands in proximity to the companies and organisations which participate in the LMRV. In this way the extent of radioactive deposition can be assessed rapidly by the LMRV in the event of a nuclear or radiological incident.

It is important to have accurate and recent information on the natural background levels of radioactivity in grass to compare with samples analysed during a nuclear or radiological incident. For this reason, every year all LMRV locations are requested to take a grass sample from their reference pasture or field, according to a standardised protocol, and measure this sample using the food monitoring system.

In addition to grass, also animal feed samples are analysed for gamma content as part of the regular monitoring programme of RIKILT.

6 VERIFICATIONS

6.1 GENERAL

The verification team was informed about the routine and emergency environmental radioactivity monitoring arrangements in the Netherlands during the opening meeting. Verifications were carried out according to the agreed programme in Bilthoven (RIVM), Lelystad (RWS) and Wageningen (RIKILT). Monitoring work carried out in RIVM, RWS and RIKILT covers the total territory of the Netherlands including the marine area and inflow of major rivers on both routine and emergency conditions.

Environmental monitoring carried out in the area surrounding the Borssele nuclear power plant was not included in the verification. Arrangements at the Borssele NPP have been verified by the Commission in 2008[9].

[9] Technical report on Commission verification under the term of Article 35 of the Euratom Treaty, Borssele Nuclear Power Plant, 3 to 7 March 2008, 21.1.2009.

6.2 National Institute of Public Health and the Environment (RIVM), Bilthoven

6.2.1 Routine monitoring facilities

Automatic dose rate monitoring

RIVM has one of the Saphymo dose rate monitoring stations of the national network. The station is based on two GM-tubes (low and high dose rate range) and also equipped with rain intensity sensor. Communication is based on fixed telephone lines.

Additionally, RIVM has 25 mobile dose rate stations, which are technically identical to the fixed stations, but they can be quickly located anywhere in the Netherlands. These stations have wireless communication systems and solar panels for extended autonomous operation.

The dose rate stations are calibrated annually using a test source.

Atmospheric deposition activity monitoring

Atmospheric deposition samples are collected using three collectors with 0.33 m^2 collection area and one larger collector with 0.5 m^2 collection area. Collectors are rinsed during sample collection; samples are stabilised using an acidifying agent. Samples from the three smaller collectors are analysed for ^{3}H, gross alpha/beta and ^{210}Po. Gamma spectrometry is performed on the sample of the large collector.

Automatic atmospheric monitoring

RIVM has a monitoring container, which houses the following air monitoring systems:

- Aerosol alpha/beta monitor Berthold BAI9120. This station is equipped with a rolling filter paper and a coincidence system for distinguishing artificial radiation.
- Low volume air monitor equipped with a rolling filter paper and an HPGe gamma spectrometer (Canberra 25%), allowing automatic high-resolution nuclide-specific air radioactivity measurements. The filter step is 24h. This station is the only one of its kind in the Netherlands.

The automatic systems do not currently have the possibility to install activated charcoal cartridges for monitoring ^{131}I in the event of an emergency. This capability is, however, available in the RIVM emergency monitoring vehicles.

Atmospheric particulate radioactivity monitoring

RIVM operates a Snow White high-volume air sampler (no filter heating) installed on the roof of the laboratory building. The sampler pumps air through a fibreglass filter at a constant flow rate of 750 m^3/h. The system has an uninterruptable power supply for data collection (to prevent loss of data), but not for the air pump. However the air pump itself is attached to an emergency power supply which is guaranteed to be online within 15 minutes.

Unlike many other such devices in Europe, the RIVM device is equipped with a flow controller, which adjusts the air pump to maintain a constant air flow through the filter. The air flow data is collected on a PC and pressure and temperature are normalised to obtain an accurate total flow result for each filter. The reading of the Snow White mechanical flow counter is not used in the total flow determination.

> *The verification team suggests that the RIVM considers including the possibility of monitoring gaseous ^{131}I in the automatic atmospheric radioactivity monitoring systems.*
>
> *The verification team acknowledges the quality of the monitoring equipment and the advanced total flow determination method of the high-volume air sampler.*

6.2.2 Radionuclide laboratory

RIVM radionuclide laboratory is very well equipped for environmental radionuclide measurements. There are altogether 10 staff members trained for radioactivity measurements. The laboratory holds ISO17025 accreditation. Samples are labelled and handled according to the laboratory quality manual; each work step has its own written instruction.

Laboratory analytical equipment includes the following:

- Liquid scintillation counters (2) for ^{3}H, ^{14}C and ^{90}Sr measurements (Perkin Elmer tri-Carb 31000TR and 2910TR)
- Gas proportional counters (8 detector chambers) for gross alpha/beta measurements (Canberra LB 4110)
- Alpha spectrometer (4 detector chambers) (Canberra Alpha Analyst)
- HPGe gamma spectrometers (5) (Genie 2000 Canberra)

Laboratory counting rooms are air conditioned and provided with back-up power systems. Commercial standards are used for calibration of the instruments. Environmental samples are typically kept for 10 years after publication of the monitoring results.

RIVM laboratory has prepared emergency protocols to manage an inflow of a large number of contaminated samples in the event of a radiological emergency; special sample management arrangements have been planned to avoid cross-contamination and increase of laboratory radiation background in this type of situation.

No remarks.

6.2.3 Emergency monitoring equipment

In addition to the mobile dose rate stations (section 6.2.1), the main mobile emergency radiation monitoring capability in the Netherlands is achieved via the two advanced emergency monitoring vehicles operated by the RIVM and the supporting hand-held monitoring devices. In addition the nuclear power plant at Borssele operates its own terrestrial monitoring vehicles and local authorities have been equipped with basic radiation monitoring equipment. There is no airborne radiation monitoring capability in the Netherlands.

The monitoring vehicles are based on IVECO-trucks. They have been in operation since 2009 and are equipped for the following:

- Dose rate monitoring with GPS plotting
- Alpha/beta monitoring
- Air sample collection (5 minute particulate and active charcoal filter sample, collection rate 50 litres/minute)
- Pressurised air sample compressor for noble gas measurement (200 bar)
- Hand-held radioactivity monitor (NaI detector)
- On-site swipe test and liquid sample analysis (LSC)
- Gamma spectrometry (one electrically cooled portable and one fixed N_2-cooled HPGe detector)

The vehicles are air-conditioned and over-pressurised. In order to provide autonomy they are equipped with electrical generators and UPS systems. Typically operation requires a driver and two measurement staff. Altogether, 8 members of the RIVM staff have been trained for vehicle operation. The vehicles are on standby in Bilthoven and are available for deployment anywhere in the Netherlands.

No remarks.

6.3 RIJKSWATERSTAAT (RWS), LELYSTAD

6.3.1 Radionuclide laboratory

RWS radionuclide laboratory is very well equipped for environmental radionuclide measurements. There are altogether 3 staff members trained for radioactivity measurements and 12 for preparation of the samples. The laboratory holds ISO17025 accreditation. Samples are labelled, registered in the Laboratory Information Management System (LIMS) and handled according to the laboratory quality manual; each work step has its own written instruction. Typical water sample size is from 100 ml to 10 litres; other typical sample types are sediments, biota and suspended matter. After analysis, the samples are stored for at least 10 years in large temperature controlled storage rooms or freezers.

Laboratory analytical equipment includes the following:

- Liquid scintillation counter (Quantulus 1220 Ultra Low Level)
- Liquid scintillation counter (2) (ALORA low background)
- NaI food radioactivity measurement unit (one of the LMRV network units)
- Gas flow proportional counters for alpha/beta measurements (5) with automatic sample changer system (Thermo FHT770).
- Alpha counter (2) for Ra and Po counting (Canberra Alpha Analyst)
- Proportional counter for ^{90}Sr analysis (Tennelec LB4110)
- HPGe gamma spectrometers (4) (Genie 2000 Canberra)

Laboratory counting rooms are air conditioned and provided with back-up power systems. Commercial standards are used for calibration of the instruments.

RWS laboratory has prepared emergency protocols to manage an inflow of large number of contaminated samples in the event of a radiological emergency; special sample management arrangements have been planned to avoid cross-contamination and increase of laboratory radiation background in this type of situation.

No remarks.

6.4 INSTITUTE OF FOOD SAFETY (RIKILT), WAGENINGEN

6.4.1 Food and milk monitoring network

RIKILT is in charge of the fixed food and milk radioactivity monitoring stations, which are located in food production facilities all over the Netherlands. 50 such units are operational today and 30 more are in storage. Measurement data from these stations is automatically transferred to RIKILT and RIVM. RIKILT organises training courses for the station operators, so they are able to carry out measurements in their facility according to a regular programme on both routine and emergency situations.

Use of the measurement station was demonstrated to the verification team. The components are a lockable casing, a NaI-detector, a sample holder inside lead shielding, a modem, PC and a printer. Altogether seven samples types are available in the system parameters. The sample is placed in a sampling position under a hatch. Each system has its own calibration standard, which is used to carry out control of the efficiency calibration. In addition the system requires a background measurement once a year.

6.4.2 Radionuclide laboratory

RIKILT radionuclide laboratory is well equipped for food radioactivity measurements. There are altogether 12 staff members trained for radioactivity measurements. The laboratory holds ISO17025 accreditation. Samples are labelled, registered in the Laboratory Information Management System (LIMS) and handled according to the laboratory quality manual; each work step has its own written instruction.

Laboratory analytical equipment includes the following:

- Alpha spectrometer (Canberra Alpha analyst, 12 chambers)
- Liquid scintillation counter (Quantulus 1220)
- Liquid scintillation counter (HIDEX)
- Liquid scintillation counter (Tri-Carb 2300TR)
- HPGe gamma spectrometer (2) (Canberra, one equipped with an automatic Marinelli sample changer)

Laboratory counting rooms are air conditioned and provided with back-up power systems. Commercial standards are used for calibration of the instruments.

RIKILT laboratory has prepared emergency protocols to manage a throughput of a large number of contaminated samples in the event of a radiological emergency; special sample management arrangements have been planned to avoid cross-contamination and increase of laboratory radiation background in this type of situation.

No remarks.

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, were to a high standard and proved very useful.

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

(1) Overall, the national environmental radioactivity monitoring programme in the Netherlands complies with the requirements of Article 35 of the Euratom Treaty.

(2) The verification activities found that the facilities needed to carry out continuous monitoring of levels of radioactivity in the air, water and soil are adequate. The Commission ascertained that these facilities are in operation and running efficiently.

(3) One suggestion for improvement has been formulated. This concerns the capability to monitor gaseous ^{131}I in the event of an emergency. Notwithstanding this suggestion the verified parts of the national monitoring system for environmental radioactivity in the Netherlands are in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(4) The recommendations are set out in detail in the 'Main Conclusions' document addressed to the Netherlands competent authority through the Netherlands Permanent Representative to the European Union.

(5) The Commission services kindly request the Netherlands authorities to submit a report on any significant changes in the set-up of the monitoring systems, before the end of 2019. Based on this report the Commission will consider the need for a follow-up verification in the Netherlands.

(6) The verification team acknowledges the excellent cooperation it received from all persons involved in the activities undertaken during its visit.

ANNEX 1

VERIFICATION PROGRAMME

National environmental radioactivity monitoring network in the Netherlands

4 – 6 July 2017

Day/date	Time	Verification
Tuesday 4 July	**10.30 – 12:00**	**Opening meeting**
	13:30 – 17:00	**Verification of automatic radiation monitoring stations and sampling arrangements in RIVM, Bilthoven**
Wednesday 5 July	**09:00 – 17:00**	**Verification of laboratories involved in environmental radiation monitoring in RWS, Lelystad**
Thursday 6 July	**09:00 – 13:30**	**Verification of arrangements for monitoring radioactivity in drinking water and food in RIKILT, Wageningen**
	15.00 – 16.00	**Closing meeting**