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Notifications relating to radioactive substances and radiation in 2003, 2004 and 2005

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Summary

This document provides a summary of the notifications relating to radioactive substances received in 2003, 2004 and 2005 by the Inspectorate for Housing, Spatial Planning and the Environment for the South-West Region (VI-ZW). The Inspectorate for Housing, Spatial Planning and the Environment is responsible for dealing with notifications received, as part of its supervision of compliance with the Nuclear Energy Act.

In 2003, 2004 and 2005 a total of 289, 429 and 414 notifications respectively were received by the VI-ZW. The majority of those notifications concerned reports of scrap cargoes with an elevated level of radiation. Approximately 60 additional reports, alerts and tips are dealt with annually. In the past few years, support was provided to other government authorities, citizens and others on approximately 20 occasions.

In following up on the notifications, a total of 159, 255 and 269 violations were found in 2003, 2004 and 2005 respectively. The majority of those violations concerned instances of holding, without a permit under the Nuclear Energy Act, scrap containing radioactive substances requiring a permit and/or requiring to be reported.

Since 2004, the VI-ZW has provided support to customs as part of combating terrorism, which means that, if customs identifies a suspect container or a container giving rise to suspicion of a violation under the Nuclear Energy Act, it requests the VI-ZW to examine this in further detail. To date, no Special Nuclear Material (SNM) or material for making a “dirty bomb” has been found. However, in 2005, violations of the provisions of the Nuclear Energy Act were found in half of the instances where support was requested.

A number of notifications involved a considerable risk for workers at scrap-processing companies to be exposed to comparatively high doses of ionising radiation. In those cases an INES report was made to the IAEA. A number of other notifications involved a real danger of dissemination of radioactive substances in the environment.

In a number of cases, the VI-ZW was faced with serious violations or a refusal to eliminate the violation found. In those cases, the VI-ZW instituted administrative (other than warning letters) and/or criminal-law proceedings.

Finally, we wish to express our appreciation for the staff of the RTD and NRG, who on behalf of third parties performed a great deal of work in dealing with notifications (especially sorting etc. of scrap cargoes with elevated levels of radiation) and often formed a welcome link between those who submitted the reports or alerts and the staff of the VI-ZW.

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1 Introduction

1.1 General

The Nuclear Energy Act (NEA) contains two articles providing that “Anyone who, without due authorisation, has in their possession or obtains fissionable materials or ores (article 22), radioactive substances (article 33), or substances which must reasonably be suspected to be fissionable materials or ores or radioactive substances, is obliged to report this without delay to the mayor of the municipality where those goods are located”. The aforesaid articles further provide that “The mayor shall without delay notify the report received to one of the officials designated pursuant to article 58, first subsection”. In practice, virtually all reports are made directly to the officials designated pursuant to article 58, first subsection of the Inspectorate for Housing, Spatial Planning and the Environment of the South-West Region (VI-ZW), with or without mediation by the Ministry of Housing, Spatial Planning and the Environment incident reporting unit.

In some cases the reports as referred to in article 22 and 33 of the Nuclear Energy Act are made to other government authorities. Those authorities (regional environmental services, fire service, etc.) then submit a request to the VI-ZW to take over and deal with the report. Also, other government authorities (customs, for instance) sometimes encounter situations giving rise to the suspicion of a violation of the NEA. Arrangements have been agreed under which the VI-ZW will institute an examination at the request of those other government authorities. Furthermore, other government authorities (the police for instance) can receive notifications in their investigations that fissionable materials, ores or radioactive substances are potentially involved that constitute a risk factor. In such cases, they will request radiation protection support from the VI-ZW. Citizens likewise sometimes ask for support from the VI-ZW for problems potentially involving radioactive substances and/or radiation.

In addition, most permits under the NEA set out, in requirements connected with the permit, provisions mandating, in essence, that incidents or accidents involving the use, loss or disappearance of fissionable materials, ores and radioactive substances must be reported without delay to the inspection services, including the VI-ZW.

At the VI-ZW, staff members are available and can be reached continually (365 days a year, 24 hours a day) for receiving and assessing reports, alerts and requests. If necessary, the staff member concerned can take or initiate measures immediately after having assessed the report, alert or request and start an onsite examination. Assistance and support from other specialised services and companies, for instance the National Institute for Public Health and the Environment [Rijksinstituut voor Volksgezondheid and Milieu - RIVM), the Radiation Technical Service [Röntgen Technische Dienst – RTD] and the Nuclear

Research Group (NRG), is an option. The VI-ZW has made the necessary arrangements with those services and companies.

1.2 About this report

The overarching term used here to refer to the reports, alerts and requests mentioned in the preceding section is notifications. This report will draw no further distinction between fissionable materials, ores and radioactive substances, all of which will be referred to as radioactive substances, unless a distinction is essential.

This report provides a summary of the notifications relating to radioactive substances and radiation received in the years 2003, 2004 and 2005 by the VI-ZW. The structure of this report differs from the report on the notifications in 2001 and 2002 (ref. 1) in a number of respects. Where possible and available, tables contain the (more or less) comparable figures for 2001 and 2002 from ref. 1 for comparative purposes. Bracketed numbers in tables refer to the number of violations found.

Types of notifications
This report provides information on the numbers of notifications received, drawing a distinction between:
- reports of cargoes with elevated radiation levels;
- other reports, alerts (of incidents, accidents, loss, disappearance, etc.) and tips;
- requests for support.

The relevant sections will provide a further breakdown and also spotlight one or more special notifications.

Violations
In addition, the various sections in this report will state, where possible, to what extent the notifications involved a violation under the NEA. Violations reviewed include, in particular:
- holding, without a permit, fissionable materials, ores or radioactive substances (article 15 and article 29 of the NEA) for which permits are required;
- holding, without having reported them, radioactive substances requiring to be reported (article 32 of the NEA);
- failure to report (or report in time) the unauthorised holding of fissionable materials, ores or radioactive substances (article 22 and article 33 of the NEA);
- failure to comply with a requirement connected with a permit granted under the NEA (article 76a of the NEA).

For further information on the method of counting violations used in this report, see section 6.

Guide to reading
Section 2 provides a general summary of the notifications received in 2003, 2004 and 2005 by the VI-ZW relating to radioactive substances and radiation. Section 3 describes the reports of scrap cargoes with an elevated radiation level from the Netherlands and abroad. Section 4 discusses the other reports and alerts of incidents, accidents, loss and disappearance and the tips. Next, section 5 zooms in on the requests for support. Sections 3, 4 and 5 contain a discussion of a number of selected, noteworthy notifications. Section 6 discusses enforcement by the VI-ZW. Finally, section 7 presents the conclusions and recommendations.

1.3 Other

Major changes in regulatory requirements.

- On 1 January 2003, the “Detection of Radioactive Scrap Decree” came into force. This decree provides, among other things, that scrap-processing companies with a turnover above certain specific limits are required to meter without delay the ionising radiation of the scrap taken inside the establishment.
- On 26 September 2004, the “Natural Sources of Ionising Radiation Regulation” came into force. Article 14 of that regulation provides that work on which no report or for which no permit was required previously by the NEA, had to be reported before 1 March 2005. In addition, the regulation contains a number of conditions to be met in carrying out work.
- On 29 July 2004, a number of changes in the “Transport of Fissionable Materials, Ores and Radioactive Substances Decree” came into force. Mayor changes include the requirement of a permit for all transport of fissionable materials and for bringing them into or taking them out of Dutch territory, and that a report will suffice in almost all cases for the transport of radioactive substances and for bringing them into or taking them out of Dutch territory.

Other reports

Further information on the enforcement of the NEA at scrap-processing companies is contained in the reports “Metering is a must!” and “Metering is a must II!” (ref. 2 and 3). Further information on the enforcement of the NEA in hospitals is contained in the report “Op visite” (ref. 4).

2 Types and number of notifications in 2003, 2004 and 2005

2.1 Types of notifications

The notifications are divided into three categories in this report.

- "Reports of scrap cargoes with an elevated radiation level". These are reports by scrap-processing companies that have found, with the aid of gate detectors, crane detectors and/or hand-held metering equipment, that a (part of) a scrap cargo delivered to them or stored on their premises has an elevated level of radiation. The procedure to be followed by them in reporting this, is set out in the "Inspection guideline for metal and scrap with radioactive substances" (ref. 5).
- "Other reports, alerts and tips". These are reports relating to other situations than scrap in which a company holds or obtains, without the required authorisation, radioactive substances or substances which must reasonably be suspected to be radioactive substances. They also include alerts by permit holders under the NEA relating to incidents, accidents, loss and disappearance they are to make under the provisions of their permit. This category includes tips from third parties relating to the suspicion of a violation of the NEA and incidents involving radioactive substances.
- "Requests for support". These include requests from other government authorities to process their reports, because their own officials have not been designated as "article 58 officials". Additionally, some government services suspecting a violation of the NEA are not sufficiently knowledgeable and/or sufficiently equipped to be able to assess these matters reliably. Finally, citizens sometimes ask for an examination by and on behalf of the VI-ZW if they suspect, in their personal life, issues concerning radiation and/or radioactive substances, or if they wish to dispose of radioactive substances they hold as private persons.

2.2 Number of notifications

Table 1 provides an overview of the number of notifications in the period covered by the report. In contrast to the previous report, the category referred to as "non-relevant notifications" has not been included in the numbers stated in table 1. The numbers in the category "other incidents" in table 1 or ref. 1 for the years 2001 and 2002 have been adjusted accordingly. In the years 2003, 2004 and 2005 84, 119 and 141 notifications respectively were received which rather swiftly proved not to require immediate follow-up. These notifications have not been included in the other numbers stated in this report. These notifications are, however, summarily recorded, since some of them are used for regular company inspections.

A few examples of “non-relevant notifications” are: gate alerts due to NDMT work (Non Destructive Materials Testing) using ionising radiation (sources and x-ray equipment) in the vicinity of the gate detector; gate alerts due to weighing tanks containing potassium hydroxide, rubble with bricks, etc. (the gate detectors are often located right beside the weigh bridge); gate alerts by persons who have been administered diagnostic radioactive substances in a hospital. Reports on (temporarily) malfunctioning of a gate detector are also assigned to the category “non-relevant reports”. The operator of the gate detector is, however, required to record these alerts carefully, to be able to explain these alerts, which are included in the gate detector database, in the event of an inspection by the VI-ZW.

Table 1: Overview of the number of notifications per year and per category for the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Reports of scrap with elevated radiation levels	152	208	210	343	336
Other reports, alerts and tips	57	55	70	67	56
Requests for support	16	9	9	19	22
Total	225	272	289	429	414
Increase in the number notifications versus prior year (%)	n/a	21	6	48	- 4

Table 1 shows that the number of reports of scrap cargoes with an elevated radiation level was considerably higher again in the years 2004 and 2005 than in the years 2002 and 2003. The number of other reports, alerts and tips has remained more or less constant over the years. The number of requests for support has clearly increased in the past few years.

In addition, there still is a considerable increase in the number of “non-relevant notifications” each year. This is attributable on the one hand to the still increasing number of gate detectors, on the other hand it may be caused by the fact that the owners of gate detectors want to “play safe” and avoid the risk of a gate alarm being designated as “cannot be explained” in the event of a company inspection.

3 Reports of metal scrap cargoes with elevated radiation levels

This section discusses the reports of scrap cargoes with elevated levels of radiation. Reports by scrap traders are usually made following an alarm by a gate detector. Virtually all large and medium-sized scrap traders now use gate detectors. In addition, a number of large scrap traders also have detectors fixed to cranes and shovels. A few smaller scrap traders use hand-held detectors to check the cargoes.

3.1 General

Table 2 provides an overview of the number of reports of scrap cargoes with elevated levels of radiation. The table draws a distinction between the following sub-categories:

- Scrap cargoes coming from the Netherlands. This category also includes the reports made following a gate alarm (or claw alarm) for scrap cargoes leaving a company in the Netherlands. The category also includes the reports made upon identifying radioactive substances on a company's own premises (after more detailed checks using hand-held detectors and with crane detectors when blending and moving scrap), when it is not possible to establish unambiguously that the radioactive substances originated from a cargo from abroad.
- Scrap cargoes that have come from abroad and have been sent back abroad without separating out the materials causing the elevated levels of radiation;
- Scrap cargoes coming from abroad whereby the materials causing the elevated levels of radiation have been separated out at the receiving Dutch company and examined. As part of the examination, the radionuclides were qualified and quantified as accurately as possible. Quantifying them is particularly difficult sometimes and will sometimes have to be done using estimates.

Table 2: Overview of the number of scrap cargoes with elevated levels of radiation per year and per sub-category for the years 2001-2005.

	2001	2002	2003	2004	2005
Reports of scrap cargoes from the Netherlands	83	124	121	177	186
Reports of scrap cargoes from abroad that were returned	20	14	15	29	30
Reports of scrap cargoes from abroad that were examined	49	70	74	137	120
Total	152	208	210	343	336
Share of scrap cargoes from the Netherlands (%)	55	60	58	52	55

Table 2 shows that the number of reports of scrap cargoes with elevated radiation levels was significantly higher again in the years 2004 and 2005 for all three subcategories than in the years 2002 and 2003. Also, the share of reports of scrap cargoes from the Netherlands, including reports made following identification of radioactive substances on a company's own premises, has been more or less constant over the years. The increase in the number of reports might be attributable to the increase in the number of gate detectors and the introduction of crane detectors at some companies.

A majority of the number of reports of scrap cargoes from the Netherlands comes from two large stainless steel scrap traders who have not only a gate detector but also crane detectors and who regularly perform additional checks using hand-held detectors on stocks of scrap in storage. Objects with elevated radiation levels are regularly found during those checks using hand-held detectors and during loading and blending of scrap using claws and cranes. In view of the fact that a large proportion of the scrap at those companies comes from abroad, it is reasonable to assume that a large proportion of the reports in effect does not relate to scrap from the Netherlands. As already stated above, these reports are nonetheless included in scrap coming from the Netherlands, because it cannot be established with certainty that the scrap originally came from abroad.

To illustrate and substantiate the above, table 3 shows the number of scrap cargoes with elevated radiation levels reported by the two large stainless steel traders and the other scrap traders.

Table 3: Overview of the number of reports of scrap cargoes with elevated radiation levels per year and by company or companies for the years 2003 to end-2005.

	2003	2004	2005
Stainless steel scrap-processing company A	68	133	73
Stainless steel scrap-processing company B	17	52	67
Other scrap-processing companies in the Netherlands	125	158	196
Total	210	343	336
Share of stainless steel scrap-processing companies A + B (%)	40	54	42

Table 3 shows that the two large stainless steel scrap-processing companies, averaged over the three years, accounted for almost half of the reports. The high number of reports by stainless steel scrap-processing company A in the year 2004 could be attributable to the large number of checks using hand-held detectors following the first-time detection of uranium-contaminated objects from Iraq at the end of 2003. The increase in the number of reports by stainless steel scrap-processing company B in 2004 and 2005 is likely to have been due to the intensified monitoring of the company by the VI-ZW.

3.2 Metal scrap cargoes from the Netherlands

In all cases, the cause of the elevated radiation levels was examined for these cargoes. The radioactive substances requiring permits and/or requiring to be reported were separated out from the cargo and were (or will be) transported to a company that is authorised to store them (Central Organisation for Radioactive Waste [Centrale Organisatie Voor Radioactief Afval – COVRA] in the case of radioactive substances requiring permits, and to landfills for hazardous waste in the case of radioactive substances requiring to be

reported), or were transported to a company that is authorised to process them (NRG location Petten for decontamination and Siempelkamp in Krefeld, Germany, for smelting). Companies that have a Nuclear Energy Act permit to sort scrap cargoes are the RTD and NRG. RTD and NRG send a copy of the reports on the findings of examinations and sorting to the VI-ZW. The VI-ZW reviews the reports, establishes whether or not there has been a violation of a provision under the NEA and takes further action if required.

Table 4 lists a number of comparatively frequent specific causes of elevated radiation levels in scrap cargoes. It also states whether this concerned a (closed/encapsulated) source or a contamination (as a thin-layer surface deposit on an object or a thin-layer of distributable dust on an object). Examples of measuring instruments include compasses, spirit levels, watches and dials of pressure gauges. Examples of comparatively frequent closed sources are lightning rods (containing the nuclides Ra-226 or Am-241) and Ra-226 tubes in old electronic equipment. Fireproof material does not include the material (with elevated levels of radiation) used to fireproof and theft-proof safes, cash dispensers, etc.

Table 4: Overview of the materials/objects/causes generating elevated radiation levels on scrap cargoes from the Netherlands by year and by categories for the years 2003 to end-2005.

	2001	2002	2003	2004	2005
Slag wool with Th-232/U-238 (isolation material)	21 (18)	22 (15)	31 (28)	32 (28)	52 (51)
Source (closed/encapsulated)	24 (20)	28 (28)	6 (6)	17 (17)	12 (12)
Measuring instrument with Ra-226	-	-	8 (8)	14 (14)	10 (10)
Fireproof material (stone, mortar, ceramic)	6 (0)	11 (2)	7 (0)	8 (0)	11 (1)
Uranium protection container	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)
Contamination	20 (9)	37 (24)	18 (13)	40 (28)	41 (34)
Other	11 (6)	25 (7)	50 (14)	66 (21)	60 (29)
Total	83 (54)	124 (77)	121 (70)	177(108)	186 (137)
Share of total violations (%)	65	62	58	61	74

In ref. 1, the 2001 and 2002 figures combine sources and measuring instruments as sources.
The lightning rods classed separately in ref. 1 for 2001 and 2002 have been counted as sources.

Table 4 shows that the share of the various causes of elevated radiation levels can fluctuate considerably over time. Nonetheless, no major shifts appear to be discernible for the time being. The most frequent causes of the elevated levels of radiation are slag wool and contaminations. The majority of the contaminations concern Ra-226 deposits (scale).

The percentage of reports for which a violation is found, is at around 60% for the years 2001 to end-2004. The higher percentage found for 2005 may be due to the fact that on 1 March 2005 the reporting obligation for radioactive substances requiring to be reported came into force. Only a single violation (reporting obligation) was found in the period 2003 to end-2005 in the fireproof material category.

3.3 Scrap cargoes from abroad that were returned

Table 5 provides an overview of the number of scrap cargoes with elevated radiation levels from abroad that were returned without separating out the material causing the elevated radiation levels. The table provides a breakdown of returns to the various countries, country clusters and continents.

A condition for such returns is that the radiation level on the outside of the container in which the cargo is transported must not exceed 5 microSievert per hour. In addition, the sender has to submit a declaration abroad confirming that he is aware of the reason for the non-acceptance of the cargo and that he will "process" the cargo after its return in line with the rules applicable in his country. The VI-ZW usually reports the return of the cargo to the competent authority in that country.

Table 5: Overview of the number of returns abroad of scrap cargoes with an elevated radiation level by year and origin over the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Belgium	4	6	9	4	0
Germany	9	8	2	20	30
Eastern Europe (former Eastern bloc countries)	1	0	1	0	0
Rest of Europe	2	0	3	5	0
Asia (including the European part of Turkey)	4	0	0	0	0
Africa	0	0	0	0	0
South America	0	0	0	0	0
Other	0	0	0	0	0
Total	20	14	15	29	30

Table 5 shows that the increase in the number of returns more or less parallels the increase in the total number of reports of scrap with elevated radiation levels. In the past few years, there have been no returns to non-European countries. In 2005 the only returns were to Germany. Returns to Germany are made predominantly by companies in the border area.

3.4 Metal scrap cargoes from abroad that have been examined in the Netherlands

In all cases, the materials with elevated radiation levels were separated out from these cargoes, and the cause of the elevated radiation level was examined. Both the nature and the quantity of radionuclides were examined. The radioactive substances requiring permits and/or requiring to be reported were separated out from the cargo and were (or will be) transported to a company that is authorised to store them (Central Organisation for Radioactive Waste [Centrale Organisatie Voor Radioactief Afval – COVRA] in the case of radioactive substances requiring permits and to landfills for hazardous waste in the case of radioactive substances requiring to be reported), or were transported to a company that is authorised to process them (NRG location Petten for decontamination and Siempelkamp in Krefeld, Germany, for smelting). As stated above, companies that have a Nuclear Energy Act permit to sort scrap cargoes are the RTD and NRG. RTD and NRG send a copy of the reports on the findings of examinations and sorting to the VI-ZW. The VI-ZW reviews the reports, establishes whether or not there has been a violation of a provision under the NEA and takes further action if required.

Table 6 provides an overview of the number of scrap cargoes from which the materials causing the elevated radiation levels were separated out in the Netherlands. The table provides a breakdown of returns to the various countries, country clusters and continents. The figures stated in ref. 1 for 2001 and 2002 for the country of origin have been clustered to facilitate meaningful comparison with the figures for 2003, 2004 and 2005.

Table 6: Overview of the number of scrap cargoes with elevated radiation levels that were sorted in the Netherlands by year and origin over the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Belgium	2 (2)	10 (9)	3 (2)	12 (10)	9 (7)
Germany	3 (1)	9 (4)	6 (4)	18 (14)	16 (15)
Eastern Europe (former Eastern bloc countries)	15 (14)	12 (7)	17 (10)	16 (15)	30 (24)
Rest of Europe	3 (2)	8 (3)	8 (7)	24 (17)	11 (8)
Asia (including the European part of Turkey)	12 (12)	8 (3)	20 (20)	38 (33)	18 (18)
Africa	8 (7)	5 (5)	6 (5)	13 (13)	15 (15)
South America	1 (1)	2 (1)	13 (13)	12 (10)	17 (17)
Other	5 (2)	16 (6)	1 (0)	4 (4)	4 (4)
Total	49 (41)	70 (38)	74 (61)	137 (116)	120 (108)
Share of total violations (%)	84	54	82	85	90

Table 6 shows that the number of scrap cargoes with elevated radiation levels coming from Asia peaked in 2004. This is probably due to the delivery of large quantities of stainless steel scrap from Iraq. Also notable is the increase in the number of cargoes with elevated radiation levels from South America. The cause of the comparatively large number of cargoes with elevated radiation levels from the “Rest of Europe” in 2004 is not known.

The percentage of the reports for which a violation is found is at around 85% for the years 2001 to end-2005, except in 2002. This means that this percentage is some 25% above that for scrap cargoes from the Netherlands.

Table 7 lists a number of comparatively frequent specific causes of elevated radiation levels in scrap cargoes. It also states whether this concerned a (closed/encapsulated) source or a contamination (as a thin-layer surface deposit on an object or a thin-layer of distributable dust on an object). Examples of measuring instruments include compasses, spirit levels, watches and dials of pressure gauges. Examples of comparatively frequent closed sources are lightning rods (containing the nuclides Ra-226 or Am-241) and Ra-226 tubes in old electronic equipment, etc. Fireproof material does not include the material (with elevated levels of radiation) used to fireproof and theft-proof safes, cash dispensers etc. No comparative figures for 2001 and 2002 are provided in ref. 1.

A notable feature reflected in table 7 is that no slag wool with elevated radiation levels is found in scrap cargoes from abroad. Slag wool containing concentrations of radionuclides requiring a permit or requiring to be reported is evidently a typically Dutch issue. Also, scrap from abroad only sporadically contains fireproof material with elevated radiation levels.

In 2004, a container with scrap from South America was found to hold three uranium protection containers. In 2005, a container with scrap from Africa was found to hold two uranium protection containers. The contaminations, as for scrap from the Netherlands, are mainly Ra-226 deposits.

Table 7: Overview of the materials/objects/causes generating elevated radiation levels on scrap cargoes from abroad by year and by categories for the years 2003 to end-2005.

	2003	2004	2005
Slag wool with Th-232/U-238 (isolation material)	0 (0)	0 (0)	0 (0)

Source (closed/encapsulated)	14 (14)	18 (18)	20 (20)
Measuring instrument with Ra-226	2 (2)	2 (2)	8 (8)
Fireproof material (stone, mortar, ceramic)	1 (0)	1 (0)	1 (0)
Uranium protection container	1 (1)	6 (6)	3 (3)
Contamination	35 (34)	73 (65)	58 (56)
Other	21 (10)	37 (25)	30 (21)
Total	74 (61)	137 (116)	120 (108)

3.5 Selected instances of radioactive substances in scrap

3.5.1 Slag wool requiring a permit

On 4 June 2003, the VI-ZW received a report of a gate alarm for a scrap cargo. Initially, the cargo appeared to consist of the fuselages of two planes. After removal of these two aircraft fuselages, which did not have elevated radiation levels, other scrap was found at the bottom of the container. Closer examination of this scrap revealed two gas discharge tubes containing quantities of radium-226 requiring a permit, as well as 500 kg ceramic material containing radioactive substances requiring to be reported and 140 grams slag wool. In view of the small quantity, the slag wool was exempted material (the concentration was within the range of the reporting obligation). Given the combination of the substances found, it was decided to investigate the origin of the radioactive material and the possibility of other issues being involved in this case. Extensive investigations and further examination by third parties engaged by the original owner of the scrap revealed that the plants of the company that had supplied the slag wool held a further 30 tonnes of slag wool that required a permit. A Nuclear Energy Act permit was issued to the company concerned for holding and disposing of these substances.

3.5.2 Source holders containing Cs-137 sources in scrap

On 23 July 2003, the VI-ZW received a report of a container with scrap from Venezuela with a slightly elevated radiation level (surface level of 0.13 microSievert per hour). Further examination revealed that the elevated radiation level was caused by a source holder with a Cs-137 source of some 20 GBq. The VI-ZW then received, on 24 July 2003, a report of the detection of a source holder with a Cs-137 source of some 2 GBq in a subsequent scrap cargo from Venezuela. This source was detected using a claw detector. The container in which the scrap with the source was transported had not triggered an alarm (almost certainly because the scrap was shielded). On 4 August 2003 a third container of scrap from Venezuela was found to hold unshielded Cs-137 of some 4 GBq, for which the radiation at the container surface was approximately 10 milliSievert per hour. The detection of these three sources was reported to the International Atomic Energy Agency (IAEA) in an INES report (International Nuclear Event Scale; see ref. 6).

3.5.3 Source stem with Sr-90 source

On 6 November 2003, the VI-ZW received a report of a container with scrap with an elevated radiation level (surface level of 2.5 microSievert per hour) from Nigeria. Examination of the cargo revealed a source stem with a Sr-90 source of 2.8 GBq. The rem radiation level at the front of the capsule was 14 milliSievert per hour. The beta dosage speed at 10 cm distance from the capsule was estimated at 2.8 Gray per hour.

In view of these high radiation levels, the detection of this source was reported to the IAEA (a so-called INES report; see ref. 6).

3.5.4 Process barrel with uranium from Iraq

On 16 December 2003, the VI-ZW received a report of a scrap cargo from Jordan with a slightly elevated radiation level. Examination revealed that the elevated radiation level was caused by a process barrel containing some 3 kg of natural uranium. The country of origin of the scrap cargo was found to be Iraq. In the next few months, further scrap cargoes originating from Iraq in the form of parts of process equipment containing natural uranium were found. The detection of the process barrel and the other process equipment was reported to the IAEA. The IAEA itself commenced the necessary examination of the parts of installations that contained uranium and/or were contaminated with uranium. This was done in connection with the investigation by the IAEA into Iraq's arms programme. The Lower House of Parliament was informed of this matter by the minister of Housing, Spatial Planning and the Environment. The case was covered extensively in the media.

3.5.5 Source holders with Cs-137 sources in scrap

O 11 April 2004, the VI-ZW received a report of a container with scrap from Venezuela with an elevated radiation level (surface level of 30 microSievert per hour). Examination revealed that the elevated radiation level was caused by three source holders with Cs-137 sources of originally approximately 2, approximately 2 and approximately 7.5 GBq respectively. The sources were in the radiation positions. The maximum radiation level measured reached a maximum of some 17 milliSievert per hour in reachable places. The source containers were still equipped with the plates showing type number, hazard symbols etc. The detection of these three sources was reported to the IAEA (a so-called INES report; see ref. 6).

3.5.6 Illegal acts concerning fissionable materials

Op 31 August 2005, the VI-ZW received a report of a container with scrap from the Netherlands with an elevated radiation level. Examination revealed that the elevated radiation level was caused by thorium metal. Further tracing led to a company that had been carrying out, without a permit, work such as flattening, rolling, machining, etc. of thorium metal and uranium metal for a Dutch university and others. The radiation protection status at the company was such that the VI-ZW decided immediately to apply administrative coercion and to instruct the National Institute of Public Health and the Environment (RIVM) to remove fissionable materials and contaminations with fissionable materials from the company. An official report has been filed against the company and the university.

4 Other reports, alerts and tips

This section discusses reports other than reports of scrap cargoes with elevated radiation levels. It also discusses the alerts by permit holders, and tips. Table 8 at the end of this section shows the numbers per year, broken down by subcategory.

4.1 Other reports

Most of these concern reports by companies that, for various reasons, carry out radiation testing as part of their operations. These tests are usually performed with a view to ensuring adequate protection. An example is the detection of an elevated radiation level of a container on which contaminated tubing has been used for the upper rim, at a scrap trader's when it passed a gate detector. Another example is the detection of contamination in a gasket used for extracting oil or natural gas and that was given to a specialised reconditioning company for overhaul. The reconditioning company performed the tests prior to commencing the reconditioning process with a view to labour protection and preventing environmental contamination. A third example is the detection of an elevated radiation level in cargoes of residues to be recycled other than scrap. The reports of companies that process both scrap and (occasionally) other residues with metals are stated as part of the reports of scrap cargoes with elevated radiation levels, as this often relates to mixed cargoes. The reports referred to in the category recycling, all relate to a single company.

4.2 Alerts

Most of these concern reports by companies that have a permit under the NEA. On the one hand, these include reports of incidents arising in working with radioactive substances in laboratories and hospitals. An example is the occurrence of a contamination in an unmonitored area owing to a leak in a sewer that is used to dispose of waste water contaminated with radioactive substances. Another example is the occurrence of a serious contamination in a radionuclide laboratory owing to a fracture in a test structure using radioactive substances.

On the other hand it includes reports of loss, disappearance and theft of radioactive substances. An example is the disappearance of a package containing radioactive substances during transport from the producer of the radioactive substances to a user of those radioactive substances. Mostly this relates to 'misrouting', and the radioactive substances are later delivered at their intended destination. Very occasionally, this kind of package will be impossible to locate. Another example is the theft of a radioactive source from the car in which the source is transported.

These usually do not, in the first instance, represent violations of a provision under the NEA. However, the examination of the cause of the incident or disappearance does sometimes reveal underlying violations of provisions under the NEA.

4.3 Tips

A few times a year, the VI-ZW receives notifications of (supposed) shortcomings in terms of radiation protection. Violations are regularly identified in verifying the tips and such can therefore be concluded to have been justified.

4.4 Overview of other reports, alerts and tips

Table 8: Overview of the number of other reports, alerts and tips per year and by sub-category for the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Reports of container with contaminated tubing	10 (9)	6 (3)	15 (15)	11 (11)	6 (6)
Reports of material used in oil and gas extraction	8 (5)	12 (4)	8 (3)	4 (0)	4 (4)
Reports of recycling of metals other than scrap	- (-)	- (-)	14 (0)	10 (0)	13 (3)
Remaining other reports	16 (4)	25 (11)	15 (2)	22 (7)	14 (5)
Reports of incidents and accidents	16 (12)	8 (5)	4 (1)	5 (2)	10 (3)
Reports of loss, disappearance and theft	- (-)	- (-)	1 (0)	2 (1)	3 (0)
Other alerts	2 (1)	0 (0)	3 (0)	5 (2)	1 (0)
Tips	5 (?)	4 (?)	10 (4)	8 (4)	5 (2)
Total	57 (31)	55 (23)	70 (25)	67 (27)	56 (23)
Share of violations in the total number (%)	54	42	36	40	41

Ref. 1 includes no separate figures for 2001 and 2002 for the categories reports on recycling of metals other than scrap and reports of loss, disappearance and theft.
Ref. 1 includes no figures for 2001 and 2002 for the number of violations under tips.

Table 8 reveals substantial year-on-year fluctuations in the numbers in the various sub-categories. However, there seems to be no discernible significant trends.
The percentage of the reports, alerts and tips for which a violation is found, is about 40% for the years 2001 to end-2005, with the exception of 2001.
All three violations that were found in 2005 for the reports of recycling of metals other than scrap, relate to material that should be reported.

4.5 Selected instances of other reports, alerts and tips

4.5.1 Thorium-containing gas mantles

On 4 July 2003, the VI-ZW received a tip from the Food and Consumer Product Safety Authority that this authority had established that trading in thorium-containing gas mantles continued in the Netherlands, despite having been designated a non-justified activity since December 2002 (and hence being

impermissible). On the basis of that tip, the VI-ZW undertook a brief investigation into the trade in thorium-containing gas mantles, as part of which 18 companies were visited.
At four companies, substantial numbers of (500 – 1750 pieces) of thorium-containing gas mantles were found. The thorium-containing gas mantles were disposed of through COVRA. The results of the examination were published in an article in NVS news (ref. 7).

4.5.2 Use of small Co-60 source without a permit

On 23 March 2005, the VI-ZW received a report of a gate alarm triggered by a passenger car passing through the gate. According to additional information provided by the reporting party, the alarm was caused by a Co-60 source of some 4.5 MBq in the trunk of the car. The source was used to check CO_2 levels inside fire extinguishers. No permit had been issued for the use of the source. Additionally, there were no procedures and work instructions for using the source, no storage place available for storing the source and, finally, the source was not transported as a class 7 hazardous substance. An official report was drawn up on this by the VI-ZW.

4.5.3 Thorium-containing welding electrodes

On 7 February 2005, the VI-ZW received a report of a gate alarm caused by a box of tungsten welding electrodes (7.2 kg) that had been offered to a scrap-processing company by an employee of a company selling welding accessories. Further examination at the company selling welding accessories revealed that the company held more than 4,000 thorium-containing tungsten welding electrodes (type WT20) without having a Nuclear Energy Act permit. Additional examination by the VI-ZW revealed that there are many more companies that trade in thorium-containing welding electrodes without having a Nuclear Energy Act permit. Various company inspections showed that given the current state of technology, the use of thorium-containing welding electrodes is no longer necessary. Alternatives with lanthanum, cerium etc. are available. On the basis of the information obtained, the VI-ZW published an information letter in the specialist welding technology journal Lastechniek (ref. 8), stating that the use of thorium-containing welding electrodes is not a generally justified technology and that a Nuclear Energy Act permit is required for trading in or welding with thorium-containing welding electrodes.

4.5.4 Contaminated plant installation

On 17 March 2005, the VI-ZW received a report of the detection (by a scrap company employee before disposal to a scrap trader) of an elevated radiation level for a number of pipes that had been removed from an installation for the production of lactic acid during modification work. Examination by the VI-ZW revealed that the pipes were contaminated by thin radium 226 deposits. Further examination revealed that a part of the production installation was likewise contaminated with radioactive deposits for which a permit was required. The cause giving rise to the deposits was a calcium sulphate precipitation phase in the process. The majority of the radium probably originated from the tap water used. The company concerned has applied for a Nuclear Energy Act permit for holding and for carrying out work on/using the contaminated installations.

4.5.5 Contaminated jacket of former gas production platform

On 29 April 2005, the VI-ZW received a report of the detection of an elevated radiation level on a scrapped portion of a jacket that had come from a former gas extraction platform on the Dutch part of the North Sea Continental Shelf. The jacket had been brought onshore for general scrapping in the industrial area Vlissingen-Oost. Only after part of the jacket had already been scrapped were radiation tests performed on

the scrapped parts, and an elevated radiation level was found on one of the parts. The examination performed by the VI-ZW on that same day showed that there were more scrap parts contaminated with radioactive substances on these premises and that the company premises were partly contaminated with radioactive deposits containing radium-226 that had been dispersed from the contaminated parts. Decontamination of the contaminated part of the company premises took several days and involved substantial costs. An official report was filed against the company that had offered the jacket for scrapping without removing the deposits requiring permits in advance.

4.5.6 Illegal disposal of two Cs-137 sources

Op 9 May 2005, the VI-ZW received a tip that two Cs-137 sources might be present at the scrap facilities of a former iron foundry, namely two Cs-137 sources with a nominal activity of 370 MBq each. Examination by the VI-ZW revealed that the official receiver who had been engaged to wind up the company concerned, had already been informed in 1999 by the government authorities of the presence of the sources in the iron foundry buildings. Further examination showed that the sources had not been disposed of in a legal manner. In all probability, the sources, together with other waste, were disposed of at a landfill for hazardous waste. Given the substantial amounts of waste that have since been deposited on top of the sources, the sources can no longer be traced. Official reports were drawn up.

5 Requests for support

This section discusses requests for support by the VI-ZW. This includes, on the one hand, requests for support from other government authorities such as customs, the fire brigade and police, and requests from citizens on the other. In terms of support provided to other government authorities, the support given to customs as part of combating terrorism is a special task. The various subcategories of support provided are discussed in greater detail below. Table 9 at the end of this section shows the number per year, broken down by subcategory.

5.1 Support provided to customs as part of combating terrorism

Following the terrorist attacks in the US on 11 September 2001, the US government urged the Dutch government to install radiation detection gates in the port of Rotterdam. These gates are intended to identify Special Nuclear Material (SNM) and other radioactive substances that can be used for terrorist activities. Initially, four detection gates were installed at the ECT Delta terminal on the Maasvlakte. These gates are operated by customs, which itself deals with the majority of the alarms (around 12,000 per year). In cases where further examination requiring more specialist knowledge is needed, arrangements have been made for the VI-ZW to provide support to customs. For more information on the support provided in this context and the findings, see the article published in NVS news (ref. 9).

5.2 Other support provided to government authorities

The other requests for support relate, for instance, to reports as referred to in article 22 and 33 of the Nuclear Energy Act that were initially received by other government authorities. Also, other government authorities sometimes come across situations that give them cause to suspect a violation under the NEA. Arrangements have been made for the VI-ZW providing specialist support to those other government authorities on their request. Additionally, the VI-ZW provides radiation protection support to other government authorities (for example the police) if, in the course of their investigations, they receive an indication that fissionable materials, ores or radioactive substances might be involved.

In 2004, support was provided on two occasions to IAEA staff in Vienna in connection with an investigation into scrap from Iraq transported to the Netherlands, which was contaminated with substantial quantities of uranium. The Lower House of Parliament was informed on the support provided to the IAEA and the main findings of the investigation.

5.3 Support provided to citizens

On the one hand, citizens occasionally request support in disposing of radioactive substances that require a permit or should be reported. Examples are the disposal of old measuring instruments containing radioactive substances, and the disposal of collections of minerals containing relatively high levels of uranium and thorium.

On the other hand, citizens are sometimes concerned because they suspect, for various reasons, that they are exposed to excessive levels of ionising radiation. These usually are delusions caused by psychiatric afflictions. The VI-ZW aims to eliminate unnecessary concerns by metering radiation levels on request. Where necessary, general medical practitioners or specialised health services are informed of the results.

5.4 Overview of support provided

Table 9: Overview of the number of requests for support per year and by sub-category for the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Support for customs in combating terrorism	n/a	n/a	n/a	14 (3)	14 (9)
Support for other government authorities	14	9	4 (1)	0 (0)	5 (1)
Support for citizens	2	0	2 (0)	2 (1)	1 (0)
Other support	0	0	3 (0)	3 (0)	2 (1)
Total	16	9	9 (1)	19 (4)	22 (11)
Share of violations in the total number (%)	-	-	11	21	50

Ref. 1 includes no data for the number of violations in 2001 and 2002.

Table 9 shows a considerable increase in the number of requests for support in 2004 and 2005 compared with 2002 and 2003. The rise is fully attributable to support provided to customs as part of combating terrorism. In 2005, the percentage of violations found in supporting customs in combating terrorism was significantly higher than in 2004. This is probably due to better selection of alarms by customs staff, before transfer to the VI-ZW. Until now, no SMN or materials for manufacturing a ‘dirty bomb’ have been found.

5.5 Selected instances of support provided

5.5.1 Stacking kits contaminated with Co-60 and Zn-65

On 30 December 2004, the CCP-team of the customs office Rotterdam-Maasvlakte transferred a gate alarm on an outgoing cargo at the ECT Delta terminal to the VI-ZW for further examination. Customs had manually confirmed an elevated radiation level for the container, and the nuclide Co-60 had been found with the use of a portable gamma spectrometer (Exploranium GR-135).

This was found to relate to a group container of domestic appliances from China destined for the Dutch and German markets. The container held a total of some 2100 packages with a total weight of more than 9 tonnes. Upon unloading, 180 boxes each containing 10 so-called stacking kits were found to have elevated radiation levels. A stacking kit comprises three aluminium profiles that can be assembled and then used to

stack driers on washing machines. Further examination by the RIVM showed that a part of the profiles contained concentrations of Co-60 and Zn-65 requiring permits. Eventually, the stacking kits were returned to China, and the Chinese authorities were informed of this.

5.5.2 Transport of container with residues of UF_6

On 23 June 2005, the CCP-team of the customs office Rotterdam-Maasvlakte transferred a gate alarm on an outgoing cargo at the ECT Delta-terminal to the VI-ZW for further examination. Customs had manually confirmed an elevated radiation level for the container and the nuclides U-238 and U-235 had been found with the use of a portable gamma spectrometer (Exploranium GR-135).

This concerned the transport from Japan to France of four UF_6 containers, which the sender claimed were empty and therefore had been transported and brought into Dutch territory without a permit. After the VI-ZW had performed its own tests to confirm the findings arrived at by customs, the VI-ZW asked the RIVM to quantify as accurately as possible the quantity of uranium isotopes in the four containers. On the basis of radiation levels found and gamma spectrometric metering, the RIVM showed that the quantity of uranium isotopes in the containers amply exceeded the threshold for exemption. Accordingly, a permit was required for transportation and bringing the cargo into Dutch territory. The sender in Japan and the (leading) forwarding agent in Europe were addressed on the matter. As a result, in future an appropriate NEA permit is also required for the transportation of “empty” UF_6 containers and bringing them into Dutch territory.

6 Enforcement by the VI-ZW

6.1 Number of violations

Table 10 provides an overview of the number of notifications involving one or more violations. The violations are sub-classified in accordance with the following articles of the NEA:

- 15 (holding, transporting, taking into or out of Dutch territory, or having taken into or out of Dutch territory, or removing fissionable materials or ores, without a permit);
- 22 (failing to report the possession or obtention of fissionable materials or ores);
- 29 (holding, transporting, taking into or out of Dutch territory, or having taken into or out of Dutch territory, or removing radioactive substances without a permit);
- 32 (failing to report having, using, removing radioactive substances requiring to be reported);
- 33 (failure to report the possession or obtention of radioactive substances);
- 76a (violation of permit provision).

If a violation of article 22, 33 or 76a has been found, concurrence with a violation of article 15 and/or 29 has not been included in the figures in Table 2 for violations of article 15 and/or 29. Sources in protective containers or depleted uranium have been included only as a violation of article 29. In the event of concurrence with a violation of article 29 and 32, only the violation of article 29 has been counted. No more than one violation has been counted for each notification.

The fact that two companies trading in stainless steel scrap have an NEA permit, has not been taken into consideration in counting the violations. The reason for this is that the NEA permits for those companies are directed only at providing a pragmatic solution for the disposal of separated materials with elevated radiation levels.

Table 10 shows that the number of violations is rising continually each year. The year 2004 showed a very significant increase, of 60%. At an average of three violations per year for the years 2003, 2004 and 2005, the number of violations of article 22 and article 33 identified in the course of following up on notifications, is at a low level. The violations of article 32 concern mainly failures to report possession of substances that require to be reported. The violations of article 15 mainly concern, besides the presence of protective containers or depleted uranium, the presence in scrap of:

- natural uranium as deposits on objects and as bulk material in objects (mainly scrap from Iraq);
- various objects of depleted uranium (e.g. collimators and counterweights);
- thorium-containing alloys;
- thorium-containing optical lenses.

No enriched uranium or plutonium was found in the years 2003, 2004 and 2005 in scrap cargoes or in connection with other reports, alerts and tips.

Table 10: Overview of the number of violations per year and per NEA article for the years 2001 to end-2005.

	2001	2002	2003	2004	2005
Article 15 (holding fissionable materials or ores without permit)	-	-	10	22	23
Article 29 (holding radioactive substances without permit)	126	120	139	228	215
Article 32 (failure to report possession of radioactive substances etc.)	-	13	0	2	29
Article 22 or 33 (failure to submit report)	-	5	5	3	1
Article 76a (violation of permit provision)	-	-	5	0	1
Total	126	138	159	255	269
Increase in the number of violations versus prior year (%)	n/a	10	15	60	5

Ref. 1 does not draw a distinction between violations of article 15 and 29 for 2001 and 2002.
The violations of the reporting obligation stated in ref. 1 (thirteen cases in 2002) are likely not to have been violations, as in 2002, all substances requiring to be reported were deemed to have been reported.
For 2001, the total number of violations in Tables 5, 8 and 9 of ref. 1 has been used. The number of 139 violations in Table 1 of ref. 1 is (probably) not correct.

6.2 Sanctions applied

The VI-ZW responded to most of the violations with a warning letter and instructions to eliminate the violations, since most of the violations were not, or only to a limited extent, attributable to the party found to be in violation. For example: scrap companies only find that scrap contains elevated radiation levels after it has arrived and passed through a gate detector on their company premises.

In a number of cases, the VI-ZW was confronted with serious violations or refusals to remedy the violation identified. In these cases, VI-ZW instituted administrative-law (other than waning letters etc.) and/or criminal-law proceedings. An overview of the number of sanctions applied in the years 2003 to end-2005 is shown in Table 11.

Table 11: Number of instances of administrative-law and/or criminal-law proceedings by type and by year.

	2003	2004	2005
Proposed administrative coercion	1	0	0
Administrative coercion	0	0	0
Administrative coercion and official report	0	0	1
Proposed fine	4	3	0
Proposed fine and official report	1	4	0
Proposed fine (and fine collected)	1	0	0
Official report	2	6	7
Total	9	13	8

Table 11 shows that the number of times per year when a sanction was imposed is in the order of magnitude of ten. The proposal to impose a fine in 2003 and 2004 concerned primarily owners of

containers with contaminated tubing (contaminated rim), who refused to have the radioactive substances removed from the containers.

7 Conclusions and recommendations

7.1 Conclusions

The findings in following up on the notifications in the years 2003, 2004 and 2005 lead to the conclusions set out below.

1. The number of notifications received in 2004 and 2005 by the VI-ZW amounted to over 400 per year. This represents an increase of around 50% compared to the years 2002 and 2003.
2. The number of reports of scrap cargoes with an elevated radiation level has increased in 2004 and 2005 to approximately 350 per year. The number of violations found in connection with them increased proportionally to almost 250 per year.
3. For scrap cargoes with an elevated radiation level from abroad, the percentage of violations which averaged around 85%, was significantly higher than the percentage of violations for scrap cargoes with an elevated radiation level from the Netherlands, which averaged some 60%.
4. The number of other reports, alerts and tips, at an average of approximately 60 per year, did not increase in the period 2001 to end-2005. The number of violations found in connection with them had likewise little changed, at around 25 per year.
5. The number of requests for support rose in 2004 and 2005 to some 20 per year. The percentage of violations found in connection with them increased to 50% in 2005. The support provided to customs in combating terrorism was the main reason for the increase in the number of requests for support and the number of violations found in connection with them.
6. The number of times that administrative-law (other than warning letters and instructions to eliminate the violations) and/or criminal-law sanctions were applied was at some 10 per year in the years 2003 to end-2005.
7. A number of reports involved hazardous situations for the workers at the scrap-processing companies and/or for the environment. In a few instances, the situation was considered to be serious enough for an INES report to be submitted to the IAEA.

7.2 Recommendations

The findings in following up on the notifications in the years 2003, 2004 and 2005 lead to the following recommendations.

1. It is desirable for the VI-ZW to maintain and where possible improve its procedures for the receipt and processing of notifications. Sufficient resources (human, financial and supporting) need to be provided to that end.

2. In following up on notifications in the past few years, the limited staffing levels have meant that examinations of the underlying causes of the violations did not take place in all cases. If it is considered to be desirable to examine the underlying causes of violations in all cases, the necessary steps to facilitate this will need to be taken.
3. It is desirable for the Inspectorate to continue stringent monitoring of (timely) reporting of scrap cargoes with elevated radiation levels, even if these involve only a slightly increased radiation level on the outside of scrap containers. In a number of instances, a slightly elevated radiation level on the outside was found to be due to the presence of a medium-sized closed source in the scrap.
4. It is desirable for companies abroad to become more aware of the risks that can arise in putting radioactive substances in scrap, especially large and medium-sized closed sources. The VI-ZW can contribute to raising awareness of this by sharing its experience with international organisations seeking to address this issue and at international conferences where the issue of radioactive substances in scrap is discussed.

8 References

Ref. 1 **Incidenten met radioactieve stoffen in 2001 en 2002.**

Ref. 2 **Metering is a must!** Enforcement of the Nuclear Energy Act at scrap-processing companies in 2002 and 2003.

Ref. 3 **Metering is a must II!** Enforcement of the Nuclear Energy Act at scrap-processing companies in 2004 and 2005.

Ref. 4 **Op visite.** Naleving van de Kernenergiewet door ziekenhuizen in de periode 2001 t/m 2003.

Ref. 5 **Inspection guideline for metal and scrap containing radioactive substances** (dated 25-02-2003).

Ref. 6 **IAEA website.** http://www-news.iaea.org/news/topics/default.asp (INES reports).

Ref. 7 **Gloeikousjes. Nog steeds actief in Nederland.** NVS-nieuws jaargang 28 2003 nr. 4.

Ref. 8 **Thoriumhoudende laselectroden.** Lastechniek Vakblad voor verbinden en snijden. Jaargang 72 * maart 2006.

Ref. 9 >>>>>>> NVS-nieuws jaargang >> 2006 nr. >.