Authority for Nuclear Safety and Radiation Protection

Report on events in Dutch nuclear facilities during 2017

Publisher's details

This document is a translation of the ANVS report "Rapportage ongewone gebeurtenissen in Nederlandse nucleaire inrichtingen in 2017". The original report shall prevail in case of textual differences between the Dutch report and this translation.

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Contents

Summary

Number of events

In 2017, the ANVS was notified of twenty-one events at Dutch nuclear facilities. Four events occurred at the Borssele Nuclear Power Plant. The Nuclear Research and Consultancy Group (NRG) notified the ANVS of one event in the High Flux Reactor (HFR) in Petten and of thirteen events in the other NRG facilities, and there were three events at the other nuclear facilities in the Netherlands.

INES rating and severity

Nuclear safety was not compromised during any of the events that occurred in 2017 and none of the events therefore qualified for an INES rating of 1 or higher. An event cannot be given a final rating until its nature and circumstances have been fully investigated and the conclusions have been endorsed by the ANVS. Therefore, when this report refers to an INES rating, that may be a 'preliminary rating'. However, previous final ratings have rarely differed from the preliminary ratings. Detailed investigation has led the ANVS to conclude that two events in 2016, which were initially considered to be outside the scope of the notification requirement, did in fact require notification. The events in question are described in Chapter 2. Hence, the number of compulsory notification events stated in the event report for 2016 requires amendment. The ANVS endeavours to supplement the annual reports by making a running summary available on its website, showing all notified events during the current year and previous years. The descriptions of the individual events contained in this report accordingly reflect those available on the website on 20 April 2018.

Borssele Nuclear Power Plant

Electricity Production Company South-Netherlands (EPZ), the licensee of the Borssele Nuclear Power Plant, notified the ANVS of four events in 2017. EPZ notified the events promptly and generally resolved them in an adequate manner. However, further attention should be given to the resolution of events that require more complex analysis and reporting. The ANVS is actively supervising the investigation and implementation of the proposed measures. Follow-up questions have been posed by the ANVS where appropriate.

Nuclear Research and Consultancy Group (NRG)

One event at the High Flux Reactor in Petten was notified to the ANVS in 2017. Thirteen events at NRG's other facilities were notified to the ANVS in 2017. All events at NRG facilities were rated as INES-0 (no safety significance) or did not require rating on the INES scale.

The other NRG facilities have for several years accounted for the largest number of events. Numerous complex activities of various kinds take place at the facilities in question. The mere occurrence of events is therefore not a cause for concern; the main consideration is the severity of the individual events. As in 2016, none of the events influenced nuclear safety at NRG's facilities. The ANVS notes that, in recent years, NRG has gone about the recording and notification of events at its other facilities more diligently. One consequence of that is that NRG has investigated more events and submitted details to the ANVS for approval. NRG has been paying more attention to the notification, investigation and reporting of events, but is not yet resolving all events promptly and adequately. Consequently, final event reports have been delayed unnecessarily in some cases.

Higher Education Reactor Delft

The Higher Education Reactor (HOR) in Delft notified the ANVS of two events this year. Both events were notified promptly and the licensee, Reactor Institute Delft (RID), followed the notification procedure correctly.

URENCO

URENCO notified the ANVS of one event this year, which was rated as INES-0. It was also concluded that the ANVS had incorrectly treated one event notified in 2016 as outside the scope of the notification requirements. That error is corrected in Chapter 2 of this report, on the ANVS website and in the historical statistics.

Other nuclear facilities

No events occurred at other Dutch nuclear facilities in 2017. However, it was concluded that the ANVS had incorrectly treated one event at the Central Organisation for Radioactive Waste notified in 2016 as outside the scope of the notification requirements. That error is corrected in Chapter 2 of this report, on the ANVS website and in the historical statistics.

General conclusion

Table 1 summarizes all the events that occurred in 2017. The ANVS is positive about the progress being made in terms of licensees' notification behaviour, both in relation to events that are subject to notification requirements and in relation to the maintenance of comprehensive internal event records. Nevertheless, the ANVS considers that further attention should be given to the resolution of events, in particular the promptness and quality of final event reports.

Role of the regulator ANVS

ANVS oversees the improvement of safety at Dutch nuclear facilities. It monitors the progress and effectiveness of the measures taken, carries out on-site inspections and, where necessary, applies enforcement instruments to improve compliance with Nuclear Energy Act licences. In recent years, the ANVS has worked to improve the approach to the resolution of events and the associated communication activities. For example, the ANVS has started to make a sharper distinction between, on the one hand, events that are subject to notification requirements but have no significance for nuclear safety or radiation protection and are therefore outside the scope of the INES rating system, and, on the other hand, events that do require scaling but did not influence safety (INES-0).
Event notification requirements are contained in the Technical Specifications for each facility, because of the diversity of the activities undertaken. In view of the inter-facility diversity, the ANVS intends to further harmonize the notification criteria and the associated timescales where possible, and to bring them into closer alignment with the public desire for the prompt provision of information regarding events.

Table 1: The total number of compulsory notification events at each company in 2017, categorized according to INES level.

Facility	Total number of events requiring notification	INES level 0	INES level 1	INES level 2
Borssele Nuclear Power Plant	4	4	0	0
High-Flux Reactor, Petten	1	1	0	0
Other NRG facilities, Petten	13	13	0	0
Central Organisation for Radioactive Waste, Nieuwdorp	0	0	0	0
Higher Education Reactor, Delft	2	2	0	0
Energy research Centre of the Netherlands, Petten	0	0	0	0
Joint Research Centre, Petten	0	0	0	0
Joint Nuclear Power Plant Nederland, Dodewaard	0	0	0	0
URENCO Nederland, Almelo	1	1	0	0
Total for all nuclear facilities	**21**	**21**	**0**	**0**

Introduction

This report summarizes events at Dutch nuclear facilities in 2017. On 27 February 1980, the then Minister of Social Affairs undertook to inform the House of Representatives about the functioning of Dutch nuclear power plants, in writing, annually. In the course of time, this report has expanded to include all nuclear facilities in the Netherlands and the radiological laboratories associated with those facilities. When the ANVS was established, it was determined that the ANVS would publish annual event reports. This report documents events that interfere with normal operation of the facility in question. These events may involve technical defects at the facilities or human error. In exceptionally severe cases, they may involve situations where radioactive materials were, or could have been, released, an abnormal increase in a normal release of radioactive materials, an increase in the radiation level at the site boundary or the unintended release of radioactive materials into the environment outside the facility. The events also include instances of the contamination of staff members within the nuclear facilities, where notification is a condition of the facility's license or the Radiation Protection Decree.

The conditions of a Nuclear Energy Act licence require that the ANVS is notified of any abnormal event. The applicable notification requirements vary, depending on the nature of the event. Notification criteria are laid down in the Nuclear Energy Act licence issued to the individual nuclear facility. The criteria specify the events that have to be notified to the ANVS and the periods within which notification must take place. The length of the period allowed for notification depends on the nature of the event; in some cases, immediate notification is required, while in others notification must take place within a period of up to four weeks. Certain events do not require active notification. Such events include slight contaminations of surfaces or equipment and technical defects or organizational abnormalities without immediate consequences for the operation of the facility or for nuclear safety, which require inclusion in, for example, quarterly, six-monthly or annual reports. Such notifications are outside the scope of this report. The ANVS examines such events annually and assesses whether they were resolved correctly.

Two aspects of each event are significant. First, the event itself: its nature and severity must be determined and its consequences must be mitigated. Second, after an event has occurred, it is important that the event is systematically analysed and that appropriate action is taken to prevent recurrence. Events vary in severity, from relatively insignificant incidents to major accidents. 'Minor' events may be symptomatic of an underlying problem and the simultaneous occurrence of several minor events may have more severe consequences. It is therefore important that all events are recorded accurately and immediately, and that the ANVS is notified accordingly. Following an initial notification, a licensee is required to investigate the precise nature and circumstances of the event. In that context, consideration must be given to the lessons that can be learned and to the scope for making improvements to prevent recurrence. That is the responsibility of the licensee of the nuclear facility in question. Such post-event analysis contributes greatly to the continuous improvement of safety at nuclear facilities. The ANVS oversees the fulfilment of licensees' obligations in this context, from the moment of notification, through resolution of the case to implementation of the associated learning points and improvements.

Notified events are classified according to the International Nuclear and Radiological Event Scale (INES).
The INES scale is to nuclear events what the Richter scale is to earthquakes: an indication of severity. Further details about the INES scale can be found in the annex to this report.

The ANVS actively informs the general public about nuclear safety and radiation protection. To that end, information about events at nuclear facilities is placed on the ANVS website as soon as possible[1]. This report contains the ANVS communications regarding events available on the ANVS website on 20 April 2018. The current status of each case may be ascertained by referring to the site.

[1] See *https://english.autoriteitnvs.nl/topics/nuclear-safety-and-radiation-protection-in-the-netherlands/events-at-nuclear-facilities*.

Accurate INES rating depends on the availability of adequate information. An INES rating reflects both the severity of the event itself and the underlying causes. In exceptional cases, the underlying causes of an event can warrant its INES rating being raised by one level. Such an adjustment cannot be made until investigation of the underlying cause has been completed.
Hence, the INES rating given to some events described in this report remains 'preliminary' where investigation and assessment of the event in question is still in progress. In addition, the ANVS performs a comprehensive annual inspection of each licensee's internal event records in order to verify that the ANVS has indeed been notified of all events that are subject to notification requirements. The ANVS does not expect that the definitive resolution of the notified events or the results of its inspections will lead to fundamentally different conclusions regarding the nature and number of events. In the unlikely event that fundamentally different conclusions are ultimately drawn, details will be published on the ANVS website at the earliest opportunity and in the event report for 2018. Hence, the 2018 report will include an explicit statement regarding the completeness of the notifications detailed in the report on 2017. This report draws attention to the fact that the report on 2016 omitted two compulsory notification events. That error is corrected in Chapter 2 of this report, on the ANVS website and in the historical statistics.

This report includes the notifications submitted by the following holders of Nuclear Energy Act licenses[2]:

- Electricity Production Company South-Netherlands (EPZ) of Borssele, licensee of the Borssele Nuclear Power Plant (KCB)
- Nuclear Research and Consultancy Group (NRG) of Petten, licensee of the following facilities:
  - High Flux Reactor (HFR)
  - other NRG facilities[3]
- Central Organisation for Radioactive Waste (COVRA) of Nieuwdorp
- Reactor Institute Delft (RID) at Delft University of Technology, licensee of the Higher Education Reactor (HOR), the DELPHI sub-critical ensemble and laboratories
- Dutch Energy Research Centre Netherlands (ECN) of Petten
- Joint Research Centre of the European Commission (GCO) of Petten
- Joint Nuclear Power Plant Nederland (GKN) of Dodewaard, whose facility was definitively shut down in March 1997 and is currently in a state of safe enclosure
- URENCO Nederland, licensee enrichment plants at Almelo

[2] The named licensees may be divided into two groups: first parties licensed in accordance with the Nuclear Energy Act, Section 15(b) (Electricity Production Company South-Netherlands, Central Organisation for Radioactive Waste, Reactor Institute Delft, Nuclear Research and Consultancy Group-High Flux Reactor, Nuclear Research and Consultancy Group (other), GKN and URENCO); second parties licensed in accordance with the Nuclear Energy Act, Section 15(a), Section 29 and Section 34 (Dutch Energy Research Centre and GCO).

[3] The Low Flux Reactor (LFR), the Hot Cell Laboratories (HCL) comprising the Research Laboratory (RL) and the Molybdenum Production Facility (MPF), the Decontamination and Waste Treatment Facility (DWT) and the Waste Storage Facility (WSF).

1 Events in the Netherlands in 2017

This chapter summarizes the events at Dutch nuclear facilities in 2017, concerning which the ANVS was notified. The event descriptions are derived from those on the ANVS website on 20 April 2018. The ANVS seeks to provide a clear, up-to-date summary of all events on its website. Nevertheless, some descriptions may not reflect the current situation. The event details on the website are updated whenever relevant new information becomes available.

1.1 Borssele Nuclear Power Plant (KCB), Borssele

In 2017, Electricity Production Company South-Netherlands (EPZ), the licensee of the Borssele Nuclear Power Plant, notified the ANVS of four events.

12 July 2017: Automatic shutdown of reactor after the turbine was switched off; INES level 0 (preliminary rating)
On 12 July 2017, EPZ reported an automatic reactor shutdown in the morning of that same day. EPZ reported that, at 6:25, a malfunction occurred in one of the turbine control valves at the same time as several other malfunction messages that could not immediately be explained. Subsequently, the decision was made to switch off the turbine. As a result of the closure of the steam supply to the turbine, steam was released from the secondary (non-nuclear) system for a short period and the reactor safety system shut down the reactor as it is designed to do.
EPZ notified the ANVS of the event promptly and indicated that all the safety systems worked properly. The company is carrying out an investigation into this event.
The ANVS is supervising the event and the investigation into the cause and will consider its outcome and any proposed measures. On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

1 August 2017 Abnormal boric acid concentration in the storage tanks of the aftercooling and injection system; INES level 0 (preliminary rating)
On 1 August 2017, EPZ reported that, during the regular check on the boric acid concentration in the water in the storage tanks of the aftercooling and injection system, the boric acid concentration was found to be too low. The power output of the reactor was decreased to 0 megawatts in accordance with the technical specifications. At the same time, EPZ started adding more boric acid to the water to raise the concentration to the required level. The boric acid concentration has now been restored and the reactor is once more fully operational.
The ANVS is supervising the investigation into the cause of the event. The ANVS will consider the outcome and any proposed measures in due course. On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

17 October 2017: Borssele Nuclear Power Plant - Automatic shutdown of reactor after a short circuit in electrical switch cupboard; INES level 0 (preliminary rating)
On 17 October 2017, EPZ reported that the reactor had automatically shut down at 15:09 on that same day. EPZ indicated that the automatic safety system was tripped as a result of a short circuit between two connections in an electrical switch cupboard in the non-nuclear part of the power plant. According to EPZ, all the safety systems worked properly and the reactor stopped safely when this event occurred. EPZ is carrying out an investigation to determine the underlying causes of the short circuit so that improvement measures can be taken.

The ANVS is supervising the event and the investigation into the cause and will consider its outcome and any proposed measures. On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

5 December 2017: Outage of external power supply; INES level 0 (preliminary rating)

On 5 December 2017, EPZ reported that, earlier that day, one of the connections between the Borssele Nuclear Power Plant and the Dutch high-voltage grid had briefly gone down. The outage was caused by external circumstances. In response, the plant's emergency power generator was automatically started to supply the power required by the plant. The plant is prepared for such circumstances. All emergency and safety systems functioned correctly.
The external network fault was rectified after twelve minutes. The reactor remained operational throughout the power outage, entirely in accordance with the requirements.
EPZ is investigating the possibility of making improvements in light of the external power supply outage. The ANVS is supervising the investigation and will assess the result and any measures that may be adopted in light of the findings.
On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

1.2 High Flux Reactor (HFR), Petten

In 2017, Nuclear Research and Consultancy Group (NRG), the licensee of the High Flux Reactor, notified the ANVS of one event.

September 2017: Unintended processing of waste containing fissionable material in the hot cell of the High Flux Reactor; INES level 0

On 13 September 2017, NRG notified the ANVS that it had started an investigation into the origin of incorrectly registered waste containing fissionable material, which was detected during processing in the Hot Cell Laboratories (HCL). The waste proved to originate from the High Flux Reactor (HFR). For details, see the notification submitted on 21 August 2017.
It was found that the underlying cause of the event was that two fuel storage casks in the HFR's fuel pool had been confused in November 2012. One of the casks contained material for an irradiation experiment, which included fissionable material, while the other contained no fissionable material. The two casks had been confused, leading to the wrong one being processed and transferred to the Waste Storage Facility (WSF) in a waste drum. That additionally led to an error in the fissionable material records.
NRG's investigation found that the fuel storage casks were confused because no unique identifying codes were shown on the outside, and the locations of the casks within the storage facility were not recorded precisely enough in the fissionable material records. Furthermore, when the work was undertaken, insufficient checks were carried out to verify that the correct cask was taken away, and processing was not aborted when it took an unexpected course. NRG reported that the unintended processing of the storage cask containing fissionable material led to radioactive contamination of the HFR's hot cell, where processing is undertaken. The radioactive contamination was detected and investigated by NRG, but the investigation failed to identify the cause. The contamination had no implications for personnel, the general public or the environment. NRG took various measures to prevent recurrence. All unused storage equipment without clear external markings were replaced with new equipment with appropriate marking, and the way that storage locations are recorded in the fissionable material records was revised. Moreover, since 2013, NRG has been working to increase the safety awareness of personnel, to improve communication among personnel and to manage the risks associated with processes and modifications. In consultation between NRG and EURATOM, which supervises fissionable material record keeping in Europe, it was concluded that the event did not require notification in relation to safeguards and that the errors in the records could be corrected in accordance with the relevant procedure.
The ANVS considered the results of the investigation and the measures proposed by NRG and concluded that they were sufficient. The ANVS is now monitoring implementation and evaluation of the measures. On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.

1.3 Other NRG facilities[4], Petten

In 2017, NRG notified the ANVS of thirteen events at its other facilities.

10 February 2017: NRG/WSF - Damaged drum in Waste Storage Facility; INES level 0

On 10 February, NRG notified the ANVS that a corrosion-damaged drum of radioactive waste had been found in the Waste Storage Facility (WSF) on 1 February 2017. In accordance with the procedures, the drum was placed in a separate storage pipe within the WSF to be collected for processing at a later date. When it was winched up, the bottom of the drum and some of its contents remained in the storage pipe. Measurements performed by NRG showed that no radioactive material had escaped from the designated storage pipe and entered the transport container. The event had no consequences for the safety of staff members or the general public.
NRG notified the ANVS of the event correctly and within the required period. NRG is aware that several other waste drums at the WSF have corrosion damage, attributable to the presence van PVC in the waste. NRG is investigating the cause of the damage to the drum involved in the event and whether other drums are in danger of failing in a similar way. The ANVS is supervising NRG's investigation and will consider its outcome and any proposed measures in due course. In that context, the ANVS will ensure that NRG gives proper consideration to the possible consequences of the event for the disposal of the radioactive waste stored at the WSF.
On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: no safety significance, since no radioactivity was released and sufficient safety barriers remained to prevent the release of radioactive material. It will only be possible for a final rating to be assigned when the results of the NRG investigation are known.

Update 3-1-2018
The ANVS has considered and approved the results of the investigation and the proposed measures. NRG has conclusively established that the corrosion was caused by remnants of PVC from previously repackaged waste. NRG has also analysed the way that the situation was dealt with following discovery of the corrosion. The analysis revealed that, when the drum was winched up again, the applicable procedure was not followed. NRG is accordingly taking steps to improve compliance with procedures and to reduce the pressure on the internal transport system. The ANVS is monitoring implementation and evaluation of the measures adopted by NRG.
On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.

21 March 2017: NRG/DWT - Evacuation of Decontamination and Waste Treatment facility (DWT) in response to suspected natural gas smell; INES rating not applicable

On 21 March 2017, NRG notified the ANVS that, earlier that day, the smell of natural gas had been reported in the vicinity of the Decontamination and Waste Treatment facility (DWT). Because the source of the smell was initially unclear, NRG mobilized the company emergency service and evacuated the building as a precaution. Investigation by the public fire service and NRG found no evidence of a gas leak. It was concluded that the smell was coming from standing water in the DWT's waste water tanks. The smell was associated with the normal operational pumping of standing water from and into tanks. The particular meteorological conditions at the time, with a strong westerly wind, had carried the smell to the eastern side of the water treatment facility. Air extracted from tanks was tested by the fire service, leading NRG to conclude that there had been no safety repercussions.

The ANVS has considered the results of the investigation and has concluded that there is no need for measures to prevent recurrence. On the basis of the information provided by NRG, the ANVS has concluded that the event was of no significance in relation to nuclear safety or radiation risk. No INES rating has therefore been assigned.

26 April 2017: NRG/HCl - Irregular emission of noble gas due to operating error during removal of radioactive waste; INES level 0

On 26 April 2017, NRG notified the ANVS that, on 9 March 2017, a small quantity of radioactive noble gas (mainly Xe-133) had been released into the atmosphere from the Molybdenum Production Facility (MPF). The emission occurred when radioactive waste was being pumped from an underground waste tank into a transport container in preparation for its

[4] 'Other facilities for which NRG has a licence' means the Hot Cell Laboratories (HCL), comprising the Research Laboratory (RL) and the Molybdenum Production Facility (MPF), the Low Flux Reactor (LFR), the Waste Storage Facility (WSF), the Decontamination and Waste Treatment (DWT) and other laboratories, including the Jaap Goedkoop Laboratory (JGL).

removal. While pumping was in progress, it was discovered that a joint in the pipe assembly (inside a 'glove box') was not properly gastight. A glove box is a housing around the valves used to control the gas flow, which serves to prevent noble gases from escaping into the production areas, where people may be working. The glove box has an outlet to the outside atmosphere as a safety precaution. Consequently, a small proportion of the gaseous fraction of the waste escaped into the atmosphere. The emission was detected by instruments in the outlet pipe, and the operating personnel immediately intervened to stop the emission in response to the alarm.
The pipe system was not gastight at the time of the operation as a consequence of maintenance work being done to a different part of the system. The operating personnel were unaware of the maintenance work or the state of the system. The emission of noble gases was well within the limits permitted under the licence.
NRG has investigated the causes of the incident and has taken measures to prevent recurrence. The measures entail the definition of more detailed rules on the maintenance of operational equipment, including a prohibition on routine maintenance while equipment is in use and (additional) safety measures to be taken in circumstances where maintenance to operational equipment is unavoidable.

On the basis of NRG's investigation findings, the ANVS has given this event a final rating of INES level 0: no safety significance. Only a small amount of noble gas was emitted and sufficient barriers were in place to ensure that the emission did not result in contravention of the licence conditions.

18 May 2017: NRG/HCL - Contents of waste drum not fully documented; INES level 0

On 18 May 2017, NRG notified the ANVS that an internal inspection had revealed that in 2016 the contents of a drum of radioactive waste removed from a laboratory had not been fully specified. In addition to the normal radioactive waste, the drum had been found to contain a small amount of fissionable material, which would have warranted a different control regime. The fissionable material was not more hazardous than the normal radioactive waste and, despite the error, the waste was processed and stored at the Central Organisation for Radioactive Waste (COVRA) in an appropriate manner. However, because of the error, COVRA was unaware of the presence of fissionable material in the waste and consequently did not document the consignment correctly. In consultation between NRG and EURATOM, which supervises fissionable material record keeping in Europe, it was concluded that the event did not require notification in relation to safeguards and that the errors in the records could be corrected in accordance with the relevant procedure. NRG has established that the safety of personnel, the general public and the environment was not compromised during processing, transportation and reception of the waste at COVRA.
NRG additionally established that the information on the label on the waste drum was incomplete during those procedures. Furthermore, personnel were not sufficiently familiar with the procedures governing the removal of radioactive waste from the laboratory. In response to the event, NRG has tightened up and extended the training on working with fissionable materials provided to personnel. Moreover, NRG has taken organizational steps to provide additional assurance that waste drums containing fissionable material are correctly labelled. Finally, NRG is reviewing the siting of an instrument array so that even small quantities of fissionable material present in waste drums can be detected.

The ANVS has considered and approved the results of the investigation and the proposed measures. The ANVS is now monitoring implementation and evaluation of the measures. On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.
In view of the potential security and safeguarding aspects of this event, it was decided that no information about the event would be published on the website while the investigation was in progress.

7 July 2017: NRG/HCL - Negative pressure loss at the Molybdenum Production Facility (MPF); INES level 0

On 7 June 2017, NRG notified the ANVS that, on 6 June 2017, the Molybdenum Production Facility (MPF) had been evacuated in response to a negative pressure alarm in one of the hot cells. The MPF is part of the Hot Cell Laboratories (HCL) at the Petten Research Centre. The negative pressure drop was due to a door to the hot cell (for the introduction or removal of radioactive material) not being closed properly. NRG reported that, as soon as the alarm was triggered, the door was closed by an operator and the MPF was evacuated. Following the evacuation, NRG established that no radioactive materials had dispersed from the hot cell and that no personnel had been exposed to an elevated radiation level.
NRG is investigating how this incident could have taken place and will take measures to prevent recurrence. Following previous negative pressure alarms with similar causes, NRG had already responded by giving personnel extra training on use of the door and the associated transport system. The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course.

On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: no safety significance, since no radioactivity was released and sufficient safety barriers remained to prevent radioactive material escaping from the facility. It will only be possible for a final rating to be assigned when the results of the NRG investigation are known.

Update 2-2-2018
The ANVS has considered and approved the results of the investigation and the proposed measures. NRG has established that incomplete closure of the door was due to human error. NRG will accordingly extend the extra training already being given to personnel on use of the relevant type of door and transport system by creating a practice rig.
The ANVS is monitoring implementation and evaluation of the measures adopted and proposed by NRG. On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.

July 2017: NRG/other - Anticipated breach of dose limit at NRG facility boundary near STEK hall; INES level 0
On 14 July 2017, NRG notified the ANVS that, on 11 July 2017, it had established that the measured radiation dose at the facility boundary (Current Individual Dose) at the end of the second quarter of 2017 was 39 microsievert, approaching the annual limit of 40 microsievert set in NRG's Nuclear Energy Act licence. At the time of notification, the annual limit had not been breached, but NRG anticipated that it would be breached in the short term. The anticipated breach was confined to a single monitoring location, on the boundary of the NRG facility, near to the STEK hall. The hall is used for the temporary storage of transport-ready radioactive waste. The monitoring location is inside the boundary between the NRG facility and ECN; it is not adjacent to the exterior fence surrounding the Petten Energy Research Centre (OLP). NRG is investigating the cause of the impending breach of the annual limit and will take measures to minimize exposure at the relevant location and to prevent recurrence. The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course. If the ANVS ascertains that NRG's licence conditions have been breached, the breach will be dealt with separately.
On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: no safety significance, since no radioactivity was released and the measured radiation dose at the relevant location remains sufficiently low that no excessive human exposure has occurred at the facility boundary. It will only be possible for a final rating to be assigned when the results of the NRG investigation are known.

Update 2-2-2018
When data for the third quarter became available, it was observed that, as expected, the annual radiation dose limit applicable at the boundary between the NRG facility and ECN had been breached shortly after the previous notification. According to NRG, the elevated radiation level is attributable to the increasing amount of radioactive waste in storage, and the consequent removal backlog. Moreover, the building is not designed specifically for the storage and transfer of larger quantities of radioactive material. When waste drums are brought in and subsequently removed, transport procedures take place in front of the door of the hall, adjacent to and at the facility boundary. According to NRG, the event had no consequences for NRG or ECN personnel, or for visitors to either site. No annual dose limit breaches had been detected at the facility's exterior boundaries. Hence, the event had no consequences for the general public or the environment.
NRG has since revised the way that the hall is used and implemented a number of immediate technical and organizational measures to minimize the radiation dose at the facility boundary. NRG is also taking structural measures to prevent recurrence. The ANVS has considered and approved the results of the investigation and the associated measures.

The ANVS is monitoring implementation and evaluation of the measures proposed by NRG and is dealing with the observed breach of the licence condition separately. On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.

21 August 2017: NRG/HCL - Erroneous storage and processing of waste containing fissionable material: INES level 0
On 21 August 2017, NRG notified the ANVS that, on 10 August 2017, during the processing of radioactive waste in the Hot Cell Laboratories (HCL), fissionable materials were discovered in materials originating from research at the High Flux Reactor (HFR). The fissionable materials were discovered in a waste drum that had not been registered as containing waste that included fissionable materials. In consultation between NRG and EURATOM, which supervises fissionable material record keeping in Europe, it was concluded that the event did not require notification in relation to safeguards and that the errors in the records could be corrected in accordance with the relevant procedure.

It appeared that the waste drum was transferred to the Waste Storage Facility (WSF) by the HFR in 2012, without the relocation of the fissionable material being noted in NRG's fissionable materials records. Consequently, the waste drum had been stored in the wrong area of the NRG site since 2012. The drum was subsequently collected from the WSF by NRG with a view to preparing the waste for removal to the Central Organisation for Radioactive Waste (COVRA). Checks performed at that time failed to reveal the presence of fissionable material, with the result that the waste drum was presented to the HCL for processing without the appropriate procedures being followed. NRG indicated that the applicable safety limit for fissionable material was not exceeded in the hot cell, and that the event had no consequences for the safety of personnel, the general public or the environment. After discovering the fissionable material, NRG stored the waste in the permitted manner and location, and corrected its fissionable materials records. NRG has since taken technical and organizational measures to prevent similar events occurring in the future. The irregular removal of the waste by the HFR in 2012 was reported to the ANVS as a separate event; it is now the subject of a separate NRG investigation. For details, see the notification submitted on 13 September 2017.
The ANVS has considered and approved the results of the investigation and the proposed measures. The ANVS is now monitoring implementation and evaluation of the measures. On the basis of the information provided by NRG, the ANVS has given this event a final rating of INES level 0: a minor anomaly with no safety repercussions.
In view of the potential security and safeguarding aspects of this event, it was decided that no information about the event would be published on the website while the investigation was in progress.

August 2017 NRG/other - Mobilization of NRG emergency service following fall of a staff member; INES level not applicable

On 22 August 2017, NRG notified the ANVS that, on 21 August 2017, its company emergency service had been mobilized in response to a staff member falling from a landing 0.5 metres above ground level. An ambulance was sent as a precaution, but it was decided that the worker in question did not need to go to hospital. The worker did, however, visit their GP.
The technical specifications require NRG to notify the ANVS of any event involving mobilization of the company emergency service. On the basis of the information provided by NRG, the ANVS has concluded that the event was of no significance in relation to nuclear safety or radiation risk. No INES rating has therefore been assigned.

2 October 2017: NRG/other - Mobilization of emergency service in response to release of harmful vapours following overheating of local emergency power supply; INES level not applicable

On 2 October 2017, NRG notified the ANVS that, earlier that day, its company emergency service had been mobilized in response to the release of harmful (non-radioactive) vapours following the overheating of the local uninterruptible power supply (UPS) to the Hot Cell Laboratories (HCL). In response to the event, the HCL was evacuated and a number of ambulances attended as a precaution. Several members of staff were examined, but none were found to require further examination at a hospital.
NRG is investigating how this incident could have taken place and will take measures to prevent recurrence. The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course. On the basis of the information provided by NRG, the ANVS has concluded that the event was of no significance in relation to nuclear safety or radiation risk. No INES rating has therefore been assigned.

20 October 2017: NRG/HCL - Instrumentation communication failure on NRG site following lightning strike; INES level 0

On 20 October 2017, NRG notified the ANVS that, on 18 September 2017, as a result of a lightning strike, there was a brief failure of communication between the local radiation monitoring equipment in the buildings and the central building management system. NRG reported that all radiological monitoring equipment continued to function locally, and that no emissions occurred during the period in question as a result of the failure.
On the basis of NRG's investigation findings, the ANVS has given this event a final rating of INES level 0: no safety significance. NRG's existing procedures are adequate and were followed appropriately during the event. No safety barriers were compromised.

20 November 2017: NRG/DWT/WSF - Elevated radiation level due to inadequate shielding; INES level 0 (preliminary rating)

On 20 November 2017, NRG notified the ANVS that, on 8 November 2017, a slightly elevated radiation level had been unexpectedly detected in a laboratory at the Decontamination and Waste Treatment facility (DWT). The elevated radiation level proved to be attributable to activities taking place at the neighbouring Waste Storage Facility (WSF). While the radiation level associated with a waste drum was being measured, the closure mechanism on the protective container was

open. The shielding against radiation was consequently diminished and the risk of exposure increased. The compromised shielding was insufficient to protect against the strongly radiating source while the activities were in progress. As soon as the problem was detected, the activities with the source were stopped. NRG is investigating whether any personnel were exposed to elevated radiation levels as a result of the event. NRG is investigating how this incident could have taken place and will take measures to prevent recurrence. The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course. Insufficient information is currently available to support an INES rating.

Update 2-2-2018
Having performed tests, NRG has concluded that the event had no consequences for the personnel present. The brief elevation of the local radiation level did not result in any increase in the radiation level at the site boundary, so there were no consequences for the surrounding area.

On the basis of the information provided by NRG in its preliminary report, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly with no safety repercussions. It will only be possible for a final rating to be assigned when the full results of the NRG investigation are known.

30 November 2017: NRG/other - Mobilization of NRG emergency service in response to data server fault; INES level 0 (preliminary rating)

On 30 November 2017, NRG notified the ANVS that, earlier that day, its company emergency service had been mobilized in response to a fault with a data server. The fault resulted in the interruption of internal data and telephone traffic on the NRG site. That affected the performance of the building management system, which triggers central alarms in the event of abnormal values being measured by monitoring equipment, such as that which monitors radiation levels in working areas. The safety systems themselves continued to work normally, according to NRG. The technical specifications require NRG to notify the ANVS of any event involving mobilization of the company emergency service.
NRG is investigating how this incident could have taken place and will take measures to prevent recurrence. The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course.
On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly with no safety repercussions. It will only be possible for a final rating to be assigned when the results of the NRG investigation are known.

28 December 2017: NRG/HCl - Temporary outage of monitoring equipment in the research laboratory due to power failure; INES level 0 (preliminary rating)

On 28 December 2017, NRG notified the ANVS that, the previous day, communication between the local radiation monitoring equipment in the cells where radioactive material is processed and the central building management system had been interrupted for several hours due to a power failure. According to NRG, the cause of the power failure was the blowing of a fuse. NRG reported that some of the radiological monitoring equipment in the cells continued to function normally during the outage. The activities were halted and the fault was rectified. According to NRG, no emissions occurred as a result of the fault.

NRG is investigating the causes of this event and seeking to establish why, when the fuse blew, the automated systems did not quickly detect the power failure and the outage of some of the radiological monitoring equipment.
The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course.
On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: no safety significance, since no radioactivity was released. It will only be possible for a final rating to be assigned when the results of the investigation are known.

1.4 Other nuclear facilities

1.4.1 Central Organisation for Radioactive Waste (COVRA), Nieuwdorp (Borssele)

In 2017, COVRA did not notify the ANVS of any events.

1.4.2 Higher Education Reactor (HOR), Delft

In 2017, Delft University of Technology, the licensee of the Higher Education Reactor, notified the ANVS of two events.

13 July 2017: Erroneous reactor power measurement; INES level 0 (preliminary rating)

On 13 July 2017, the Reactor Institute Delft (RID) notified the ANVS that, when its monitoring equipment was calibrated using an improved method, it came to light that an invalid calibration factor value had previously been used for reactor power determination. The reactor power measurement in question is used in the context of reactor power control. As a result, the reactor's true operational thermal power output was higher than the set value of 2 megawatts. However, the error did not cause a breach of the power limits specified in the licence conditions, since RID normally operates the installation at a power output lower than the permitted maximum and well within the safety margins. Nevertheless, because the reactor power is also used to set the flux shutdown point, the fault did mean a small reduction in the safety margin for flux measurement shutdown, and the licensee is required to notify the authorities of any such reduction. During the regular summer shutdown, the RID adjusted the calibration factor using the more accurate calibration and analysis method and thus restored the shutdown safety margins. The RID has begun an investigation into the cause of the calibration error and its consequences for nuclear safety. The RID also immediately restored the shutdown safety margin. The ANVS subsequently gave the RID permission to restart the reactor after the scheduled summer shutdown. However, conditions were made regarding the power output pending the outcome of the investigation.
The ANVS is supervising the investigation into the cause of the event. The ANVS will consider the outcome and any proposed measures in due course. On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

Update following further analyses:
By performing further analyses, the RID has verified that the reactor can operate within the appropriate safety limits. The temporary power limits have accordingly been withdrawn.

24 November 2017: HOR - Incorrectly set valve in liquid nitrogen system; INES level 0

On 29 November 2017, the Reactor Institute Delft (RID) notified the ANVS that, on 24 November 2017, it was discovered that a valve in the liquid nitrogen system was set incorrectly. The liquid nitrogen pipes run through the wall of the reactor room. In an emergency, the pipes are automatically closed by means of four isolation valves.
During repairs to a part of the isolation valves, the automatic valve closure mechanism was temporarily bridged in order to draw off nitrogen in the reactor room. Following the procedure, the valves were not reset correctly. Despite the mistake, the nitrogen pipes were kept closed at all times by other valves. The isolation valve setting was corrected as soon as the error was detected; the valves were then immediately tested to verify that they were working properly.
The RID subsequently investigated the event. On 21 December, the RID submitted a report to the ANVS explaining the underlying causes of the event and the associated measures. In future, repairs to safety-relevant systems will be undertaken by teams of at least two people. The relevant work instructions are being revised in line with the new policy. The ANVS has considered the results of the investigation and the proposed measures. On the basis of the information provided by the RID, the ANVS has given this event a final rating of INES level 0: a minor anomaly.

1.4.3 Energy research Centre of the Netherlands (ECN), Petten

The Energy research Centre of the Netherlands did not notify the ANVS of any events in 2017.

1.4.4 Joint Research Centre (GCO) of the European Commission, Petten

The Joint Research Centre of the European Commission did not notify the ANVS of any events in 2017.

1.4.5 Joint Nuclear Power Plant Nederland (GKN), Dodewaard

The Dodewaard Nuclear Power Plant was definitively shut down on 26 March 1997 but is subject to monitoring pending its final decommissioning. GKN, the licensee of the Dodewaard Nuclear Power Plant, did not notify the ANVS of any events in 2017.

1.4.6 URENCO Nederland, Almelo

URENCO notified the ANVS of one event in 2017.

19 December 2017: URENCO - Overfilled container; INES level 0 (preliminary rating)

On 19 December 2017, URENCO notified the ANVS that a cylinder of uranium hexafluoride (UF6) had been checked and found to contain more UF6 than permitted. The check was part of a routine procedure. URENCO reported that it remained unclear how the discrepancy had arisen between the measurements made at the time of filling and in the context of the routine checks. URENCO is accordingly investigating the matter. The excess UF6 was transferred from the overfilled cylinder to another cylinder under controlled conditions.

The ANVS is supervising the investigation and will consider its outcome and any proposed measures in due course. When the outcome of the URENCO investigation is considered, the ANVS will take account of the causes of a similar incident in 2015 and the response measures taken.

On the basis of the information available so far, the ANVS has given this event a preliminary rating of INES level 0: a minor anomaly. The event will be assigned a final rating after assessment of the results of the more detailed investigation.

1.5 Dutch event reports to the IAEA in 2017

Events of INES level 2 and higher must be reported to the International Atomic Energy Agency (IAEA) by the more than seventy countries which participate in INES. The purpose of these notifications is to inform the international community, at an early stage, of the nature and severity of any such events. No INES notifications were made to the IAEA by the Netherlands for 2017.

The IAEA manages databases of events which have occurred at nuclear facilities[5]. Countries enter reports on the events in question into these databases, the objective being to actively inform one another of the causes of, and solutions for, events which, after all, can also occur at similar facilities and under similar circumstances in other countries.

[5] The databases can be found here: *http://nucleus.iaea.org/Pages/default.aspx*. Most databases are not open to the public.

2 Updates to information published in previous reports

Sometimes, the INES rating ascribed to one or more events detailed in an annual report, or the number of compulsory notification events stated as having occurred, has to be revised after the report has been published. Revision may be necessitated by the findings of investigations still in progress at the time of publication, by subsequent site inspections, or by reassessment by the ANVS or the facility's internal supervisors. This chapter describes the revisions made since the last annual report. The ANVS endeavours to ensure an up-to-date list of events is always available on its website.

2.1 Completeness of licensees' notification activities

2.1.1 *URENCO Nederland, Almelo*

In 2017, inspection activities revealed one compulsory notification event that had occurred at URENCO in 2016 but that had not been notified to the ANVS. URENCO accordingly notified the ANVS about the event following the inspection. The notification was published on the ANVS website, as follows:

3 August 2016: URENCO - Fire in filter dryer; INES level 0

On 13 November 2017, URENCO notified the ANVS that, on 3 August 2016, a fire had occurred in the filter dryer at the Recycling Centre. The filter dryer is an installation where wet filters are dried, so that they can then be disposed of as radioactive waste. The fire was quickly extinguished with the help of the public fire service. Immediately after the fire, checks were performed to establish whether any radioactive material had been released. No pollutants containing radioactive material were detected. URENCO subsequently investigated the cause of the fire. The conclusion was that the dryer had not been designed for the kind of use it was actually receiving and did therefore not meet the corresponding requirements. That had given rise to a fire hazard. The dryer was therefore taken out of use and decommissioned. URENCO also adopted measures to ensure that, in future, greater attention was paid to verifying whether systems and installations at the facility met the corresponding requirements.
The reason for belated notification of the event was that URENCO and the ANVS did not initially recognize the event as subject to a notification requirement. That stems from the fact that the notification requirement is based on the cost of the damage caused by a fire, rather than its significance for safety. During the ANVS's annual inspection of the internal faults reports, the notification requirement was recognized. URENCO then formally notified the ANVS of the event. The ANVS has considered and approved the measures proposed by URENCO. The ANVS is now monitoring their implementation.

On the basis of the information made available by URENCO, the ANVS has rated this event as INES level 0: a minor anomaly.

2.1.2 *Central Organisation for Radioactive Waste (COVRA), Nieuwdorp (Borssele)*

In 2016, COVRA notified the ANVS promptly of a 'radiation incident', and the ANVS processed the notification accordingly. However, the findings of a recent inspection led the ANVS to conclude that, under the conditions of COVRA's Nuclear Energy Act licence, the event should have been treated by the ANVS as an abnormal event, and details should therefore have been published on the ANVS website and in the annual event report. The reporting obligation is therefore fulfilled below. The event in question was as follows:

4 November 2016: COVRA - Contamination of a worker and a laboratory during fume cupboard cleaning; INES level 0

On 4 November 2016, COVRA notified the ANVS that, on 26 October 2016, while a fume cupboard was being cleaned, the shoe of a member of staff had been contaminated with radioactive material. That led to contamination of the floor of the laboratory and an adjacent room in various places.

Investigation led to the discovery that an old plastic sample flask in a fume cupboard was degraded and disintegrating. The laboratory worker had collected all the material from the fume cupboard and disposed of it in accordance with the relevant procedure. COVRA established that, during the cleaning activities, a fragment of plastic had apparently fallen on the floor, leading to contamination of the worker's shoe and the floor. The contamination was removed from the shoe and the floor in accordance with the normal procedures.
The event did not result in any emissions to the exterior environment. The laboratory is connected to an extractor system, which is monitored for airborne radioactive materials. No such materials were detected during the event. No contamination of exterior locations can have occurred either, since incoming and outgoing personnel and goods were monitored effectively during the event and nothing was detected.
The reason for the plastic's disintegration could not be established. The possibility of such events can never be fully excluded. That is why activities involving objects of the kind associated with this event are undertaken in a protective location, such as a fume cupboard.
COVRA has taken measures to further reduce the possibility of contamination of the kind involved in this event. The fume cupboards have since been replaced with an improved type.
Having considered the COVRA investigation into the cause of the event and COVRA's response to the event, the ANVS is satisfied that the matter was dealt with appropriately.
The ANVS has rated this event as INES level 0: no safety significance. The contamination of the worker's shoe was modest and did not result in contamination of the surrounding area. The safety barriers for the prevention of contamination functioned as intended.

2.2 Updates to preliminary INES ratings

The event report for 2016 contained details of a number of events whose INES ratings were at the time preliminary. The final ratings determined for 2016's notified events were all consistent with the previously reported preliminary ratings.

2.3 Updated overview of events in 2016

The overview of events in 2016, updated to reflect the additional events described in 2.1, is as follows:

Table 1 The updated total number of compulsory notification events at each company in 2016, categorized according to INES level.

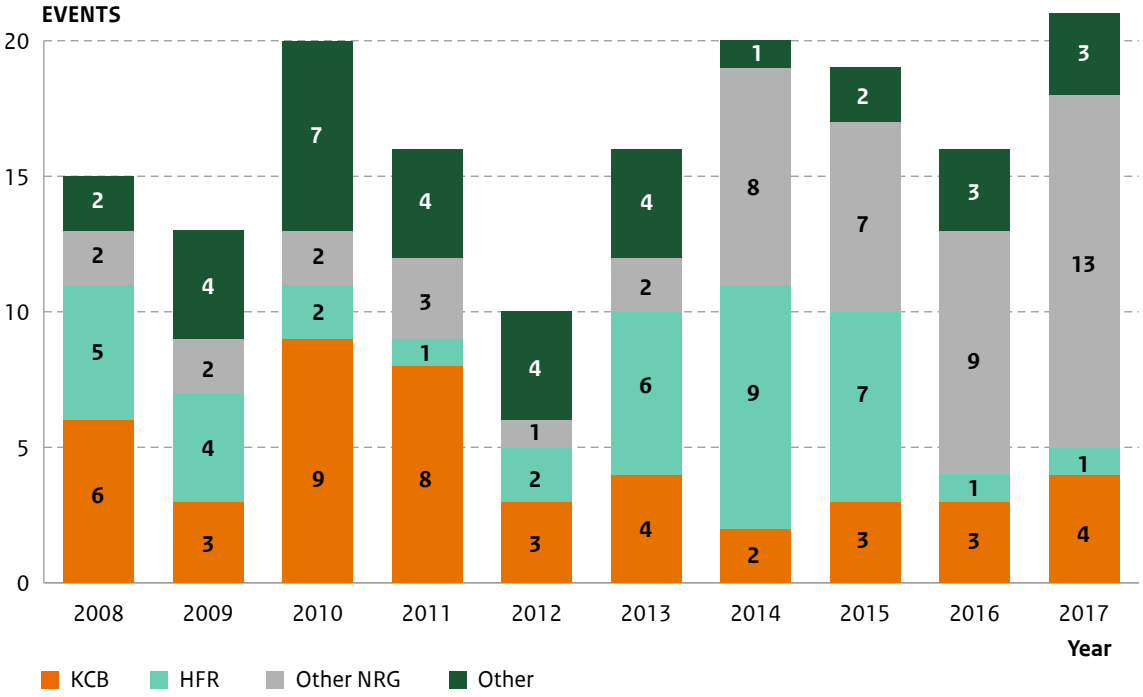
Facility	Total number of events requiring notification	INES level 0	INES level 1	INES level 2
Borssele Nuclear Power Plant	3	3	0	0
High-Flux Reactor, Petten	1	1	0	0
Other NRG facilities, Petten	9	9	0	0
Central Organisation for Radioactive Waste, Nieuwdorp	1	1	0	0
Higher Education Reactor, Delft	0	0	0	0
Energy research Centre of the Netherlands, Petten	0	0	0	0
Joint Research Centre, Petten	0	0	0	0
Joint Nuclear Power Plant Nederland, Dodewaard	1	1	0	0
URENCO Nederland, Almelo	1	1	0	0
Total for all nuclear facilities	**16**	**16**	**0**	**0**

3 ANVS analysis of events in the Netherlands in 2017

All the events at the various Dutch nuclear facilities regarding which the ANVS was notified in 2017 are described in Chapter 1. In order to analyse the performance of the facilities on the basis of those events, a number of questions must be answered: How severe were the events? How did the licensees deal with them? Is the situation getting better or worse? How does the situation in the Netherlands compare with the situation elsewhere, and do the events suggest the existence of other safety problems?

Figure 1 shows the numbers of events at the facilities in recent years. The numbers are broken down into component numbers for the main nuclear facilities and other nuclear facilities collectively.

Figure 1: All compulsory notification events, broken down into the numbers at the main nuclear facilities and other nuclear facilities collectively, 2008 to 2017 inclusive.

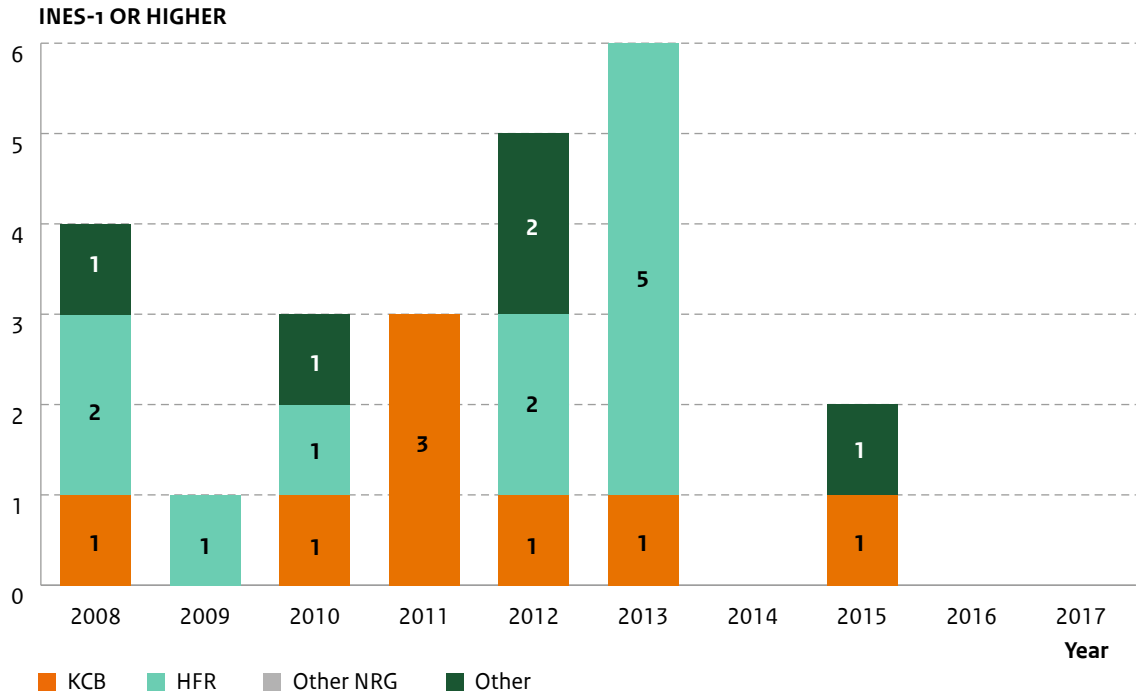


The first question introduced above (how severe the events were) can be answered by referring to the events' INES ratings. When the INES scale was set up in 1989, the rating criteria for each level were defined so that, as an annual average, about ten INES level 0 events and a single INES level 1 event may be expected at a 'normal' nuclear facility. An INES level 2 event may be expected once in ten years.

On the basis of that international benchmark, the severity of events at Dutch facilities in 2017 was low: the twenty-one events that occurred in 2017 were characterized as 'less severe' (INES level 0 or INES level 1) or did not qualify for INES rating. Figure 2 shows events occurring in the last ten years with INES ratings of 1 or higher.

It should be noted that some of the events have yet to be assigned a final rating. Final ratings cannot be given until the investigation of the underlying causes is concluded. Some complex investigations inevitably take longer than a year. It is highly unlikely that any final rating will be more than one level higher than the corresponding preliminary rating.

Figure 2: The number of compulsory notification events rated as INES 1 or higher, broken down into the numbers at the main nuclear facilities and other nuclear facilities collectively, 2008 to 2017 inclusive.



Whether the situation at the nuclear facilities in 2017 was better or worse than in previous years, and how they compare with each other and with facilities abroad, is harder to determine. The reasons are as follows:

- Statistics relating to the data are scarce. Too few events occurred to support statistically informed conclusions.
- The INES scale provides a good indication of the severity of an event, but it says nothing about, for example, whether two INES level 0 events represent a more or less serious situation than a single INES level 1 event.
- An event must be rated as at least INES level 2 before the country concerned is obliged to record it in the INES system. No objective numerical comparison of INES level 0 and level 1 events can therefore be made between the Netherlands and other countries.
- The notification criteria always allow room for interpretation. Consequently, an increase in the number of notifications due to a greater willingness to report events could give the false impression that the situation is deteriorating.
- The severity of the great majority of compulsory notification events is below the INES scale. The specific criteria for notification depend on national conventions and, in particular, on the technical details of the design of the individual facilities. Inevitably, therefore, there can be major differences in the notification criteria that apply to different facilities.

Since 2013, there has been a clear decline in the severity of the events notified to the ANVS. In the same period, however, there has been an increase in the number of events notified, particularly by NRG. That increase coincides with NRG placing greater emphasis on event registration and notification: at all levels of the organization, the registration of both compulsory notification events and other abnormal events is now treated as a higher priority.

The conclusions of the ANVS's analysis are presented below for each facility individually.

1. 3.1 Borssele Nuclear Power Plant

EPZ notified the ANVS of four events in 2017, all of which were rated INES level 0. All the event notifications were made in good time, and EPZ demonstrated a willingness to learn from the events with a view to minimizing the chance of recurrence. The event notifications were of satisfactory quality, and EPZ responded appropriately to the ANVS's follow-up questions regarding the events and EPZ's investigations. On the basis of the information available at the time of writing, the ANVS concludes that EPZ is willing to learn from events and takes a serious approach to event analysis and improvement planning. The ANVS nevertheless intends to undertake an inspection for the specific purpose of considering events at the Borssele Nuclear Power Plant that EPZ considers to be outside the scope of the notification requirements. If that inspection or the findings of ongoing event investigations should warrant revision of conclusions presented above, the revised conclusions will be presented in the event report for 2018 and on the ANVS website.

3.2 Other Dutch nuclear facilities

3.2.1 NRG

NRG notified the ANVS of one event at the High Flux Reactor in 2017. The event was given a preliminary rating of INES-0. The notification of a single event was consistent with the low number of events at the HFR notified to the ANVS in recent years. NRG notified the ANVS of thirteen events at its other facilities in 2017, none of which qualified for a rating of INES 1 or higher. In view of the number and complexity of the activities undertaken at NRG's other facilities, the number of events does not give cause for concern. The ANVS notes that, in recent years, NRG has gone about the recording and notification of events at its other facilities more diligently. One consequence of that has been a structural increase in the number of events that NRG is required to investigate and discuss with the ANVS. However, NRG currently pays structurally inadequate attention to the investigation of events and to their prompt and qualitatively sound resolution. The ANVS notes that NRG is seeking to improve that situation, but that progress remains too slow. The ANVS has accordingly written to NRG acknowledging the progress being made in this sphere, but stressing that the situation currently remains unsatisfactory. The letter additionally specified the improvements that NRG must make in order to fulfil its obligations.

3.2.2 Higher Education Reactor

The ANVS was notified of two events at HOR in 2017. The notifications were made promptly and RID resolved both events satisfactorily.

3.2.3 URENCO

URENCO notified the ANVS of one event in 2017. The notification was made promptly.

3.3 General conclusion

In response to the compulsory notification events and other abnormal events, the companies have undertaken analyses to identify the direct and indirect causes. Where necessary, measures have been taken to prevent recurrence.
The ANVS considers that the licensees in question make active use of event analysis findings, with a view to realizing improvements.

The ANVS stays abreast of the progress and effectiveness of the measures taken, carries out on-site inspections and, where necessary, applies enforcement instruments to promote compliance.

On the basis of the available information, the ANVS concludes that, in general, the licensees of the nuclear facilities tackled the events which occurred at their facilities in 2017 with due care. The policies adopted by EPZ and NRG a few years ago with a view to further reducing the number of events at the Borssele Nuclear Power Plant and the High Flux Reactor appear to be bearing fruit. Nevertheless, although events are generally dealt with well, prompt and thorough event resolution requires ongoing attention. Where NRG's other facilities are concerned, improvements are needed in the short term.

Annex

The severity of nuclear incidents, rated according to the International Nuclear and Radiological Event Scale (INES)
An assessment is made of the severity of all events that are subject to notification requirements. Assessment is based on the International Nuclear and Radiological Event Scale (INES) defined by the International Atomic Energy Agency (IAEA) and the Organisation for Economic Cooperation and Development (OECD)'s Nuclear Energy Agency (NEA). INES ratings, from level 1 (anomaly) rising to level 7 (major accident), are used to make the level of events at nuclear facilities all over the world clear to the general public, in consistent terms.

The INES rating is the result of three separate ratings:
2. radiation or radioactive material released,
3. harm to people and the living environment, and
4. degradation of safety barriers.

The ultimate rating of an event is based on the highest rating of the three. When 'radiation or radioactive material released' and 'harm to people and the living environment' are rated, the actual consequences involved are examined. Measurements are taken of the amount of material ending up in the living environment or of how many people were exposed, and to what degree of radiation. However, radiation is seldom actually released during an 'incident' or 'accident' and no harm is caused to people or the environment. The purpose of the INES rating on the 'degradation of safety barriers' is to additionally give an indication of the severity of the event in terms of that particular consequence. In that context, the number of safety barriers that protect against the release of radiation is relevant. The rating is determined by the number of barriers remaining unbreached. The fewer barriers that remain, the higher the rating. The severity of the event that could occur if the remaining barriers were breached also influences the rating.

Almost none of the events described in this report have had any actual consequences for people or the environment.

In this report, events that are subject to a reporting requirement but have no consequences for safety are rated as 'INES-0' or 'below scale'. Events that are entirely irrelevant in the context of nuclear safety and radiation protection are not rated.

INES levels 1 to 3 are defined as follows:
- **Level 1** is an 'anomaly'. Level 1 anomalies are events in which, for example, problems arise with a facility's safety provisions, but where the remaining safety margin is sufficient to prevent exposure to radiation. Another example of an INES level 1 anomaly is an event in which a member of the public is exposed to radiation from radioactive materials and the dose incurred exceeds the legally permitted dose in the Netherlands of 0.001 sieverts per year.
- **Level 2** is an 'incident'. Level 2 incidents are events in which, for example, heightened radiation levels occur in the workplace (more than 0.05 sieverts per hour). An event in which parts of the facility become severely contaminated with radioactive materials is also an INES level 2 incident.
- **Level 3** is a 'severe incident'. Level 3 severe incidents include events in which, for example, parts of the nuclear facility become very severely contaminated with radioactive materials. Another example of an INES level 3 severe incident is an event in which an accident is only just avoided and there is no remaining margin present in terms of safety provisions.

The higher levels have not been included in this report. Definitions of the higher levels can be found on the ANVS website (see the link below).
No incidents of level 3 or higher have ever occurred at Dutch nuclear facilities.

It should be noted that the INES ratings are applied not only to events at nuclear facilities but also to events occurring during transport, work with radioactive sources, devices and materials and, since early 2007 (in a test phase), also to medical events. Non-civilian events and nuclear terrorism do not fall under the INES regime.

Events of INES level 2 or higher must be reported to the IAEA by the more than seventy countries which participate in INES.

As a result of recent experience with the INES scale following the nuclear accident in Fukushima, the IAEA reviewed the INES scale to establish whether it requires modification. The conclusion of the investigation was that the scale does not need modifying, but that users should be more cautious when assigning *preliminary* ratings. Proper rating is possible only once the event has reached a stable phase and there is a reliable picture of the ultimate consequences. Member states are encouraged to make INES notifications within twenty-four hours of a reliable and stable picture of the situation emerging (not within twenty-four hours of the event beginning).

In the Netherlands, the events that have to be reported to the ANVS by a nuclear facility are stipulated in the facility's Nuclear Energy Act licence and, specifically, the associated Technical Specifications. The Dutch notification regulations are *more stringent* than those of INES. Licensees therefore also notify the ANVS of events that are not relevant under the INES criteria but nevertheless warrant detailed safety analysis.
Such low-level events, which are not significant for nuclear safety and thus fall below this nuclear scale, are rated INES level 0 or 'below scale'. Where an event cannot be rated because it has no significance for radiological or nuclear safety, the report indicates that INES is not applicable.

More information about the INES scale can be found on the ANVS website (*http://www.autoriteitnvs.nl/onderwerpen/ines*) and the International Atomic Energy Agency website (*https://www.iaea.org/sites/default/files/ines.pdf* and *http://www-pub.iaea.org/MTCD/Publications/PDF/INES2013web.pdf*).

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