



Inspectie Leefomgeving en Transport
Ministerie van Infrastructuur en Milieu

Report on events in Dutch nuclear facilities during 2012

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In case of textual differences between the original report and this translation the original report is binding.



Report on events in Dutch nuclear facilities during 2012

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Summary

In 2012 ten events¹ have occurred in the Dutch nuclear facilities. Three events took place in the Nuclear Power Plant Borssele and seven events in the other Dutch nuclear facilities.

Five out of the ten events (one at the Nuclear Power Plant Borssele, two at the HFR of NRG Petten, one at Mallinckrodt Medical and one at Urenco Almelo) are of such importance with respect to nuclear safety that they have been classified on INES level 1. This is the lowest level of the internationally used method to classify the severity of events (the International Nuclear and Radiological Event Scale, INES). Of one event at the Nuclear Power Plant Borssele the INES classification still has to take place, because not all necessary information is available yet. The other events are less serious with respect to nuclear safety and fall below this scale (INES level 0).

The investigation shows that in 2012 in none of the Dutch nuclear facilities the number of events and their severity has differed statistically from previous years. Admittedly, few events have been recorded this year and the total number of INES level 1 events is higher than was the case in preceding years, but there is no reason to assume that there is a question of a trend.

For the Nuclear Power Plant Borssele, no special developments in the field of events can be reported. In 2012 there have been few disturbances. The KFD notices that since some years EPZ has been giving special attention to the reduction of the number of disturbances by means of the improvement of the internal communication and their operating processes and the implementation of various investments intended to improve the functioning of the plant.

By these measures EPZ expects to reduce the number of events at the nuclear power plant. However, it would be premature to conclude that the positive effects of these measures are already visible as a reduction of the number of events.

At the other Dutch nuclear facilities seven events have occurred in 2012. Relative to earlier years this is a normal number. Of the seven events, four have been classified on INES level 1. This is more than in preceding years. The events concerned are divided over three licensees, namely two events at the HFR of NRG, one at Mallinckrodt Medical and one at URENCO, so that in 2012 there has not been an increase of problems at one licensee.

¹ In this report, as events have been considered those occurrences / disturbances which are of importance for the nuclear safety. Those are practically all disturbances which have to be reported at once to the KFD in the framework of the Nuclear Energy Act licence plus occurrences which admittedly do not have to be reported, but which the KFD nevertheless considers to be of importance for the nuclear safety.

The INES classification is determined both on the basis of the severity of the incident itself and on the basis of the circumstances concerning the incident. This year, the INES-1 classifications are based in particular on the fact that in those events "ageing of the plant" was involved and/or imperfections in the field of the "corporate culture" have been observed. It is found that operating procedures are not always strictly adhered to.

In 2012 the KFD has given much attention to the undesired occurrences at the HFR of NRG. Also because of these occurrences, NRG is placed under intensified surveillance. The observed technical and organisational problems and the studies and repairs executed as a result required much priority and effort in the surveillance by the KFD.

The KFD concludes on the basis of the available information that the operators of the nuclear facilities have generally speaking carefully handled the events occurring in 2012 in their facilities. The events have been reported and analysed in time. The causes have been determined and, where necessary, measures have been taken to prevent a recurrence in the future.

The opinion of the KFD is that, also in 2012, the licensees have learned from the events, thus contributing to the continuous improvement of the safety of the nuclear facilities in the Netherlands. The KFD continues to inform itself about the progress and the effectiveness of the measures taken, inspects on site and, where necessary, applies enforcing instruments to enhance the compliance.

Introduction

This report presents an overview of the events which have occurred in 2012 in the Dutch nuclear facilities.

On February 27, 1980 the then Minister of Social Affairs promised to inform the Tweede Kamer (House of Commons) every year in writing on the performance of the Dutch nuclear power plants. The active informing of citizens by the authorities undergoes developments. There is more transparency and reporting is faster. Therefore, since the beginning of 2013 the events in the nuclear facilities are placed up-to-date on the website of the ILT².

The Department of Nuclear safety, Security, Safeguards and Radiation Protection (Kernfysische Dienst, KFD) has been charged with the editing of this report. The KFD supervises all facilities in the Netherlands that are operated based on a licence in accordance with article 15 under a or b of the Nuclear Energy Act (Kernenergiewet). The KFD is part of the Human Environment and Transport Inspectorate (Inspectie Leefomgeving en Transport), which as of January 1, 2012 was created from the VROM Inspectorate and the Inspectorate Transport, Public Works and Water Management.

In the course of the years this reporting has been extended to all nuclear facilities in the Netherlands and the radiological laboratories connected to them.

In this report the reports of the following licensees³ have been recorded:

- The Elektriciteits-Produktie maatschappij Zuid-Nederland (EPZ) at Borssele with the Nuclear Power Plant Borssele (KCB);
- The Central Organisation for Radioactive Waste (COVRA) at Borssele;
- The Technological University Delft with the Reactor Institute Delft (RID) with the University Research Reactor (HOR), the sub-critical ensemble DELPHI and laboratories;
- the Nuclear Research and Consultancy Group (NRG) at Petten with two facilities:
 - The High Flux Reactor (HFR),
 - The Low Flux Reactor (LFR), the Hot Cell Laboratories (HCL), consisting of the Research Laboratory (RL) and the Molybdenum Production Facility (MPF), the Decontamination and Waste Treatment (DWT) and the Waste Storage Facility (WSF);

²

http://www.ilent.nl/onderwerpen/leefomgeving/nucleair_en_straling/nucleair/nucleaire_installaties/ongewone_gebeurtenissen_2013/

³ The licensees mentioned can be divided into two categories: the licensees in accordance with the Nuclear Energy Act (Kernenergiewet) article 15 under b (EPZ, COVRA, RID, NRG-HFR, NRG-others, GKN and URENCO) and the licensees in accordance with the Nuclear Energy Act article 15 under a, article 29 and article 34 (ECN, GCO and MM).

- The Energy Research Centre Nederland (ECN) at Petten;
- The Joint Research Centre (JRC) of the European Union at Petten;
- Mallinckrodt Medical (MM), a subsidiary of Covidien, at Petten⁴;
- The Joint Nuclear Power Plant Nederland (GKN, Gemeenschappelijke Kernenergiecentrale Nederland) at Dodewaard, which has been taken out of service finally in March 1997 and which since then has been in safe enclosure;
- The enrichment plants of URENCO Nederland at Almelo.

Also, a report has been included about a radiological source which was lost during international transport.

For the reported events the INES scale is used. This scale shows the safety importance of nuclear and radiological events, comparable with the scale of Richter for earthquakes. An explanation of the INES scale is given in the Annex.

⁴ Since July 1, 2013 the name of the company has been changed into Mallinckrodt Pharmaceuticals and the company is no longer part of Covidien

Events in Dutch nuclear facilities in 2012

In this chapter an overview is given of the events, which have occurred in 2012 in the Dutch nuclear facilities.

Events feature two important aspects. First is the event itself, the nature and the severity of which must be determined and the consequences eliminated. In addition, it is important that after the occurrence of an event this event is systematically analysed, in order to learn from it and to prevent a recurrence in the future. This contributes in an important degree to the continuous improvement of the safety of the nuclear facilities.

Events can occur in various gradations, from seemingly unimportant to very weighty, but they must all be taken equally seriously. "Small" events can be a symptom of an underlying larger problem and the simultaneous occurrence of several small events may have serious consequences. It is therefore necessary to record and analyse all events thoroughly. This is the task of the licensees of the nuclear facilities. The KFD supervises this. Based on the Nuclear Energy Act licences granted to the nuclear facilities, the licensees must report events which occur in the facility. For every Dutch nuclear facility, reporting criteria have been established that specify which events must be reported to the KFD and which must not. The total number of events in every facility is higher than the number of events shown in this report. The KFD is informed on these other events by means of monthly, quarterly or annual reports, meetings and during inspections. The events reported below all have been given an INES classification, where INES stands for International Nuclear and Radiological Event Scale. The INES scale is for nuclear events what the scale of Richter is for earthquakes: it indicates the severity of the events.

2.1 Nuclear Power Plant Borssele

In 2012 EPZ, the licensee of the Nuclear Power Plant Borssele (KCB), has reported three events to the authorities. These events are described below.

February 3, 2012: Unplanned reactor shut-down as a result of freezing of measuring equipment; INES level 0

On February 3, 2012 the control room staff has taken the reactor out of service by hand action. The reason was that a disturbance occurred in the level control of both high-pressure preheaters in the main feed water system. The advanced shutdown is done "as a precaution" because at that moment reliable level measurements are lacking and potential risks are created when the level in the preheaters changes. It was found that the disturbance in the level measurement was caused by frost. By freezing of lines incorrect level indications were caused. As a result, it seemed that level limit values were exceeded and as a consequence, automatic actions were

executed.

The lines could freeze because these measuring lines are located directly opposite of the inlet ducts of the turbine building ventilation and the outside air temperature sank to below -7 °C that evening. Although this kind of weather conditions are not unique, such a case of freezing has never occurred before.

In reality, the level limit values have not been exceeded. The safety of the plant has not been endangered.

In order to prevent a recurrence, EPZ has established a new policy with respect to the ventilation of the turbine building during periods of frost. Freezing of measuring lines is thereby prevented. KFD has classified this event on INES level 0.

March 21, 2012: Absence of a testing regime for a siphon breaker in the cooling system of the fuel storage pool; INES level 1

One of the international recommendations as a result of the occurrences at Fukushima is the inspection of the technical status of the cooling system of the fuel storage pools. During an internal inspection by EPZ it was established that a siphon breaker in the cooling system had not been included in any testing programme and therefore was not tested periodically for correct functioning. It was found that in the design of the device a possibility for functional testing had not been taken into account.

After this was found, a new siphon breaker with a provision for testing was installed. After removing from the system the original siphon breaker was yet tested for correct functioning. It was found that the siphon action was only interrupted at a lower level in the storage pool than was to be expected. In accident conditions, if no use was made of other possibilities to maintain the water level, the water level would have sunk to such an extent that the fuel elements would in that case become partly uncovered, causing the potential of fuel damage.

EPZ has included the siphon breaker⁵ into the programme for periodically testing and carries out a re-evaluation of the cooling system.

The KFD has classified this event on INES level 1, because of the deficiencies found in the siphon breaker.

April 20, 2012: Defective pump causes pollution of cooling system and reactor pool; INES level not yet decided.

During the annual maintenance stop a pump (high pressure TJ-pump) was replaced. During testing of the newly installed pump, this became defective and metal particles were released and entered the cooling system and the reactor pool.

EPZ has cleaned the systems involved, by which a large part of the metal particles

⁵ Siphon breaker: One of the provisions which must prevent that, in case of a leak in the inlet line of the cooling system, the fuel pool empties itself and the fuel elements in the pool are becoming uncovered.

was retrieved. After taking various samples, the systems have been declared clean again. The cleaning operations have caused a delay of more than two weeks in the start-up of the power plant.

EPZ has investigated the failure of the pump and, based on the results, taken technical and organisational measures to prevent a recurrence. EPZ has not reported the event to the KFD, because (in the opinion of EPZ) at the moment of the failure the nuclear safety was not involved, because the power plant was out of service. The KFD has demanded the EPZ, nevertheless, to report this event and its cause formally. The EPZ has complied with this request.

On the basis of the data from this report the KFD is carrying out a further investigation of the cause of the disturbance. For that reason, the KFD has not yet defined an INES classification of this event.

2.2 Other Dutch nuclear facilities

2.2.1 High Flux Reactor (HFR) of NRG at Petten

In 2012 two events have occurred at the HFR, which were reported at once to the KFD. The first event, the tritium contamination of the groundwater, has also been discussed already in the report of events of 2011, because the contamination was discovered in November 2011. In this report on 2012 an actualised description of the event has been included.

November 25, 2011: Tritium contamination of the groundwater, as a result of corrosion of transport lines; INES level 1

NRG has reported on January 2, 2012 (orally) and on January 16, 2012 (in writing) that during the annual sampling of the groundwater on November 25, 2011 an elevated concentration of tritium (^3H) has been observed in one of the monitoring tubes around the HFR. The measured concentration amounted to 29 Bq/l, whilst normally less than 10 Bq/l is measured. In the first instance the condensate discharge of an air-conditioning device of the primary pump building was indicated as the cause of the elevated tritium level. The moisture from this device dripped through a tube into the ground and the liquid was found to contain a small quantity of tritium. However, after removal of this source, elevated tritium levels in the groundwater were still measured in 2012. NRG then started an investigation of the cause of the tritium contamination. It increased the number of monitoring tubes for sampling in the field and thereby encountered even higher tritium levels, of which it was concluded that they could not be attributed to the air-conditioning. Under supervision of the KFD NRG has since worked at establishing the cause of the tritium contamination in the groundwater, by means of a further expansion of the sampling grid of the groundwater, the execution of a geohydrological investigation and a systematic inspection of all parts of the facility for possible leaks. The

investigation was successful. In November 2012 the sources of the contamination were found. An underground line, buried in the sand and running between the reactor pool and a storage tank, was found to be corroded. During a number of years a limited quantity of tritium-containing liquid escaped through a small hole in the line into the ground. Another underground line was also found to be in poor condition and contributed in a small measure to the contamination of the ground. NRG has replaced the lines, whereby the lines have also been laid in a leak-tight casing provided with leak detection. In addition, NRG has mapped its complete underground piping grid and entered it into a control programme, so that "unobserved" leaks cannot longer occur. It is estimated that in the last few years in total approx. 33 GBq tritium has entered the groundwater. Meanwhile, NRG is carrying out a groundwater cleaning. At this moment groundwater is extracted in the places where the highest tritium concentrations are found. Thus, approx. 1/3 of the contamination has meanwhile been cleaned. As a final action, NRG will carry out a (long term) cleaning of the less contaminated places. The KFD has closely supervised the search of the source of the tritium contamination. In addition, it has evaluated the modification plans and supervised the execution. It also supervises the cleaning of the ground. The KFD has this event, because of the imperfections found in the underground piping system and the lack of an inspection programme for the lines, classified on INES level 1.

November 23, 2012: Ageing of a seal ring leads to leakage between to separated cooling systems; INES level 1

During a maintenance stop an anomaly in the cooling water system of the HFR is observed. A leakage is found in a seal ring between the primary cooling system and the cooling system of the so-called bottom plug. Because two different cooling water qualities are involved, such an internal exchange of cooling water is not allowed. In addition, by the leak in the seal ring the risk of accelerated loss of cooling water in case of calamities is increased, which is undesirable for safety reasons. The restart of the reactor after the maintenance stop has therefore been postponed and possible solutions for the leaking sealing ring have been mapped. The seal ring is located in a place which is not accessible for inspection. Therefore, the real cause of the failure of the seal ring has not been clarified. NRG assumes that the aluminium ring has been attacked by corrosion in the course of its service life (of meanwhile more than 50 years). Also because it was found that the ring could not be replaced without a very extensive temporary disassembly of the reactor, the problem has been solved in a different way, which could offer the same level of safety. The cooling system has been adapted in some parts, additional safety provisions have been installed and the new configuration has been evaluated again with respect to safety. The KFD has evaluated the solution and the execution of the technical adaptation, on the basis of reports in the fields of safety analysis, design calculations, evaluations, inspections and tests, necessary for such a fundamental

adaptation of the facility. Lloyd's Register (classification, certification and inspection group) has been closely engaged in the testing of the reliability of the redesign. On June 3, 2012 the KFD has issued a declaration of no objection for the restart of the reactor. The KFD has classified this event on INES level 1, because of the imperfections found in the cooling system of the reactor.

2.2.2 Other facilities⁶ of NRG at Petten

In 2012 from the other facilities of NRG one event has been reported to the authorities.

January 26, 2012: Fire starting in tray with batteries ; INES level 0

On January 26, 2012 a smoke detector is activated in a room where calibrations are carried out. It is found that the smoke emerges from a tray with batteries, which presumably have caused a short-circuit. The fire is extinguished in a few minutes. There is a limited soot and water damage in the room. No radiation sources have been involved in the fire and no radioactive material has escaped.

In view of the fact that the works fire brigade has been involved in the fire fighting activities, this is an event for which reporting is required. The KFD has classified this event on INES level 0.

2.2.3 Central Organisation for Radioactive Waste (COVRA) at Nieuwdorp (Municipality Borssele)

At COVRA one event requiring reporting has occurred in 2012.

November 19, 2012: Hydrogen formation in cylinders with high-radioactive waste; INES level 0

In one of the buildings of COVRA (the HABOG⁷) high radioactive waste is stored. Part of the waste is glazed and packed in storage vessels ("canisters"). These vessels are in turn placed in storage cylinders ("containments") with a controlled atmosphere, in which only argon is present.

On November 19, 2012 COVRA reports that hydrogen gas in low concentrations has been detected in these storage cylinders.

The concentration of hydrogen gas is low and no oxygen is present in these storage cylinders, so that e.g. an explosion does not have to be feared. However, the formation and presence of the hydrogen gas in the HABOG is anyhow not allowed.

⁶ The other facilities for which NRG has a licence are the HCL (Hot Cell Laboratories), consisting of the Research Laboratory (RL) and the Molybdenum Production Facility (MPF), LFR (Low Flux Reactor), WSF (Waste Storage Facility), DWT (Decontamination and Waste Treatment), as well as other laboratories, amongst which the Jaap Goedkoop Laboratory (JGL).

⁷ HABOG: Hoogradioactief Afval Behandelings- en Opslag- Gebouw, High-Radioactive Waste Treatment and Storage Building.

Having regard to the fact that the waste is present in glazed form, it is considered highly unlikely that the hydrogen is coming from the waste.

In view of the design of the storage cylinders and the concentrations measured, it is assumed that this hydrogen gas is formed in the storage cylinders themselves.

COVRA has started an investigation of the origin of the hydrogen gas, in consultation with the designer of the storage building. Until the moment that a structural solution is found, COVRA periodically renews the argon in the cylinders, to ensure that the hydrogen concentration remains sufficiently low.

The KFD conscientiously follows the investigation of the COVRA of the cause of the hydrogen gas release and the measures to be taken. The KFD has classified this event on INES level 0.

2.2.4 University Research Reactor (HOR) at Delft

At the University Research Reactor no events requiring reporting have occurred in 2012.

2.2.5 Energy Research Centre Nederland (ECN) at Petten

At the Energy Research Centre Nederland no events requiring reporting have occurred in 2012.

2.2.6 Joint Research Centre (JRC) of the European Union at Petten

At the Joint Research Centre of the European Union no events requiring reporting have occurred in 2012.

2.2.7 Mallinckrodt Medical⁸ (MM) at Petten

At Mallinckrodt Medical one event requiring reporting has occurred in 2012. In addition, MM has reported two times about technical defects which have led to incidental limited increased emissions of radioactivity (I-123) to the atmosphere. In view of the facts that the Nuclear Energy Act licence, specifying the annual emissions limit, takes account of the fact that this kind of occurrences is unavoidable, and that the total emissions norm for 2012 has not been exceeded, these occurrences are not further described here.

August 6, 2012: Missing radiation source; INES level 1

The KFD has been informed by the French supervising authority Autorité de Sûreté Nucléaire (ASN) that a radiation source (Iridium-192, source category 4), which had

⁸ Until July 1, 2013, Mallinckrodt Medical was a subsidiary of Covidien and since that date is called Mallinckrodt Pharmaceuticals.

been dispatched from France, was found not to have arrived at MM. A closer investigation could not show where the source had disappeared. There is no reason to assume that the source has disappeared during transport, so the loss must have occurred at the sender or at the receiver. After an additional investigation the source still was not found.

Because of this occurrence MM has improved the administrative provisions around the receipt and handling of used sources. In future it can be unequivocally proven if a source has been received or not.

The KFD has, like the ASN, classified this event on INES level 1.

2.2.8 Joint Nuclear Power Plant Nederland (GKN) at Dodewaard

The Dodewaard Nuclear Power Plant has been finally taken out of service on March 26, 1997. The fuel has been removed from the reactor and transported from the site. Dispensable systems have been switched off and, if necessary, cleaned. Then the power plant has been taken out of service. The systems which had been taken out of service have been conserved and locked. Architectural adaptations have been made and new systems installed.

On July 1, 2005 a waiting period of 40 years has begun. After this waiting period the power plant will be dismantled. At the Dodewaard Nuclear Power Plant no events have occurred in 2012.

2.2.9 URENCO Nederland at Almelo

At URENCO no events have occurred in 2012, which required immediate reporting to the KFD. Below one event observed by URENCO is described, which does not require immediate reporting, but is considered to be of interest for this report, in view of the nature of the occurrence.

July 1, 2012: Contamination of persons and equipment as a result of incorrect actions of employees; INES level 1

When leaving the take-off room (this is the room in which UF₆-cylinders are connected and disconnected) a hand contamination with radioactive material is observed with an employee. An investigation shows that the contamination can be traced to actions which have been taken by other employees in preceding shifts. When disconnecting a UF₆-cylinder by an employee in a preceding shift, the working room has become locally contaminated.

The investigation has shown that the contamination is caused when an employee, against the operating procedures, has carried out the disconnection of the cylinder without assistance and without the obligatory presence of a colleague.

Subsequently, the contamination of the room is not discovered in time because the sample of the wiping test, which is done as a check after the end of this type of

work, has not immediately been examined for possible contamination, also against the operating procedures.

In the same shift as that in which the contamination mentioned above occurred, two other employees have subsequently connected a new UF₆ cylinder in the working room. After completion of that work the employees have observed that the working room and the hands of the employees were contaminated. Against the operating procedures, they have not reported this contamination and have carried out themselves an investigation of the extent of the contamination. They found contaminations in five places and devices. The employees have tried to remove these contaminations themselves. They have not reported the contaminations and the cleaning attempt. When after the next shift an employee reported a hand contamination, which is attributed to the fact that the room and the equipment had been incompletely cleaned by the preceding shift, an inquiry has been made into the occurrences described above. This has clarified the cause of the contaminations. In addition, a urine investigation is carried out to determine if the employees had become contaminated internally. This proves that this has not been the case. After this occurrence URENCO has made a number of measures. The room has been cleaned and employees have been addressed for the fact that they ignore operating procedures and hygiene rules. Meetings have been organised to bring the importance of reporting undesired occurrences (such as contaminations) to the attention of the staff.

At present, the KFD has no reason to assume that a safe and responsible operation is not guaranteed and that rules of the Nuclear Energy Act licence are broken. Nevertheless, the opinion of the KFD is that URENCO has acted contrarily to its own operating procedures.

The KFD has classified this event, because of the shortcomings in the corporate culture that were found, on INES level 1.

2.2.10 Transport of radioactive sources

August 8, 2012: Missing radiation source; INES level 0

On August 8, 2012 Mallinckrodt Medical (MM, see 2.2.7) has reported the suspicion that a radiation source (Ir-192) has become lost during the transport between Brazil and The Netherlands. The source would be dispatched in Brazil as early as June 2011. The loss has not been observed earlier because the sender of the source has not announced the shipment in advance and has not checked immediately afterwards if the source has actually arrived. In the transport and handling chain of this source several companies are involved. The KFD has carried out an inspection of the course of this occurrence and concludes that it cannot be determined when and where the source has got lost and that this source, in view of its nature and age, does not represent a radiation risk.

The KFD has classified this event on INES level 0.

2.3 Dutch INES reports to the IAEA in 2012

The IAEA (International Atomic Energy Agency) requires the participating countries to report serious disturbances in nuclear facilities internationally, to enable other countries to learn from these events. As an aspect of the pursuing of continuous improvement, this knowledge is actively distributed among the national nuclear supervising authorities and the nuclear companies in the participating countries. The disturbances are analysed and discussed in international working groups.

In most cases, the reports are related to events with a "weight" of INES-1 and higher. They are included in data bases. There are data bases for different nuclear activities and purposes⁹.

The Netherlands complies with this IAEA requirement by checking annually whether disturbances requiring reporting have occurred and by reporting the relevant occurrences.

In 2012 no INES reports were made by The Netherlands to the IAEA. However, an IRS report has been made to the IAEA of the event on March 21, 2012 at the Nuclear Power Plant Borssele, when shortcomings were observed in the cooling system of the fuel storage pool (INES-1). Concerning the undesired occurrences at NRG of November 25, 2011 and November 23, 2012 about the tritium leakage and the leakage between two cooling systems, respectively (both INES-1), reports (IRSRR- database) to the IAEA will be made in 2013.

⁹ The most important databases are:

- INES (the incident data base)
- IRS (the data base for disturbances in nuclear power plants)
- IRSRR (the data base for disturbances in research reactors)
- FINAS (the data base for facilities in the fuel cycle, among which uranium enrichment plants and storage locations for radioactive waste)

3 KFD analyses of Dutch events in 2012

In chapter 2 the events in 2012 in the various Dutch facilities are summed up. To translate these into an analysis how these facilities have functioned, a number of questions must be answered: How serious were these events? How did the licensees cope with these events? Is the situation improving or deteriorating? How is the Dutch situation relative to the international state of affairs and are these events an indication for possible other safety problems?

For information, Table 1 gives an overview of the events from 1997 up till and including 2012, divided between Nuclear Power Plant Borssele (KCB) and the other facilities. Table 1 also contains an overview of all events with an INES level higher than 0, for KCB and the other facilities.

Year	TOTAL			INES > 0		
	Total	KCB	Others	Total	KCB	Others
2012	10	3	7	5	1 ¹⁰	4
2011	14 ¹¹	8	6 ¹²	3	3	0
2010	20	9	11	3	1	2
2009	13	3	10	1	0	1
2008	15	6	9	4	1	3
2007	15	5	10	2	1	1
2006	25	17	8	3	1	2
2005	23	13	10	4	2	2
2004	21	8	13	3	0	3
2003	18	6	12	3	1	2
2002	19	10	9	1	0	1
2001	18	9	9	3	2	1
2000	23	12	11	2	2	0
1999	14	8	6	2	1	1
1998	21	10	11	2	1	1
1997	26	15	11	2	1	1
Average	18.5	8.9	9.6	2.7	1.1	1.6

Table 1: The number of events of KCB and other nuclear facilities during the past sixteen years

¹⁰ Of one of the events in 2012 at KCB the INES classification still has to be made.

¹¹ Number over 2011 corrected from 15 to 14 to avoid double counting. The tritium leakage of NRG, already described and counted in 2011 has been removed there and now counted in 2012.

¹² Number over 2011 corrected from 7 to 6. See note 11.

To the first question, how serious were these disturbances, an answer can be given with the aid of the INES classifications given to them. Of the ten events in 2012 four are "relatively unimportant" (below-scale, INES level 0) and five of some importance (INES level 1). Of one event the INES classification still has to be done, because not all required information is available yet. On the basis of these figures it can be concluded that in 2012 (as in the preceding years) no serious events (of an INES level 2 or higher) have occurred.

When the INES scale was conceived in 1989, the criteria for the classification on the different levels were drawn up such that in a "normal" nuclear facility on the average about ten INES level 0 and one INES level 1 events could occur annually. Seen in this light it is to be remarked that in 2012 more INES level 1 events have occurred than in preceding years. The question if this indicates a trend will be discussed below in more detail.

The KFD concludes on the basis of the available information that the operators of the nuclear facilities in general have carefully handled the events which occurred in 2012. The occurrences have been reported and analysed timely. The causes have been determined. All the licensees have been able to show that they make efforts to learn from the events which have occurred and that they take measures, where necessary, to prevent a recurrence.

The question whether the situation has become better or worse in 2012 than in preceding years and whether the Dutch nuclear facilities perform better or worse than abroad, cannot be simply answered. This has the following reasons:

- The statistics of the data are meagre. There are (too) few events to support a sound judgement.
- The INES scale does give a good insight into the severity of a situation, but it does not give a judgement whether for instance two INES level 0 events are more or less serious than one INES level 1 event.
- The international obligation to enter events into the INES system lies on minimum INES level 2. Consequently, for the INES levels 0 and 1 an objective numerical comparison with foreign countries is not possible.
- The reporting criteria always give room for interpretations. This means that an increase in the number of reports by greater reporting willingness could possibly be wrongly seen as a deterioration of the situation.

In view of these considerations it cannot be determined whether the increase of the number of events with an INES-1 classification (from 3 to 5) observed in 2012 indicates a trend; only a series of data over more years could suggest this. This is not now the case.

In 2012 the Dutch events are all of the "low" INES levels 0 or 1. In the international INES database over the year 2012 2 events in nuclear facilities with an INES level above 1 have been recorded. Here, too, in view of the low numbers no objective

comparison between the situation in The Netherlands with that in other countries can be made.

The question, whether the reported events are a signal of underlying safety problems, is discussed in more detail in the following two paragraphs.

3.1 Nuclear Power Plant Borssele

At KCB three events have occurred in 2012, one of which has been classified as INES level 1. Of one event the classification still has to be defined. The number of events is low in comparison with preceding years. The relative severity of the events (the INES classification) does not deviate from that in preceding years. In the report over 2011 it was remarked that the severity of the events possibly could increase, but that of an increase could only be spoken if this was confirmed by a trend analysis. The figures over 2012 show that there is no indication of a deterioration of the situation.

The KFD is of the opinion that EPZ in 2012 has sufficiently learned from the events to make the necessary improvement steps. The KFD remains informed on the progress and the effectiveness of the subject improvement programmes, carries out inspections on the site and applies enforcement instruments where necessary to enhance the compliance.

3.2 Other Dutch nuclear facilities

At the other Dutch nuclear facilities, in 2012 seven events have occurred. With respect to preceding years this is a normal picture. However, of the seven events four have been classified as INES level 1. This is more than in the preceding years. The events concerned are divided between three licensees, namely two events at the HFR of NRG, one at Mallinckrodt Medical and one at URENCO. Therefore, of an increase of problems at one licensee cannot be spoken in 2012.

Here, too, the annual overview only features low numbers and consequently it is not possible to base a trend analysis on them.

The INES classification is determined both on the severity of the incident itself and on the basis of the circumstances with respect to the incident. This year, the classifications INES-1 are in particular based on the fact that in these events "ageing of the facility" was a factor and/or shortcomings in the field of the "corporate culture" have been noted. It is found that operating procedures are not always strictly adhered to.

In 2012 the KFD has given much attention to the undesired events at the HFR of NRG. Also because of these events, NRG has been placed under increased surveillance. The technical and organisational problems observed and the resulting studies and repairs required much effort in the surveillance of the KFD.

The undesired events have stimulated the companies to an analysis of the event. The direct and indirect causes have been mapped and, where necessary, measures have been taken to prevent the risk of recurrence in future.

The KFD is of the opinion that the licensees concerned have effectively learned from the events to realise improvements. The KFD continues to receive information on the progress and the effectiveness of the measures which have been taken, carries out inspections on the site and applies enforcement instruments, where necessary to enhance the compliance.

Annex A INES classification

To all events, for which reporting is obligatory, an INES classification is given. For this purpose the "International Nuclear and Radiological Event Scale" (INES) of the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) is used. To explain the severity of events in nuclear facilities worldwide to the public in consistent terms, an INES classification is used which increases from level 1 to level 7.

The Nuclear Energy Act licence (and more specifically the Technical Specifications of a facility included in them) prescribes which events must be reported. The Dutch rules for reporting are more stringent than those of INES. Consequently, there are a number of events that the licensee must report and subject to a closer safety analysis, which are not relevant on the basis of the INES criteria. These light events, which are not significant to the nuclear safety and are therefore situated below this nuclear scale, are classified as INES level 0, or "below scale".

For the levels 1 up to and including 3 the following descriptions apply:

- Level 1 is an anomaly or a disturbance. This concerns events during which e.g. the limits of the operating conditions are exceeded. Examples are an involuntary exposure of a member of the public to a radiation dose of more than 1 mSv per year inside, and 0,1 mSv per year outside a facility where radioactive sources are used (the legal limit), the finding or loss of a small radioactive source, or a small technical disturbance in a nuclear power plant, which has not caused the escape of radioactive material to the outside world.
- Level 2 is an incident. This concerns events by which an affection of the safety level occurs. Examples are an exposure of a radiological worker to more than 20 mSv per year (the legal limit), the loss or the finding of a larger radioactive source, involuntary exposure of a member of the public to more than 10 mSv, or a large leak in the primary system of a nuclear power plant.
- Level 3 is a serious incident. This concerns events in which the level of safety is further affected, but still just without an accident occurring. Examples are an excessive irradiation by which (permanent or temporary) physical damage is caused, ten or more persons who receive a level 2 dose (see under level 2), the loss or the finding of a very large radioactive source, exposure of a radiological worker to more than 200 mSv and occurring of radiation levels above 1 Sv/h in a work accommodation.

The other levels are not considered in this report, because they have not been encountered in 2012 and the preceding years in the Netherlands.

Events from INES level 2 are compulsorily reported to the IAEA by the over 70 participating countries.

The INES classification is not only applicable to nuclear facilities, but also to other events, such as excessive irradiations, transports, events with radioactive sources

and equipment, accelerators and, since the beginning of 2007 on an experimental base, medical events. Non-civil events and nuclear terrorism are outside of the INES regime.

The accident, which has been the direct cause to start the annual reporting of events to the House of Commons (in the US Three Mile Island II Nuclear Power Plant near Harrisburg on March 28, 1979), was classified on INES level 5.

The accident at Fukushima, Japan, on March 11, 2011 is the second accident on INES level 7 after the accident in the nuclear power plant at Tsjernobyl, Ukraine, on April 26, 1986.

The accident at Fukushima was initially classified on March 18, 2011 on level 5 on the INES scale. However, as of April 12, 2011 the classification was increased to INES level 7. This classification was done on the basis of the estimated radioactive emissions that have occurred. The classification is still characterized as "preliminary", because uncertainty still exists about the exact quantity of released radioactive material. In view of the experience recently obtained with the INES scale with respect to the nuclear accident at Fukushima, the IAEA has investigated whether the INES scale needs to be adapted. From this investigation it has been concluded that the scale does not have to be adapted, but that preliminary classifications should be treated with more restraint. A classification can only be made when the event has entered into a stable phase and a reliable picture of the final consequences exists. Member states are stimulated to record INES reports within 24 hours, but these 24 hours are counted from the moment that a reliable and stable picture is defined and not from the beginning of the event.

More information on the INES scale can be found on the website of the IAEA. A general brochure under:

<http://www.iaea.org/Publications/Factsheets/English/ines.pdf> The user's manual with all details of the classification under: http://www-pub.iaea.org/MTCD/publications/PDF/INES-2009_web.pdf



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