Public Health England

Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK – 2012 Review

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ABSTRACT

This report includes descriptions of 16 accidents and incidents involving the transport of radioactive materials to, from or within the UK, which occurred in 2012. The number of events reported in 2012 was lower than in 2011 (38 events), and below the range of the number of events that have occurred in the last five-year period: 38 events in 2011, 30 events in 2010, 33 events in 2009, 39 events in 2008 and 26 events in 2007. Of the 16 events included in this review, one involved an irradiated nuclear fuel flask (there were 11 such events in 2011). None of the events reported resulted in any potentially significant radiation dose.

The details of these events have been entered into the Radioactive Materials Transport Event Database (RAMTED), which now contains information on 1034 events that are known to have occurred since 1958.

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EXECUTIVE SUMMARY

Up to half a million packages containing radioactive materials are transported to, from and within the UK every year. Accidents and incidents involving these shipments are rare. However, there is always the potential that such an event could lead to the release of the contents of a package, or an increase in radiation level caused by damaged shielding, and result in radiological consequences for transport workers. Such events could also lead to radiological consequences for the public. The Office for Nuclear Regulation (ONR) supports work to compile, analyse and report accidents and incidents that occurred during the transport of radioactive materials. Annual reports have been produced since 1989 and this report for the year 2012 is the latest in the series. The details of these events are recorded in the Radioactive Materials Transport Event Database (RAMTED), which is maintained by the Centre for Radiation, Chemical and Environmental Hazards (CRCE) of Public Health England, on behalf of ONR. The database now contains information on 1034 events that are known to have occurred since 1958.

This report includes descriptions of 16 accidents and incidents involving the transport of radioactive materials to, from or within the UK, which occurred in 2012. The number of events reported in 2012 was lower than that in 2011 (38 events), and below the range of the number of events that have occurred in the last five-year period: 38 events in 2011, 30 events in 2010, 33 events in 2009, 39 events in 2008 and 26 events in 2007. Of the 16 events included in this review, one involved irradiated nuclear fuel flasks (there were 11 such events in 2011). None of the events reported resulted in any potentially significant radiation dose to an individual.

Almost all the events were of a similar type to those occurring in recent years. An event involving an irradiated nuclear fuel flask was due to loose bolts.

CONTENTS

1 INTRODUCTION

Reviews of the accidents and incidents involving the transport of radioactive materials to, from and within the UK have been carried out for the years 1958 to 2011 (Gelder et al, 1986; Shaw et al, 1989; Hughes and Shaw, 1990–1999, 1996b; Hughes et al, 2001a,b, 2006; Warner Jones et al, 2002a,b; Warner Jones and Jones, 2004; Watson and Jones, 2004; Roberts et al, 2005; Hesketh et al, 2006; Hughes and Harvey, 2007; Harvey and Hughes, 2008; Harvey, 2009, 2010; Harvey and Jones, 2011, 2012). The objectives of these reviews were:

- **a** To assess the radiological impact of such accidents and incidents on both workers and members of the public over the period of study
- **b** To comment on transport practices
- **c** To provide information pertinent to future legislation and codes of practice
- **d** To produce and maintain a database of events covering the period of study

The initial reviews (Gelder et al, 1986; Shaw et al, 1989) were supplemented by annual analyses (Hughes and Shaw, 1990–1999; Hughes et al, 2001a,b; Warner Jones et al, 2002a; Warner Jones and Jones, 2004; Watson and Jones, 2004; Roberts et al, 2005; Hesketh et al, 2006; Hughes and Harvey, 2007; Harvey and Hughes, 2008; Harvey, 2009, 2010; Harvey and Jones, 2011). A comprehensive review was carried out of events that occurred in the whole period from 1958 to 1994 using an improved event classification system (Hughes and Shaw, 1996b), which has been updated to include events up to and including 2004 (Hughes et al, 2006). The improved classification system was used to provide a summary and analysis of all events to 2000 that was presented at the Sixth International Conference on Radioactive Materials Transport (Warner Jones et al, 2002b).

Throughout this review accidents and incidents are collectively referred to as events. The information on these events is stored in the Radioactive Materials Transport Event Database (RAMTED). In 2004, the database was reviewed and revised as the original version was approximately 20 years old and had many limitations compared to typical software and hardware specifications of today (Watson, 2004). The relational format of the current version of the database allows for more efficient recording of the details of an event. The classification systems were reviewed and, though only minor changes were made, the change in the database structure now allows for an event to be more efficiently classified, with a main category and subsidiary categories if appropriate.

This report describes the events reported during 2012 and analyses these events based on the revised classification system and the main event categories. Ten other occurrences of interest that did not meet the criteria for inclusion in the database are briefly described in Appendix A. Descriptions of the information stored in the database, including the coding system used to classify events, are given in Appendix B.

A glossary (Appendix C) contains descriptions and definitions of a number of technical terms that are associated with the transport of radioactive materials.

2 DATA COLLECTION AND ANALYSIS

For this review, information on accidents and incidents has been mostly obtained from official files at the Office for Nuclear Regulation (ONR) (www.onr.org.uk) and the Civil Aviation Authority (CAA) (www.caa.co.uk). Other sources of information for past annual reviews include events reported by the Department for Environment, Food and Rural Affairs (www.gov.uk/government/organisations/department-for-environment-food-rural-affairs), Environment Agency (EA) (www.gov.uk/government/organisations/environment-agency), Northern Ireland (www.doeni.gov.uk), Scottish Environment Protection Agency (SEPA) (www.sepa.org.uk) and from independent radiation protection advisers (RPAs), records of incidents reported under the National Arrangements for Incidents Involving Radioactivity (NAIR) (www.hpa.org.uk/nair/) and incidents dealt with under RADSAFE (www.radsafe.org.uk). Under the NAIR scheme, the police attending an incident involving radioactive material can summon assistance from a health physics expert in the region. Only occasionally do these NAIR events directly involve the transport of radioactive materials. RADSAFE is a consortium of organisations that offer mutual assistance in the event of a transport accident involving radioactive materials belonging to a RADSAFE member and provides early advice and support to the emergency services.

2.1 Reporting of events and criteria

The transport of radioactive materials involves a number of activities, such as the preparation of the package by the consignor, its loading on to a vehicle, and finally its shipment carried out by carriers using various modes of transport. The shipment phase may involve a number of loading and unloading operations between different modes of transport before final delivery of the package to the consignee. The reported accidents and incidents included in these reviews come within the scope of these activities, for shipments and transhipments within the UK. Events involving shipments from the UK are also included if the event was as a result of a failing in the UK. However, events occurring on site, ie within the premises of consignors and consignees, are not included unless they are relevant to transport in public areas or if they originated from an incident that occurred during transit.

The normal transport of radioactive materials may give rise to small radiation doses to transport workers and in some circumstances members of the public might also receive very low doses. Conditions of transport that are intended to minimise these exposures are given in current national legislation and international agreements, which cover transport by road (UK Parliament, 2009; UNECE, 2013), rail (UK Parliament, 2009; OTIF, 2013), sea (UK Parliament, 1997; IMO, 2006; MCA, 2012) and air (UK Parliament, 2002, 2011; ICAO, 2008). These conditions include, for example, the specification of segregation distances for packages during stowage. It may be noted that the most significant accidents and incidents that are included in this and previous reviews are those that give rise to increased radiation exposures during transport. In addition, events are included that had the potential for increased radiation exposures. Some events in this group may seem trivial, such as those involving administrative errors; however, experience has shown that in some circumstances such errors can have serious consequences. In practice, all but those reported events that are deemed to be trivial by the ONR, are included in this review.

For transport by land in Great Britain, the regulations (UK Parliament, 2009) require the carrier or consignor (as appropriate) of radioactive material to report any notifiable event to the competent authority (which in this case means ONR). A notifiable event means:

a A radiological emergency as defined in the regulations

b The theft or loss of the radioactive material being carried

c An occurrence subject to report as construed in accordance with sub-section 1.8.5.3 of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) (Class 7) (UNECE, 2013). That sub-section includes the release of contents, or risk of loss of contents, environmental damage or personal injury

Similar criteria apply in Northern Ireland (UK Parliament, 2010).

In practice, many other less serious events are reported voluntarily by consignors, carriers and consignees. Other types of events that are relevant to the transport of radioactive materials may also be reported by other parties, such as the police, suppliers and manufacturers. There have also been a few instances where members of the public have found lost packages and informed the emergency services.

Events involving undeclared radioactive material discovered in packages or cargoes of scrap metal are included only if they have involved illegal or unauthorised transport after the radioactive material has been discovered or where there is evidence that the radioactive material had been deliberately transported. For the purpose of this review, which is concerned with contraventions of the regulations in addition to incidents and accidents, a similar criterion is applied to radioactive material discovered at ports and airports by installed radiation detectors. Where such intercepted material was known to be radioactive (or there were reasonable grounds to assume radioactivity would have been present) but was not being transported in accordance with the regulations, this is always recorded as an event. Appendix A includes a summary of events which have come to the attention of the ONR but did not meet this inclusion criterion. The ONR is generally only contacted following the discovery of radioactive material if advice is required regarding onward transportation. Therefore Appendix A is not an exhaustive list and other incidences of radioactive interceptions may exist.

Irradiated nuclear fuel (INF) flasks are typically loaded and unloaded underwater in ponds at nuclear power stations and reprocessing plants. The water in these ponds tends to be contaminated with radioactive material and this contamination may become attached to the flask surfaces. Before transport, the flasks are thoroughly cleaned and monitored. The level of non-fixed contamination must be below the regulatory limit of 4 Bq cm^{-2} for beta emitters and low toxicity alpha emitters and 0.4 Bq cm^{-2} for all other alpha emitters (IAEA, 2012). In the past, operational quantities related to these values, termed derived working levels (DWL), were used. Events involving excess levels of contamination on INF flasks were included if at any point on the surface the level was 10 DWL or above. Since 2008 (Harvey, 2009), changes in industry protocols mean that flask contamination is now reported directly in terms of its value in Bq cm^{-2} rather than DWL. Similar pessimistic assumptions are made when calculating the contamination in Bq cm^{-2} as were previously used in deriving DWL. Therefore, when contamination is reported post-shipment as being just over 4 Bq cm^{-2} the flask is unlikely to have actually been transported with contamination above the regulatory limit. A criterion of 20 Bq cm^{-2} (2 Bq cm^{-2} for alpha emitters) has been applied to the calculated contamination level to separate those events where the regulatory limit is likely to have been exceeded (DfT, 2009).

As with previous reviews, this report does not include any events that may still be subject to legal proceedings at the time of publication. Any such events will be reported in later annual reviews.

A system known as the international nuclear event scale (INES) (IAEA and NEA, 2008) has been established for rating events that occur in the nuclear industry, by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD). This system enables a rating, from Level 0 to Level 7, to be applied to an event to give a prompt and consistent indication of the severity of the event to the media and members of the public. Level 7 refers to the most severe type of accident and Level 0 refers to an event with no safety consequences. The INES scale has been extended to cover other events, including events involving the transport of radioactive materials. Significant events are reported to the IAEA, from where the details are distributed and made publicly available. The UK, in common with most other countries, only reports events that are rated at Level 2 or above.

3 DATABASE OF REPORTED EVENTS

As mentioned in Section 1, details of the reported events have been entered into RAMTED. A comprehensive review of the events in the database was undertaken in 1996 (Hughes et al, 2006) and includes a description of the systems of reporting and scope of the types of events recorded in the database. Some of the information in the database is held in coded form to facilitate analysis. Descriptions of the information stored, including the coding system used to classify events, are given in Appendix B.

The database contained information on 1018 events up to and including the events in 2011. The earliest reported events are from 1958. During the collection of information for this current review, details were obtained for 16 events in 2012, which brings the total number in the database to 1034. The collection of information for this review did not reveal any further events from previous years that were not in the database.

Table 1 provides a summary of the main category code for the 16 events reported in 2012. The details of each event are given in Section 4 and are included in the database record of each event. Other details that are entered in the database record are listed in Appendix B, including a broad description of the event as either an accident or incident that occurred during either the transport or handling phase (TI, TA, HI and HA). In addition, events where the main occurrence was radioactive contamination of external surfaces of intact packages, or conveyances, are recorded as category C.

In order to give a better description of the type of event, a classification system has been developed for RAMTED that gives more information than the broad descriptive categories noted above. This system enables events to be grouped into logical categories and facilitates analyses. Column 1 of Table 1 gives the identifiers for the events detailed in Section 4. Columns 2–4 give the material category code, the transport mode code and the package type, which are defined in Tables B3, B4 and B5, respectively, of Appendix B. The classification system covers a further three aspects: a descriptive classification, the effect of the event on the package and the level of radiological consequences, which are defined in Tables B6, B7 and B8, respectively, of Appendix B.

TABLE 1 Summary of events included in the 2012 review

Event ID (Section 4)	Material category (Table B3)	Transport mode (Table B4)	Package type (Table B5)	Event classification (Table B6)	Effect on package (Table B7)	Radiological consequence (Table B8)
2012001	7	0	A	AP121	13	L
2012002	4	1	BMF	FP131	3	N
2012003	7	5	UPX	AG111 SP111	14	E
2012004	2	0	BF	SC211	7	N
2012005	11	0	IP1	AG221	4	N
2012006	11	5	UK	SC811	14	N
2012007	7	0	A	SP121	3	N
2012008	6	0	UK	SP212	5	L
2012009	6	0	IP	AP111	3	N
2012010	2	0	BF	AG211	3	N
2012011	0	0	UK	AG311	4	N
2012012	7	12	E	AG251	4	N
2012013	11	0	UK	AG251 SP141	3	N
2012014	0	2	E	AG221	3	N
2012015	6	0	E	AG241 AG221	13	N
2012016	8	2	A	SP151	13	E

The event classification given in the fifth column of Table 1, specifies the nature of the event, following the descriptive structure set out in Table B6 of Appendix B. The first character of the code gives the general subject or area under which the event is categorised, ie administrative (A), general shipment (S) or INF flask (F). Events involving INF flasks are separated from the other general shipments of radioactive materials for other nuclear, industrial and medical uses because of the special circumstances of INF flask movements. The identification of the second character of the code and following numbers is shown in the full coding system, which is given in Table B6. The new database structure allows for events to be classified into a number of categories, as seen in Table 1, where some events have more than one entry in the fifth column. In these cases the event classifications are prioritised within the database and are listed in order of priority in Table 1.

The effect of the event on the package integrity, or the package deficiency, is allocated to 12 categories (D03–D14), as set out in Table B7 of Appendix B. In addition, category D01, ‘No package’, applies to events in which the radioactive material is not within a package. Category D02 is for contaminated conveyances, with no package involvement.

The radiological consequence of an event is allocated into one of four categories, which are described in Appendix B. The ‘none’ category (‘N’) applies to events where there are no dose rates or contamination above that expected from normal transport, or where there is no evidence that individuals have received any dose. Events in which people received a small excess dose, but not at a level thought to be worth a detailed assessment, are categorised in the ‘extremely low, not assessed’ band (‘E’). Such doses may be received when a worker repackages a poorly packaged item. Events in which workers are exposed to radiation for a significant period and an assessment is carried out of their likely dose fall into either the ‘assessed, lower category’ (‘L’) or the ‘assessed, upper category’ band (‘U’), depending on whether their effective dose exceeded 1 mSv, or an extremity dose exceeded 50 mSv.

4 EVENTS RECORDED FOR THIS REVIEW

Brief descriptions of the events reported in 2012 are listed below. The level of detail in the descriptions reflects the level of detail contained in the original reports. The package types used are listed in Appendix B.

4.1 Events for 2012

4.1.1 January

2012001 A Type A package containing a medical ^{99}Mo generator source was received from an overseas supplier by a hospital with an incorrect TI of 0.9 given on the package label. The measured dose rate at the hospital indicated that a TI of 5 would have been more appropriate. The generator was therefore rejected by the hospital and the manufacturer exchanged it. The generator was returned in a correctly labelled package with a TI of 2.5 as indicated by the measured dose rate at the time.

2012002 On receipt of a flask from a nuclear power station, it was found that one of the lid-chock locking bolts was loose.

4.1.2 February

2012003 A 35 MBq ^{241}Am source from the yield meter of a combine harvester was removed and packaged incorrectly for transport back to the manufacturer. The mechanic who removed the source had not been trained in radiation protection for several years. The manufacturer of the combine harvester had ceased using radioactive sources in yield meters.

2012004 During a routine operation to remove a type 30B uranium hexafluoride cylinder from its UX30 protective shipping package, the swivel which connects the lifting equipment to the fork lift truck jib failed. The cylinder fell approximately 2 m on to the raft, causing slight damage to the cylinder skirt. No damage to the cylinder valve occurred as a result of the impact and the cylinder integrity was confirmed. Operations were suspended and the lifting rig taken out of service. The type 30B cylinder was inspected for signs of damage which could have compromised integrity; none was found. Although this event happened during transport within a nuclear site, it is still included in RAMTED because the transport regulations also apply to unloading operations.

2012005 An IP1 package was consigned to an incorrect delivery address within a nuclear facility. It was probably because that the consignment documentation was incorrect and also the inspection/maintenance period for the package may have expired.

4.1.3 March

2012006 A van carrying mop heads that had been used to clean a non-active building in a nuclear facility caused the portal radiation alarm to be tripped when leaving the site. The van was sent through the portal alarm again and it did not activate the alarm. It was later discovered that the portal alarm was faulty. It is not known whether the radioactive content would have caused the load to fall within the transport regulations.

2012007 Two Type A packages were despatched without stainless steel discs in place as a result of human error. A review was carried out and it was concluded that there were no safety implications for the transport of the packages. Procedures were introduced to prevent this error from happening again.

4.1.4 May

2012008 A number of items were stolen from a scrap metal facility, including some orphan radioactive sources. The stolen waste included pipes and plates containing NORM scale and thorium magnesium alloy. Surface dose rates were generally between 0.03 and 4.9 $\mu Sv\ h^{-1}$, with two items at 14 $\mu Sv\ h^{-1}$. The Environment Agency was informed and recommended that the incident be dealt with by the local constabulary.

2012009 An ISO container dispatched to a waste facility from a nuclear reprocessing site for disposal was found, upon arrival, to have an expired container safety convention plate. The ISO container had been resident at the nuclear reprocessing site for a long time and was partly filled before the safety convention plate expired. It was subsequently filled and dispatched to the waste facility. A condition report was raised and appropriate action was taken but no details were given as to what these were.

2012010 Six full 30B cylinders of a total delivery of thirteen were dispatched from a nuclear site in the UK to be delivered to an overseas site. The consignor was informed by the consignee that one of the cylinders delivered did not match the consignment documentation. Corrected documentation was subsequently provided.

2012011 Two consignments were delivered to the wrong consignees. One package was rejected on arrival as it contained a source of significantly greater activity (11.1 GBq) than had been expected (38 kBq had been ordered). The carrier returned the packages to its depot. An investigation carried out by the carrier found that the packages had been wrongly addressed when consigned. Both consignments were subsequently re-labelled and delivered to the correct destinations.

4.1.5 June

2012012 A package which was initially reported lost from a consignment was later found at the consignee’s address.

4.1.6 July

2012013 Three metal bars coated with a thin layer of encapsulated ^{210}Po, each 55 inches long, were dispatched from a manufacturer in the UK to an overseas customer. The customer reported that they had received only one of the bars. The manufacturer conducted an investigation in conjunction with its courier, the consignee and ONR, which resulted in modifications to its procedures.

4.1.7 October

2012014 During security screening, a consignment was found to be marked and labelled as containing radioactive material. The consignment was labelled as UN2911, which refers to radioactive material in excepted packages or articles, but the appropriate information had not been included on the air way bill. The freight forwarder and shipper amended their procedures to ensure documentation would be correct for future consignments.

2012015 A consignment of 65 drums of waste desiccant was sent as excepted packages from one nuclear site to another. When the packages arrived, it was found that one drum contained tritiated liquor with an activity of 7 GBq. Following investigation by the ONR, corrective actions were put in place.

4.1.8 December

2012016 A consignment of five radiography instruments was returned to the UK to have the decayed radioactive sources replaced. The instruments were incorrectly identified as being empty packages, but since they contained radioactive sources the package should have been classified as Type A. The instruments had a surface dose rate of 15 µSv h^{-1} and activities of up to 2.6 GBq. In addition, it was found that the locking mechanism was not engaged. However, it was unlikely that there was any radiation exposure as specialist tools would have been required to access the sources, which were located further inside the instrument.

5 DISCUSSION OF EVENTS THAT OCCURRED IN 2012

5.1 General

In 2012, 16 events were reported in RAMTED; this excludes any events that are still subject to legal proceedings at the time of publication of this report.

The number of events in each of the descriptive classifications that occurred in 2012 is given in Table 2. Using primary classification in the three broad categories, ten (63%) were administrative events, five (31%) were general shipment events and one (6%) event involved shipment of INF flasks. This compares to 16%, 61% and 23%, respectively, for these categories of event in 1958–2004 (Hughes et al, 2006). Three events were given more than one event classification. In 2012, the most numerous type of event involved ten instances of an administrative nature such as incorrect documentation or insufficient worker training. There were a further five general incidents where there was either insufficient worker training, the consignor’s certificate was incorrect or absent, the package was returned to the consignor or re-consigned, or the incorrect TI was displayed on the package label. Of the five incidents involving the general shipment of packages, one event was found to have the load stowed inappropriately, one where the inner container of a package was found to be insecure, another where material was found in a supposedly empty package, and one where a package was lost and not recovered. There was one incident that involved an INF flask shipment which concerned a loose bolt.

TABLE 2 Numbers of 2012 events in each classification

Event classification	Event classification code (see Table B6)	Primary classification	Secondary classification	Tertiary classification
Administrative	AG111	1	0	0
	AG211	1	0	0
	AG221	2	1	0
	AG241	1	0	0
	AG251	2	0	0
	AG311	1	0	0
	AP111	1	0	0
	AP121	1	0	0
Total		**10**	**1**	**0**
General (non-INF) shipments	SC211	1	0	0
	SC811	1	0	0
	SP111	0	1	0
	SP121	1	0	0
	SP141	0	1	0
	SP151	1	0	0
	SP212	1	0	0
Total		**5**	**2**	**0**
INF flask shipments	FP131	1	0	0
Total		**1**	**0**	**0**

The number of events in 2012 was lower than in any of the last five years. In 2011, 38 events were reported, 30 events in 2010, 33 in 2009, 39 in 2008 and 26 in 2007. The average annual number of recorded events during the period 1958 to 2004 was approximately 17 (Hughes et al, 2006), although in the first decade of that period events were probably under-reported. Over the past 20 years the annual number of events has fluctuated between 11 and 42, with an average of 26 events. The number of events in 2012 was therefore lower than this long-term average.

Table 3 shows an analysis of the events by material category. Definitions of the codes used to identify transport events are given in Table B6 of Appendix B. During 2012, there were four events that involved the transport of medical and industrial isotopes (25%). Of the remaining events, the next largest groups involved three events concerning the transport of radioactive wastes and three events concerning the transport of a category of material known as ‘other’; this includes radioactive material that is not covered by any of the codes (19%). There were two events involving the transport of pre-fuel material and two events involving material of an unknown nature. Only one event involved the transport of irradiated fuel and one involved the transport of radiography sources.

TABLE 3 Classification of 2012 events by material category

Material code	Category	A*		S*		F*	Total	Proportion (%)	
		G	P	C	P	P		2012†	1958–2004
M00	Unknown	2	0	0	0	0	**2**	12	N/A‡
M01	Uranium ore concentrate	0	0	0	0	0	**0**	0	4
M02	Pre-fuel material	1	0	1	0	0	**2**	12	3
M03	New fuel	0	0	0	0	0	**0**	0	<1
M04	Irradiated fuel	0	0	0	0	1	**1**	7	13
M05	Residues	0	0	0	0	0	**0**	0	14
M06	Radioactive wastes	1	1	0	1	0	**3**	19	8
M07	Medical and industrial radioisotopes	2	1	0	1	0	**4**	25	47
M08	Radiography sources	0	0	0	1	0	**1**	6	10
M09	No radioactive material	0	0	0	0	0	**0**	0	–
M10	Consumer products	0	0	0	0	0	**0**	0	1
M11	Other	2	0	1	0	0	**3**	19	<1
Total		**8**	**2**	**2**	**3**	**1**	**16**	**100**	**100**

* Primary classifications only (see Table B6 for a description of event classifications).

† With a sample size of 16 events, interpretation of these rounded percentages must be made with care. The total of 100% is of the unrounded values.

‡ This material category is a new addition to the database; no comparison can be made with previous data.

Table 4 gives an analysis of the events by mode of transport: ten events involved shipments by an unknown mode of transport (62%), one by rail (6%), two by air (13%), two by road (13%), and one (6%) by road and air. The proportion of events involving transport by air and road are similar to the long-term annual averages. However, the proportion of events where both road and air are involved in the same event is higher than the long-term average. The remaining events are lower than the long-term average percentage.

TABLE 4 Classification of 2012 events by mode of transport

Transport code	Category	A*		S*		F*	Total	Proportion (%)	
		G	P	C	P	P		2012†	1958–2004
V00	Unknown	5	2	0	2	1	**10**	62	N/A‡
V01	Rail	0	0	0	0	1	**1**	6	24
V02	Air	1	0	0	1	0	**2**	13	13
V03	Sea	0	0	0	0	0	**0**	0	7
V04	Road: > 1.5 t (lorry)	0	0	0	0	0	**0**	0	15
V05	Road: < 1.5 t (van)	1	0	1	0	0	**2**	13	13
V06	Road: car	0	0	0	0	0	**0**	0	3
V07	Road: unknown	0	0	0	0	0	**0**	0	<1
V08	Fork-lift truck	0	0	0	0	0	**0**	0	22
V09	Other	0	0	0	0	0	**0**	0	<1
V10	Road and sea	0	0	0	0	0	**0**	0	<1
V11	Road and rail	0	0	0	0	0	**0**	0	<1
V12	Road and air	1	0	0	0	0	**1**	6	<1
Total		**8**	**2**	**1**	**3**	**2**	**16**	**100**	**100**

* Primary classifications only (see Table B6 for a description of event classifications).

† With a sample size of 16 events, interpretation of these rounded percentages must be made with care. The total of 100% is of the unrounded values.

‡ This material category is a new addition to the database; no comparison can be made with previous data.

5.2 Effects on packages

Table 5 shows an analysis of the events in terms of the package condition by type of package; definitions of the codes used to identify package conditions are given in Table B7 of Appendix B. In nine events there was no damage or report of damage to the packages. For two events there was the potential to cause damage or minor damage to the package. For five events an improper package had been used.

5.3 Radiological consequences

Table 6 shows the likely radiological consequences for the events in 2012, analysed by material category. Table B8 in Appendix B provides a description of the categories for radiological consequences. Of the 16 events, 12 were categorised as ‘none’, indicating no radiological consequences and two were categorised as ‘extremely low, not assessed’. There were two events categorised as ‘assessed, lower category’ where the effective dose was estimated to be below 1 mSv. One involved a package with an incorrect TI given on the package label; the TI indicated a lower TI than was actually the case. The second involved the theft of a number of orphaned sources. There were no events in the ‘assessed, upper category’ involving effective doses above 1 mSv or extremity doses over 50 mSv.

TABLE 5 Nature of package deficiency by type of package

Code	Description	A	BF	BMF	E	IP	IP1	UK	UPX	Total
D01	No package	0	0	0	0	0	0	0	0	**0**
D02	Contaminated conveyance	0	0	0	0	0	0	0	0	**0**
D03	No damage or threat of damage to package	1	1	1	1	1	0	1	0	**6**
D04	No report of damage or increase in dose rate, but potential to cause damage to the package (lower category)	0	0	0	1	0	1	1	0	**3**
D05	No report of damage or increase in dose rate, but potential to cause damage to the package (upper category)	0	0	0	0	0	0	1	0	**1**
D06	Defective or poor condition, without increase in dose rate or loss of containment	0	0	0	0	0	0	0	0	**0**
D07	Minor damage without increase in dose rate or loss of containment	0	1	0	0	0	0	0	0	**1**
D08	Severe damage without increase in dose rate or loss of containment	0	0	0	0	0	0	0	0	**0**
D09	Damage with increase in dose rate but without loss of containment	0	0	0	0	0	0	0	0	**0**
D10	Damaged with loss of containment	0	0	0	0	0	0	0	0	**0**
D11	Contamination inside package	0	0	0	0	0	0	0	0	**0**
D12	Contamination outside package	0	0	0	0	0	0	0	0	**0**
D13	Improper package with loss of shielding or containment – inappropriate contents	2	0	0	1	0	0	0	0	**3**
D14	Improper package with loss of shielding or containment – inadequate shielding	0	0	0	0	0	0	1	1	**2**
Total		**3**	**2**	**1**	**3**	**1**	**1**	**4**	**1**	**16**

TABLE 6 Radiological consequences by material category

Material		Radiological consequences				
Code	Category	None	Extremely low, not assessed	Assessed, lower category (< 1 mSv)	Assessed, upper category (> 1 mSv)	Total
M00	Unknown	6	0	0	0	**6**
M01	Uranium ore concentrate (UOC)	0	0	0	0	**0**
M02	Pre-fuel material	0	0	0	0	**0**
M03	New fuel	0	0	0	0	**0**
M04	Irradiated fuel	0	0	0	0	**0**
M05	Residues (including discharged INF flasks)	1	0	0	0	**1**
M06	Radioactive wastes	2	0	1	0	**3**
M07	Medical and industrial radioisotopes	2	1	1	0	**4**
M08	Radiography sources	0	1	0	0	**1**
M09	No radioactive material	1	0	0	0	**1**
M10	Consumer products	0	0	0	0	**0**
M11	Other	0	0	0	0	**0**
Total		**12**	**2**	**2**	**0**	**16**

6 CONCLUSIONS

During 2012 there were 16 accidents and incidents involving the transport of radioactive materials to, from or within the UK and this report includes descriptions of each event. The number of events reported in 2012 was lower than that in 2011 (38 events) and below the range of the number of events that have occurred in the last five-year period: 38 events in 2011, 30 events in 2010, 33 events in 2009, 39 events in 2008 and 26 events in 2007. The number of events in 2012 was lower than the annual average over the past 20 years (26 events). This variation can be attributed to statistical fluctuation and is not indicative of any long-term trend. The events reported for 2012 are in general similar to those reported in recent years.

Most of the events that occurred in 2012 resulted in no radiological consequences. There were four events that may have resulted in radiation doses but these were considered to be extremely low or below 1 mSv.

The details of the 16 events that occurred in 2012 and described in this review have been added to RAMTED, bringing the total number of reported events since 1958 to 1034.

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APPENDIX A Summary of Portal (Air, Sea and Scrap Yard) Radiation Detector Events not Included as Transport Events

Table A1 summarises events in which the consignor could not be reasonably expected to recognise that they involved radioactive material and they were therefore not classified as transport events. These events all concerned items entering the UK from overseas.

TABLE A1 Summary of portal detector events not included in RAMTED

General information on portal detector event category	Additional information on event
Contaminated metal	
A number of consignments were detected at a UK airport and seaport containing radioactively contaminated consumer products	An ISO container was found to contain some radioactively contaminated consumer products. The contents were assessed and it was found that various consumer products had been manufactured using steel containing ^{60}Co. A surface dose rate of about 40 µSv h^{-1} was recorded. A notice was issued to allow for movement for unloading, inspection and removal of contaminated products
	An ISO container was found to contain stainless steel dog bowls, some of which were contaminated with ^{60}Co. The maximum activity was 26 Bq per gram and the dose rate for individual bowls was 0.36 µSv h^{-1}. The importer was notified
	An ISO container was found to contain waste bins caddies contaminated with ^{60}Co
	A container was found to containing 48 cartons of small electrical connectors that were contaminated with ^{60}Co with a total activity of 26 MBq. A dose rate of 0.45 µSv h^{-1} was detected
	A consignment declared as an 'unsolicited gift' was found to contain 14 stainless steel bowls that were radioactively contaminated. The bowls were disposed of as very low level waste to landfill
	An imported 20 foot container was found to contain various goods including metal tiffens. Some of these were found to contain ^{60}Co with a maximum dose rate of 3.4 µSv h^{-1}. The contaminated bowls were all identified and disposed of
A consignment was detected at a UK seaport containing radioactively contaminated aluminium	An ISO container was found to contain aluminium ingots contaminated with natural or depleted uranium. The dose rate outside the container was found to be below the IAEA limit of 5 µSv h^{-1}
A consignment was detected at a UK airport containing radioactively contaminated mineral gemstones	A package en route through the UK activated the portal alarms at a UK airport. On inspection the package was found to contain topaz, aquamarine and morganite which had been passed through a 10 MeV electron accelerator at the supplier's premises. Aquamarine and morganite contain beryllium which becomes radioactive after irradiation with electrons above 1.6 MeV. The surface dose rate was recorded as 3–4 µSv h^{-1}
An ISO container was detected at a UK airport as containing radioactively contaminated teaspoons	A 20 x 20 foot ISO container was found to contain boxes with teaspoons contaminated with ^{60}Co. The boxes were identified and returned to the sender as an excepted package
Source within scrap metal	
A container was found to contain radioactively contaminated scrap metal entering a UK seaport	An ISO container was found to contain ^{137}Cs, scrap metal nickel and cobalt. An assessment of the dose rate was carried out and the container was allowed to be exported as an excepted package

APPENDIX B Information System Used in the Radioactive Materials Transport Event Database (RAMTED)

B1 RAMTED Information and Code Descriptions

The details of each event are stored in a computer database by the use of descriptive text and alphanumeric coding systems that are described in Table B1.

TABLE B1 Information on transport events recorded in RAMTED

Information	Description
Event ID	The events are numbered using a 7-digit identifier with the format YYYYXXX, where YYYY is the year of the event and XXX is a sequential figure
Date	The date is recorded in the format DD/MM/YYYY
Source	Information regarding events is obtained from the following sources (among others): Civil Aviation Authority Office of Nuclear Regulation – Radioactive Material Transport Public Health England – Centre for Radiation, Chemical and Environmental Hazards National Arrangements for Incidents involving Radioactivity Environment Agency Health and Safety Executive The source of the information is given for each event, together with the event identifier used by the source organisation
Type of event	This coding gives the broad type of event, classified as occurring either during the moving phase of transport operations or during handling before or after movement. Furthermore, events occurring during either the moving or handling phases are categorised either as accidents or as incidents. Alternatively, events may be classified as contamination events. More information on the types of event is given in Table B2
Regional location of event	The location at which the event occurred is given, if known, together with a code assigning the location to one of a number of defined geographical regions
Mode of transport	A code is given to identify the mode of transport for each event. Codes and their definitions are given in Table B4
Category of material	A code is given to identify the type of material for each event. Codes and their definitions are given in Table B3
Consignor	The name and address of the company/organisation that despatched the shipment is given for each event, if known
Consignee	The name and address of the destination company/organisation is given for each event, if known
Carrier	The name and address of the carrier (and sub-carrier, if appropriate) is given for each event, if known
Description of event	A brief description of the event is given in words
Activity release	The activity, in TBq, of any radioactive material released into the environment is given for each event
Worker doses	The maximum dose received by workers from an event is given in mSv, if known
Public doses	The maximum dose received by the public from an event is given in mSv, if known
INES ratings	The INES rating assigned to each event is given, if known
INES conditions	The INES rating is partly dependent on whether certain conditions applied to the event. A record is made of whether these conditions did apply for the event, if known

Information	Description
Event implications	Implications such as worker or public safety implications, or environmental implications are given, if known
Nuclear industry and airport events	It is recorded for each event if the event involved the nuclear industry or damage to a package at an airport, if known
Emergency action	It is recorded for each event if emergency action was taken, if known
Additional information	Any additional information, including photos if appropriate, is recorded for each event
Description of packages	A description of each package is given, if known
Package type	For each package, a package type is given, using the codes given in Table B5
Transport index	For each package the transport index (TI) is given, if known (see the glossary for a definition of transport index)
Radionuclides	The radionuclides contained in each package are listed by their chemical symbol and mass number, with a record of whether or not each nuclide is a sealed source or a fission product
Activity	The activity of each radionuclide is given, in TBq, if known

TABLE B2 Codes used to identify types of events in RAMTED

Code	Definition	Description
TA	Transport accidents	A transport accident is defined as any event during the carriage of a consignment of radioactive material that causes damage to the consignment or significant damage to the conveyance so that the conveyance could not continue its journey
TI	Transport incidents	A transport incident is defined as any event, other than an accident, occurring before or during the carriage of a consignment of radioactive material which caused, or might have caused, damage to or loss of the consignment or unforeseen radiation exposure of workers or members of the public
HA	Handling accidents	A handling accident is defined as an event during the loading, transhipping, storing or unloading of a consignment of radioactive material and which caused damage to the consignment, eg a package falling from a fork lift truck and subsequently being run over or a package being dropped owing to crane failure during handling
HI	Handling incidents	A handling incident is defined as an event, other than an accident, during the loading, transhipping, storing or unloading of a consignment of radioactive material which caused, or could have caused, damage to or loss of the consignment or unforeseen exposure of workers or members of the public
C	Contamination	A contamination event is defined as an event where radioactive contamination is found on the surface of the package or conveyance in excess of the regulatory limit

TABLE B3 Codes used to identify the type of material of an event in RAMTED

Code	Definition
M00	Unknown
M01	Uranium ore concentrate (UOC)
M02	Pre-fuel material
M03	New fuel
M04	Irradiated fuel
M05	Residues including discharged nuclear fuel flasks
M06	Radioactive wastes
M07	Medical and industrial radioisotopes
M08	Radiography sources
M09	No radioactive material
M10	Consumer products
M11	Other

TABLE B4 Codes used to identify modes of transport of an event in RAMTED

Code	Definition
V00	Unknown
V01	Rail
V02	Air
V03	Sea
V04	Road: lorry > 1.5 t
V05	Road: van < 1.5 t
V06	Road: car
V07	Road: unknown
V08	Fork-lift truck
V09	Other (including crane)
V10	Road and sea
V11	Road and rail
V12	Road and air

TABLE B5 Codes used to identify the type of package in an event in RAMTED

	Code	Definition
Type A package codes	A	Type A
	AP	Presumed to be Type A
	AF	Type A, with fissile material
	AFP	Presumed to be Type A, with fissile material
Type B package codes	B	Type B
	BP	Presumed to be Type B
	BF	Type B, with fissile material
	BFP	Presumed to be Type B, with fissile material
	BM	Type B(M)
	BMP	Presumed to be Type B(M)
	BMF	Type B(M), with fissile material
	BMFP	Presumed to be Type B(M), with fissile material
	BU	Type B(U)
	BUP	Presumed to be Type B(U)
	BUF	Type B(U), with fissile material
	BUFP	Presumed to be Type B(U), with fissile material
Type C package codes	C	Type C
	CP	Presumed to be Type C
	CF	Type C, with fissile material
	CFP	Presumed to be Type C, with fissile material
Excepted package codes	E	Excepted
	EP	Presumed to be excepted
Exempted package codes	X	Exempted
	XP	Presumed to be exempted

	Code	Definition
Industrial package codes	IP	Industrial package, any type
	IPP	Presumed to be an industrial package, any type
	IPF	Industrial package, any type, with fissile material
	IPFP	Presumed to be an industrial package, any type, with fissile material
	IP1	Industrial package, Type 1 (IP-1)
	IP1P	Presumed to be an industrial package, Type 1
	IP1F	Industrial package, Type 1, with fissile material
	IP1FP	Presumed to be an industrial package, Type I, with fissile material
	IP2	Industrial package, Type 2 (IP-2)
	IP2P	Presumed to be an industrial package, Type 2
	IP2F	Industrial package, Type 2, with fissile material
	IP2FP	Presumed to be an industrial package, Type 2, with fissile material
	IP3	Industrial package, Type 3 (IP-3)
	IP3P	Presumed to be an industrial package, Type 3
	IP3F	Industrial package, Type 3, with fissile material
	IP3FP	Presumed to be an industrial package, Type 3, with fissile material
Other codes	CV	Contaminated conveyance only
	NIL	No radioactive material carried
	NR	Packaged item, but not in recognised package type
	SC	Item carried within load of scrap
	UK	Unknown packaging status
	UPX	Unpackaged item, which should be packaged
	UPY	Unpackaged item, which is OK to be unpackaged

B2 Event classification system

The analysis of the database of events is facilitated by the use of classification systems that define the description of the event, the type of package damage or deficiency and the extent of any radiological consequence. These three classification systems are set out in Tables B6, B7 and B8. Each event is characterised by the allocation of the alphanumeric codes shown in Table B6 and each package is characterised for damage or deficiency by the codes shown in Table B7. The radiological consequences of each event are characterised by the allocation of the codes shown in Table B8.

TABLE B6 Classification of reported transport events

Area	Subject	Item	Sub-item		Description
A – Administrative (all packages)					
	G – General	1 – Training	1	1	Insufficient worker training
		2 – Documents	1	1	Consignor's certificate incorrect or absent, normally the 'dangerous goods transport document'
			2	1	Other shipment documents incorrect or absent, normally the 'instructions in writing'
			3	1	Correct contents but wrongly described in documents
			4	1	Material undeclared as being radioactive
			5	1	Accounting error, ie apparent loss of package
		3 – Delivery	1	1	Administrative difficulty or error, returned to consignor or re-consigned
		4 – False alarm	1	1	Suspected incident but none found
	C – Conveyance	1 – Placards	1	1	Correct vehicle placards not displayed
			1	2	Placards displayed but no sources carried
		2 – Excessive TI	1	1	Excessive TI on conveyance or in stowage hold
	P – Package	1 – Labels	1	1	Insufficient or incorrect package labels
			1	2	Labels on empty package
			2	1	Incorrect TI on package label
			3	1	Incorrect radionuclide or activity on package label
		2 – Marking	1	1	Package type unmarked or wrongly marked
S – Shipments, general (not irradiated nuclear fuel flasks)					
	C – Conveyance	1 – Load	1	1	Excessive load on conveyance
		2 – Mechanical	1	1	Faulty conveyance, or mechanical failure
		3 – Security	1	1	Locks or security devices: insecure, insufficient or defective
		4 – Tie-downs	1	1	Tie-downs or similar devices: insufficient or defective
		5 – Accidents	1	1	Collisions and other accidents, without fire
		6 – Accident/fire	1	1	Collisions and other accidents, with fire
		7 – Fire	1	1	Spontaneous fire on conveyance
		8 – Stowage	1	1	Inappropriate stowage conditions
	P – Package	1 – Preparation	1	1	Poor standard of packaging or containment
			2	1	Incomplete package, insecure inner container
			3	1	Incomplete package, insufficient shielding
			4	1	Incorrect contents or package type
			5	1	Material in supposedly empty package
			6	1	Contamination inside package
			7	1	Contamination outside package
			8	1	Excessive dose rate

Area	Subject	Item	Sub-item		Description
S – Shipments, general (not irradiated nuclear fuel flasks) *(continued)*					
	P – Package *(continued)*	2 – Loss/disposal	1	1	Stolen and recovered
			1	2	Stolen, not recovered
			2	1	Lost, found, temporary loss, wrong destination or wrong conveyance
			2	2	Lost, not recovered
			3	1	Lost at sea and recovered
			3	2	Lost at sea, not recovered
			4	1	Inappropriate disposal
			5	1	Radioactive material in scrap metal
		3 – Damage	1	1	Spontaneous mechanical failure of package, including leakage
			2	1	Deliberate damage or interference
			3	1	Damaged by falling from or within conveyance, or by falling object, or by external object
			4	1	Damaged during cargo handling
			5	1	Damaged due to broken or loose tie-downs
F – Irradiated nuclear fuel flasks					
	C – Conveyance	1 – Flatrol/ HGV	1	1	Flatrol or HGV problem eg buffers, brakes, canopy not correct, including significant overheating of wheel or axle
		2 – Accident	1	1	Collision
			2	1	Derailment during low speed marshalling
			3	1	Inadvertent decoupling
			4	1	Fire on the conveyance
		3 – Contamination	1	1	Flatrol or HGV contaminated above regulatory limits
			2	1	Fixed-contamination above 5 μSv h^{-1}
	P – Package	1 – Preparation	1	1	Shock absorber damaged or unsatisfactory
			2	1	Tie-down bolts insufficient or defective
			3	1	Lid, defective or loose bolts
			3	2	Lid seal unapproved or obsolete
			4	1	Water level valve defective
			5	1	Discharged flask containing fuel rod, excessive deposit, or other incorrect contents
			6	1	Faulty test procedures
			7	1	Fuel not fully covered by water
			8	1	Other minor preparation error
		2 – Mechanical	1	1	Mishandled during loading or unloading
			2	1	Venting system or valve problem
		3 – Contamination	1	1	Contamination of surface above regulatory limits
			2	1	Other: poor standard of decontamination

TABLE B7 Classification of package deficiency associated with the transport event

Code	Deficiency	Examples/comments
D01	No package	No package involved in event
D02	Contaminated conveyance	Contaminated conveyance only with no package involved
D03	No damage to package or threat of damage	Administrative errors and false alarms. Inadequate locks and security devices. Inappropriate or wrong contents. Obsolete lid seals
D04	No report of damage or increase in dose rate, but potential to cause damage to the package. Lower category	Package temporarily lost or mislaid, or wrong destination, or put on wrong conveyance. Low speed derailments and collisions. Flatrol decoupling. Faulty conveyance or tie-downs
D05	No report of damage or increase in dose rate, but potential to cause damage to the package. Upper category	Stolen source. Unretrieved lost package. Inappropriate disposal. Severe collision. Fire on the conveyance
D06	Defective or poor condition, without increase in dose rate or loss of containment	Package of generally poor standard, corroded or other deterioration. Parts missing or mechanical defect
D07	Minor damage without increase in dose rate or loss of containment	Damage to outer packaging: knocked, dropped or dented. Conveyance overturned
D08	Severe damage without increase in dose rate or loss of containment	Severely damaged: crushed. Scorched by fire. Part of container, eg lid, knocked off
D09	Damaged with increase in dose rate but without loss of containment	Increased dose rate outside package caused by damage or fire en route. Includes internal leakage and other mechanical failure. No loss of material outside package
D10	Damaged with loss of containment	Leakage out of package caused by damage or fire en route. Includes material or source(s) released from package. Usually accompanied by some increase in dose rate
D11	Contamination inside package	Unexpected contamination or other residual material found inside package
D12	Contamination outside package	Fuel flask contamination above regulatory limits. Any other contamination above IAEA limits
D13	Improper package with loss of shielding or containment – inappropriate contents	Activity unexpectedly high for package, leading to dose rates higher than expected
D14	Improper package with loss of shielding or containment – inadequate shielding	Package shipped with poor, ineffective or damaged shielding, or source exposed en route

TABLE B8 Radiological consequences resulting from transport events

Code	Definition	Circumstances
N	None	No dose rates or contamination above those expected during routine transport. No evidence of exposures having been received
E	Extremely low, not assessed	Some increased exposure above that associated with routine transport but considered to be so low that an assessment was of little value
L	Assessed and below 1 mSv*	Some increased exposure above that associated with routine transport and considered to be of a magnitude worth investigating, but found to be low
U	Assessed and above 1 mSv* or exposure to significant contamination	Some increased exposure above that associated with routine transport and considered to be of a magnitude worth investigating. Some exposures found to be appreciable

* An effective dose of 1 mSv or an extremity dose of 50 mSv.

APPENDIX C Glossary

Term	Description
Absorbed dose	Measured in grays (Gy), it is the amount of energy absorbed per kilogram of matter, eg tissue, as a result of exposure to ionising radiation
Activity	The number of radioactive decays per unit time in a given material. Normally measured in disintegrations per second (Bq)
AGR	Advanced gas-cooled reactor. Used in the UK's second generation of gas-cooled nuclear power stations
Alpha emitter	A radionuclide that decays emitting an alpha particle
Alpha particle	A particle emitted by a radionuclide consisting of two protons and two neutrons (ie the nucleus of a helium atom)
Beta emitter	A radionuclide that decays emitting a beta particle
Beta particle	An electron or positron emitted by a radionuclide
Category	Packages other than excepted packages and overpacks must be assigned to either category I-White, II-Yellow or III-Yellow, depending on the maximum dose rate at the surface and at 1 m from the surface and must be labelled accordingly
Committed effective dose	A measure of the total lifetime radiation exposure of an individual from intakes of radioactive material. The effective dose received across the lifetime of an individual (taken up to the age of 70 years for members of the public), from an ingestion or inhalation of radionuclides
Effective dose	Measured in sieverts (Sv), it is a measure of the overall exposure of an individual from ionising radiation from internal or external irradiation. It is dependent on the absorbed dose, type of radiation and regions of the body affected. Since the sievert is a large unit, doses are more commonly expressed in millisieverts (mSv) or microsieverts (µSv)
Dose rate	The rate at which whole body dose from external radiation is received, measured in units of Sv h^{-1}, or mSv h^{-1}
Flatrol	A type of rail wagon used to carry INF flasks
Irradiated nuclear fuel (INF) flask	A Type B package used to transport irradiated nuclear fuel (see packages)
Ionising radiation	Radiation capable of breaking chemical bonds, causing ionisation and damage to biological tissue
Label	Apart from excepted packages all packages must be labelled with a diamond shaped warning label which gives information on the contents of the package
Low toxicity alpha emitters	Natural uranium, depleted uranium, natural thorium, ^{235}U, ^{238}U, ^{232}Th, ^{228}Th and ^{230}Th, when contained in ores or physical and chemical concentrates; or alpha emitters with a half-life of less than 10 days
Magnox	The first generation of the UK's gas-cooled nuclear power stations.
NAIR (National Arrangements for Incidents Involving Radioactivity)	A scheme designed to provide assistance to the police when dealing with an incident which involves, or is suspected to involve, radioactive material
NORM	Naturally occurring radioactive material
Nuclide	A species of atom characterised by a nucleus with a specific number of protons and neutrons
Overpack	An enclosure such as a box or bag which is used by a consignor to transport a number of packages as a single unit

Term	Description
Package	There are five main types of packages used to carry radioactive material: *Industrial packages* are industrial containers, such as drums, used to carry bulky low activity materials, or contaminated items *Excepted* packages are simple packages used to carry low activity materials and sources. They are mainly used to transport low activity diagnostic test materials to hospitals *Type A* packages are used to transport medium activity material such as medical or industrial isotopes. They must withstand normal conditions of transport including minor mishaps *Type B* packages are used to transport high activity sources and materials, such as irradiated nuclear fuel (INF). They provide shielding from high radiation levels even under extreme circumstances. They must meet severe mechanical and thermal test requirements, which simulate accident conditions *Type C* packages are for the transport by air of greater quantities of radioactive material than is allowed to be transported by air in Type B packages. They must be designed to withstand very serious accidents such as aircraft crashes
Radionuclide	A nuclide which spontaneously loses energy or disintegrates into another nuclide, resulting in the emission of ionising radiation
RADSAFE	An emergency response plan operated by the main consignors of radioactive materials
Special form radioactive material	An indispersible solid radioactive material or a sealed capsule containing radioactive material
Transport Index (TI)	A number equal to the maximum dose rate, at 1 m from the surface of the package, overpack or freight container, measured in mSv h^{-1} multiplied by 100. This number is used to control radiation exposure from a group of packages during transport