asn AUTORITÉ DE SÛRETÉ NUCLÉAIRE

SCALES USED

TO CLASSIFY NUCLEAR INCIDENTS AND ACCIDENTS AND RADIATION PROTECTION EVENTS IN THE CONTEXT OF RADIOTHERAPY PROCEDURES

The need to inform the public of the severity of nuclear events, in particular after the Chernobyl accident (1986), made it necessary to develop classification scales. The first scale was introduced in 1987 by the French High Council for Nuclear Safety and Information (CSSIN[1]). The Autorité de sûreté nucléaire (ASN – French Nuclear Safety Authority) played an essential role in 1991 in the establishment of the INES[2] international nuclear event classification scale published by IAEA.
In 2002, ASN proposed a new scale to cover radiation protection events (irradiation, contamination), including those affecting workers, whatever the event location.
In July 2007, in collaboration with the French Society for Radiation Oncology (SFRO[3]), ASN introduced a scale intended to classify radiation protection events affecting patients undergoing radiotherapy procedures, which was published in 2008.
In July 2008, IAEA published a revised INES, better able to deal with events occurring in the transport field or involving human exposure to radioactive sources.
In September 2008, ASN proposed that the French High Committee for Transparency and Information on Nuclear Security (HCTISN) participate in the work that ASN has been carrying out since 2007 with the aim of introducing an index for the measurement of radioactivity in the environment.

The INES NUCLEAR INCIDENT AND ACCIDENT CLASSIFICATION SCALE

DESCRIPTION AND OBJECTIVES

Following the example of the classification of natural phenomena such as earthquakes, wind and avalanches, in 1987 France introduced a nuclear event severity scale, which the IAEA drew upon extensively to design INES.
INES, in international use since 1991, is based on both objective and qualitative criteria. Applied by sixty countries, it is intended to facilitate media and public perception of the significance of nuclear incidents and accidents.
It is not a tool for assessing or measuring nuclear safety and radiation protection and cannot constitute a basis for either compensation or penalties. INES is not designed to be used to draw international comparisons, and in particular no cause-and-effect relationships can be established between the number of incidents notified and the probability of occurrence of a severe accident at an installation.

INES SCALE APPLICATION

	CONSEQUENCES OFF THE SITE	CONSEQUENCES ON THE SITE	DETERIORATION OF DEFENCE IN DEPTH
7 MAJOR ACCIDENT	Major release: considerable effects on health and the environment		
6 SERIOUS ACCIDENT	Significant release likely to require full application of planned countermeasures		
5 ACCIDENT	Limited release likely to require partial application of planned countermeasures	Severe damage to reactor core/radiological barriers	
4 ACCIDENT	Minor release: public exposure close to the stipulated limits	Significant damage to reactor core/radiological barriers/lethal exposure of a worker	
3 SERIOUS INCIDENT	Very small release: public exposure equivalent to at least a percentage of the limits defined by the IAEA guide*	Serious contamination/Acute effects on the health of a worker	Near-accident/loss of barriers
2 INCIDENT		Significant contamination/overexposure of a worker	Incident associated with significant failures in safety provisions
1 ANOMALY			Anomalous excursion from authorized operating conditions
0 DEVIATION		No safety significance	
EVENT BELOW SCALE		No safety significance	

(1) CSSIN: Conseil Supérieur de la Sûreté et de l'Information Nucléaires (Fench Higher Council for Nuclear Safety and Information) • (2) INES: International Nuclear Event Scale •
(3) SFRO: Société Française de Radiothérapie Oncologique (French Society for Oncological Radiotherapy)
*Guide viewable on the IAEA website at www-ns.iaea.org/tech-areas/emergency/ines.htm

NATURE OF EVENTS CLASSIFIED ON INES

INES enables ASN to classify all events occurring in civil basic nuclear installations (BNIs) and during transport of radioactive materials according to their significance. Since 1 July 2008, INES can also be used by the 60 member countries of IAEA for the classification of radiation protection events related to the use of radioactive sources in medical (excluding patients), industrial and research facilities. The application of INES to BNIs is based on three classification criteria (columns 2, 3 and 4 of the table overleaf):

- **the consequences off the site,** assessed in terms of releases of radioactivity that can affect people and the environment;
- **the consequences on the site,** potentially affecting workers and installations;
- **deterioration of the facility's defence in depth,** consisting of consecutive barriers (safety systems, procedures, technical or administrative controls, etc.) designed to prevent accidents.

The classification criteria for radiation protection events are given in the table overleaf.

EXAMPLES OF EVENTS CLASSIFIED ACCORDING TO INES

Level 0. In France: several hundred events are classified at level 0 each year. They concern deviations from normal facility operations, normal use of radioactive sources or normal transport operations. They have no safety significance.

Level 1. In France: about a hundred events are classified at level 1 each year. This concerns anomalies, deviations from the facility's authorised operating conditions, abnormal use of radioactive sources or abnormal transport operations, owing to equipment failure, human error or inadequate application of procedures.

Level 2. In France: 2006: blockage of a water intake by the large-scale arrival of plant debris at the Cruas NPP. Under-estimation of plutonium deposits in the gloveboxes of the plutonium technology facility (ATPu). Accidental irradiation of a worker from the HORUS company during a gamma radiography weld inspection. Safety-criticality limit exceeded in the MELOX facility. 2006: improper use of a MOX fuel fabrication scrap crusher at the ATPu on the Cadarache site, resulting from the application of inappropriate procedures and instructions without official validation. 2005: anomaly concerning certain safety system pumps of EDF 900 MWe reactors, potentially leading, under certain accident conditions, to loss of the cooling water recirculation function.

Level 3. In France: 2008: irradiation by a Cobalt 60 source of a worker in an irradiation bunker on the ONERA site in Toulouse. 2002: incident classified by the competent Swedish authority during transport by the carrier Federal Express (FedEx) between Sweden and the United States via Paris Roissy airport of a package showing on arrival a dose rate above the regulatory limit. 1981: fire in a storage silo at La Hague. **In other countries:** 2008: abnormal release of iodine 131 by the stack of the Institut des radioéléments (IRE – national radioelements institute) building at Fleurus (Belgium) during a transfer of liquid effluents between tanks. 2005: detection of a radioactive leak in piping in the Thorp fuel reprocessing plant at Sellafield (United Kingdom). 2002: discovery in the reactor of the Davis Besse plant (United States) of a cavity in the vessel closure head due to metal corrosion by boric acid.

Level 4. In France: 1980: damage to the core of reactor A1 at Saint-Laurent-des-Eaux. **Abroad:** 2006: irradiation by a Cobalt 60 source of a worker in a sterilisation facility using ionising radiations (Belgium). 1999: criticality accident in a fuel fabrication plant at Tokai-Mura (Japan), with acute irradiation of three workers, two of whom died. 1973: release of radioactive materials following an exothermic reaction in a reprocessing tank at the Windscale plant (United Kingdom).

Level 5. In France: none. **In other countries:** 1979: partial reactor core meltdown at Three Mile Island NPP (United States).

Level 6. In France: none. **In other countries:** 1957: explosion of a tank containing radioactive materials at the Kyshtym reprocessing plant (USSR).

Level 7. In France: none. **In other countries:** 1986: explosion of the reactor 4 at Chernobyl NPP (Ukraine).

USE OF INES IN FRANCE

All events significant for nuclear safety must be notified to ASN by the licensees within 48 hours, with a proposed INES classification.
ASN retains sole responsibility for the final classification decision.
The use of INES enables ASN to identify the events and incidents of sufficient importance for it to issue a communication.

- **Events classified at level 0** are not reported in incident notices, unless they are of particular interest.
- **All events classified at level 1** are reported in incident notices published on the ASN website www.asn.fr.
- **Events classified at level 2** and above are also reported by press releases and notified to the IAEA.

International transport events concerning a foreign country are also notified to IAEA as of level 1 and as of level 0 if they involve the loss of a radioactive source. ■

INES CLASSIFICATION OF RADIATION PROTECTION EVENTS

In France, the application guide for the new INES allowing classification of radiation protection events (not affecting patients) involving radioactive sources and radioactive material transport operations, is currently being produced. Radiotherapy events affecting patients are classified on the ASN-SFRO scale issued by ASN in July 2008.

EVENT	NUMBER OF PERSONS EXPOSED AND FINAL CLASSIFICATION		
	MINIMUM CLASSIFICATION	NUMBER OF PERSONS	FINAL CLASSIFICATION*
Death or lethal dose received		> 10	6
	4	> 1	5
		1	4
Deterministic effect or potential deterministic effect given the received dose		> 10	5
	3	> 1	4
		1	3
Exposure higher than 1 Sv or 1 Gy		> 100	6
	4	> 10	5
		≤ 10	4
Exposure higher than 100 mSv		> 100	5
	3	> 10	4
		≤ 10	3
Worker exposure to a dose above the annual regulatory limit or exposure of a member of the public to a dose greater than 10 mSv		> 100	4
	2	> 10	3
		≤ 10	2
Worker exposure to a dose greater than one quarter of the annual regulatory limit or exposure of a member of the public to a dose above the annual dose limit		> 100	3
	1**	> 10	2
		≤ 10	1

** The highest classification is selected.*
*** When a dose limit is exceeded as a result of accumulated exposure over a given period of time, ASN systematically assigns a level 1 classification because of inadequate safety culture.*