CENTRE D'ETUDE SUR L'EVALUATION
DE LA PROTECTION DANS LE DOMAINE NUCLEAIRE

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NOTE

OCCUPATIONAL EXPOSURE MANAGEMENT CRITERIA IN EMEGENCY SITUATIONS – SYNTHESIS OF ISOE AND ERPAN SURVEYS

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1. INTRODUCTION

After the Fukushima nuclear accident (11th of March, 2011), two international networks started some investigations on the international regulations concerning occupational dose management in emergency situations:

- ISOE network[1] (Nuclear utilities and Safety Authorities Network)
- ERPAN network[2] (European Radioprotection Authority Network)

The questions asked in the ISOE survey were the following:

1. What dose criteria are used for emergency workers in your country and what is the basis?
2. What is your dose management criteria for high dose/dose rate areas?
3. What sort of protective equipment is recommended for emergency workers, especially for high dose areas?
4. What is recommended for individual monitoring for this type of work?
5. Do you have any special requirement for assessment of this kind of dosimeters, in particular in terms of the need, or not, for specific high-dose algorithms for converting passive dosimeter measurements into mSv?

The questions asked in the ERPAN survey were the following:

1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?
2. Does the legislation include:
    i. Explicit numerical values
    ii. Statements on optimisation
3. What does the legislation say (please supply a short summary) ?
4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

This document presents a synthesis of the answers from the 2 surveys.

Please note that in the ISOE survey, the answer to the question on the dose management criteria for high dose / doserate areas is not included in the synthesis as the answers were dealing with criteria in normal situation, and not in emergency.

Complete answers to both surveys are presented in Appendix 1 and 2.

[1] ISOE : www.isoe-network.net

[2] ERPAN : see on the European ALARA Network (EAN) website : www.eu-alara.net

Table 1. Countries who participate to ISOE and/or ERPAN surveys

	ISOE **(Nuclear power plant or utility)**	**ERPAN** **(Safety Authority or equivalent)**
Germany	ISAR NPP State NPP	LfU Bayerisches Landesamt für Umwelt
Belgium		FANC
Brazil	Angra NPP	
Finland	Loviisa NPP	
France	EDF / GPRE	ASN
Greece		GAEC
Ireland		RPII
Luxembourg		Health Ministry (RP Department)
Malta		OHSA
Norway		NRPA
Pakistan	Chasnupp NPP	
Romania	Cernavoda	
United-Kingdom	Sizewell NPP	
Russia	Rosenergoatom Concern	
Slovenia	Krško NPP	Slovenian Radiation Protection Administration
Sweden	Ringhals NPP	SSM
Switzerland	Leibstadt NPP	

2. OCCUPATIONAL DOSE LIMITS IN RADIOLOGICAL EMERGENCY

Table 2. Occupational dose limits in radiological emergency

	Occupational dose limits in radiological emergency
Belgium	Dose guidelines, depending of the type of emergency action i. Urgent actions for life saving purposes or to avoid catastrophic conditions : 1. Strive for a maximum level of 250 mSv; if possible use multiple persons (rotation) to achieve maximum doses levels of 50 mSv/person 2. To do everything to not exceed a dose level of 500 mSv (5 Sv to skin): this level is only tolerated for life saving actions and only if the person confirms a second time to volunteer for the intervention ii. Other urgent actions 1. Strive for respecting the dose limits of radiation workers 2. If sufficiently justified, a total dose of up to 250 mSv is tolerated
Brazil	Reference level for saving lives or preventing serious health injuries : - as much as possible under 100 mSv - If exceptionally the value of 100 mSv has to be exceeded, the exposure should be below the threshold for deterministic effects
Finland	For immediate measures necessary to limit the radiation hazard from an accident: - Except where the matter concerns the saving of human lives, the effective dose shall no exceed 500 mSv and the equivalent dose at any point of the skin shall no exceed 5 Sv
France	Two groups of response personnel are defined: - Group 1: personnel making up the special technical or medical response teams set up to deal with a radiological emergency. These personnel benefit from radiological surveillance, a medical aptitude check-up, special training and equipment appropriate to the nature of the radiological risk. - Group 2: personnel who are not members of the special response teams but who are called in on the basis of their expertise. They are given appropriate information Reference individual exposure levels: - Group 1 : effective dose <100 mSv. When the intervention measure is aimed at protecting other people: effective dose < 300 mSv. - Group2: effective dose < 10 mSv. In exceptional circumstances, volunteers informed of the risks involved in their acts may exceed the reference levels, in order to save human life. In no case must the cumulative effective dose over the lifetime of an intervening person exceed 1 Sv.

	Occupational dose limits in radiological emergency
Germany	During measures for associated with the defence against nuclear hazards to humans it is to be aimed that - an effective dose of more than 100 mSv occurs only once per year - an effective dose of more than 250 mSv occurs only once per lifetime. The lifetime occupational dose limit (400 mSv) has to be taken into account. There is a regulation for the fire service, that includes several guidance values for different scenarios - protection of material assets: 15 mSv per mission - danger defence for persons: 100 mSv per mission and year - rescue of human lives: 250 mSv per mission and lifetime
Greece	Emergency workers are submitted to the regulation on "specially authorized exposures" - The dose constraints or committed doses received during specially authorized exposures shall be determined by GAEC (Safety Authority) and may not in any year exceed twice the annual dose limits[a], and, in a lifetime, five times those dose limits [a] *Annual effective dose limit for exposed workers: 20 mSv in any single year and 100 mSv in a consecutive five-year period* *Annual equivalent dose limit: 150 mSv in a year for the lens of the eye, 500 mSv for the skin*
Ireland	In case of emergency, RPII (national RP authority) will set maximum emergency dose limits for workers involved in intervention These maximum emergency dose limits may only be exceeded where emergency worker is saving lives and is an informed volunteer. A multi-agency protocol on response to radiological emergencies has been elaborated. It notes that there are few situations in Ireland where it is envisaged that ionising radiation could become a hazard to emergency services personnel in the normal course of their duties. It is not anticipated therefore, that the radiation dose received by an emergency responder would exceed those laid down in law for normal occupational exposures (20 mSv in a 12-month period) As an indication, the protocol recall the IAEA guidelines : - Saving life actions : < 1000 mSv - Actions to prevent severe health effects or injuries: < 500 mSv - Actions to avert a large collective dose : <500 mSv
Luxembourg	- Effective dose limit for volunteers exposed during an emergency : 50 mSv cumulated on one year - In case of saving life actions : effective dose limit is 250 mSv

	Occupational dose limits in radiological emergency
Malta	No worker undertaking an intervention shall be exposed in excess of the maximum single year dose limit for occupational exposure (50 mSv) except : (a) For the purpose of saving life or preventing serious injury; or (b) If undertaking actions to prevent the development of catastrophic conditions. All reasonable efforts shall be made to keep doses to workers below twice the maximum single dose year limit (i.e. 100 mSv), except for life saving actions, in which every effort shall be made to keep doses below ten times the maximum single dose year limit (i.e. 500 mSv), in order to avoid deterministic effects on health.
Norway	Rescue work in emergency situations shall as far as possible be carried out within the upper dose limits for occupationally exposed employees (i.e. 50 mSv). Exceeding this limit can only be accepted in order to save lives, avert serious damage to health or prevent a dramatic escalation of the accident. Radiation doses above 500 mSv shall as far as possible be avoided.
Pakistan	No worker undertaking an intervention shall be exposed in excess of the maximum single year dose limit (i.e. 50 mSv) For life-saving or intend to avert large collective dose or prevent catastrophic condition, the dose shall be < ten times the maximum singlke year dose (i.e. 500 mSv)
Romania	Under emergency, all possible efforts shall be made to keep the emergency exposures of the intervention personnel below the legal dose limit of 20 mSv The legal dose limit can be exceeded in the following situations : - saving life or preventing serious injuries - averting a large collective dose or preventing the development of catastrophic conditions In these situations, all reasonable efforts shall be made to keep doses below 100 mSv, except for saving life actions, in which the dose limit is 500 mSv
Russia	- Dose limit in case of accident : 200 mSv

	Occupational dose limits in radiological emergency
Slovenia	Adoption of international criteria (AIEA – Tec Doc 955) in total effective dose: - Type 1 actions (saving life, preventing a core melt, ..): < 500 mSv (this dose can be exceeded if it is justified, but all should be done to avoid deterministic effects) - Type 2 actions (avoid serious injuries, avoid large collective dose, …): < 100 mSv - Type 3 actions (short term actions, environment samples, …): < 50 mSv - Type 4 actions (long term actions, …): < 20 mSv Also base on the IAEA Tec Doc 955, reference dose limits are prescribed for planned intervention, for the external dose measured by electronic dosimeters. (the IAEA document note that these values have been set up to take account of the part of internal contamination by inhalation in case of an accident with core melt, and assuming that thyroid blocking was taken before exposure). The values are the following: - Type 1 actions (saving life, preventing a core melt, ..): < 250 mSv (this dose can be exceeded if it is justified, but all should be done to avoid deterministic effects) - Type 2 actions (avoid serious injuries, avoid large collective dose, …): < 50 mSv - Type 3 actions (short term actions, environment samples, …): < 25 mSv - Type 4 actions (long term actions, …): < 20 mSv
Sweden	Rescue work must be performed only by volunteers if the effective dose from this work is estimated to exceed the annual limit (50 mSv). Rescue work that implies an effective dose higher than 100 mSv must only be carried out for the purpose of saving lives by persons well aware of the radiation risks related to the work.
Switzerland	Emergency workers are limited to 50 mSv in the year after the start of the emergency, and 250 mSv to save lives.
United-Kingdom	- For all but severe accident : maximum of 20 mSv/y - For severe accident, dose up to 100 mSv can be authorized - For life saving, or intervention to prevent a significant escalation of an accident, doses up to 500 mSv can be authorised

3. PROTECTIVE EQUIMENTS

3.1. Protective suits recommended for emergency workers, especially for high dose areas

There are not a lot of differences between the protective suits which would be used during emergency and those which are used in normal operation (protective suits, mask, glasses, respirators,..). The selection will be adapted to the situation and to the working conditions. Some countries also mention the use of mobile protective shielding (Germany, Russia).

Some specific information provided:

- The Germans make a reference to the potential use of remote operating equipments. In fact, the German utilities have created in common a company dedicated to the creation and production of remote tolls and robots, to be used notably in emergency situations (Kerntechnische Hilfsdienst GmbH – KHG – web site: www.khgmbh.de)
- The Sizewell nuclear power plant (UK) mention that several emergency locations are provided with protective equipment, respiratory protective equipment, dosimetry and high dose rate radiation monitoring instruments. This equipment is dedicated to emergency response. They provide:
  - around 500 TLDs dedicated to emergency response
  - around 50 electronic personal dosimeters dedicated to emergency response
  - 4 telescopic radiation dose rate instruments that can measure up to 10 Gy/h
  - Large number (hundreds) of self-contained breathing apparatus
  - Large number of respirators plus iodine filters
  - protective clothes for fire, water, etc
- The Cernavoda nuclear power plant (Romania) is also providing several emergency locations, where equipments dedicated only for emergency response are stored:
  - Protective suits (browns, tyvek, plastic suits, protective suits for fire
  - Respiratory protective equipments (mask with iodine and particles filters, SCBA, Ram's Horn)
  - Dosimetry (TLDs and Electronic PADs)
  - High dose rate radiation monitoring instruments (gamma meters, contamination meters, air sampling pumps.

3.2. Individual monitoring

The following tables summarize the answers to the question related to the individual monitoring of emergency workers. Some details are also provided on the dosimeters calibration (energy range, dose, dose rates).

All countries mention the use of both passive (TLDs or OSL) and electronic dosimetry. A few note that they may place dosimeters at various places on the body (head, finger, ..) according to the exposure situation. The use of teledosimetry, video coverage and audio communication is also mentioned (Brazil and Slovenia).

According to the data provided, the passive dosimeters can measure until 10 Sv (5 Sv mentioned in Switzerland). Most countries specify that the dose calculation algorithm used are adapted to the conversion of very high dose. There are apparently no specific procedures (but it has to be noticed that the answers where not very detailed).

Table 3. Individual monitoring of emergency workers

	Passive dosimeter	Electronic dosimeter	Neutron dosimeter	Additional dosimeters	Remote monitoring	Contamination	Leucocytes monitoring
Brazil	X	X		X	X (teledosimetry, audio link, video link)		
Finland	X	X		X			
France	X	X	X				
Germany	X	X	X	Ring for fingers	X		
	X	X		TLDs on fingers, head, …			
Pakistan	X	X		X		Internal contamination.	
Romania	X	X		X			
Russia	X	X				Regular measurement of surface and internal	X
Slovenia	X			OSL on body and extremities	X (teledosimetry, audio link)		
Sweden	X	X		X			
Switzerland	X	X					
United-Kingdom	X	X					

Table 4. Dosimeters' characteristics

<table>
<tr><th></th><th>Passive dosimeter</th><th>Electronic dosimeter</th><th>Neutron dosimeter</th></tr>
<tr><td>Brazil</td><td>TLD UD-802 (βγ)
max. 10 Sv</td><td></td><td>UD-809
max. 10 Sv</td></tr>
<tr><td>Finland</td><td>TLD
<table>
<tr><th></th><th>Energy (MeV)</th><th>Dose (mSv)</th></tr>
<tr><td>Photon
Hp(10) à Hp(0,07)</td><td>0,08 – 3,0</td><td>0,1 - 1000</td></tr>
<tr><td>Beta Hp(0 ,07)</td><td>0,5 – 3,0</td><td>0,1 – 1000</td></tr>
<tr><td>Neutron</td><td>0 – 1 MeV</td><td>0,2 à 1000</td></tr>
</table>
Extremity dosimeter: Hp (d)* : 1 mSv – 10 Sv</td><td>50 keV to 6 MeV
0,001 à 10 Sv</td><td></td></tr>
<tr><td>France</td><td>gamma film badge - 0,1mSv to 10 Sv</td><td>0,001mSv to 8 Sv</td><td>0,1mSv to 250 mSv</td></tr>
<tr><td rowspan="2">Germany</td><td>Max.10 Sv</td><td>Max.15 Sv/h</td><td></td></tr>
<tr><td></td><td>MGP –
Max. 1Sv/h</td><td></td></tr>
<tr><td>Romania</td><td>TLD UD-814AS9 (βγ)
0,5 mSv – 10 Sv</td><td>MGP DMC 20005
0,0001 mSv/h – 10 Sv/h
0,0001 mSv – 10 Sv</td><td></td></tr>
<tr><td>Slovenia</td><td>Landauer OSL
Max. 10 Sv</td><td></td><td></td></tr>
<tr><td>Sweden</td><td>TLD
until more than 100 mSv</td><td>MGP DMC 2000 S</td><td></td></tr>
<tr><td>Switzerland</td><td>TLD
until 5 Sv</td><td></td><td></td></tr>
<tr><td>USA</td><td>TLD UD-802
10 keV to 10 MeV
0,01 mSv to 10 Sv

OSL
Beta : 227 keV to 761 keV E-ave
Photons : 16 keV to 1250 keV
Neutron : 40 keV to 5000 keV
0,01 mSv to 10 Sv</td><td></td><td></td></tr>
</table>

4. REFERENCES

Table 5. Synthesis of references provided in the ISOE and ERPAN survey

Belgium	Articles 2, 20.2, 72.3 and 72.4 of the Royal Decree of 20/07/2001 on radiation protection and the Royal Decree of 17/10/2003 on nuclear emergency planning (all regulation available et http://www.jurion.fanc.fgov.be/jurdb-consult/)
France	Public Health Code (Articles R. 1333-84 and 86) Safety Authority guidance : http://www.asn.fr/index.php/S-informer/Publications/Guides-pour-les-professionnels/Situation-d-urgence/Guide-national-d-intervention-medicale-en-cas-d-evenement-nucleaire-ou-radiologique Result of a working group on post-accidental management: http://www.asn.fr/index.php/S-informer/Dossiers/Gestion-post-accidentelle2/Comite-directeur-gestion-de-phase-post-accidentelle/Synthese-et-rapport-de-chaque-groupe-de-travail
Finland	Regulatory guide YVL7-4 – Nuclear Power Plant Emergency Preparedness
Germany	German Radiation Protection Ordinance (RPO) Regulation for fire service: Feuerwehr-Dienstvorschrift FwDV 500 - “Einheiten im ABC – Einsatz” , 2003
Greece	Greek Radiation Protection Regulations - paragraph 1.2.3
Ireland	Regulation: http://www.irishstatutebook.ie/2000/en/si/0125.html#partviii-sec39 Multi-agency protocol on response to radiological emergencies: http://www.mem.ie/memdocuments/a protocol for multi-agency response to radiological-nuclear emergencies.pdf
Luxembourg	Regulatory act on radiation protection – article 5.1.8
Malta	Legal notice 44 of 2003, Nuclear Safety and Radiation Protection regulations Reg 58(1) & Schedule 7
Norway	Nordic guideline (document under revision): http://www.nrpa.no/dav/a0d1078002.pdf
Slovenia	articles 39 and 40 of the Decree on dose limits, radioactive contamination and intervention levels, Off. Gazette, Republic of Slovenia, No. 49/2004 IAEA TECDOC 955: http://www-pub.iaea.org/MTCD/publications/PDF/te_955_prn.pdf
Sweden	SSMFS 2008:51 - The Swedish Radiation Safety Authority's regulations concerning basic provisions for the protection of workers and the general public in practices involving ionising radiation;

ANNEXE 1. ISOE SURVEY

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USA
Richard LaBurn
Fermi NPP

1. What dose criteria are used for emergency workers in your country and what is the basis?	
German law has a recommendation on the personal dose limit to apply during an emergency situation. It indicates that an effective dose of 250 mSv once in a lifetime should not be exceeded for such an event (Strahlenschutzverordnung § 59). The "German ICRP" called the Strahlenschutzkommission recommends not to exceed an effective dose of 1000 mSv for life saving actions.	**Ralph Brunner** Germany
Normal dose limits for nuclear power plant workers are 20mSv/a or 100mSv/5a. During an incident there are special dose limits (for example fire worker): 100mSv for one single situation ones in a lifetime); there is another limit for incidents, where persons are in danger: 250mSv for one single situation ones in a life time.	**Heinrich Harke** Germany
Emergency workers are limited to 50 mSv in the year after start of the emergency and 250 mSv to save lives.	**Andreas Ritter** Switzerland
This dose criteria was 25 rem during the Chernobyl Accident (Russian Radiation Safety Regulations, publication ICRP # 26). Now – not more 200 mSv.	**Boris Bezrukov** Russian Federation
For all but severe accidents a maximum of 20 mSv/y For severe accidents doses of up to 100 mSv/y can be authorized For life saving, or intervention to prevent a significant escalation of an accident, doses of up to 500 mSV/y can be authorized (exceptional). These dose levels are defined in the Operator's Emergency Plans and have been agreed in advance with the Regulator.	**Guy Renn** United Kingdom
The national criteria are stated in the regulation (www.ursjv.gov.si/zakonodaja .../veljavni predpisi) «Uredba o mejnih dozah, radioaktivni kontaminaciji in intervencijskih nivojih«, articles 39 for intervention workers and intervention dose limits; and article 40 for operational intervention levels for electronic dosimeter external exposure dose limits. Slovenian regulation complies with international guidelines for maximum intervention dose (500 mSv) for volunteers in case of saving human lives or preventing catastrophic releases or reactor core melt. There are appropriate guidelines included for the required actions with appropriate dose limit (20, 50, 100 or 500 mSv). After the emergency, the dose limits for planned corrective actions should be lower (20 or 50 mSv). Krsko NPP has a special administrative procedure how to control personal exposure in case of the accident. Main points are listed here below: Dose limits for the normal situation are applicable also in emergency situation (20 mSv effective dose). All exposure should be planned and checked that a more safe approach is not possible. Professionally exposed workers should be completely informed about emergency situation and the risk for health in case of exposure to the radiation up to 100 mSv. This limit is for example allowed to prevent the releases which might be serious threat to the population. Corrective actions with exposures over 100 mSv can be performed by volunteers but still there should be precautionary approach to check the situation and corrective action not to have another more safe result. The workers should be completely informed about health risks. Exposures over 250 mSv can be taken into account only in case of saving human lives or a larger population group. Workers should be trained if possible. For all workers in intervention groups radiological and medical control should be assured. There are also reference dose limits prescribed for electronic dosimeters for the scheduled actions (25, 50 or 250 mSv) for intervention workers.	**Borut Breznik** Slovenia
The emergency dose is a reference level, recommended as much as possible to be less than 100 mSv for Effective Dose, only for saving lives or preventing serious health injuries, avoiding high collective doses or preventing catastrophic situations. In case is not feasible 100mSv as reference level, exceptions are allowed for saving lives where the threshold values for deterministic effects shall be observed. Only volunteers are allowed to receive emergency exposures. Basis: IAEA Basic Safety Standards 115 and related safety guides.	**Marcos Amaral** Brazil
In Finland the criteria is stated in Regulatory guides (http://www.edilex.fi/stuklex/en/lainsaadanto/saannosto/YVL7-4?toc=1) -basic criteria is to limit the exposure so that *the effective dose caused to a worker by radiation work shall not exceed an average of 20 millisieverts (mSv) per year reckoned over a period of five years, nor 50 mSv in any one year.*	**Timo Kontio** Finland

-*when applying the maximum values for radiation exposure, no allowance shall be made for exposure arising from immediate measures necessary to limit the radiation hazard resulting from an accident and to bring a radiation source under control. These measures shall be arranged so that the radiation exposure resulting from the situation is limited to the least possible.* Except where the matter concerns the saving of human lives, the effective dose of a person involved in the measures referred to in this Section shall not exceed 0.5 Sv and the equivalent dose at any point on the skin shall not exceed 5 Sv. A goal shall be to limit the radiation exposure below 50 mSv. Exceptions to this are life saving operations and prompt action to bring a radiation source under control.	
SSMFS 2008:51 chapt.3 §14 Rescue work (operations) limit is 50 mSv/y, if the rescue work exceeds 50 mSv it has to be on voluntary basis. A rescue action that can lead to effective dose higher than 100 mSv can only be performed in life-saving situation and only by individuals having good knowledge about the radiation risks involved in the action. Women can only participate in such work if they can exclude pregnancy.	**Torgny Svedberg** Sweden
In France, for an intervention during a radiological emergency situation, individual exposure reference levels, defined in terms of effective dose (all doses received by internal and external exposure) are fixed by the regulation ("code de la santé publique") : - For workers of special technical intervention groups, medical or health fields, trained to cope with a radiological emergency situation (personal of group 1): the effective dose to be received during their mission is set at 100 mSv and in case of saving human lifes, the effective dose is set at 300 mSv. - For workers not belonging to special intervention groups, but intervening within their mission under their skills (personal of group 2): the effective dose to be received during their missions is set at 10 mSv. - These reference levels may be exceeded only in exceptionally circumstances to save lives but with the exception that workers are voluntary and informed of the risk of their intervention. - Workers called to intervene must be equipped with personal protective equipment and appropriate dosimeters. - In any case, the total effective dose of a worker in a lifetime shall not exceed 1 Sv.	**Laurence Millet** France
Under emergency conditions all possible efforts shall be made to keep the emergency exposures of the intervention personnel below the legal dose limit of 20 mSv. It si permitted to exceed the legal dose limit in the following situations: • saving life or preventing serious injury; • averting a large collective dose or preventing the development of catastrophic conditions. For these situations the Emergency Manager approves the dose exceeding. All resonable efforts will be made to keep doses below 100 mSv, except for life saving actions, in which the dose limit is 500 mSv . Workers who undertake actions in which the dose may exceed the maximum single year dose limit shall be volunteers and clearly and comprehensively informed in advance of the associated health risk, and shall to extend feasible, be trained in the actions that may be required.	**Vasile Simionov** Romania
Following is the dose criteria at C-1 based on BSS-115 and National Regulations a) Annual Limits i) An effective dose of 20 mSv/a, averaged over five consecutive years ii) An effective dose of 50 mSv/a in any single year in special circumstances b) Planned Special Exposures for Exceptional Situations Dose equivalent / committed dose less than 2 times of annual limits in any single event and less than 5 times of annual limits (life time) c) Abnormal Exposures in Emergencies or Accidents i) No worker undertaking an intervention shall be exposed in excess of the maximum single year dose limit. (i-e 50 mSv) ii) For life saving / intended to avert large collective dose or prevent catastrophic condition the dose shall be < ten times the maximum single year dose (i-e 500 mSv).	**Makshoof Mubbasher** Pakistan

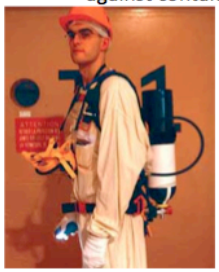
2. What are your dose management criteria for high dose/dose rate areas?

During normal operations high dose areas are so called restricted areas (Sperrbereich as stated in Strahlenschutzverordnung § 36) where access is generally prohibited, e.g. by locked doors. If there is a possibility that the dose rate of 3mSv/h can be exceeded this area has to be declared a restricted area. For restricted areas, the annual dose limits have to be taken into account for every operation in the radiation field. In Germany that limits the effective dose to 20 mSv/a for the licensed worker and 1 mSv/a for the rest (like the general public). For emergency recovery the workforce is limited to licensed worker.	**Ralph Brunner**
In Germany we have a supervised area (<6mSv/a) the control area (>6mSv/a) and an exclusion area with restricted access (>3mSv/h).	**Heinrich Harke**
We consider more than 1 mSv/h as a high dose rate area.	**Andreas Ritter**
There were 3 areas organized around the Chernobyl NPP: Pγ (dose rate) > 20 mR/h Pγ (dose rate) 5 – 20 mR/h Pγ (dose rate) 3 – 5 mR/h	**Boris Bezrukov**
Workers entering the affected areas are expected to enter via an Access Control Point where they are briefed on the expected radiological conditions. Workers would be provided with Electronic Dosemeters with dose and dose rate alarm set based upon expected radiological conditions. In the first instance the expectation is to start with lower EPD settings with increases authorized through the established chain of command - any decision to authorize doses above those allowed in normal operation has to come from the person in charge of the accident (called Emergency Controller)	**Guy Renn**
For operating conditions the plant is required to follow NRC Standard Technical Specifications Section 5.12. There are specific requirements for high (> 1 mSv/h – 10 mSv/h) and very high radiation areas (> 10 mSv/ but less than 5 Gy/h at 1 m distance). Plant has a special administrative procedure for RP technicians and RPO how to control and approve the entrance to such areas.	**Borut Breznik**
We classify the areas as follow: a) High Radiation Area: doses greater than 1 mSv/hour. Such areas shall be clearly posted, well barried, entry only with a Special Radiological Work Permit, mandatory ALARA Pre Job Briefing. b) Very High Radiation Areas: doses greater than 10 mSv/hour. Beyond the above administrative controls, those areas are locked or physically blocked, and works are allowed under a complete and formal ALARA Plan.	**Marcos Amaral**
Areas where ambient dose rate is over 1 mSv/hour classified as high dose rate areas. Such areas are locked to avoid unplanned exposures. If a work is planned in these rooms, a written ALARA-plan is required.	**Timo Kontio**
Radiation Protection Officer makes the decision if admittance is possible. RP states the necessary actions and issues Radiation Work Permit. Pre Job Briefing is a necessity. In situation with general dose rates exceeding 3 mSv/h working alone should be avoided. All high dose areas shall be locked. A radiation survey shall be performed initially and recurrent, a decision is done if online alarm instruments are required. In high radiation areas > 3 mSv/h alarm instrument shall be used in all situations. Extremity/ part body dosimeters shall be used according to special criteria.	**Torgny Svedberg**
Public: In France, intervention levels associated with the implementation of measures to protect the population in case of radiological emergency situation are specified in the regulation (“code de la santé publique”): ❖ Effective dose of 10 mSv for the safekeeping ❖ Effective dose of 50 mSv for evacuation	**Laurence Millet**

❖ Equivalent dose to the thyroid of 50 mSv for the administration of stable iodine For operational exposures (workers), the limits are: ❖ Red area: D rate > 100 mSv/h: forbidden area, this area is locked. A license from the site manager is needed ❖ Orange area: 2 mSv/h < D rate < 100 mSv/h: A license from the RP department is needed ❖ Yellow area: 25 µSv/h < D rate < 2 mSv/h: limitation of the working time duration included on the RP work permit ❖ Green area: D rate < 25 µSv/h: limitation of the working time duration included on the RP work permit	
Depending of how high are general radiation fields (gamma + neutron) radiological area is divided as follows: Normal radiation area – dose rates less than 0.1 mSv/h High radiation area – dose rates between 0.1 – 3 mSv/h Very high radiation area - dose rates between 3 – 100 mSv/h Extremely high radiation area - dose rates higher than 100 mSv/h Along dose rates increase progressive restrictions are to be followed to prevent unexpected exposures.	**Vasile Simionov**
As per Plant Technical Specifications, the High Radiation Area has dose rate greater than 0.150 mSv/hr and Very High Radiation Area with dose rate greater than 1.0 mSv/hr. For these areas, dose management is performed by ensuring Lock & Key Control, Issuance of Radiation Work Permits, Radiation Protection Qualification, Work Scheduling, ALARA Planning, Managing Dose and Dose Rate Alarms of EPD and Pre / Post Job Briefings.	**Makshoof Mubbasher**

3. What sort of protective equipment is recommended for emergency workers, especially for high dose areas?

The main focus of our protective gear is occupational safety in general and protection against personal contamination or incorporation, not so much shielding of radiation. Plastic suits and respiratory masks also protect against beta rays of course but that is not their main purpose. When it comes to shielding issues you have always to compare mobility and speed against the other aspects. If you cover the workers in lead they will perform their tasks less effective. If we had very high dose rates that cannot be avoided we would try remote operating equipment first like provided by the Kerntechnische Hilfsdienst GmbH (http://www.khgmbh.de/wEnglisch/index.php).	**Ralph Brunner**
For high contaminated areas we have protective clothes like jump suit with respirator mask, sometimes with compressed air. For protection of high dose rates nobody really has a chance for protection. We have movable absorbing walls (made from lead or steel) for protection of the workplace, but we don't have anything to carry it with you. Normally we have a well known situation and can prepare special absorbing material (walls, lead mattresses) to protect single workplaces.	**Heinrich Harke**
There are instruments to measure dose rate for high-dose rate-only-areas. If there is contamination involved, protective clothing and respirators are to be used.	**Andreas Ritter**
The following well known protective equipment is recommended: • protective respirators • protective glasses • protective clothes and shoes • protective shielding (Pb ets.) Besides that – limited working time, distance.	**Boris Bezrukov**
Several emergency locations are provided with Protective Equipment, Respiratory Protective Equipment, Dosimetry and high doserate radiation monitoring instruments. This equipment is dedicated to emergency response. We provide: ~500 TLDs dedicated to Emergency Response ~50 Electronic Personal Dosemeters dedicated to emergency response ~ 4 Telescopic Radiation doserate instruments that can measure up to 10 Gy/h. Large number (hundreds) of Self-Contained Breathing Apparatus. Large number of respirators plus iodine filters Protective Clothing for fire, water etc	**Guy Renn**
For an emergency entry to the containment in serious contaminated or steam air conditions, it is requested to use breathing apparatus (a light design with carbon fiber bottle), complete PVC suite, sealed gloves and shoe covers, electronic dosimeters, passive TLD dosimeters (plant has own ISO accredited methods for passive and electronic dosimeters). In the containment, there should be measured concentration of explosive gases before entry. In year 2011 the accreditation has been extended to OSL dosimeters. OSL dosimeters can be read or reread also elsewhere in an outside laboratory in case of an emergency situation. These laboratories are for example in other EU countries or in USA. Plant has also own manual field OSL reader.	**Borut Breznik**
For prompt response, Self Contained Breath Apparatus (SCBA). For emergency but planned works, the PPE will be according the working area conditions, in terms of contamination can be single or double protective cloths, for wet contamination can be plastic or tyvek suit, for airborne contamination can be full face piece respirator with particles filter or combined for radio-iodine and particles, for very high contamination and/or airborne contamination a suit with breathable air like “mururoa suit”. The increase for PPE´s will also affect the time spent in the high dose area, thus it should be balanced according the actual contamination risks.	**Marcos Amaral**
Prompt response: fire brigade would be the first organization to arrive on the scene. Their PPE consist of breathing apparatus and gear that	**Timo Kontio**

<table>
<tr><td colspan="2">allow entrance to hot environment.
For planned emergency works the PPE would be assigned according to the conditions: this includes respirators (full mask with radioiodine filter or in extreme conditions fresh air equipment), overalls (plastic).</td><td></td></tr>
<tr><td colspan="2">It depends on the amount of unshielded surface activity (beta) and airborne activity (aerosols, iodine, noble gases). The recommendation is to follow normal procedures as far as possible, concerning type and level of protective clothing and respiratory equipment. See tables in enclosed file "RP protection levels and equipment.ppt".</td><td>Torgny Svedberg</td></tr>
<tr><td colspan="2">The individual protective equipments recommended are those used during operation, mainly:</td><td>Laurence Millet</td></tr>
<tr><td>❖ ventilated helmet
 
❖ Full face mask with air supply (full face mask with filter are not used against contamination in operating units, due to Nitrogen hazard)
  </td><td>❖ and ventilated tight protective suits (Bubble suits).
 
❖ Tyvec suits
  </td><td></td></tr>
<tr><td colspan="2">Within the plant there are several emergency locations which are provided with Protective Equipment (browns, tyvek, plastic suits, protective suits for fire), Respiratory Protective Equipment (masks wih iodine and particles filters, SCBA, Ram's Horn), Dosimetry (TLDs and Electronic PADs) and high dose rate radiation monitoring instruments (gamma meters, contamination meters, air sampling pumps) . This equipment is dedicated only for emergency response.</td><td>Vasile Simionov</td></tr>
<tr><td colspan="2">Masks of different specifications for protection from internal contamination, respirators, lead gloves and lead aprons in very high dose rate areas and paper suits are provided to radiation workers.</td><td>Makshoof Mubbasher</td></tr>
</table>

4. What is recommended for individual monitoring for this type of work?

There is no difference to normal operations. Everyone will be equipped with a legal personal dosimeter (passive, up to 10000 mSv personal dose), an electronic personal dosimeter (max. dose rate of 1000 mSv/h and max. personal dose of 10000 mSv) and depending on the type of task to perform we issue neutron dosimeter, finger ring etc. For higher dose rates we use remote monitoring of the electronic dosimeters.	**Ralph Brunner**
Our workers have to wear some dosimeters for instant knowledge of the dose rate. Film dosimeter, an electronic device with dose rate alarm and sometimes additional dosimeters (e.g. TLD) on the finger tips, the head or other organs in very special, well known surroundings.	**Heinrich Harke**
TLD and electronic dosimeter for each individual.	**Andreas Ritter**
• Individual external dose exposure (with individual TLD or Digital dosimeters) • Individual surface contamination • Individual internal dose exposure with Whole body counter (periodically) • Control of leukocytes quantity in blood after some difficult situation	**Boris Bezrukov**
All workers entering the affected area are provided with a passive dosimeter (TLD) and an electronic personal dosimeter.	**Guy Renn**
It is important to assess and measure dose rate and air contamination conditions before entry to high radiation areas. First entry is therefore scheduled to be by RP technician or his supervisor. Beta and gamma dose rate should be known in the area. In case of unknown radioactive source distribution, it would be suggested to cover the body and extremities of the worker with more OSL dosimeters to get enough information for proper dose evaluation. Just testing teledosimetry to be used next year at the plant. These electronic features are not any more expensive and there are also user friendly designs (for example: MGP Mirion with computer software or stand-alone Saphymo). It would be suggested to equip the workers with teledosimetry, radio link.	**Borut Breznik**
Use of remote monitoring devices, like teledosimetry, video coverage, radio communication and real time supervision of a senior RP officer. Alarming dosimeters shall be used, and a suitable dosimeter for high doses. Also, extremity dosimeters and/or multiple dosimeters may be recommended.	**Marcos Amaral**
All actions should be planned in advance, meaning that there will be RP coverage at all times. To monitor radiation exposure, those participating in accident restriction must carry a dosimeter which reliably records the dose incurred (TLD) and also a real-time electronic alarming dosimeter. Extremity dosimeters may be assigned according to the task at hand.	**Timo Kontio**
Normal procedures as far as possible (TLD (Lithium Fluoride and Lithium Borate) and EPD (MGP)). The amounts of dosimeters and positions have to be depending on each situation. In cases with heavy ground contamination foot and hand dosimeters would be used.	**Torgny Svedberg**
Gamma direct reading dosimeters with a dose range of 0.001 mSv to 8 Sv. Gamma film badges with a dose range of 0.1 mSv to 10 Sv. Neutron film badges with a dose range of 0.10 mSv to 250 mSv.	**Laurence Millet**
All workers entering the affected area are provided with a passive dosimeter (TLD) and an electronic personal alarming dosimeter. If it is the case, extremity passive dosimeters needs to be used.	**Vasile Simionov**
For individual monitoring Electronic Pocket Dosimeters, Thermo-luminescence Dosimeters, Extremity Dosimeters and External Whole Body Contamination Monitors are used.	**Makshoof Mubbasher**

5. Do you have any special requirement for assessment of this kind of dosimeters, in particular in terms of the need, or not, for specific high-dose algorithms for converting passive dosimeter measurements into mSv?

Not to my knowledge, but our passive dosimeters are issued by the state owned dosimetry service, an independent third party that also does the assessment. Use of electronic personal dosimeters, measure up to higher max. dose rate of 15000mSv/h.	**Ralph Brunner**
Due to decommissioning stage of the plant, we don't really have high dose rates any more. Our electronic dosimeters (Mirion MGP™ DMC2000) are working from 50nSv/h until 1Sv/h.	**Heinrich Harke**
The passive dosimeters (TLD) are good to use up to 5 Sv. They are processed under standard procedures.	**Andreas Ritter**
This transmitting coefficient lies from 1.10 up to 0.86 for gamma ray energy between 0.15 MeV and 3.0 MeV. My opinion is not take this coefficient into account.	**Boris Bezrukov**
It is a requirement of UK regulations that any dosemeters provided for emergency response are tested to prove that they are capable of performing when exposed to high dose/dose rates. There are specific performance requirements for emergency dosemeters specified by the UK regulator. Any dosimetry service must meet these criteria in order that the dosimetry service can be authorized to provide emergency dosemeters.	**Guy Renn**
Landauer OSL dosimeter features and reading procedure has algorithms for detecting all relevant radiation energies and to report deep and shallow dose for beta/gamma. Neutron dose is also a part of the report. Upper dose range is 10 Sv. TLD dosimeters have been accredited up to 4 Sv (Hp(10) and can measure also skin dose. In the year 2011 the change is scheduled - all the workers will be equipped with OSL dosimeters	**Borut Breznik**
The passive dosimeter that we use are Panasonic TLD UD-802 for beta-gamma and UD-809 for neutron, used in conjunction with a designed algorithm which cover a broad range from very low doses until doses as high as 10 Sv.	**Marcos Amaral**
Our TLD's respond according to the table below. Energia-alue [MeV] | Annosalue [mSv] Fotonisäteily Hp(10) ja Hp(0,07) | 0,080 - 3,0 | 0,1 - 1000 Beetasäteily Hp(0,07) | 0,5 - 3,0 | 0,1 - 1000 Neutronisäteily Hp(10) | 0 - 1,0 | 0,2 - 1000 Electronic dosimeters: 50 keV-6MeV & 0,001 mSv - 10 Sv Extremity dosimeters: Personal dose equivalent Hp(d)* energy range 1 mSv-10Sv	**Timo Kontio**
No, the TLD has enough linearity up to more than 100 mSv, for expected photon energies. The combination TLD and EPD (MGP DMC 2000 S) gives a robust and diversified approach.	**Torgny Svedberg**
We performed compliance tests of our dosimeters compared with current standards.	**Laurence Millet**
<u>Panasonic Model UD-802 Dosimeters</u> Application The Panasonic UD-802 TLD can be used for personnel whole body monitoring, personnel extremity monitoring, area monitoring, and environmental monitoring. The UD-802 TLD is capable of assessing deep dose equivalent (DDE), neutron dose, lens dose equivalent (LDE), and shallow dose equivalent (SDE) to the whole body and extremities. Dosimeter Characteristics Energy response: 10 keV to 10 MeV. Humidity: Li2B4O7: Cu elements are affected by moisture and humidity. Reproducibility: Li2B4O7: Cu +/- 5%, CaSO4 :Tm +/- 2.5%. Cannot re-read dosimeter to verify dose. Fading: <5%/quarter.	**Richard LaBurn** Fermi RPM- US

Detectable Dose: 0.01mSv to 10 Sv. Reuse: TLD can be annealed and reused. Cannot re-read dosimeter to verify dose following initial read. Daily readout: Dosimeter would need to be processed (zeroed out) daily to track daily dose. <u>OSL Dosimeters</u> Application The InLight Basic OSLN dosimeter is designed for personnel whole body monitoring. The OSLN is capable of assessing deep dose equivalent (DDE), neutron dose, lens dose equivalent (LDE), and shallow dose equivalent (SDE). Dosimeter Characteristics Energy response: Beta: 227 keV to 761 keV E-ave Photons: 16 keV to 1250 keV Neutron: 40 keV to 5000 keV Humidity: Aluminum oxide material and the OSL analytical process are not affected by humidity. Reproducibility: The stimulation and analysis of the emitted light can be done repeatedly to verify a radiation exposure or to accumulate a total dose over time. The typical depletion per read for OSL material is less than 0.4%. Fading: <2%/quarter. Detectable Dose: 0.01mSv to 10 Sv. Reuse: OSL dosimeter can be annealed and reused. Daily readout: Dosimeter can be read with microStar reader to obtain daily estimate of dose of record. Recommendation: Use OSLN dosimeter as primary dose of record. The OSLN dosimeters can be readily processed as needed (each entry, daily, weekly) with microStar reader to obtain an up to date estimate of dose of record. Use ED as secondary dosimeter for daily estimate of deep dose equivalent (DDE).	
The passive dosimeters that we use are Panasonic insensitive neutron TLD UD-814AS9 for beta-gamma. They are designed and tested for linearity in the doses range between 0.5mSv and 10Sv. Electronic dosimeters (MGP DMC 2000S): 0.001 mSv – 10 Sv; 0.0001 mSv/h – 10 Sv/h	**Vasile Simionov**
For conversion of passive measurement (TLD Counts) into mSv, C-1 has an algorithms / procedure.	**Makshoof Mubbasher**

ANNEXE 2. ERPAN SURVEY

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Question:

As a follow up to the Fukushima accident the European ALARA Network (EAN) has requested ERPAN to undertake a small survey on the guidance for emergency worker exposures in the different EAN member countries. Therefore I would be grateful if you could provide the following information for your country:

1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

2. Does the legislation include:
- *i. Explicit numerical values*
- *ii. Statements on optimisation*

3. What does the legislation say (please supply a short summary) ?

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

Belgium

Contact Person
Simon Coenen
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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?
Yes, a directive issued by the FANC (= nuclear regulator) of 17th of Oct 2003 stipulates the related doses (see point 3 for details)

2. Does the legislation include:
    i. Explicit numerical values
Yes, see point 3 for details

    ii. Statements on optimisation
Yes, see point 3 for details

3. What does the legislation say (please supply a short summary).

The legislation (see directive of FANC from 17/10/2003 attached in annex, and articles 2, 20.2, 72.3 and 72.4 of the Royal Decree of 20/07/2001 on radiation protection and the Royal Decree of 17/10/2003 on nuclear emergency planning) provides the following information

a. Definition of Emergency Workers : i.e. personnel of emergency service implied in saving people or protecting material interests (like fire brigade, police, medical services, …) as well as personnel of supporting services (e.g. people from measurement teams, people from requested transport companies,…) . These emergency workers have to volunteer for the intervention and have to be informed prior to the intervention. They are considered as radiation workers after the intervention.

b. Definition of Emergency Situation : each situation which requires urgent protection measures and where the dose limits for members of the public could be exceeded

c. Dose guidelines, depending of the type of emergency action

    i. Urgent actions for life saving purposes or to avoid catastrophic conditions :
        1. Strive for a maximum level of 250 mSv; if possible use multiple persons (rotation) to achieve maximum doses levels of 50 mSv/person
        2. To do everything to not exceed a dose level of 500 mSv (5 Sv to skin): this level is only tolerated for life saving actions and only if the person confirms a second time to volunteer for the intervention

    ii. Other urgent actions
        1. Strive for respecting the dose limits of radiation workers
        2. If sufficiently justified, a total dose of up to 250 mSv is tolerated

d. Guidance for the protection of the population (See point 4)

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

a. All references to legal documents are available (only in Dutch or French) at: http://www.jurion.fanc.fgov.be/jurdb-consult/

b. Intervention guideline levels have been developed

i. Sheltering : effective dose (24 h) of 5-15 mSv

ii. Intake of stable iodine : 10-50 mSv for children; 50 – 100 mSv for adults (equivalent thyroid dose)

iii. Evacuation : 50-150 mSv (7 days effective dose)

France

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1.- Is there a reference to doses for emergency workers included in your national radiation protection legislation?
Yes

2.- Does the legislation include:

i. Explicit numerical values: yes
ii. Statements on optimisation: yes

3.- What does the legislation say (please supply a short summary).

The reference exposure levels for persons intervening in a radiological emergency situation are defined in the Public Health Code (Articles R. 1333-84 and 86). Two groups of response personnel are defined:

- the first group comprises the personnel making up the special technical or medical response teams set up to deal with a radiological emergency. These personnel benefit from radiological surveillance, a medical aptitude check-up, special training and equipment appropriate to the nature of the radiological risk.
- the second group comprises personnel who are not members of the special response teams but who are called in on the basis of their expertise. They are given appropriate information.

The reference individual exposure levels for the participants, expressed in terms of effective dose, is set as follows:

- the effective dose which may be received by personnel in group 1 is 100 mSv. It is set at 300 millisieverts when the intervention measure is aimed at protecting other people.
- the effective dose which may be received by personnel in group 2 is 10 millisieverts. In exceptional circumstances, volunteers informed of the risks involved in their acts may exceed the reference levels, in order to save human life.

In no case must the cumulative effective dose over the lifetime of an intervening person exceed 1 Sv.

Regarding reference to optimisation: Article L. 1333-1 of the Public Health Code states that: “Human exposure to ionising radiations as a result of a nuclear activity or medical procedure must be kept as low as reasonably achievable, given current technology, economic and social factors and, as applicable, the medical purpose involved.” .

4.- In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

http://www.asn.fr/index.php/S-informer/Publications/Guides-pour-les-professionnels/Situation-d-urgence/Guide-national-d-intervention-medicale-en-cas-d-evenement-nucleaire-ou-radiologique

In the framework of CODIRPA Programme (Steering Committee on post-accidental management), a working group has produced guidelines for those people intervening in the post-accidental phase of a nuclear accident. You will find a ling to GT "Intervenants" here:

http://www.asn.fr/index.php/S-informer/Dossiers/Gestion-post-accidentelle2/Comite-directeur-gestion-de-phase-post-accidentelle/Synthese-et-rapport-de-chaque-groupe-de-travail

Germany

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

In the German Radiation Protection Ordinance (RPO) there is a differentiation between exposure limits for occupationally exposed workers and intervention personnel (article 55 and 59)

2. Does the legislation include:

i. explicit numerical values

a) occupationally exposed workers: dose limit for effective dose 20 mSv per year and 400 mSv for the whole life
b) intervention personnel: 100 mSv in one year, 250 mSv once in a lifetime

ii. Statements on optimisation

There is a general article (article 6) in our RPO dealing with the necessity of avoiding unneccessary expositions and minimizing doses

3. What does the legislation say (please supply a short summary).

Here is a short translation of the corresponding legal text

Article 6 prevention of unnecessary radiation exposure
(1) Someone who plans or runs a practice according to article 2 RPO, is obliged to avoid all unnecessary radiation exposure or contamination of humans and the environment.

(2) Someone who plans or runs a practice according to article 2 RPO, is obliged to keep all radiation exposure or contamination of humans and the environment as low as reasonably achievable considering the state-of-the-art of science and technology and taking into account all circumstances of the particular case, even below the limit values.

Article 59 - Radiation exposure in case of endangerment of persons and assistance after accident
(1) During measures for associated with the defence against nuclear hazards to humans it is to be aimed that an effective dose of more than 100 Millisievert occurs only once per year and an effective dose of more than 250 Millisievert only once per lifetime.

(2) The rescue measures may only be carried out by volunteers over 18 years who have been informed before about the dangers of these measures.
(3) The individual dose of a person assigned to rescue measures has to be determined taking into account the exposure conditions. The rescue measures and the determined individual doses of all assigned persons have to be reported to the competent authority immediately. The radiation exposure according to number 1 has to be included in sum of the effective doses achieved over all calendar years.

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ∑.). Please provide a copy of this guidance or link

There is a regulation for the fire service ("Feuerwehr-Dienstvorschrift 500), that includes several guidance values for different scenarios (see also appendix, page 46):

- protection of material assets: 15 mSv per mission
- danger defence for persons: 100 mSv per mission and year
- rescue of human lives: 250 mSv per mission and lifetime

Ref: Feuerwehr-Dienstvorschrift FwDV 500 - “Einheiten im ABC – Einsatz” , 2003

Greece

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Regarding the reference doses to emergency workers, the Greek Radiation Protection Regulations (RPR) consider emergency worker exposures as specially authorized exposures.

The relative reference doses are defined in paragraph 1.2.3 of the RPR as follows:

“Paragraph 1.2.3

b) The dose constraints or committed doses received during specially authorized exposures shall be determined by GAEC and may not in any year exceed twice the annual dose limits laid down in paragraphs 1.2.1 and 1.2.2, and, in a lifetime, five times those dose limits.

c) Specially authorized exposures shall not be permitted:

i. if, during the previous 12 months the worker has received an exposure giving rise to doses in excess of the annual dose limits laid down in paragraphs 1.2.1 and 1.2.2;

ii. if the worker has previously received accidental or emergency exposures giving rise to doses the sum of which exceeds five times the annual dose limits laid down in paragraphs 1.2.1 and 1.2.2;”

Additionally, the relative paragraphs 1.2.1 and 1.2.2 state:

“1.2.1. Whole body exposure

a) The limit on effective dose for exposed workers shall be 20 mSv in any single year and 100 mSv in a consecutive five-year period.

b) In exceptional cases, the effective dose during any single year may amount to 50 mSv, provided that in the preceding five consecutive years, including the current year, the effective dose had not exceeded 100 mSv …"

"1.2.2. Without prejudice to paragraph 1.2.1, the limit on equivalent dose for the lens of the eye shall be 150 mSv in a year.

The limit on equivalent dose for the skin shall be 500 mSv in a year. This limit shall apply to the dose averaged over any area of 1 cm2, regardless of the skin area exposed.

The limit on equivalent dose for the hands, forearms, feet and ankles shall be 500 mSv in a year."

Finally, in addition to the aforementioned legislation, there is the GAEC's internal emergency response plan which includes specific guidelines for the optimization of the relative intervention procedures. However, at the moment there is no available translation of the document in English.

Ireland

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

Yes. There is reference to the establishment of doses.

2. Does the legislation include:
i. Explicit numerical values
ii. Statements on optimisation

i. No explicit numerical values for emergency dose limits given in legislation.
ii. Yes – includes reference to optimisation.

3. What does the legislation say (please supply a short summary).

RPII (national RP authority) will set maximum emergency dose limits for workers involved in intervention (including indicating types of situations where emergency interventions might apply). These maximum emergency dose limits may only be exceeded where emergency worker is saving lives and is an informed volunteer. The form, scale and duration of the intervention shall be optimised so that the benefits of the reduction in health detriment less the detriment associated with the intervention, will be maximised.

http://www.irishstatutebook.ie/2000/en/si/0125.html#partviii-sec39

Emergency Occupational Exposure

39. (1) The Institute shall prepare and publish guidelines with regard to the maximum level of doses, in excess of those specified in Schedule 2. workers or other persons involved in taking intervention measures ought to be exposed to in taking such measures.

(2) In preparing such guidelines, the Institute shall take account of the technical obligations and health risks associated with the intervention concerned.

(3) An exposure of a worker or other person referred to in paragraph (1) to a dose in excess of the limits indicated in the guidelines prepared under that paragraph may be permitted to save human lives but only if he or she volunteers for such exposure having been fully informed about the risks concerned.

(4) Any person responsible for the organisation of intervention measures shall provide radiological monitoring and medical surveillance for those involved in the taking of the measures.

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

Yes – some guidance is given in a multi-agency protocol on response to radiological emergencies: http://www.mem.ie/memdocuments/a%20protocol%20for%20multi-agency%20response%20to%20radiological-nuclear%20emergencies.pdf

Specific guidance for fire fighters is also currently being drafted by National Directorate for Fire and Emergency Management, but hasn't been published yet.

Luxembourg

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We have a small article on emergency exposure in our regulatory act on radiation protection. It is restricted to volunteers with an annual limit of 50mSv (250 mSv in case of saving life). I add you the exact text in French.

Art. 5.1.8. - Expositions accidentelles et expositions d'urgence des travailleurs
1. Une exposition accidentelle est une exposition de caractère fortuit et involontaire entraînant le dépassement de l'une des limites de dose fixées pour les personnes professionnellement exposées.

2. Une exposition d'urgence est une exposition justifiée dans des conditions anormales pour porter assistance à des individus en danger, prévenir l'exposition d'un grand nombre de personnes ou sauver une installation de valeur, qui entraîne le dépassement de l'une des limites de dose fixées pour les personnes professionnellement exposées, les limites fixées pour les expositions exceptionnelles concertées pouvant également être dépassées. Seuls des volontaires peuvent être soumis à de telles expositions.

3. La dose efficace pour les volontaires soumis à des expositions d'urgence est limitée à 50 mSv accumulée dans une année. S'il s'agit de sauver des vies humaines, cette limite est portée à 250 mSv. Ces doses sont enregistrées dans le dossier médical visé à l'article 9.1.2., ainsi que dans le dossier individuel établi par le registre national de dosimétrie centralisée visé à l'article 6.5.3.

4. Toute exposition accidentelle ou d'urgence doit être communiquée immédiatement à la division de la radioprotection et à l'inspection du Travail et des Mines. D'autre part, les dispositions du chapitre 9 sont d'application.

Malta

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

Yes: Legal notice 44 of 2003, Nuclear Safety and Radiation Protection regulations Reg 58(1) & Schedule 7

2. Does the legislation include:
i. Explicit numerical values
Yes Schedule 7 of Legal notice 44 of 2003

ii. Statements on optimisation
No specific statement of optimisation for emergency workers

3. What does the legislation say (please supply a short summary).

Legal notice 44 of 2003 states that:

58. (1) The Board (ie regulatory authority) shall establish exposure levels, taking into account the technical obligations and health risks, for situations where workers or intervention personnel involved in different kinds of intervention are liable to be subjected to emergency exposure resulting in doses in excess of the occupational dose limits for exposed workers. These levels are given in Schedule 7 and shall serve as operational guides and,

SCHEDULE 7
Protection of workers undertaking intervention

(1) No worker undertaking an intervention shall be exposed in excess of the maximum single year dose limit for occupational exposure specified in Schedule 3 except:
(a) For the purpose of saving life or preventing serious injury; or
(b) If undertaking actions to prevent the development of catastrophic conditions.

When undertaking intervention under these circumstances, all reasonable efforts shall be made to keep doses to workers below twice the maximum single dose year limit, except for life saving actions, in which every effort shall be made to keep doses below ten times the maximum single dose year limit, in order to avoid deterministic effects on health. In addition, workers undertaking actions in which their doses may approach or exceed ten times the maximum single dose year limit shall do so only when the benefits to others clearly outweigh their own risk.

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link.

No

Norway

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?
Yes.

2. Does the legislation include:
i. Explicit numerical values
Yes.

ii. Statements on optimisation
Yes.

3. What does the legislation say (please supply a short summary).

Rescue work in emergency situations shall as far as possible be carried out within the upper dose limits for occupationally exposed employees. If the work may entail doses in excess of 50 mSv, the work shall be carried out by volunteers who are fully informed about the risk faced and the dangers involved. Women of fertile age may only participate provided they are not pregnant. Exceeding this limit can only be accepted in order to save lives, avert serious damage to health or prevent a dramatic escalation of the accident. Radiation doses above 500 mSv shall as far as possible be avoided.

General provison regarding justification and optimisation:

"All use of radiation shall be justified. In order for radiation to be justified, the benefits of the radiation use shall outweigh the radiation detriments. Moreover, the radiation shall be optimised; i.e the radiation exposure shall be kept as low as reasonably achievable, taking into account social and economic factors (the ALARA principle)."

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ∑.). Please provide a copy of this guidance or link

There is a nordic guideline:
http://www.nrpa.no/dav/a0d1078002.pdf

But please note that this document is under revision.

Slovenia

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

Yes (articles 39 and 40 of the Decree on dose limits, radioactive contamination and intervention levels, Off. Gazette, Republic of Slovenia, No. 49/2004, see below).

2. Does the legislation include:

i. Explicit numerical values?
Yes.

ii. Statements on optimisation?
Yes (article 4, paragraph 3 of the Ionising Radiation Protection and Nuclear safety Act, Off. Gazette, Republic of Slovenia, No.102/2004-consolidated text).

3. What does the legislation say (please supply a short summary).

Act: Article 4 (the principles)
(1) ...
(2) The use of a new type or method of practice, which causes exposure of people and every intervention measure has to be pre-justified with respect to its economic, social and other effects compared to the potential health detriment to people due to exposure caused by such practice (the justification principle).
(3) Every radiation practice must be allowed to cause exposure only up to level as low as achievable with reasonable measures, taking into account economic and social factors (the principle of the radiation protection optimisation). This principle shall also apply to the planning of intervention measures so that exposure during an intervention measure is compared to the benefits of the measure, that is to the reduction of detriment caused by an emergency.
(4) Carrying out a radiation practice or practices involving exposure due to the presence of natural radiation sources exceeds dose limits for members of the public, the exposure of workers, apprentices, students and members of the public must be reduced in such a way that the sum of the doses received due to the carrying out of all the possible radiation practices does not exceed the dose limits set on the basis of this Act (the dose limits principle).
(5) ...

Decree: In articles 39 and 40 the same numerical values are cited as in IAEA TECDOC 955 (pages 135 and 82). The first table in the attached file contains dose limits and the second one contains operational interventional levels based on personal electronic dosimeter readings.

Table 1 . Dose limits

TASKS	E_T^{WG} [mSv]
Type 1: ▶ Life saving actions ▶ Prevention of core damage or given core damage to prevention of a large release.	>500 (a)
Type 2: ▶ Prevent serious injury ▶ Avert a large collective dose ▶ Prevent the development of catastrophic conditions ▶ Recovery of reactor safety systems ▶ Off-site ambient dose rate monitoring (gamma dose rate)	< 100
Type 3: ▶ Short term recovery operations ▶ Implement urgent protective actions ▶ Environmental sampling	< 50
Type 4: ▶ Longer term recovery operations ▶ Work not directly connected with an accident	Occupational exposure guidance (IAEA96)

Source: IAEA96

(a) These dose can be exceeded if justified BUT every effort shall be made to keep dose below this level and certainly below the thresholds for deterministic effects. The workers should be trained on radiation protection and understand the risk they face.

Table 2. Operational interventional levels based on personal electronic dosimeter readings

TASKS	EWG [mSv]
Type 1: ▶ Life saving actions ▶ Prevention of core damage or given core damage to prevention of a large release.	>250 (a,b)
Type 2: ▶ Prevent serious injury ▶ Avert a large collective dose ▶ Prevent the development of catastrophic conditions ▶ Recovery of reactor safety systems ▶ Off-site ambient dose rate monitoring (gamma dose rate)	< 50 (a)
Type 3: ▶ Short term recovery operations ▶ Implement urgent protective actions ▶ Environmental sampling	< 25 (a)
Type 4: ▶ Longer term recovery operations ▶ Work not directly connected with an accident	Occupational exposure guidance (IAEA96)

(a) It is supposed that thyroid blocking was taken before exposure. If no thyroid blocking is provided divide EWG by 5, if respiratory protection is provided or there is no airborne release multiply EWG by 2. Workers must be volunteers and be instructed on the potential consequences of exposure.

(b) These dose can be exceeded if justified BUT every effort shall be made to keep dose below this level (thresholds for deterministic effects). The workers should be trained on radiation protection and understand the risk they face.

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

See IAEA TECDOC 955: http://www-pub.iaea.org/MTCD/publications/PDF/te_955_prn.pdf

Sweden

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1. Is there a reference to doses for emergency workers included in your national radiation protection legislation?

Yes

2. Does the legislation include:

i. Explicit numerical values

Yes, see below

ii. Statements on optimisation

There is a general requirement on optimisation in our regulations on dose limitation etc. However not so clear and explicit on emergencies for the moment.

3. What does the legislation say (please supply a short summary).

This is one paragraph from our regulations on dose limits from year 1998:

Emergency exposure
Section 14 In connection with rescue work in emergency situations, the dose limits stipulated in these regulations do not apply.

Such rescue work must be performed only by volunteers if the effective dose from this work is estimated to exceed the annual limit (50 mSv).

Women of reproductive capacity may participate in rescue work only if they personally can rule out the possibility of their own pregnancy.<

Rescue work that implies an effective dose greater than 100 mSv must only be carried out for the purpose of saving lives by persons

4. In addition to this legislation, is there other dose guidance available (i.e. in emergency plans, intervention protocols of emergency services, ….). Please provide a copy of this guidance or link

No