# Management at County Dolj Level in Case of a Nuclear Accident

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**Abstract**

**The intervention in a nuclear accident should do more good than harm, i.e. the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including social costs, of the intervention ( justification of intervention ) .The form, scale and duration of the intervention should be optimized so that the benefit of the reduction of dose, i.e. the benefit of the reduction in radiation detriment, less the detriment associated with the intervention, should be maximized ( optimization of protection ). The study attempts at optimizing the informational influx at county Dolj level in order to shorten the reaction time of those implied in interventions in case of a nuclear accident at Kozloduy NPP (Nuclear Power Plant), which would affect Romania.**

**Key words: nuclear accident, intervention.**

The challenges of the new epoch have determined most of the states to re-evaluate their nuclear safety, taking into account the new way of defining threats that might seriously affect the health of population and their national interests.

Kozloduy Nuclear Plant it began operating in 1974 and has 6 reactors made in Russia: units 1 to 4 are VVR 440 reactors and units 5 and 6 are VVR 1000. The Plant uses as fuel enriched uranium. At present there are 2 reactors functioning, two of 1000MW. NPP Kozloduy is situated near Dolj county on the other site of the Danube [8 ].

The International Nuclear Event Scale (INES) was introduced by the **International Atomic Energy Agency (IAEA)** and the **Nuclear Energy Agency (NEA)** of the Organization for Economic Cooperation and Development (OECD) in 1990 as a tool to communicate the safety significance of reported events at nuclear installations or involving nuclear materials to the international community. The INES consists of a **7-level event** classification system. Events of greater safety significance (levels 4-7) are termed **„accidents“,** events of lesser safety significance (levels 1-3) are termed **„incidents“** and events of no safety significance (level 0 or below scale) are termed **„out-of-scale deviations“** [9, 12].

The legal basis for emergency response in Romania is made by:

*A. Special legislation for emergency response:*

- The Law no.111/1996 reduplicated about safety made of the nuclear activities

- The Order of the Administration and Intern Affaires Ministry no. 683/2005 for approval of Generic procedures for gathering dates, validation and response in a radiological emergency.

- The Order of the Administration and Intern Affaires Ministry no. 684/2005 for approval of Methodological standards about plannIng, preparation and intervention in nuclear accident or radiological emergency.

- The Order of the Heath and Family Ministry , by Agriculture, Alimentation and Forrest Ministry and by the president of the National Commission for Controlling Nuclear Activities no.856/112/91/2002 for approval of standards about foods and fodders radioactive contaminated after on nuclear accident or other radiologicall emergency.

*B. International agreements and recommendations*

In the emergency situations the definitions used in the structure of an emergency plan are:

1. Emergency – A non-routine situation or event that necessitates prompt action, primarly to

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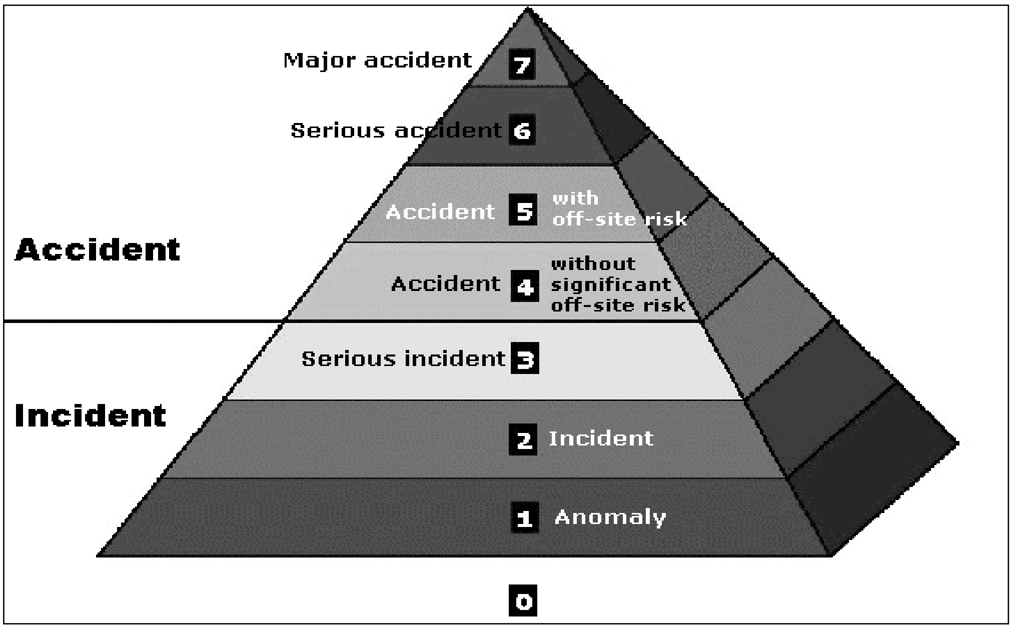



*Figure no. 1. INES Scale*

mitigate hazard or adverse consequences from human health and safety/ security, quality of life, property or the envinronment; it includes situation, like a nuclear accidents, for wich prompt action is warranted to mitigate the effects of a perceived hazard [10].

2. Radioactive contamination – the contamination of any material, surface envinronment or personn with radioactive substances. In case of the human body, the radioactive contamination include the external contamination an the skin and the internal contamination. [ 5 ]

3. Dose rate – the rate of exposure to ionizing radiation in terms: absorbed dose or equivalent dose in Gy/h, respectively Sv/h [5].

4. Decontamination – the removal of the radioactive contamination [5].

5. Exposure – the process to be irradiated or exposed to radiation, with potential consequence of un absorbed dose [5].

6. Intervention - any action intendet to reduce or avert exposure to sources wich are not part of a controlled practice or wich are out of control as a consequence of an accident [5, 9].

7. Incorporation – the internal contamination of the human body by ingestion, inhalation or skin/ wounds penetration .

8. Monitorisation – the periodic or continuous analysis of the radiation levels in some area.

The responsabilities of the central and local authorities in case of an nuclear accident are:

1. At national level, the minister of the Administration and Intern Affaires, in his position of president of the Ministerial Committee for Emergency Situations, is the coordinator of the protective activities for population and environmental factors, and for implementing the measures which are necessary in case of a nuclear accident [3, 5].

2. At county level, the prefect of Dolj County, in his position of president of the County Committee for Emergency Situations, is the coordinator of the protective activities for population and environmental factors, and for implementing the measures which are necessary in case of a nuclear accident [3, 5].

3. At local level, the maire, in his position of president of the Local Committee for Emergency Situations (CLSU), is the coordinator of the protective activities for population in case of a nuclear accident [3, 5].

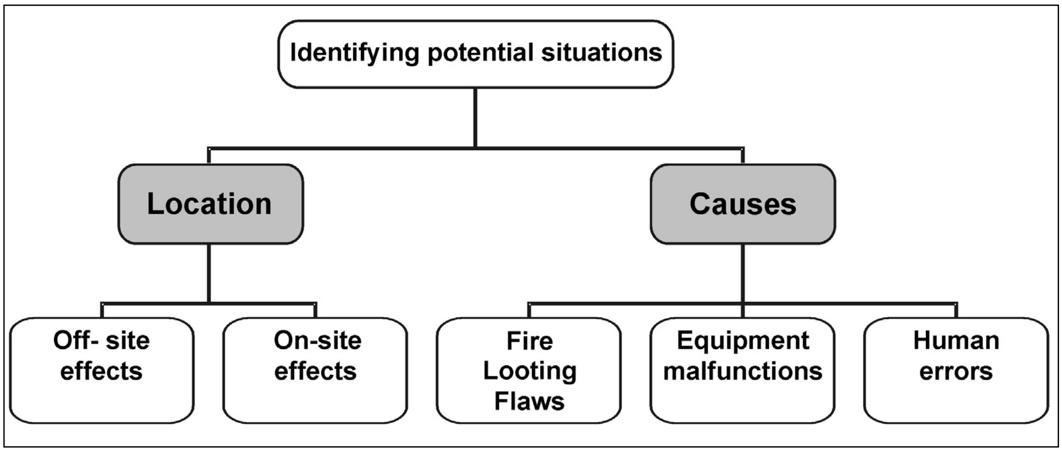
4. The Laboratory of Ionizing Radiation Hygiene from the Authority of Public Health Dolj is part in the County Emergency Plan in case of a nuclear accident at NPP Kozloduy.

The Chief Physician of the lab is the main coordinator of the plan.

We have 3 interventional teams:

- 1 team of dosimetry made of 2 physicians and 1 nurse – in the field of dosimetric instruments.
- 2 radiochemistry and spectrometry teams inside the laboratory composed of 2 physicists, 1 chemist and 1 laboratory nurse.

We have measurement instruments for dosimetry, spectrometry (type: INSPECTOR, VICTOREEN, EURISYS MESURES etc) and one mobile laboratory for the field team *(Schema no. 2).*




*Schema no. 1. The Phases of the intervention beginning*

The objectives of the emergency plan are:

- Avoids/reduces exposure and its consequences
- Protects the population (enabling people to help themselves)
- Protects the emergency staff
- Protects the environment
- Facilitates the recovery
- Integrates the radiological response into the general emergency response system
- Plans for all kinds of events and for international cooperation

The following time phase can be considered for the purpose of planning intervention for a radiological emergency: a pre – release phase, a release phase and a post – release phase. The pre-release phase is that period from the time when potential or actual accident exposure is recognised, to the time when significant amounts of radioactive material are released or the source is brought under control. During this phase and in the first few hours of the release phase, urgent decision on measures to avert doses to the public and workers is necessary. Initial results of environmental monitoring are unlikely to be avaible to aid decisions and the prediction of future developments may be subject to substantial uncertainness. For this reason, emergency response plan need to include procedures for implementing protective measures which are based on information about the condition of the facility, any measurement of released material and meteorological condition and the possible pathways for exposure [9, 11].

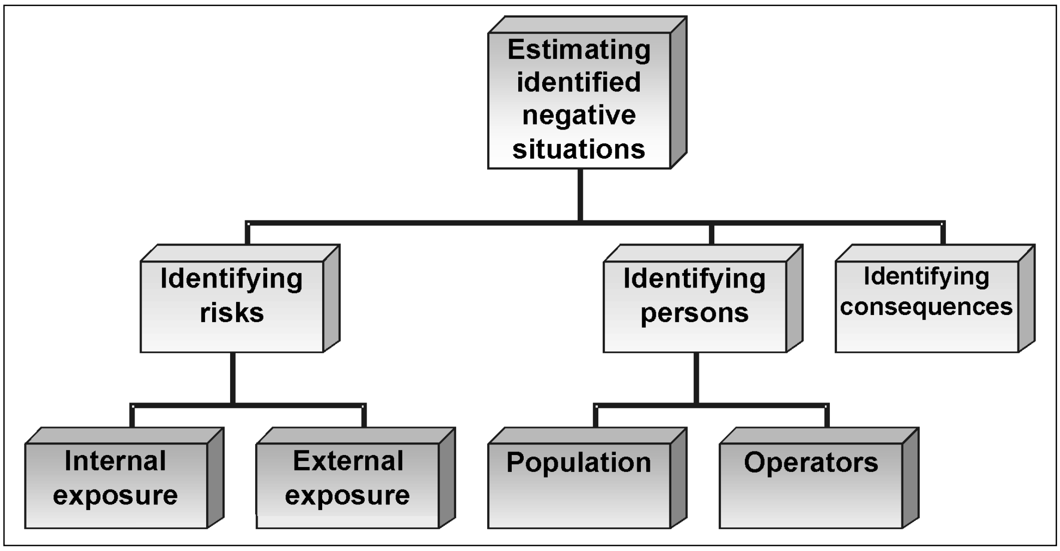
The management of radiological response require covering same steps like this:

*A. Notification*

Step 1 – to obtain information about nuclear emergency response initiator, emergency manager or local coordinator.

Step 2 – using Recording Accident Form and the dates about the risk, for achieving the first evaluation of nuclear emergency.

Step 3 – to establish communications with the emergency manager and with the accident local




*Scheme no. 2. The emergency plan*

leader. To send recommendations to the emergency manager and to the accident site leader about protective actions and about avoiding possible expansion of the contamination.

Step 4 – to prepare the measurement equipments and the protective equipments, in keeping with the nature of the expected risk.

Step 5 – to decide the personnel protective measures .

Step 6 – to train the response teams about personnel protection. To inform the emergency manager about this.

Step 7 – to establish exposure control for the people involved in the intervention.

Step 8 – to activate the radiological evaluator teams. To inform the teams about the present radiological situation, about the protective actions for interventional teams and the guidance of return. To give the intervention order to the site accident teams.

*B. At the accident place*

Step 9 – to inform the intervention coordinator about the event evolution.

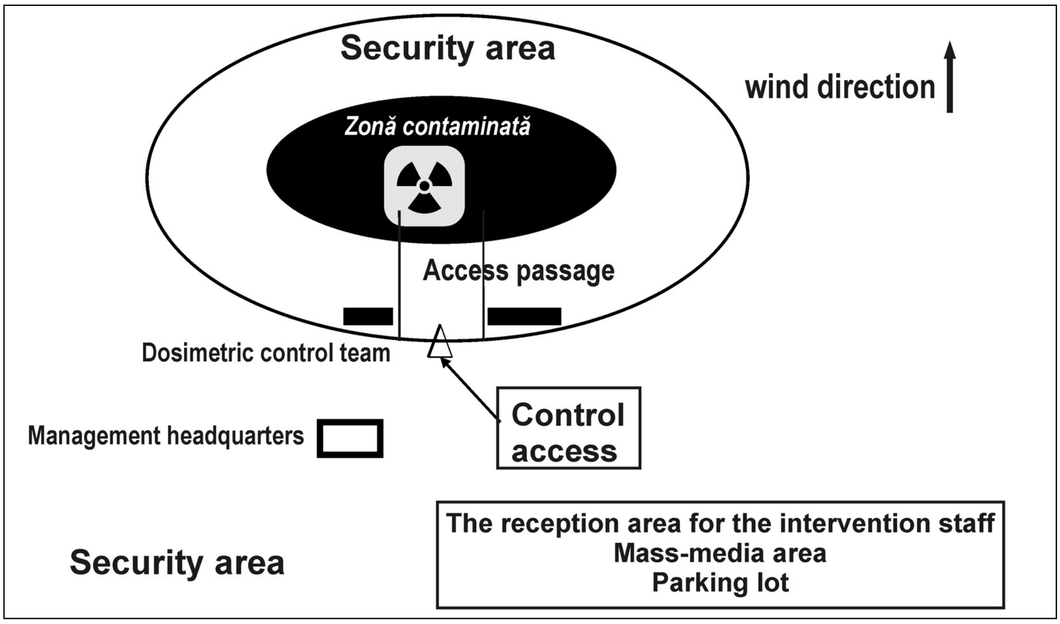
Step 10 – to approach the accident place very attentively, using the measurement instruments. To oversee the entire area. If the area is contaminated or the dose rate is higher than 10μSv/h off-site the security area, the accident manager must be recommended to delineate the area properly.

Step 11 – to evaluate the risks. To evaluate the necessity of the immediate protective actions (e.g. evacuation ) for the population using the interventional levels in radiological situations included in table no. 1.

Step 12 – to establish and to control un control access point of the contamination and access, near of the security area, to the wind direction, inside of the area, where the dose rate is same with the natural background.

*Table 1. Operational levels of intervention (OLI) in radiological situation, exprimated in envinronmental dose-rate for gamma - emmiters*

| **Major conditions** | **OIL** | **Major actions** |
|---|---|---|
| External radiations by an punctiforme source | 100μSv/h | Area isolation<br>Recommendation of the evacuation in around area<br>The control of access and exit |
| External radiations by soil contamination an small surface or in the areas where the evacuation is not necessary | 100μSv/h | Area isolation<br>Recommendation of the evacuation in around area<br>The control of access and exit |
| External radiations by soil contamination an large surface or in the areas where the evacuation is necessary | 1 mSv/h | Recommendation of the evacuation or substantial |
| External radiations by the contaminated air with unknown radionuclide | 1 μSv/h | Area isolation (if it is possible)<br>Recommendation of the evacuation in around area or removal an wind direction for an open area |




*Scheme no. 3. The model of an security and safety area*

Step 13 – to establish, if it is necessary, inside the security area, the special area for decontamination and for the contaminated objects.

Step 14 – if it is the suspicion of air contamination, take air sample and evaluated them.

Step 15 – to use properly the special equipment for breathing. If exist radioactive iodine, use the stable iodine tablets.

Step 16 – to watch implementation of the protective actions and the control of exposure. To achieve management of the radioactive monitoring actions. To evaluate the protective actions and to acct properly.

Step 17 – to grant continuous assistance in radiation protection to the interventional teams, including:

a. sending the interventional staff to the emergency
b. giving recommendations about the individual protection equipment
c. supporting the medical response teams for wounded people, if it is necessary
d. controlling the contamination and decontamination

Step 18 – if the main cause of the accident is under control, the following actions must be applied:

- decontamination of the people and equipment
- area decontamination and storing the radioactive wastes

*C. Post accident activities*

Step 19 – to evaluate the victims' doses, the interventional staff's dose and the population doses.

Step 20 – to evaluate the necessity of long term protective actions

Step 21 – to prepare the emergency report. [4, 11]

The intervention in a nuclear accident should do more good than harm, i.e. the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including social costs, of the intervention (justification of intervention). The form, scale and duration of the intervention should be optimized so that the benefit of the reduction of dose, i.e. the benefit of the reduction in radiation detriment, less the detriment associated with the intervention, should be maximized (optimization of protection) [2, 10].

In justifying and optimizing the intervention not only should the exposed population be considered as a whole, but several particular groups for whom costs and benefits will differ require separate consideration. These include pregnant women and small children, hospitalized or other institutionalized individuals [2, 10].

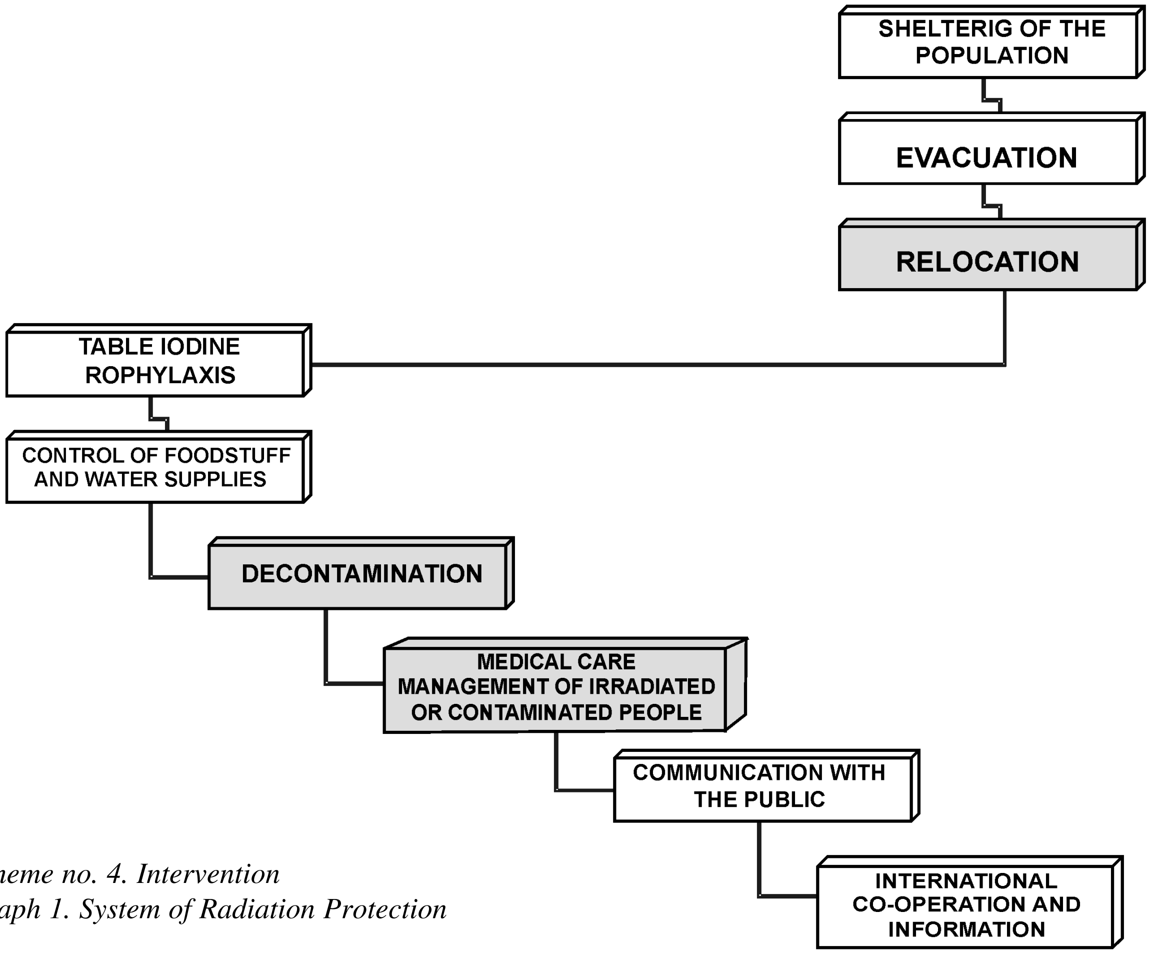
The protective actions are applicable to population, workers and workplaces in the event of an accident, the most important being control of areas, shielding, iodine prophylaxis, decontamination of surface, material and persons and protective clothing.

An emergency plan aims at minimizing negative effects on health.

Medical intervention are very important for exposed and/or contaminated patients. Training the medical and auxiliary staff is of utmost importance together with the authorities responsible with supervising the nuclear objectives. A major accident that would affect hundreds of thousands of persons may cause great difficulties especially in hospitalizing so many patients. Depending on the seriousness of the accident, the intervention levels regarding medical aid are:

*Table 2. Recommended interventional level*

| **Type of intervention** | **Intervention level of averted dose (mSv)** | |
|---|---|---|
| | **Almost always justified** | **Range of optimized values** |
| Sheltering | 50 | Not more than a factor of ten lower than the justified value |
| Administration of stabile iodine - | 500 | |
| equivalent dose for thyroid | | |
| Evacuation (<1 week) | | |
| - whole body dose;<br>- equivalent dose to skin | 500<br>5000 | |
| Relocation | 1000 | 5-15mSv per month for prolonged exposure |
| Restriction to a single foodstuff | 10 (per year) | 1000 - 10,000Bq/kg (beta, gamma emitters)<br>10 - 100Bq/kg (alpha emitters) |




*Scheme no. 4. Intervention*
*Graph 1. System of Radiation Protection*

- focusing efforts on preventing the serious effects over health
- first aid on the spot
- initial medical examination – sorting in case a great number of persons were exposed to radiation
- complete clinical and para-clinical investigation

Thorough examination and treatment in a specialized medical centre when a serious irradiation or an intense inner contamination is rendered obvious.

Iodine tablets are distributed when serious reactor accidents happen; the radioactive material including radioactive iodine may be set free and spread over large areas [7, 8].

**Near field:**

A relatively high radiation dose to the thyroid has to be expected, and short-lived isotopes of iodine play an important role. Inhalation is the main route of exposure, prompt action is required, and detailed dose assessment may not be available.

Stable iodine should be given to all population groups if the predicted thyroid dose exceeds the national intervention levels of the country concerned; all pregnant women, suckling women, newborn babies, infants and children, adults and emergency personnel.

**Far field:**

Ingestion is the major route of exposure. Inhalation could still occur, but the radiation dose to the thyroid from this route would be lower than in the near field. More time is available for decision-making, and more detailed dose assessment should be possible. The imposition of appropriate controls on contaminated food should reduce the radiation doses to the thyroid from ingested radioiodine and will also reduce the exposure to the other radionuclides.

However, if the thyroid dose is likely to exceed the national intervention level, stable iodine may be indicated.

In the far field, large populations would be involved, side effects of the prophylaxis could occur in a correspondingly larger number of people than in the near field.

Therefore, in adults over the age of 45, the potential risks of stable iodine prophylaxis may outweigh its potential benefits; stable iodine is not recommended for large populations in this age group. The balance between risks and benefits in adults between the ages of 17 and 45 is harder to define, and depends upon a number of factors, one of this being the dietary iodine content in the country.

If administered at the right time, iodine tablets, protect the thyroid gland from ingesting radioiodine, there is no protection against other radioactive substances or against damage of radiation. Additional measures such as staying in closed rooms, food control etc. have to be taken in any case.

*Table 3. Quantities of stabile iodine on age groups*

| **Age group** | **Equivalent Iodine (mg)** | **KI(mg)** |
|---|---|---|
| birth - 1 month | 12.5 | 16.3 |
| 1 month - 2 month | 12.5 - 25 | 15 - 30 |
| 3 years - 12 years | 25 | 32.5 |
| over 12 years (up to 45 years) | 100 | 130 |
| pregnant or lactating women | 100 | 130 |

For the management of intervention is very important the measured data:

- Meteorological data
- Ambient dose-rate by ground survey
- Airborne radionuclide concentration
- Plume trajectory
- Food, water, environmental contamination
- Environmental deposition
- Individual dose
- Object surface contamination [6, 11].

In the post – release phase there will be both decisions made concerning the implementation of further protective actions and about the return of normal living conditions. This phase may extend over a prolonged period of months or years [4, 10].

The major routes of exposure which exist in the post – release phase need to be reassessed at regular intervals to determine if continuation of protective actions introduced is still justified.

In the post – release phase, they are a number of social, economic and technical decisions than in the earlier phases. These factors depend upon the particular spatial and temporal aspects of the accident. The nature of land use and living habits in the area affected, the size of the population evacuated or relocated, the time of returning to their homes are some of the important factors in the decision – making process [12].

The protective countermeasures in this phase are:

- Evacuation
- Temporary relocation
- Permanent relocation
- Foodstuff restriction
- Agricultural countermeasures
- Clean up and decontamination

Evacuation – means the urgent, temporary removal of persons from the affected or potentially affected area and is intended to avoid seroius deterministic effects and a high risk of stochastic effects from high dose and high dose rate. The efficiency of evacuation depends on the ability to notify and transport people quiqly, the timing of the evacuation and the capability to predict the dispersion of radionuclides in the envinronment. It is necessary to take account of the dose that may be received during evacuation easly in a radiological emergency. The physical risks associated with evacuation in some case show to be low. These will depend upon conditions at the time that evacuation is considered : weather conditions, time of day or night and traffic conditions [4, 10].

The evacuation is almost always justifyied if the projected average individual dose to the whole body is likely to exceed 0,5 Sv within a day or the averted average individual effective dose for the duration of the evacuation is 0,5 Sv or 5 Sv dose an the skin.

Evacuation is a short - term protective action and its continuation must be justifyied by a continuing hazard . However, beyond one week, it is appopiate that this be considered as relocation and justified and optimised accordling.

Relocation is necessary if existe on great exposure risk for population in case of the major nuclear accident. Relocation it refers to the long term removal of people from an affected area. It may be undertaken as an extension to evacuation or it may introduced in the post – release phase up to weeks or months after an accident has occurred, to reduce doses from deposited radionuclides and to allow remedial measures to be carried out. The duration of relocation may be permanent or may be for a more limited period. This depend upon the decline in the dose rate (due to radioactive decay, weathering process and any remedial action) and upon social factors (provisions for rehabilitation of the affected area). The relocation can be carefully planned advance and controlled in implementation. Financial costs may be high and will depend upon the number of people involved and less of production in the affected area. The social costs of disruption and anxiety will need to keep population well – informed, to explain the risks and to proceed with relocation without delay. The efficiency of relocation in averting average individual doses, both internal and external, in relation to time should be estimated based on envinronmental measurements and modelling. In justifying and optimising the intervention level, the entire population to be relocated should be considered with the distribution of averted dose and corresponding costs. Duration of temporary relocation is no longer than a few years otherwise permanent resettlement [4, 10].

Radionuclide accidentally released into the environment may be transferred to food and drinking water. Protective actions on the food – chain and drinking water can be dividing into two categories:

1. those which directly restrict the consumption of contaminated food and water :

2. those which limit the transfer of radionuclides into the food - chain from contaminated air, soil and water.

During and especially after a radionuclide release priority must be given to controlling those foodstuffs which may be contaminated directly by deposition from the atmosphere. Control on food may be required to remain in force for considerable periods of time if long – lived radionuclides are involved, since some radionuclides may move only slowly from contaminated ground or water into plants and animals in the food – chain. In extreme conditions it may necessary to consider a complete change of agricultural land use or to exclude contaminated areas from agricultural use [1, 6, 12].

Food restrictions and agricultural countermeasures are post-release phase measures warranted at low exposure risks.. Overall costs are relatively low. Risks are normally low and duration can be relatively long.

After an nuclear accident the specialists must invetigate very atentiffe the causes of the event, the problems detected, also the intervention must analised and in the future the emergency plan will bee improved.

The intervention in an nuclear accident means colaboration between all the factors with responsabilities at national level, also at county and local level, then the effects on population and envinronmental health to be minimased.

*Table 4. Maximum permitted level of radioactive contamination foodstuff*

| Radionuclide group | Baby food Bq/kg | Dairy products Bq/kg | Other foodstuffs Bq/kg | Liquid food Bq/l |
|---|---|---|---|---|
| Isotope of strontium, notably 90Sr | 75 | 125 | 750 | 125 |
| Isotope of iodine, notably 131I | 150 | 500 | 2,000 | 500 |
| a emitting isotopes of plutonium and trans plutonium elements, notably 239Pu and 241Am | 1 | 20 | 80 | 20 |
| All other nuclides with half life greater than 10 days, notably 137,134Cs | 400 | 1,000 | 1,250 | 1,000 |

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