# An overview of the scientific support needed to establish and maintain a sustainable nuclear security regime in Romania

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**Abstract.** In order to upgrade the global framework for nuclear and radiological security and to improve nuclear security regime which needs prevention, detection and response, through a broad variety of measures, both technical and institutional based on the recommendation of the scientific support organization (TSO) have to be maintaining for a sustainable nuclear security system. The paper present the development of certain methodology for risk assessment of State Management of Nuclear Security in Transport of RAM (Radioactive Material) in Romania, evaluation of effectiveness of State Nuclear Security Regime, as well as the optimization of the nuclear security measures in accordance with the IAEA's recommendation/guidance on Management of State Nuclear Security Regime.
The results and the practical recommendation addressed to State Authorities will be used to improve and to maintain the State Nuclear Security Regime on high level. To achieve the goals of this risk assessment, the computer codes INTERTRAN II and RADTRAN have been used.

## 1. Introduction

The IAEA defines nuclear security as *"the means and ways of preventing, detecting and responding to sabotage, theft and unauthorized access to or illegal transfer of nuclear material and other radioactive substances, as well as their associated facilities"*. The IAEA works closely with Member States (MS) to establish and enhance the measures needed to control and protect nuclear and radioactive materials, as well as to prevent illicit nuclear materials trafficking [1].

On April 2010 the 47 MS attended the Nuclear Security Summit issued their Communiqué of the Washington Nuclear Security Summit, stating the they "reaffirm the essential role of the IAEA in the international nuclear security framework and will work to ensure that it continues to have the appropriate structure, resources and expertise needed to carry out its mandated nuclear security activities, in accordance with its Statute and its Nuclear Security Plans".

In the modern world the terrorism has renewed attention to security issued, prompting a profound re-thinking in the international approach to nuclear security.
As a consequence Romania, as a MS, joined to the new realities in according with the IAEA Nuclear Security Plan.

Taking into consideration the above mentioned, the paper presents a methodology for risk assessment of the State Management of Nuclear Security in transport of Radioactive Materials (RAM) in Romania [2,3.4[.

In the figure 1 is presented the main routes for the transport of RAM:

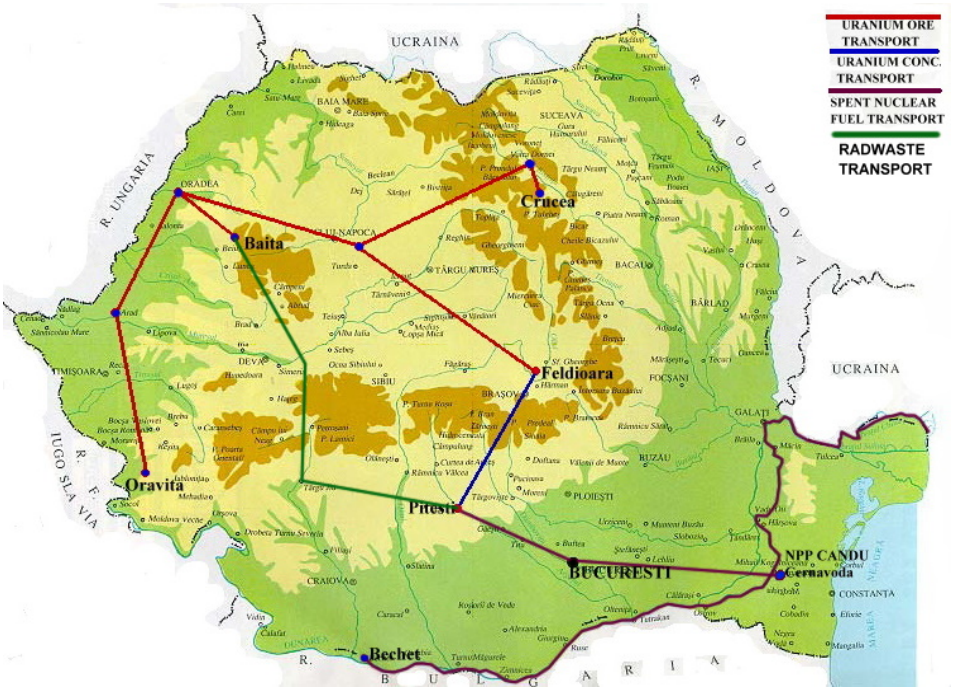


*FIG.1. RAM transportation routes in Romania*

## 2. Description of the methodology to be used

In order to determine a methodology to assess the radiological consequences due to a malicious act possible to be happening during the transport of RAM in Romania.
To determine these possible radiological consequences the INTERTRAN II and RADTRAN II computer codes have been used [2,3,4].

### *2.1. Identification and the evaluation of the potential risks due to the transport of RAM*

#### *2.1.1. Transport by road*

As shown in Figure 1 the routes for transport of the RAM in Romania. In order to evaluate the dose resulting from possible road accidents involving these radioactive shipments, based on the frequency of occurrence of accidents of specified severities the IAEA computer code INTERTRAN II has been used. On the other hand for rail transport a probabilistic risk assessment method (PRA) has been adopted [5] for this work aimed at quantifying the potential radiological consequences and the expected probability of occurrence of such accident sequences.

Data to be used as input data to the computer code INTERTRAN II has been provided by postulate possible accidents scenarios [2,3] such as: transport hazards (fixed impact hazard, mobile impact hazard), malicious acts, potential threatens, accident frequencies by road.

Based on these there were calculated road accident probabilities such as:
- probability of impact only: $0.421 \times 10^{-5}$ per journey;
- probability of impact and fire: $1.50 \times 10^{-8}$ per journey;

It is also assumed that, following an impact and a malicious actor a terrorist attacks, the content may become available for dispersion.

The collective dose assessed areas follows:
- dose to public along route: $0.25x10^{-5}$ person.Sv.$y^{-1}$;
- dose to public during stops: $0.37x10^{-8}$ person.Sv.$y^{-1}$ ;
- dose to truck crew: $0.47x10^{-5}$ person.Sv.$y^{-1}$.

The total annual collective dose is: $0.72037x10^{-5}$ person.Sv.$y^{-1}$.
The associated latent cancer fatality risk is estimated at $0.77x10^{-8}$ $y^{-1}$.

### 2.1.2. Transport by rail

There are different kinds of operation contributing to the overall risk, such as: rail transport, rail road transfer activities handling and misoperation activities, etc. Transport and handling of possible accidents [3, 4] or potential malicious acts may occur and pose a potential risk for the public and the environment.

Because the occurrence of such accidents is statistical in nature, the probability risk assessment (PRA) has been adopted in order to quantify the potential radiological consequences and the expected probability of occurrence of such accidental or potential malicious acts or terrorist attacks sequences.

The potential radiological consequences have been calculated by using INTERTRAN II computer code.
The calculated radiological risks include [5]:
(a) RAM exposure to the public and transport personnel from routine (incident free) transport of the very low level radioactive material (uranium ore);
(b) Transport accident and consequences of the potential malicious acts as well as terrorist attacks resulting in radiation exposure of the population and contamination of the environment.

The accidental sequences include steps such as:
- characterization and the type and quantity of shipment;
- determination, selection and description of the type, severity and probability of occurrence of transport and handling accidents;
- assessment of potential radiological consequences for the spectrum of wealth condition encountered along the rail route, consequences of potential malicious acts, landslide, etc;

The IAEA computer code INTERTRAN II has been used to determine the collective dose to population and transport personnel and the preliminary risk assessment results are: crew: $1.34x10^{-5}$ person.Sv/y; members of the public: $1.78x10^{-5}$ person Sv/y;
TOTAL: $3.12 \times 10^{-5}$ person Sv/y.

Radioactivity releases are not expected to occur in close proximity to a possible accident site at a probability level as low as $10^{-7}$, i.e. a chance of 1 in 10 million for the total volume of the RAM to be transported. In case of the malicious acts, sabotage or terrorists attacks the radioactivity releases can increases significantly.

## 3. Conclusions

The transport of RAM in Romania is a very sensible and complex problem taking into consideration the importance and the need of the security and safety for such activities.
The Romanian Nuclear Regulatory Body set up strictly regulation and procedures according to the Recommendation of the IAEA Vienna and other international organizations. There were implemented the adequate regulation and procedures in order to keep the environmental impacts and the radiological consequences at the lower possible level and to assure the effectiveness of state nuclear security regime in carrying out these activities including transport and the disposal site at the acceptable international levels. The levels of the estimated doses for transport and disposal are within the acceptable limits provided by national and international regulations and recommendations but can increase, significantly during potential malicious acts.

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