Environmental risk caused by dangerous substances and hazmat crimes-a case study for Romania

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Abstract: The article presents the main concepts of risk and hazmat for the environment, the legislation and some operational problems in the EU, USA and a study case for Romania. Terrorism crimes are involved in our dairy lives, and the use of the dangerous hazmat substances can create significant damage for human life and the environment.

Keywords: risk, hazmat, environment, intervention, crimes, dangerous substances

1 Considerations about risk and hazard for the environment

The risk for the environment in the case of hazmat spill and any other related crimes have long been the focus of the authorities all over the world. The comparative study presented in this article highlights the risk created by dangerous substances and a few aspects related to the operations mounted in Romania, the UK and the USA to counteract their negative effects. For instance, statistics in the UK reveal that over 300 inceidents occur each year during maritime transportation due to chemicals spill. This happens in harbours, while loading and unloading ships. The 1997 Act – The Merchant Shipping Dangerous Goods – MSDGR, stipulates the obligation to declare the nature and quantity of dangerous goods, „hazmat” class and UN number, if applicable [2].

Internationally, IMDG (International Maritime Dangerous Goods) lists extensively all dangerous chemicals which may be transported on ships. USA and Romanian legislation is in line with this international act. We can use the therms of hazard and risk and compare this wo terms as follow:

a) hazard refers to a danger or peril, i.e. the psysical and chemical properties of a material [1];

b) risk refers to the probability of suffering a harm or loss.

For the environment, the risks associated with a response will never be completely eliminated, they can be successfully managed when an incident occurs.

2 Tactical and operational response in intervention and regulation policy of risk management

By comparing the legislaton in the USA, UK and Romania we find that the tactical and operational response for the firefighters in the USA and UK or the emergency situation units in Romania is to minimize the level of risk for responders, the community and the environment.

The mainpoint in an intervention is to see how the hazards must be weighted against risk, as shown in the following table:

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable range</td>
<td>Size of leak</td>
</tr>
<tr>
<td>Expansion rate</td>
<td>Quantity involved</td>
</tr>
<tr>
<td>Vapor density</td>
<td>Flame impingement</td>
</tr>
<tr>
<td>Ignition temperature</td>
<td>Unwetted surfaces</td>
</tr>
</tbody>
</table>

Table 1
For evaluating an environmental risk, we must take into account: the hazardous nature of the materials involved (toxicity and/or flammability), quantity of the material, containment system, proximity of exposure, level of available resources.

The UK and USA use the GHBMO (General Hazardous Materials Behaviour Model), developed by Benner in 1970, and used by emergency responders. The chart of GHBMO (or GEBMO) presents the events categories and the event interruption principles [2]. For example, the event categories contain:
- stress: thermical, or radiation, chemical, mechanical;
- breach: disintegration, runaway cracking, punctures;
- release: detonation, violent rupture, rapid relief, leak, split.

The intervention units must monitorise the air, to evaluate the risk from unidentified materials using wetter pH paper, for flammability using flammable detectors (LEL meter), and for toxic risks using the photoionisation detector (PID).

For the hazmat used in crimes, and the leakage of dangerous substances, the most important physical property is the vapor pression and the time of evaporation, as presented in the table below:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Vapour pressure (mm Hg)</th>
<th>Time to evaporate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethion pesticide</td>
<td>0.15x10^{-5}</td>
<td>Years</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>0.001</td>
<td>Months</td>
</tr>
<tr>
<td>Sarin</td>
<td>2.9</td>
<td>Days</td>
</tr>
<tr>
<td>Isopropyl alcohol</td>
<td>33</td>
<td>Hours</td>
</tr>
<tr>
<td>Acetone</td>
<td>180</td>
<td>&lt; 1 hour</td>
</tr>
<tr>
<td>Ethyl Ether</td>
<td>440</td>
<td>Minutes</td>
</tr>
<tr>
<td>Chlorine</td>
<td>6.8 atm</td>
<td>Seconds</td>
</tr>
</tbody>
</table>

Table 2

The conclusion is that the impact for the environment is higher when the time is counted in years or months. The toxic substances produced by accidents or used in crimes cause many dangerous situations for the environment and people as well (including the intervention teams).

The use of risk assesment and management techniques is important in policy and regulation decisions, as well as in industry.

The design of regulation is used to determine societably „acceptable risk” level, which may form the basis of environmental standards. The risk management on an „effects-oriented approach” and „source-oriented approach” is recognised in the European Union. This is in fact one of the policies of the EEA - European Environmental Agency [3].

European governments could reduce income taxes, increase innovation and cut pollution from dangerous substances by introducing the new ETR/environmental tax reform. The aim is to foster economic growth and decouple this from environmental harm. The shift to a „green economy” which does not damage the environment will be discussed in Rio de Janeiro in June 2012, 20 years after the first historic Earth Summit.

In past years, the costs for EU countries were:
- 102-169 billion euros healt costs (air pollution, including accidents caused by dangerous goods);
- the green house gas emissions increased by 2.4% in five years;
- ground level ozone exceeds predefined limit values above World Health Organisation Guidelines, and also the NOx pollution exceeded by 17% the values in the EU.

3 The US and EU policy for dangerous goods and their risk for the environment

Among dangerous substances we can find nuclear and radioactive materials. When a radioactive material is properly contained, it is not a environmental contamination hazard, but if the material escapes, this is referred to as radioactive contamination (both exposure and contamination).

The US government points out the common types of radionuclides used in crimes committed by terrorists:
- Americium 241 used in smoke detectors;
- Cesium 137 found in radiotherapy devices (it emmits both gamma and beta radiation). Cesium 137 was used by Chechen terrorists in the April 2002 threat in Moscow;
- Cobalt-60 generates high energy gamma rays and beta particles;
- Depleted Uranium;
- Iodine 131, 132, 134 and 135-found in nuclear reactors;
- Phosphorous 32 found in research laboratories and medical facilities as a tracer.

At the EU level, we consider the Dangerous Substances Directive no. 76/464/EEC applying to inland, coastal land and territorial waters; this directive specifies two lists of dangerous substances.
for the environment: list 1 covers those which are very toxic, persistent and may tend to accumulate in the environment; list 2 covers substances whose effects are still toxic, but less serious. The directive requires that we eliminate pollution in list 1 substances and minimise pollution in list 2, and specifies some requirements for environmental monitoring. Pollution is defined as exceeding the Environmental Quality Standards (EQS) in water [5].

In the UK, the department for Environment Food and Rural Affairs (DEFRA) protects the economy, human health and ecosystems from environmental risk.

DEFRA has some regulations concerning the hazards or chemical substances. This is the famous EU REACH (Registration Evaluation, Authorisation and Restriction of Chemicals) [7].

In dealing with potential risks posed to the environment by the manufacture of chemicals, DEFRA has two advisory groups: ACHS-Advisory Committee on hazardous Substances and CSF/UK Chemicals Stakeholders Forum. In the UK, DEFRA is the lead Governmental. The environmental risk includes the risk of pollution with pesticides and implementation of nanotechnology.

In the operational field, we find the GDS-Government Decontamination Service and the Counter-Terrorism advice from the Home Office.

After a USA regulation, the most common incendiaries used in crimes are:

- a) black powder - easy to obtain by illegal means, reaching 2000 C degrees during combustion;
- b) flash powder - mixture of an oxidable metal such as aluminium or magnesium, reaching up to 3000 C degrees;
- c) matches;
- d) thermit mixture of powdered aluminium and iron oxide;
- e) pyrophoric-air reactive metals.

Terrorists can attack, using some dangerous military agents such as:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Designation</th>
<th>LCT(_{50}) (ppm)</th>
<th>ICT(_{50}) (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>CL</td>
<td>6551</td>
<td>620</td>
</tr>
<tr>
<td>Lewisite</td>
<td>L</td>
<td>141-177</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Sarin</td>
<td>GB</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Soman</td>
<td>GD</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Tabun</td>
<td>GA</td>
<td>20-60</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 3

, where LCT\(_{50}\) is the lethal concentration to 50% population for 3 minutes and ICT\(_{50}\) is incapacitating concentration in the same conditions.

Although dangerous substances rarely cause accidents when transported, they can have a negative impact on the environment, such as: surface and subterranean water pollution, mass evacuation, catastrophes.

4 Case study for Romania

In Romania, the National Agency for Environmental Protection (ANPM), acts according to the EU policy: planning the strategy, monitoring environmental factors, and authorising the activities with a great impact.

The Romanian Agency ANPM statistics shows the surfaces affected in Romania by the nuclear materials in the last 5 years [6]:

<table>
<thead>
<tr>
<th>State</th>
<th>Slow</th>
<th>Moderate</th>
<th>Strong</th>
<th>Excessive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arad</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Bacau</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Brasov</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Harghita</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Suceava</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>500</td>
<td>-</td>
<td>66</td>
<td>566</td>
<td></td>
</tr>
</tbody>
</table>

Table 4

In Romania, we apply the Directive 2008/98/CE regarding the management of pollution caused by hazmat and dangerous substances, with the following priorities:

1. highest: prevention;
2. moderate: preparation for recycling, others operations for recycling;
3. elimination.

As pointed out, the highest priority is the prevention. Another option is also represented by the possibilities named WtE - Waste to Energy, which include the process of burning the substances, if possible.

In the last two years in Romania, we have stocked the dangerous industrial goods and non-dangerous rests in 40 warehouses. The two main areas are now established in Ialomița county (Slobozia) - in South Romania and Prahova – a Subcarpathian region.

Concerning the operational field, the Romanian National General Inspectorate for Emergency Situations (IGSU), has signed in the first 8 months...
about 3,731 papers, granting authorisations, as seen in the following table [4]:

<table>
<thead>
<tr>
<th>Grant for public and private areas</th>
<th>222</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant for evacuation situations</td>
<td>793</td>
</tr>
<tr>
<td><strong>Grant for transport of dangerous substances</strong></td>
<td><strong>2603</strong></td>
</tr>
<tr>
<td>Grant for emergency internal plans</td>
<td>22</td>
</tr>
<tr>
<td>Others</td>
<td>876</td>
</tr>
</tbody>
</table>

Table 5

This shows that the biggest amount of authorisations are granted in the field of transportation for dangerous substances.

The prevention control of dangerous goods specified in the objectives (public or private) increased with 11% in 2011, comparing with 2010 (304 in 2011, and 273 in 2010).

In Romania, a specificity is also the implementation of the Intervention Plan for the Black See in case of oil pollution and dangerous substances pollution.

Our government limits the tranportation of dangerous goods, others than oil, and work to improve the intervention plans for HNS - higher risk substances for the environment.

Security reports are made for the implementation of SEVESO Directive concerning dangerous substances, where the minimum requirements for risk analysis in this field are marked [8]. In this report the following are detailed: a description of dangerous goods, the chimical description and formulas, the CAS number, the maximum quantity of dangerous goods, the toxicological characteristics, the harm for people and the environment.

The transport of dangerous products is performed in line with the National Government Directive HG 191/2006. This directive takes into account 9 classes of dangerous goods: explosives, gases, flammable liquids, autoreaction substances, peroxides, infections substances, radioactive substances, corrosive substances, etc.

Another aspect of the operational work in Romania is the setting of the Weaponry, Explosives and Dangerous Substances Office within county police inspectorates. This office controls the ownership, possession and use of dangerous substances, and supervises the operations using nuclear, bacteriological and chemical agents.

The exterior isolation zone is situated between the general public and the cold zone, holding the command post, or other support function.

In the inner circle we find the warm zone, including control points for the access coridor, helping to reduce the spread of contamination; finally, the hot zone is the area immediately surrounding a hazamat incident.

5 Conclusions

1. It is imperative to deeply acknowledge and harmonise European and N-American legislation in the field of using and shipping dangerous goods.

2. Reducing risks to the environment involves prevention measures, as well as urgent operational measures after the occurrence of the unwanted event.

3. Complex terrorist acts multiply worldwide, and target the use of hazmat incremently, which demands highly specialised civil and military forces to fight such scourges which can cause real crises and catastrophies on a short, medium and long term to the environment and the population. The maritime, riverine and land environment can be irreparably damaged on a medium and long term.

4. Romania makes a significant legislative and operational effort at a national, regional and EU level to reduce the risk for the environment and population of unsuitable use of hazmat.

References: