24. POSSIBILITIES OF DETECTION AND EARLY WARNING IN CASE OF TERRORIST CHEMICAL ATTACKS IN SUBWAYS

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INTRODUCTION

In the last decade, major cities have had bitter experience with the disastrous damages, caused by terrorist attacks appearing as a result of religious, ethnic and political fanaticism of groups. There also have been cases of violent acts of perverse psychopathologic individuals. Public facilities, transport means and other densely populated areas are among selected targets. To intended results belong, beside material damages frequent human casualties. It must be expected that growing terrorism will be accompanied with increasingly sophisticated methods of violence, including employment of supertoxic lethal chemical agents (as shown by the known case in Tokyo subway) and highly contagious biological agents. It is obvious that underground transportation system of traffic and station tunnels, crowded with people within relatively narrow and closed space, is vulnerable to attacks with toxic chemicals, both industrial (easy accessible like chlorine, phosgene, hydrogen cynide, cynogen chloride and like) and military (including supertoxic lethal nerve agents) causing immediate casualties.

After having evaluated the experience from Tokyo subway, responsible authorities of the City of Prague decided to equip the Prague underground (METRO) with a detection system for toxic gases in order to enable early warning and adopting as early as possible protection and rescue measures in case of possible terrorist attack. This paper presents information on the technical solution of this problem.

MATERIALS AND METHODS

To assure optimum choice, number and localisation of detectors, representative station tunnels were chosen for experimental modeling according to the risk analysis of the whole METRO network and important junctions. The mathematical model of potential distribution of agents within the platform area included:

- Ambient air flow within the platform area,
- Ambient temperature,
- Coefficients of turbulent difffusion,
- Evaporation of anticipated agents,
- Amount of agent.

For these purposes, the most dangerous agent (sarin) was taken in consideration. The first two parameters were measured within the platform area of the representative METRO station, all other parameters correspond to the physical characteristics of the toxic agent.
Sensors were placed to follow the less favorable conditions from the point of view of agent's distribution velocity, as well as of probability to reach detector in a concentration above the detection limit.

For choosing suitable detectors and designing the system, following criteria were suggested:

- Spectrum of agents to be detected

- Detection limits for requested agents
- Detection velocity for requested agents
- Automatic operation of sensors
- Remote transmission of sensor's information
- Possibility to attach sensor to an automated network system
- Central operating and safeguarding
- Technical availability to install sensors within the METRO tunnels system
- No interference of the sensors with the METRO traffic operation
- Safe operating of this particular monitoring system and its compatibility within the overall
  traffic operation monitoring
- Possible further development.

As sensors for this monitoring system and experimental measurements at the first METRO station, the ion mobility spectrometers RAID-S (manufactured by BRUKER-SAXONIA GmbH) were chosen as the most appropriate, meeting the desired demands, as for the spectrum of detected agents, as well as for the assured detection limits:

Agents:	- nerve agents (GA, GB, GD, VX),	
	- vesicants (HD, L)	
	- generally toxic agents (AC, CK, CG)	
	- other harmful agents.	
Detection limits:	- nerve agents	1×10^{-5} mg/L
	- vesicants	6×10^{-5} mg/L
	- generally toxic agents	1×10^{-3} mg/L.
Speed of response:	- for the limit concentrations	5 - 30 seconds.

The other advance is the possibility of a relatively simple integration to an automatic transmission and evaluation monitoring system. To another very valuable advance belong the capability of modifying present laibraries of detected agents, as well as constituting new ones which makes the possibility of an open-ended solution even for the future.

Because of actual danger of employment of agents, differing from the standard CW agents, we have measured also spectra of some homologues of GB and GD. It is obvious that this detection system enables to detect these agents too. It is a matter of consideration how wide the list of agents should be inserted in the detector's library. The longer the list of compounds presumed for detection, the longer time for the detector's response.

The results gained with the RAID-S instrument are recorded by a computer localised at the METRO station. Data are proceeded and formatted to a form corresponding with an input of a central computer. The central computer is located in the Information and Control Centre (ICC). Taking into consideration a relatively intensive electrical interference resulting from the METRO traffic, it was necessary to give great deal of attention to a safe design of the whole system including transmission lines from both HW and SW in order to obtain summarised and displayed data in the ICC safely and clearly.

As a result of processing and evaluating of obtained data, the information for operator contains:

- Warning signal of detected agent, including concentration and time of detection
- Operating instructions for the case that toxic agent is present
- Information on working conditions of monitoring system, specifying possible failures.

All relevant data are stored in the central computer for possible re-evaluation.

RESULTS AND DISCUSSION

As a result of this experimental work, the first station of the Prague METRO was equipped with the above descibed monitoring system in 1997 as one of the first technical measures in the build-up of the complex system of early warning and rescue in case of terrorist chemical attacks in a very vulnerable underground mean of urban transportation, any daytime crowded by Prague citizens and beside nearly hundred million of foreign visitors a year.

It is obvious that detection is nothing more but nothing less that the first necessary measure in the whole complex. It is, of course unable *per se* to save intoxicated persons. But it allows to adopt necessary measures to at least limit the extent of casualties *via*:

- immediately informing public to prevent panic,
- preventing entry of newcomers from outside to contaminated area,
- alarming police units (security measures, regulation, police interventions against terrorists),
- alarming prepared and trained fire-brigade and civil protection units & technical rescue
- squads (regulation, extinguishing, protection, decontamination, technical repairs,
- maintenance etc.)
- alarming prepared and trained medical rescue squads (first aid, medical treatment,
- evacuation of injured and intoxicated persons)
- evacuating people from the endangered area,
- passing trains through the endangered station without stop if necessary,
- rescheduling trains deviating or stopping them outside of endangered areas,
- adopting other protective and rescue measures, both technical and medical,
- adopting restoration measures

SUMMARY

As a result of evaluating the experience from the chemical terrorist attack in the Tokyo subway, responsible authorities of the City of Prague decided to equip the Prague METRO with a detection and monitoring system to enable early warning and adopting immediate protection and rescue measures in case of possible terrorist attack. After experimental analysis of airflows and other conditions including modeling within the system of underground stations and assessment of available gas alarms to detect the widest possible spectrum of toxic chemicals (in consideration to be misused by terrorists) with desired detection limit and within the shortest possible reponse time and their feasibility to be incorporated into a network of remote signal transmission to the central checkpoint, the ion-mobility spectrometers were suggested as the most appropriate from the available choice. These monitors started to be introduced since the 1997.

KEY WORDS

Terrorist attacks, toxic chemicals, detection, monitoring, subway stations

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