# TRANSORT ACCIDENT INVOLVING RADIOACTIVE MATERIALS

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**Greek Atomic Energy Commission**
**June 2003**

| Time | Event | Comment |
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| | A small van with two passengers from "DEMOKRITOS", Nuclear Center, had loaded radioactive materials from the OLYMPIC Airways cargo at the Athens Airport. The van is on its way to "Demokritos" Nuclear Center at Agia Paraskevi. Before leaving the Airport, a vehicle hit the van at the back.<br>The vehicle's engine got on fire. The back door of the van opened from the crash and some of the packages were ejected and dispersed.<br>None of the passengers has been hurt.<br>The van was carrying mainly radiopharmaceuticals. A list of the packages is given at the table 1. | *"Demokritos" Nuclear Center is responsible for the transportation of radioactive materials in Greece. All the radioactive materials coming at the Athens Airport, are stored in appropriated sealed warehouses at the OLYMPIC Airways Cargo, and then are loaded to shieled with Pb lorries and transferred to "Demokritos" Nuclear Center, in order to be distributed to hospitals, Universities, industries, etc.* |
| 10:30 am | Shortly after the accident the vehicle driver contacts the Fire Department of the Airport, the driver informs that he had hit a "Demokritos" van, and packages with radioactive materials were | |

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| | dispersed.<br>Meanwhile the van driver contacts "Demokritos" and the Greek Atomic Energy Commission is informed immediately for the accident. The driver gives the description of the accident scene and also the cargo that the van is carrying. | |
| 11:35 | The Fire Department arrives at the scene. | |
| 11:40 | Two fire fighters wearing protective clothes and breathing apparatus approach the vehicle in order to fight the fire.<br>The rest of the fire fighters team secures with a ribbon an area, opposite to wind direction, where they install the decontamination unit. A plastic corridor is placed on the ground. All the people transportation from the accident area to the secured area will be carried out using the corridor, in order not to disperse any contamination.<br>The passengers of the cars are asked to wait for the contamination check inside the secured area.<br>A fire fighter keeps the records.<br>A drawing of the accident scene is presented at the figure 1. | *The Fire Department of the Athens Airport is trained by the GAEC for transportation accidents involving radioactive materials and is also very well equipped.* |

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| 12:00 | The fire is extinguished. The 2 fire fighters are returning to the secured area for decontamination.<br>Decontamination is performed. The fire fighters are undressed. The uniforms are put separately into plastic bags, in order to be checked later by the GAEC team for contamination. A label with the fire fighter name is put outside each plastic bag.<br>Two other fire fighters with uniforms and radioactivity instruments are going to the accident area in order to perform a radioactivity survey.<br>The GAEC team arrives at the accident scene. | |
| 12:00 - … | • One of the GAEC team, dressed with a TYVEK uniform, boots, face protection, gloves and paper mask is responsible for the contamination check. He is using a pancake detector for surface contamination. Contamination check for passengers of the cars is being performed. No contamination is found.<br>Frisking technique for body contamination check is presented at figure 2.<br>Records are kept in special forms.<br>• During the scene inspection, increased levels of dose rate are measured. | *In normal situation, the van carrying such a cargo with radioactive material, should give* |

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| | • The fire fighters team locates 2 hot spots and they put 2 indicators.<br>• The fire fighters team returns to the secured area.<br>• Contamination control is performed.<br>• Contamination is found in one of the fire fighters.<br>• Decontamination is performed and a second contamination check.<br>• Two members of the GAEC team, dressed with a TYVEK uniforms, boots, boots protection, face protection, gloves and filter masks, TLDs and digital dosimeters proceed to the accident scene in order to perform a more detailed radiological survey, collect samples and remove the ejected packages. They use survey instruments, surface contamination monitors, NaI detector.<br>• First they close the back door of the van.<br>• They put sand over the spill and collect the material into plastic bags.<br>• They collect the packages into plastic bags.<br>• All the materials collected are put back to the van.<br>• Meanwhile, near the secured area, a member of the GAEC team installs a portable HPGe detector in order to perform gamma spectroscopic measurements in case that is needed. | *a dose rate inside the van of about 650μSv/h and outside the closed door (Pb) 50 μSv/h. So, at 3m distance from the van with the back door closed the dose rate should be at the background level*<br>*After the accident some packages were ejected out of the van. The main radioactive materials are liquid, so after the crush and the water due to the fire fight, the glass vials, are destroyed and radioactivity in dispersed all over the water spill.* |

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| | • A detailed survey of the van with smears is being performed, in order to inspect the car for contamination. The smear tests are collected into small plastic bags and transferred to GAEC base for measurement at the portable HPGe.<br>• No contamination at the smears from the van is detected.<br>• The van is permitted to leave the area.<br>• A detailed survey of the second car with smears is being performed, in order to inspect the car for contamination. The smear tests are collected into small plastic bags and transferred to GAEC base for measurement at the portable HPGe.<br>• No contamination at the smears from the car is detected.<br>• The car is permitted to be removed from the accident area.<br>• The GAEC inspection team returns to the secured area for contamination check.<br>• Contamination is detected at the gloves and at the boots covers, that are removed and put into a plastic bag.<br>• A GAEC's vehicle with a large plastic detector is used for the final survey of the area.<br>• A hot spot is observed and a small metallic container is located.<br>• According to the NaI instrument a Co-60 source is detected. | |

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| | • While a member of the GAEC team tries to collect the container, he cuts his finger. He covers the finger and immediately he is transferred to the GAEC's base for measurement.<br>• Co-60 is detected at his finger.<br>• Proper initial treatment of the contaminated wound is offered.<br>• The finger is measured once more at the HPGe and 37 kBq of Co-60 are detected.<br>• The person is transferred to a hospital for special care.<br>• Records are being kept.<br>• Final area survey<br>• End of the event | *Wound contamination with Co-60 is generally not a serious clinical problem from the viewpoint of hindering the healing of the would (requires 50 to 100 rads/day) or from causing acute necrosis (requires 200 or more rads/day). It is of concern because of the phychological effect on the individual. The amount of activity is difficut to quantify because of the unusual geometry. One method is to use a HPGe with a proper efficiency. In our case we used a HPGe with a Co-60 poiunt source efficiency calibration. In case of wound contamination, washing with sterile salibne or water. The swads used must also be measured. Experience with contamination of skin and even wounds frequently indicates only a small proportion of radioactive material is absorbed systemically into the body. If residual conatmination remains in a puncture wound,* |

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| | | *simple wet debridement of the wound may be performed following standartd surgical procedures.* |
| | | ***<u>Estimation of doses</u>***<br>***The maximum dose rate in a normal situation, inside the van with such a cargo is 0.65 mSv/h.***<br>***The members of each team have worked at a mean distance of 0.5m for 3 hours. So, the maximum dose (worst case scenario) due to external radiation is about 0.8 µSv*** |
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**TABLE 1. Contents of packages involved in the accident**

| No. of packages | Types of packages | Radioisotope | Activity (Bq) | TI | Physical form |
|---|---|---|---|---|---|
| 50 | A | Mo-99 (Tc generators) | $3.7 \times 10^{10}$ | 1 | Solid |
| 150 | A | Tl-201 | $1.85 \times 10^{8}$ | 0.1 | Liquid |
| 50 | Excepted | I-125 | $2.2 \times 10^{6}$ | | Liquid |
| 5 | Excepted | Cs-137 | $1.1 \times 10^{6}$ | | Solid |
| 2 | A | Co-60 | $3.7 \times 10^{5}$ | 0.1 | Solid |
| | | | | | |
| 257 | | | $1.88 \times 10^{12}$ | | |

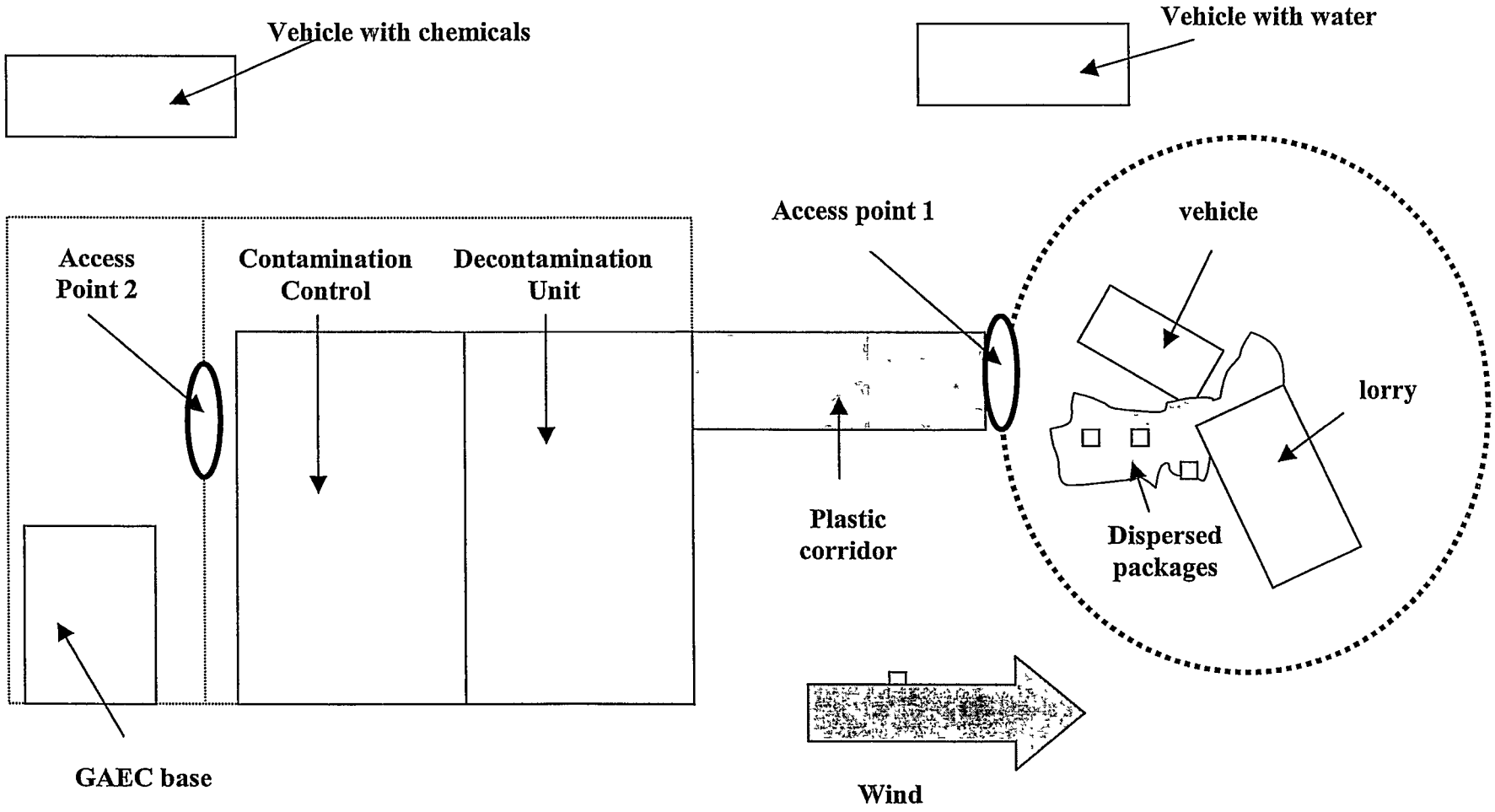
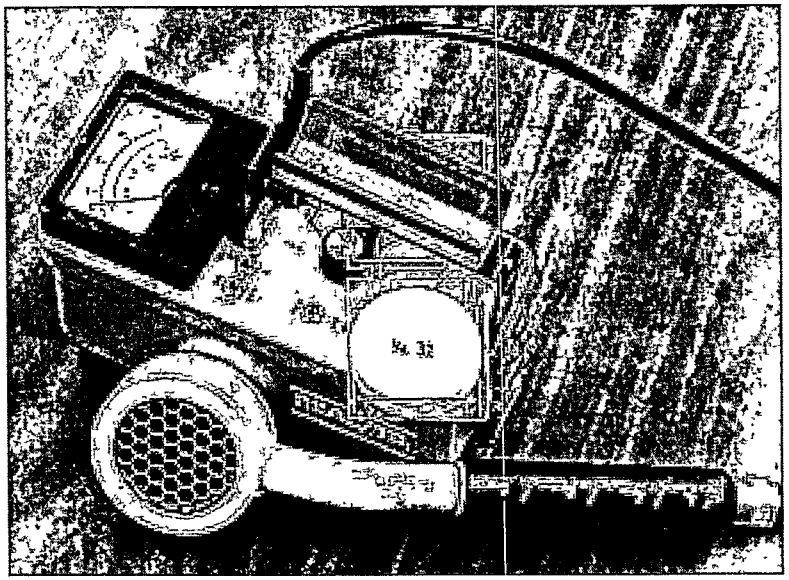
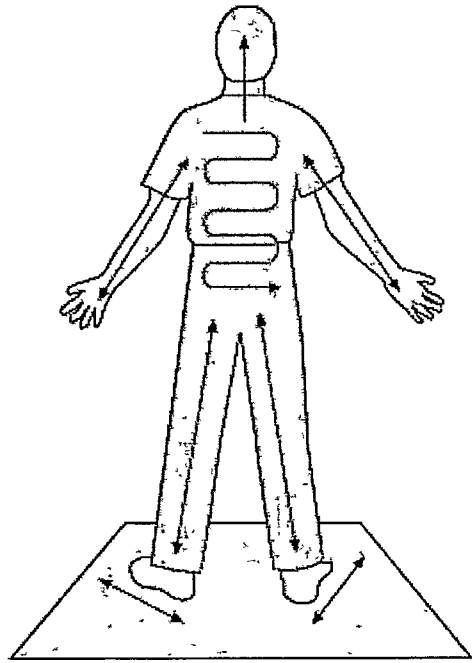



**Figure 1. Accident scene**





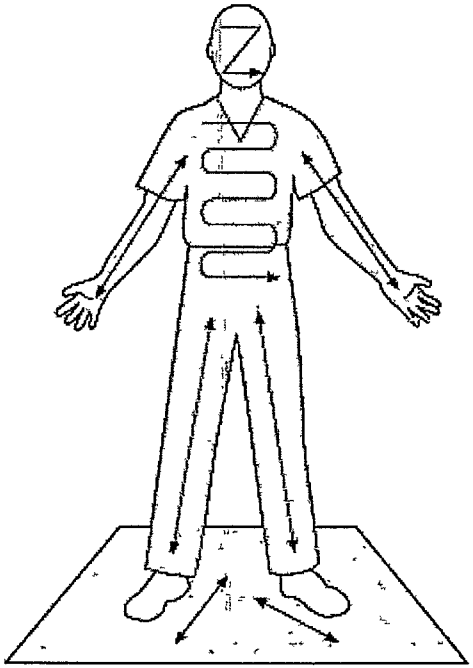


**Figure 3. Frisking technique**

| *Completed by:* *Personal Monitoring/ Decontamination Team* | **WORKSHEET A6** **PERSONAL CONTAMINATION CONTROL RECORD** | *No.* _____ |
|---|---|---|

Surveyed by: _____ Date: _____
(Full name)

Provide to: ☐ Emergency Manager Time: _____

Name of individual: _____ Ref. no.: _____

Address: _____

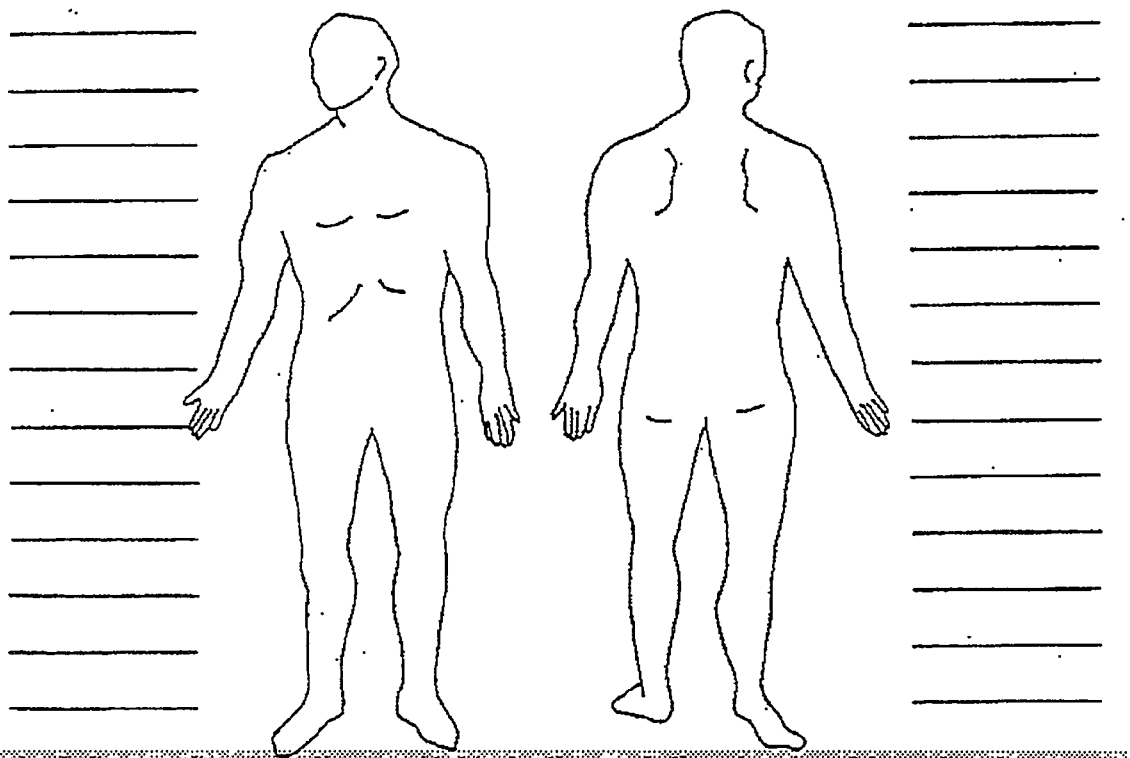
Sex: ☐ M ☐ F ☐ Emergency worker ☐ Evacuee

☐ Member of the public

***Contamination survey***

Instrument type: _____ Model: _____ Ser no.: _____

Background reading: _____ Detector active surface: _____ [$cm^2$]



**Remarks:** Indicate readings in the lines provided in the diagram. Indicate location of the readings by arrows. Only record readings greater than background.

Decontamination procedures necessary: ☐ Yes ☐ No

Results of thyroid survey: _____ [ ]
(net count rate) (Unit)

Further evaluation at medical facility necessary: ☐ Yes ☐ No

Surveyor signature: _____

| *Completed by:* *Personal Monitoring/ Decontamination Team* | **WORKSHEET A7** **PERSONAL DECONTAMINATION RECORD** | *No.* _____ |
|---|---|---|

Performed by: _____
(Full name)

Provide to: ☐ Emergency Manager

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Name of individual: _____ Ref. no.: _____

Address: _____

Date of birth: _____ Sex: ☐ M ☐ F

Injury involved: ☐ Yes ☐ No Specify: _____

Medical assistance utilized: ☐ Yes ☐ No Specify: _____

Date/Time decontamination begun: _____

Background reading: _____ [cps]

| Contamination location on body | Initial contamination level [cps] | Decontamination method and materials used | Final reading [cps] |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Date/Time decontamination was completed: _____

Remarks: _____

_____

Personal effects not returned: _____

_____

Decontamination procedures performed by: _____
(Signature)

Individual procedures performed on: _____
(Signature of individual)

| *Completed by: Environmental Survey or Personal Monitoring/ Decontamination Team* | **WORKSHEET A4a**<br>**VEHICLE CONTAMINATION SURVEY DATA SHEET** | *No.* _____ |
|---|---|---|

Surveyed by: _____
(Full name)

Provide to: ☐ Environmental Analyst/Radiological Assessor

Team no.: _____ Monitoring location: _____

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Vehicle license plate no.: _____ Driver's name: _____

Vehicle type:

☐ car ☐ truck ☐ van ☐ bus ☐ other: _____
(specify)

Contamination monitor used:

Type: _____ Model: _____ Ser no.: _____

| Date/time: | **Initial survey** / | | **After decontamination** / | |
|---|---|---|---|---|
| **Area monitored** | **Reading [cps]** | | **Reading [cps]** | |
| | $\alpha$ | $\beta+\gamma$ | $\alpha$ | $\beta+\gamma$ |
| Background | | | | |
| A. Front bumper | | | | |
| B. Rear bumper | | | | |
| C. RT. Front tire or wheel well | | | | |
| D. RT. Rear tire or wheel well | | | | |
| E. LT. Front tire or wheel well | | | | |
| F. LT. Rear tire or wheel well | | | | |
| G. Grill | | | | |
| H. Other exterior (specify) | | | | |
| a. | | | | |
| b. | | | | |
| c. | | | | |
| I. Air intake filter | | | | |
| J. Interior (specify) | | | | |
| a. | | | | |
| b. | | | | |
| c. | | | | |

***Smears***

| Sampling location | Area swapped [$cm^2$] | Date/Time | Smear code | Remark |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**Remark:** Deliver the smear samples to the Sample Analyst.

Vehicle impounded ☐ YES ☐ NO If YES, indicate reason below

**Comments:**

Team leader signature: _____