Integrated Technologies for Monitoring Hazardous Items Containing Fissile Materials in Storage and Transportation

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1. Introduction

Security of fissile materials is one of the main objectives of the Non-Proliferation Treaty.

Hazardous items containing fissile materials (U, Pu) from their manufacturing through reprocessing can be either in storage or in transportation.

A long time period (up to several years) features the storage stage and the transportation stage is characterized by increased hazard of fissile material loss.

To confirm security of hazardous item one needs to provide for continuous monitoring of container content at both stages of the life cycle.

2. Storage stage

VNIIA (the RF MINATOM) with the support of Sandia National laboratories (the US DOE) developed promising technologies for ensuring security of hazardous items.

Those technologies formed the basis of the automated hazardous item storage monitoring and remote inventory system (AMIS).

AMIS – storage incorporates several subsystems:

- Demonstration facility access control and monitoring;
- Video surveillance;
- Storage monitoring;
- Remote inventory;
- Data collection, processing, storage and transmission;
- Direct phone communication;
- Continuous electric power supply;
- Fire alarm.

Russian made "Operand T1" system is the core of the above information system.

AMIS structural diagram is shown in Fig.1.

AMIS - storage
structural diagram

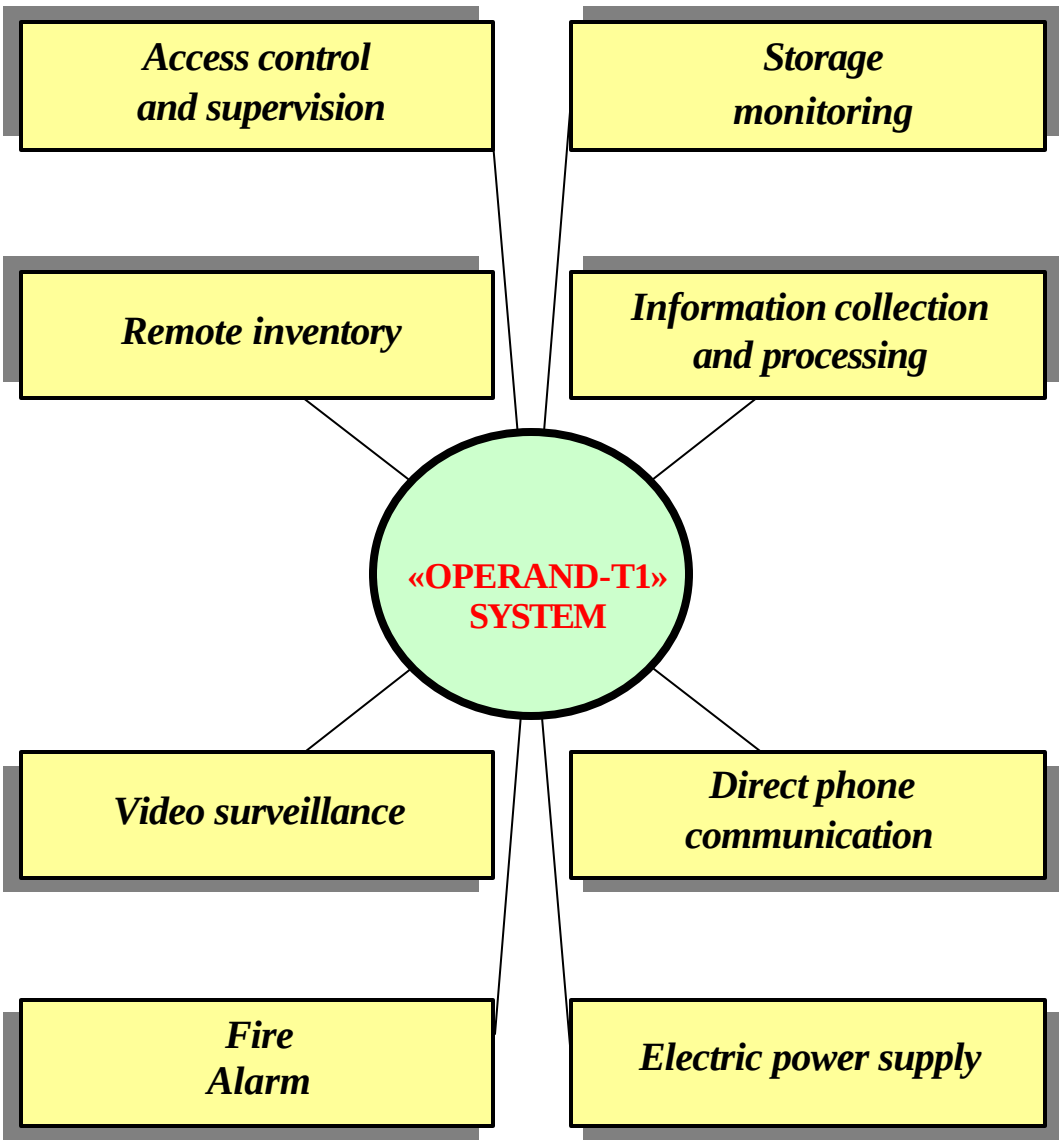

Fig. 1

AMIS – storage system meets the following objectives:

- Facility access control and monitoring;
- Hazardous item storage monitoring;
- Remote inventory of containers in storage vault;
- Collection, processing, storage and transmission of alphabetic and visual information at long distances.

That system was deployed at the demonstration facility located at two sites between which special communication channel for transmitting alphabetic and visual information was established.

A container control unit (CCU) plays the key role in hazardous item container monitoring and remote inventory.

CCU includes:

- Identification device;
- Seal with fiber-optic loop;
- CCU opening sensor;
- Radiation sensor;
- Temperature sensor;
- Self-contained power supply source;
- Self-contained power supply source replacement indicator;
- Off-line information storage unit.

CCU provides for monitoring of hazardous item container storage with registration of all events of container opening as well as remote inventory of all containers in storage.

In case of unauthorized opening of a container the "Operand T1" system uses the information received from CCU to generate alarm signal.

3. Transportation stage

At present the AMIS technologies are used for the development of a hazardous item transportation monitoring system (AMIS-transportation).

It should be noted that in the end of 90s "Eleron" company (Russia) developed an Automated Nuclear Material Rail Car Transportation Security System (ATSS).

However this system suffers two main disadvantages:

1) ATSS does not detect an event of container opening up and does not confirm that a container is in fact in a rail car.
2) A monitoring system continuously emits coordinates of a NM transportation vehicle location.

The AMIS-transportation system being under development at VNIIA does not have the above disadvantages.

1) The CCU is used for monitoring a container in a transport vehicle.

Opening up a hazardous item container is not envisaged during transportation.

The CCU detects that a container is in fact opened and transmits this information to the AMIS-transportation system.

Container removal from a transportation vehicle is accompanied either by disconnection of the CCU from the AMIS-transportation system or by braking the integrity of the CUU fiber-optic loop.

Both events are detected by the AMIS-transportation system and the system generates alarm signal.

2) The AMIS-transportation system confirms that a transport vehicle with hazardous item is in fact moving along the preset route.

A transport vehicle expected route (in form of either topographic or magnetic coordinates) is recorded in the AMIS-transportation PC.

As a transport vehicle moves along the preset route the AMIS-transportation system uses the GPS for taking measurements of actual topographic coordinates of a transport vehicle location or measures the Earth magnetic field vector X, Y, and Z with the help of special sensors.

After this the measured coordinates of a transport vehicle location are compared with those stored in the AMIS-transportation computer.

If a transport vehicle moves along the preset route a transmitter is not put on the air.

If a transport vehicle deviates from the preset route then the system generates alarm signal jointly with the geographic coordinates of vehicle actual location.

AMIS-transport structural diagram is shown in Fig.2.

4. Hazardous item continuous monitoring

Continuity of hazardous item monitoring can be ensured if at the storage and transportation stages and during movement of an item from a storage vault to a transportation vehicle one can determine item location and in case of unauthorized activities with a container alarm signal is generated.

By integrating the AMIS-storage and AMIS-transportation systems one can develop the continuous monitoring system (see Fig.3) that will ensure hazardous item security.

The key component of the hazardous item container monitoring at the storage (AMIS-storage) and transportation (AMIS-transportation) stages is the container control unit (CCU).

The CCU provides for detection of container opening and subsequent access to a hazardous item and also confirms that an item container is in fact in a storage vault or in a transport vehicle.

The AMIS-transportation system confirms that an item is transported along the preset route.

As it was mentioned above the CCU has a built-in electric power supply source that provides for the CCU continuous operation for at least 100 hours.

This allows for monitoring container content when a hazardous item is moved from a storage vault to a transport vehicle.

So application of the AMIS technologies provides for continuous monitoring and confirmation of security of hazardous item at the main operational stages.

5. Conclusions

5.1 VNIIA (the RF MINATOM) with the support of Sandia National Laboratories (the US DOE) developed promising technologies for monitoring containers with hazardous items containing fissile materials. Those technologies were incorporated in the AMIS system.

5.2 On the basis of the integrated AMIS technologies one can develop a system for confirming security of hazardous items at all operational stages.

AMIS - transportation structural diagram

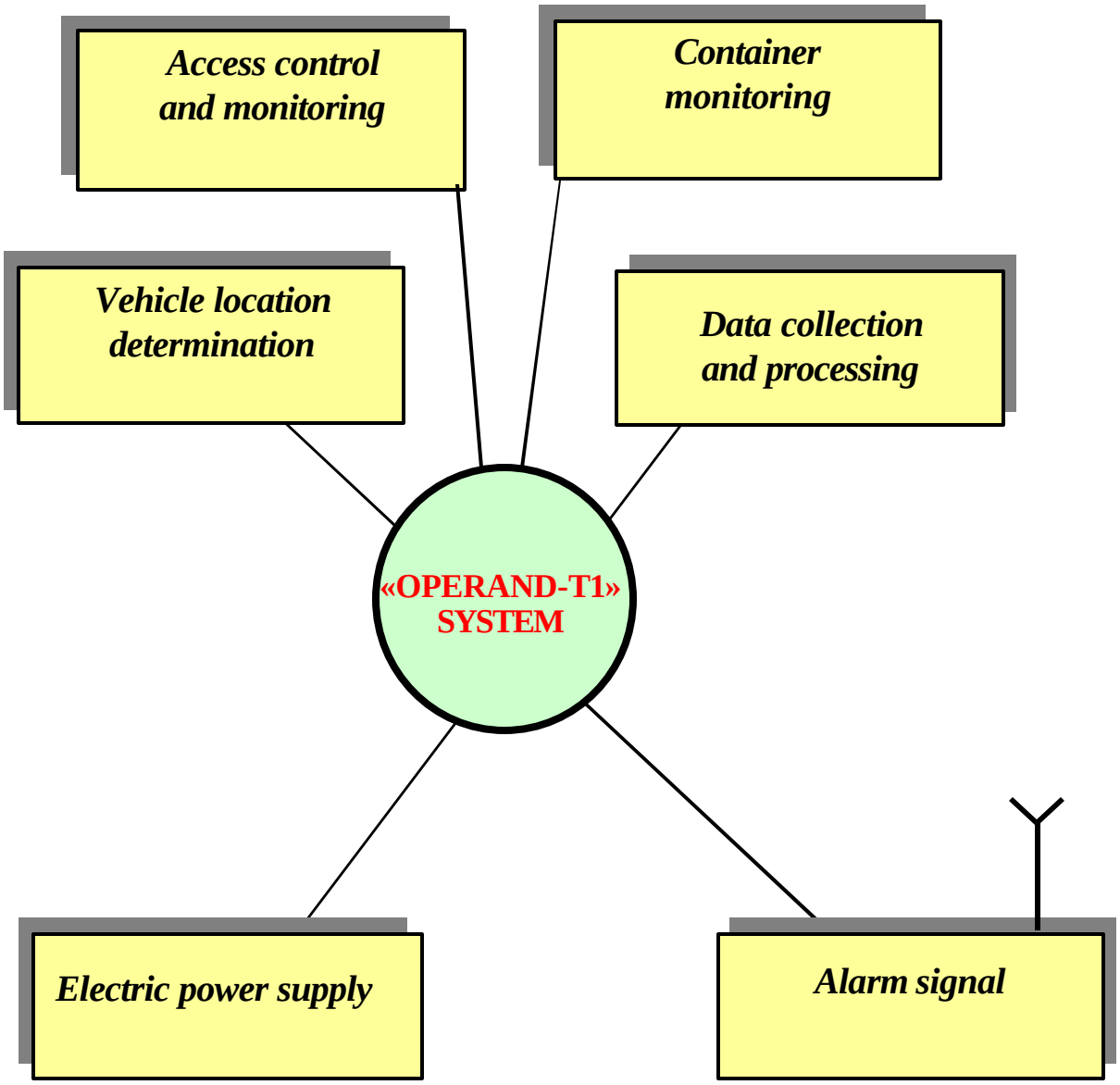

Fig. 2

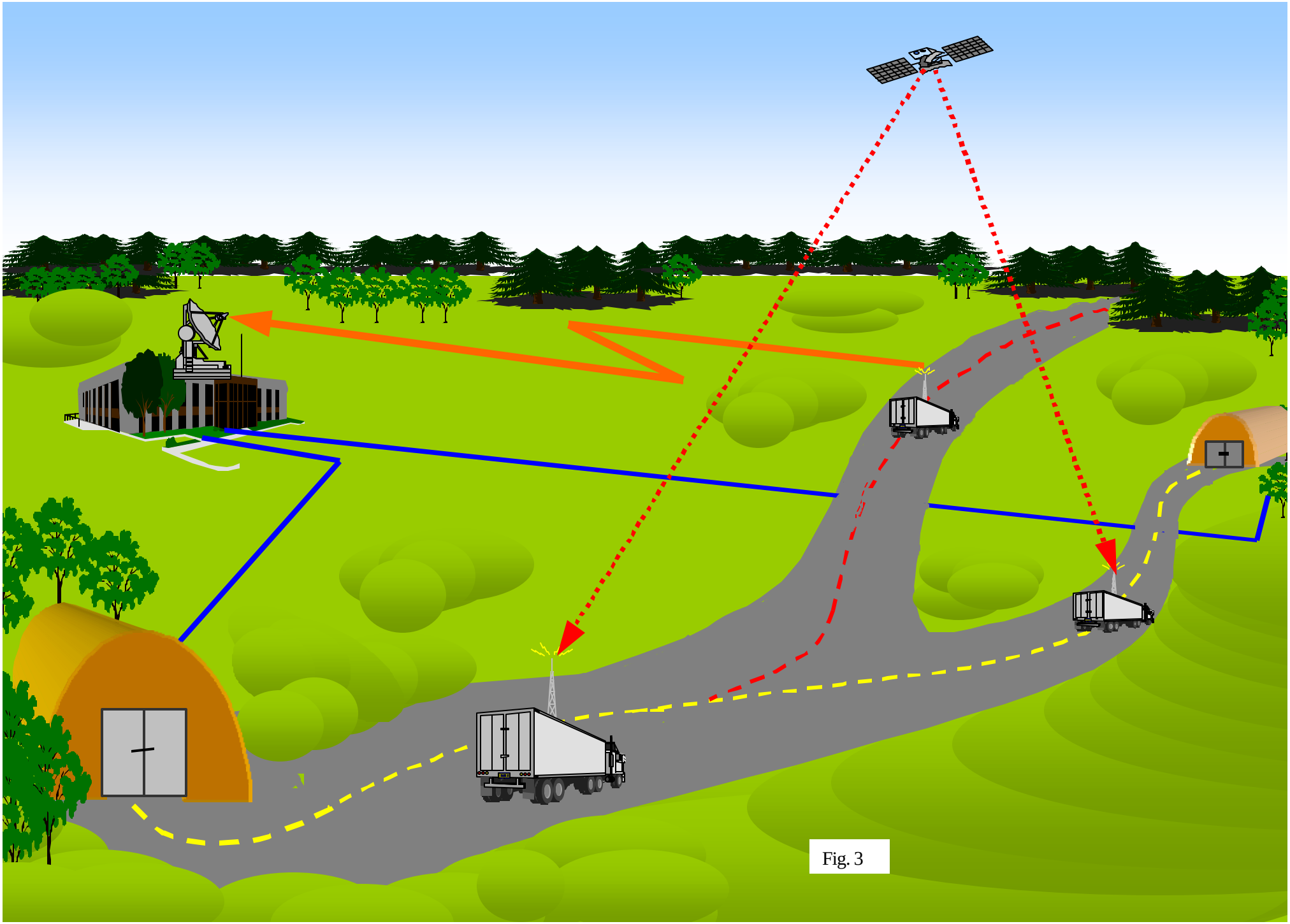

Fig. 3