LESSONS LEARNED

REGARDING PHYSICAL PROTECTION SYSTEM AT VVR-S NUCLEAR RESEARCH REACTOR FROM IFIN-HH TO IMPLEMENT PREPARATORY MEASURE FOR LOADING HEU AND LEU NUCLEAR SPENT FUEL ASSEMBLIES, LOADING ACTIVITIES AND SHIPMENTS BY ROAD AND AIR FROM ROMANIA TO THE RUSSIAN FEDERATION

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International and National Context (2003-2012)

- Active Global Threats Reduction Initiative sustained by USA and the Russian Federation:
  - - removal the nuclear fresh fuel and nuclear spent fuel HEU type from nuclear research reactor and repatriation to the origin countries (USA or the Russian Federation) only comply with: the nuclear research reactor it is in permanent shutdown in the aim to be decommissioning or change the HEU type core zone to LEU type core zone;
- Nuclear Research Reactor VVR-S from IFIN-HH permanent shutdown from 2002 by Romanian Governmental Decision in the aim to be decommissioning;
- During the 40 years (1957-1997) of operation of VVR-S Research Reactor resulted nuclear spent fuel HEU S-36 and LEU EK-10 origin Former Soviet Union;

International and National Context (2003-2012)

- Active Global Threats Reduction Initiative sustained by USA and the Russian Federation, the international project Russian Research reactor Fuel Return-RRRFR:
- Technical Characteristics of VVR-S Reactor: 2 MWth, 9.52 GW/d used for scientific research and radioisotopes production;
- Enhanced the Physical Protection System (PPS) from Reactor and Spent Nuclear Fuel Storage Ponds (2000-2009)
- Spent Nuclear Fuel HEU type S-36 was repatriated in the Russian Federation since June 2009 with technical and financial assistance from USA-DoE and NNSA, Idaho National Laboratory -INL, one shipment multimodal road-air-road, first shipment by air (RO-RU) from the world using the air commercial line;
- Spent Nuclear Fuel LEU type EK-10 was repatriated in the Russian Federation in the same mode with 3 shipments since 2012, with financial support from State Budget.
- From December 2012 no fresh or spent fuel on the IFIN-HH site.

International and National Context (2003-2012)

- In the RRRFR project Romania participated in the preparatory phase from:
- **Romania:** Research and Innovation Ministry, Public Finance Ministry-General Directorate of Romanian Custom, "Horia Hulubei" National Institute for Research and Development in Physics and Nuclear Engineering-IFIN-HH; National Commission for Nuclear Activities Control –CNCAN, Nuclear Agency and Radioactive Waste, External Affaire Ministry-National Agency for Export Control –ANCEX, Ministry of Interior Affaire- General Inspectorate for Romanian Cross Border Police-IGPFR, General Inspectorate for Romanian Police-IGPR, General Inspectorate for Romanian Gendarmerie IGJR, Intelligence Romanian Services- AT Brigade, Romanian Chamber for Commerce and Industry.

- **International Organizations**: USA DOE, NNSA, INL, IAEA, EU-Directortate Geeneral for Energy and Transportation, ROSATOM, Federal Center for Radiological and Nuclear Safety, Radiochemical Company MAYAK, Sosny Company, Volga Dnepr airlines, European Atomic Pool

The principal moments in the history of the nuclear research reactor VVR-S from IFIN-HH

- 1997, shutdown after 40 years of operation, and regulatory framework preservation license (1998-2002);
- 2002- permanent shutdown for decommissioning based on the Romanian Government Decision;
- 2003-2009, transition phase from preservation phase to decommissioning phase, maintain and enhance the PPS with own funds and with technical and financial support from USA, DoE, Argonne National Laboratory, cooperation with Idaho National Laboratory in the RRRFR-GTRI project to organize the repatriation of spent nuclear fuel to the Russian Federation, cooperation with IAEA in TCP ROM 04/029 for decommissioning, with the European Commission – PHARE project, cooperation with Sandia National Laboratory to up-grade the PPS;
- 2003, repatriation to the Russian Federation of the fresh nuclear fuel, S-36 rods, that remains unused in the core zone of the VVR-S Reactor;

The principal moments in the history of the nuclear research reactor VVR-S from IFIN-HH

- 2005-2009, implementing preparatory activities for repatriation of the HEU SNF S-36 to the Russian Federation;
- 2008- CNCAN approved the Decommissioning Plan for VVR-AS reactor aiming to implement the immediate dismantling strategy;
- 2009- the Romanian Government approved the funds from the State budget (2010-2020) to decommission the VVR-S Reactor, to repatriate the LEU SNF EK-10 to the Russian Federation, and to upgrade the Radioactive Waste Treatment Plant from IFIN-HH;
- 2009- the first shipment from Romania to the Russian Federation of the HEU-SNF assemblies with fully technical and financial support from USA DoE NNSA, followed by the multimodal road-air-road transportation of assemblies with transportation cask TUK-19, by commercial line airplane for the first time in the world;
- 2010-2012 preparatory activities for repatriation of the LEU SNF EK-10 and for implementation of the decommissioning project; 2012- three shipments of SNF LEU assemblies by road-air-road to the Russian Federation (June, November, December), no SNF left on the IFIN-HH site;
- starting the decommissioning of the VVR-S Reactor with own equipment and own workers-maintaining the PPS active, based on DBT approved by CNCAN.

The PPS characteristics

Requirements for Physical Protection System (PPS) issued by license from CNCAN, for design, develop, implement, maintain and continuously enhance the PPS;

Design and guard of the installation based on DBT;

The Romanian Gendarmerie ensures the guard and protection of the nuclear site according to the Plan for guard and protection approved by CNCAN;

IFIN-HH develops and implements means and procedures for evaluations, including performance testing, and maintenance of the physical protection system, in accordance with license requirements, Integrated Management System, Romanian Regulation for Quality Management, Romanian Regulation on the physical protection in the nuclear field, nuclear material accountancy and control measures to deter and detect the potential theft of nuclear materials;

In order to reduce the threats the techniques from the risk management concept were applied:

- protection of sensitive information, classified documentation;
- deterrence of robust PPS;
- defence in depth;
- establishes and maintains an effective nuclear safety and security culture for organization, managers and individuals.

Lessons Learned (1)

- the team taking part in those actions was built, the leaders were appointed for the teams handlings the assemblies, the transportation cask and for transferring the assemblies from the cooling pond to the transportation cask TUK-19, for the team ensuring radioprotection, for the team ensuring the labelling of transportation casks and the ISO container;
- the team members signed a confidentiality agreement and were verified and attested by ORNISS (National Register for Secret State Information);
- the team members attended a nuclear training course authorised by CNCAN for a duration of 3 weeks;
- they attended practical training, based on procedures, in the reactor hall regarding the activities for loading and handling the containers.

Lessons Learned (2)

- based on the physical protection principle “defence in depth” an additional fence was designed and built around the reactor and the platform for parking the motor vehicles authorised to transport the spent nuclear fuel casks from IFIN-HH to Bucharest-Otopeni Henry Coanda Airport, setting up a point of guard and control at the entrance to the fenced area, video camera mounting in all the area and installing an intervention team of the gendarmerie in the area intended for parking the motor vehicles loaded with containers;
- the access routes and the platform for parking the motor vehicles were consolidated;

Lessons Learned (3)

- the Security Plan was elaborated for the transfer of spent fuel assemblies from the reactor neighbouring building to the reactor hall and storage in the cooling pond from the Reactor Hall, where the loading procedures approved by CNCAN were implemented;
- the Guard and Protection Plan was elaborated by the Romanian Gendarmerie and approved by CNCAN for the transport of empty and full TUK 19 casks;
- the Plan for intervention in radiological and nuclear emergencies during loading operations, road transport from the institute to Bucharest-Otopeni Airport;

Lessons Learned (4)

- throughout the loading operations of the spent fuel assemblies (1 week) the teams were accommodated in a hotel, avoiding contact with the media, other unauthorised persons, thus strengthening team spirit, with the activity starting always at 8 a.m., the lunch break at 1 p.m. for all team members, the IAEA, EU and CNCAN safeguards inspectors leaving the reactor hall at the same time, sealing the pool containing the SNF assemblies and unsealing upon return, 7 p.m. being the time for ending all activity for the day;
- the following were elaborated, approved and used: import licence, export licence, license from strategic export agency, insurance, report for nuclear safety for loading and transportation by road and by air, license for transportation cask and for ISO container, authorization for expedition;

Lessons Learned (5)

- collaboration with road administrators for the main route and for the secondary route for transport from IFIN-HH to the airport in order to remove obstacles (fallen trees, heavy precipitation, etc.), collaboration with the airport administration and security, collaboration with the General Inspectorate of the Romanian Police that ensured traffic flow and aerial surveillance of the convoy;

- introducing in the convoy the emergency intervention vehicle, a self-supporting crane and an additional vehicle without ISO container, to move the ISO container from the truck with technical problems to the a spare truck;

CONCLUSIONS

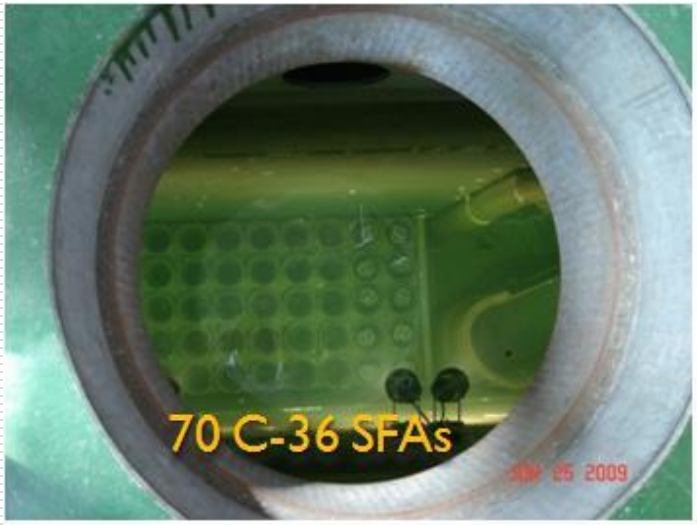
- The repatriation of the LEU and HEU spent nuclear fuel assemblies from the nuclear research reactor VVR-S Magurele, IFIN-HH to the Russian Federation with four shipments by road-air-road was a great success. No any incident, accident or delay of the actions planned were produced. The principal lessons learned were:
- - very good theoretical and practical training in the authorised Training Center from IFIN-HH for all participants in these actions;
- - all communication with partners involved in these actions were classified document regarding date and hour for expedition and shipments;
- - excellent cooperation with institution and authorities from Romania-CNCAN, ANCEX, IGJR-BSIJ, IGPR, Airport Bucharest Otopeni-Henry Coanda, IGPFR, DGV, from the Russian Federation, from the EU Directorate for Energy, Safeguards Section, from the International Atomic Energy Agency-Vienna, Safeguards Section;

Acknowledgements

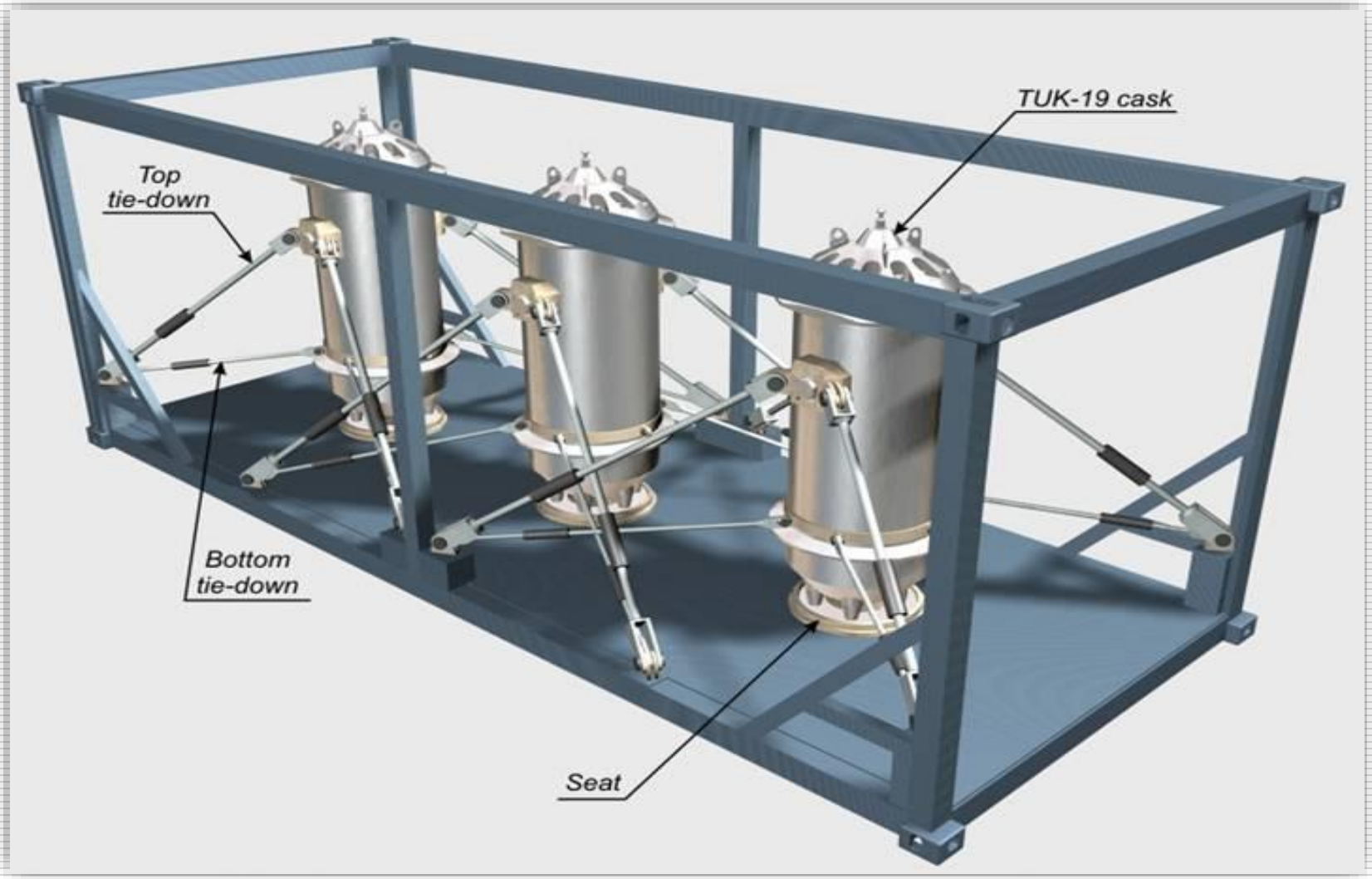
- United State of America, Department Of Energy, National Nuclear Security Administration, Idaho National Laboratory, that ensured technical and financial support to organize first air shipment by commercial line airplane from Romania to the Russian Federation with HEU SNF S-36 in the framework of the project Russian Research Reactor Fuel Return (RRRFR), GTRI.

Reactor Building

Shipment details

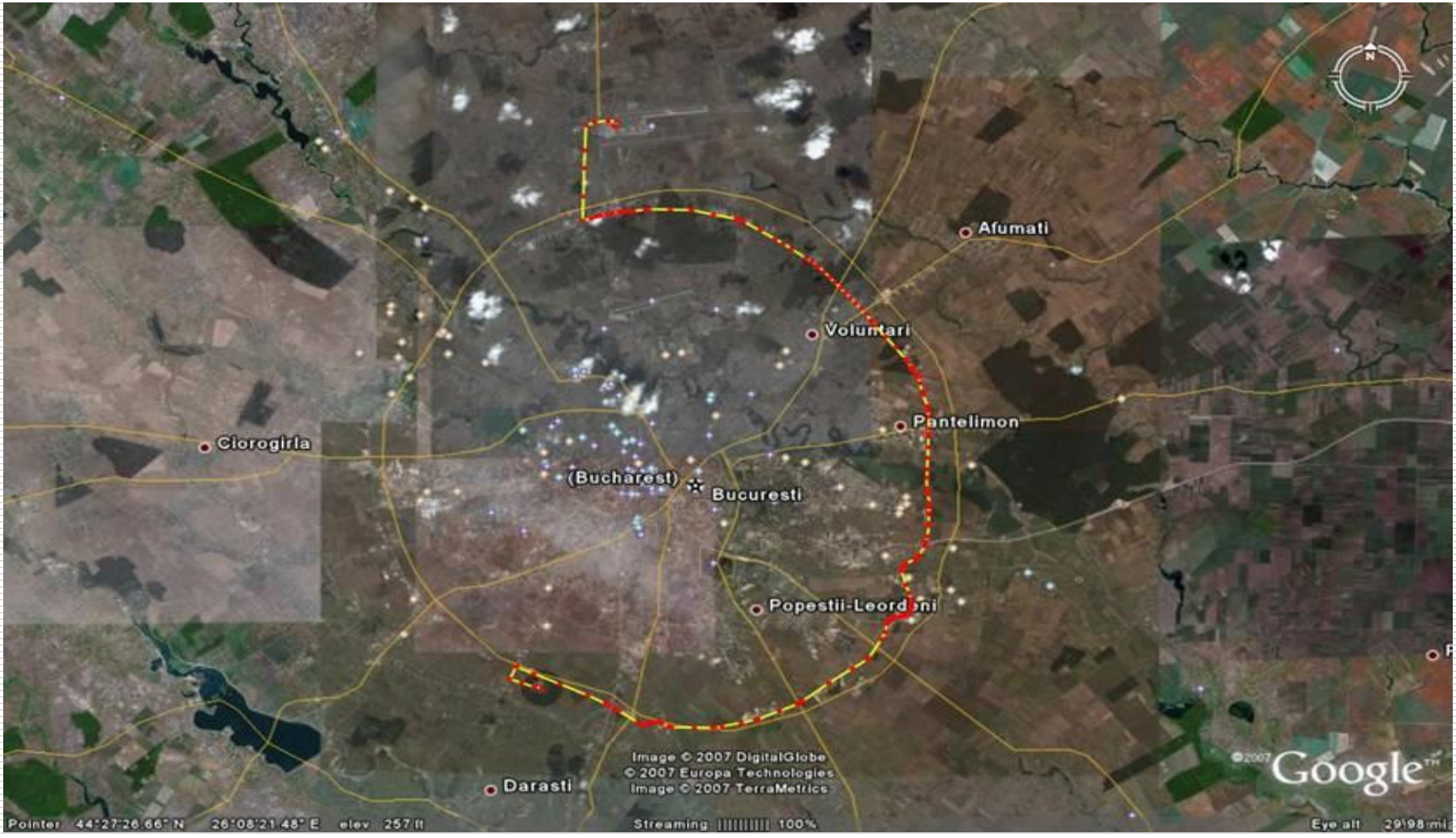


Freight ISO container for TUK-19 air shipment

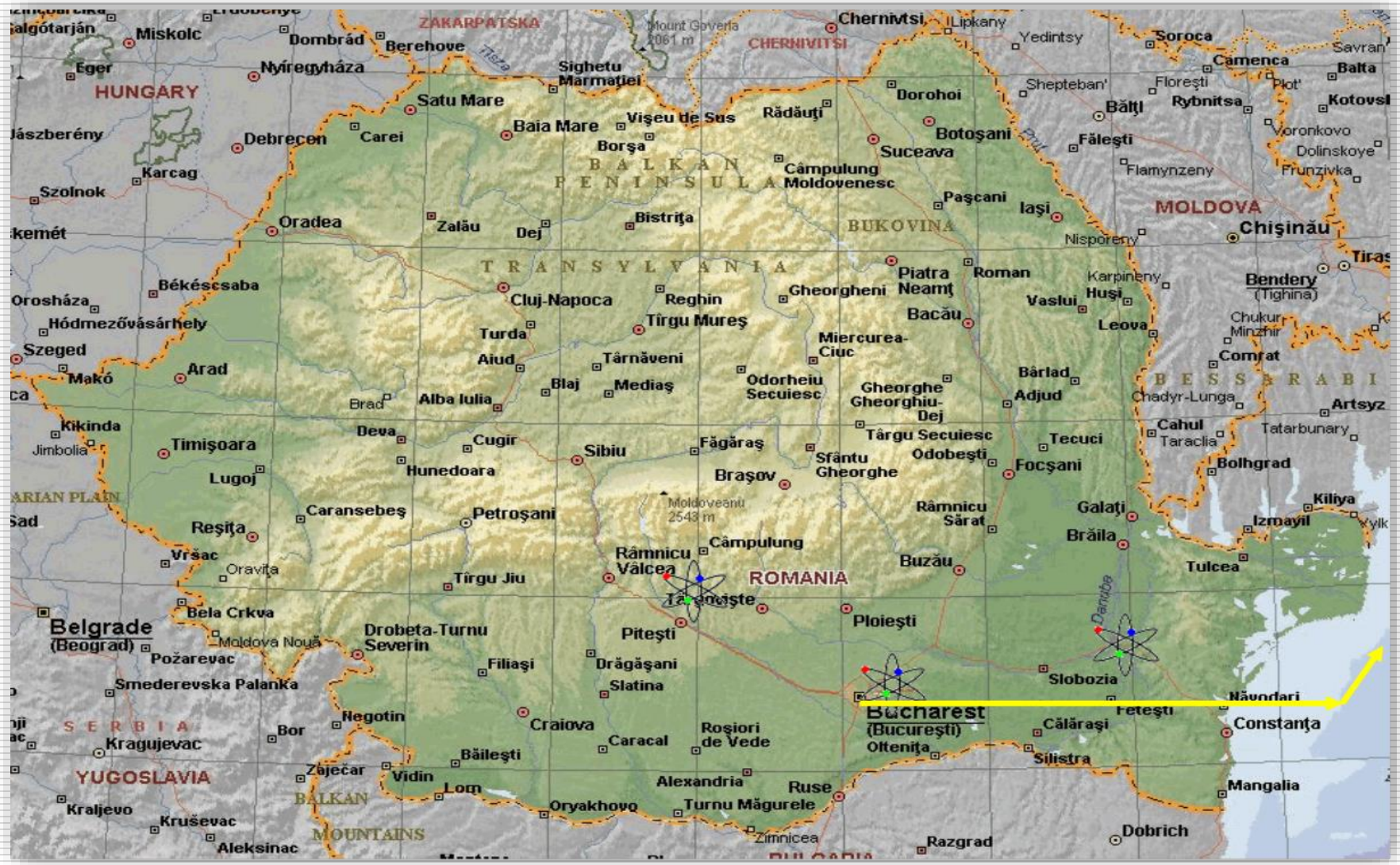


Loading SNF and surveilance

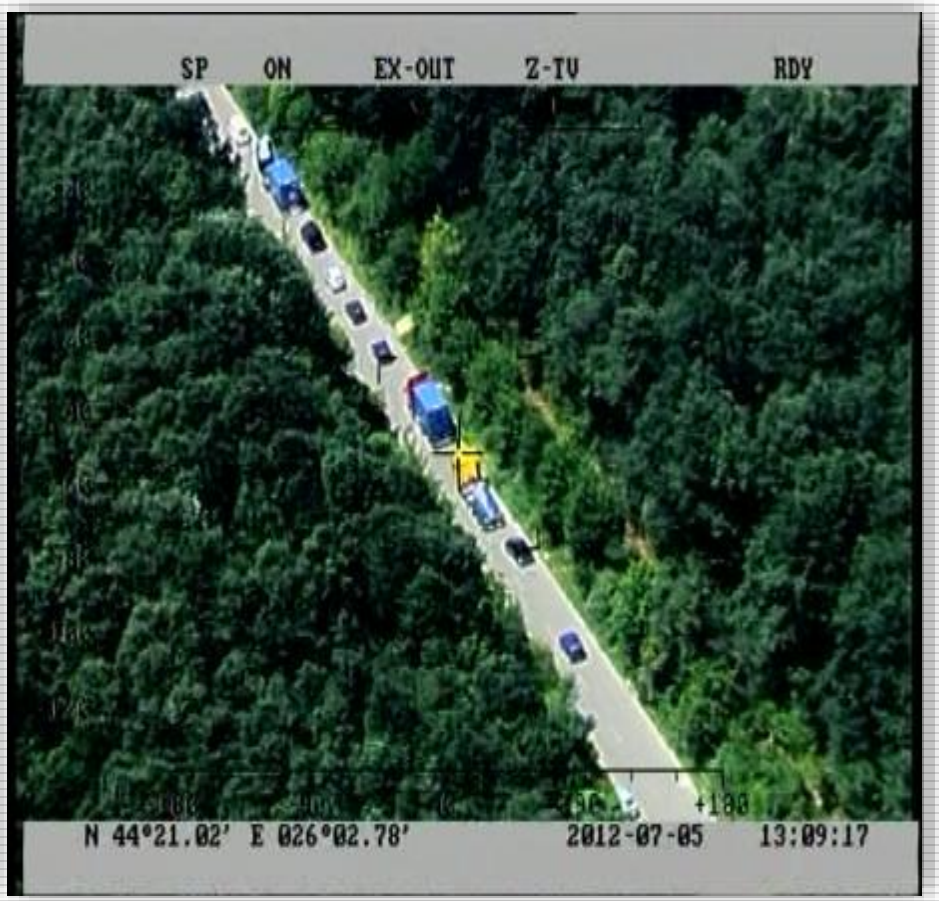
Terrestrial Route: IFIN-HH Magurele-Airport Bucharest Otopeni



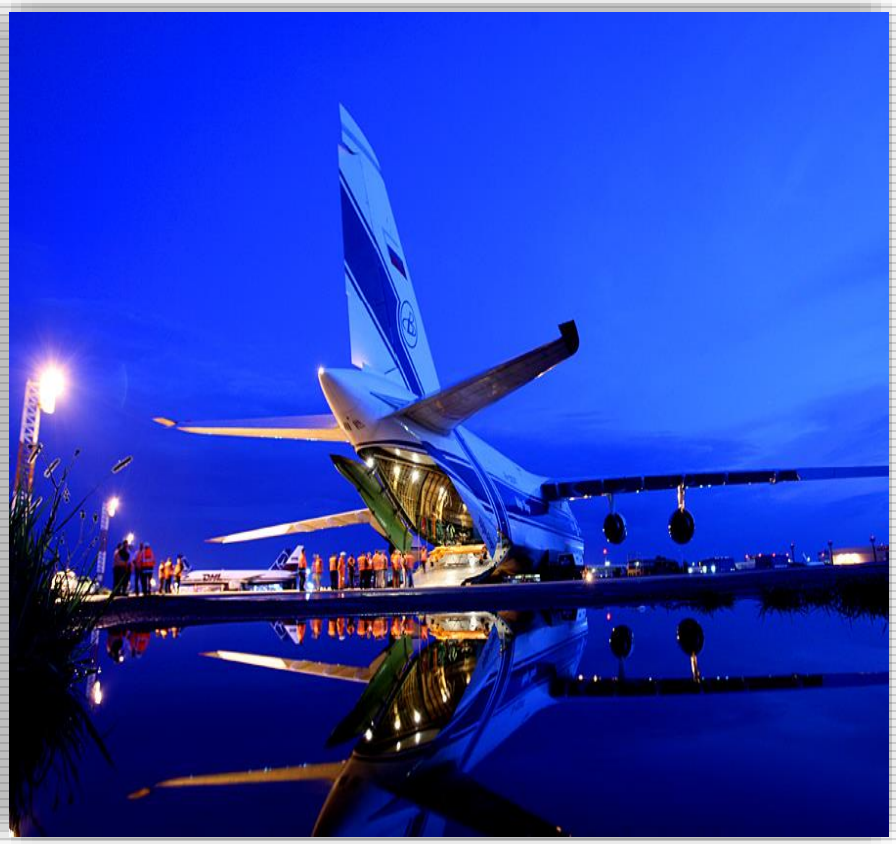
Air Shipment Route



Loading freight ISO container in airplane, road route of the convoy



ISO container with TUK 19 loaded in aircraft



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