International Conference on the Safe and Secure Transport of Nuclear and Radioactive Material
IAEA Headquarters
Vienna, Austria 23–27 March 2026 (IAEA)

Safety and security during the transportation process of the Gamma Knife system using the SAFRAN program

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ABSTRACT

•The Gamma Knife is a highly sensitive and specialized medical device used in neurosurgery to treat brain tumors with precise radiation. Transporting this equipment, especially when it contains radioactive sources, requires strict adherence to safety and security protocols to prevent physical damage, radiation exposure, or security breaches.

•This study evaluates the safe and reliable transport of the Gamma Knife system from Basra International Airport in Basra Governorate to Al-Sadr Teaching Hospital, using SAFRAN software. SAFRAN program is a project management tool widely used in critical industries such as nuclear energy and defense. It enables comprehensive risk assessment, scheduling, emergency planning, and real-time monitoring.

•Using SAFRAN software to transport sensitive equipment such as the Gama Knife system is no longer an option; it's a necessity dictated by safety and operational precision. By providing an integrated digital environment for planning and monitoring, the software increases transport efficiency and ensures the safe arrival of equipment without material or technical losses. With the continuous advancement of technology, the importance of such software solutions is expected to increase in supporting vital transport operations, especially in complex environments such as Iraq.

•Keywords : Gamma Knife ,Safety, Transportation, SAFRAN, Emergency

1. INTRODUCTION

The Gamma Knife system is an advanced medical device used to treat brain tumors with high precision, delivering concentrated doses of radiation to the targeted tissue without surgical intervention. Due to the precision and sensitivity of this device, as well as the fact that it sometimes contains radioactive sources, transporting it from one location to another is a complex process that requires careful planning and strict safety and security controls.

Given the technical, environmental, and security challenges that may face the transport process, there is a need to utilize advanced project management and risk analysis tools, such as the SAFRAN software, which is used globally in highly sensitive sectors such as nuclear energy, defense, and aerospace. This software enables integrated project management, from planning and scheduling to risk assessment, performance monitoring, and emergency response.

This study aims to evaluate the safety and security aspects of transporting the Gamma Knife system from Baghdad Governorate to Saad Al-Watri Hospital, analyzing the process using the SAFRAN software as an applied model to minimize risks and ensure the successful transport without human or material damage.

. Gamma Knife Radiotherapy:

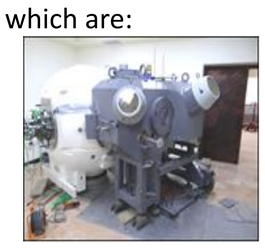
This is a modern and advanced device designed to treat deep brain tumors with a diameter of no more than 3 cm without the need to open the skull. It utilizes the high radiation energy of the radioactive cobalt isotope Co-60, which is present within the system in the form of a group of sources. Radiotherapy is one of the stages of cancer treatment aimed at destroying tumor tissue and preserving healthy tissue, in addition to treating some non-cancerous brain diseases.

The radiation energy emitted by the Co-60 isotope produces a beta particle and a gamma photon with an average energy of 1.25 MeV. Only gamma rays are used in treatment, excluding beta rays. The half-life of cobalt-60 is estimated at 5.27 years, meaning its radioactivity decreases by 50% after 5.27 years. Therefore, the decrease is proportional to the exposure rate and the absorbed dose rate. Therefore, the time required to deliver the dose increases proportionally with the decrease in the radiation dose rate

The cobalt source is placed in a container called the treatment head, shielded with lead to reduce exposure everywhere except the beneficial beam, where the gamma ray directs its full energy to the area to be treated. The device was imported by the Swedish company Alecta Instruments, a contractor with the Ministry of Health - General Company for Marketing Medicines and Medical Supplies (Kimadia), for the Basra Health Directorate/Al-Sadr Teaching Hospital. The radioactivity of the source, manufactured by the Canadian company Nordion, is 5935.7 Ci. This radioactivity represents the total radioactivity of the 192 sources comprising the device. The source belongs to Security Group A and Category 1 according to the International Atomic Energy Agency classification. The old Gamma Knife device, which contains a cobalt-60 source, consists of a patient bed that moves along

3.Transportation Challenges:

Transporting such systems faces several challenges, the most prominent of which are:



- Large weight and size.
- High sensitivity to vibration and shock.
- Risk of theft or vandalism during transport.
- Environmental factors (heat, humidity).
- Lack of logistics infrastructure in some areas.

4. Safety Procedures During Transport:

To avoid risks, a number of standard procedures are implemented, including:

- The use of special shock-resistant shipping boxes.
- Trained security escorts accompany the convoy.
- Pre-planned safe routes are identified.
- Container integrity is verified using smart sensors.
- Implementation of tracking and monitoring systems.
- 5. Safran and its Role in Enhancing Safety:
- Safran is an integrated software used to manage and track highly sensitive logistics operations. The software enables users to:
- Track equipment in real time via satellite.
- Analyze potential hazards along the transportation route.
- Accurate route and time planning.
- Comprehensive visual and graphic documentation of all stages.
- Predict anomalies and make proactive decisions.
- 6. Description of the process of transporting a similar system using the SAFRAN program
- 6.1. Description:
- A precision diagnostic medical device (the Gamma Knife system in terms of sensitivity) was transported from Basra International Airport to Al-Sadr Teaching Hospital in Basra Governorate.
- 6.2. Process Details:

Origin: Basra International Airport
Destination: Al-Sadr Teaching Hospital
Distance: Approximately 20 kilometers
Transportation Time: 2 hours
System: High-resolution thermal imaging device

3. Process Steps Using SAFRAN:

System Information Entry: The device was classified as "sensitive asset - high risk" within the software.

Route Selection: The software used updated maps to determine the optimal route away from congestion or hazardous areas.

Sensor Monitoring: The container was equipped with shock and temperature sensors, directly connected to the software.

Security Escort: Based on the software's assessment, a two-vehicle security escort was assigned to protect the shipment.

Real-Time Monitoring: Real-time monitoring was provided via the control center using the software's built-in GPS system.

Early Alert: SAFRAN sent an immediate alert when an unplanned stop occurred at a checkpoint, which was immediately addressed.

 Receipt and Documentation: Upon arrival, documentation and delivery of the device without any damage.

7. Results and Recommendations:

7.1.Results

The SAFRAN program provided a high degree of control and monitoring throughout the transportation process.

The program reduced the potential for human error and delays.

Provided accurate documentation that can be used for later evaluation or auditing.

8. Recommendations:

Formalize the SAFRAN program for the transportation of all critical systems.

- Train logistics teams to handle the program efficiently.
- Update the program's risk maps periodically.

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