

Challenges and Lessons Learned in Offshore Transport of Radioactive Tracer Sources

Abstract

This paper analyzes challenges and lessons learned from transporting radioactive tracer sources to offshore oil platforms, emphasizing safety protocols, regulatory compliance, and operational efficiency. A case study involving Bromine-82 transport with 300 mCi activity demonstrates successful multi-modal transportation from reactor facility to offshore platform, providing insights for future operations.

Introduction

Offshore radiotracer applications require complex transportation of radioactive sources to remote marine platforms. This study documents operational experience from a successful Bromine-82 transport mission, highlighting critical coordination, safety, and regulatory considerations for high-activity source movement in offshore environments.

Methodology

Tracer Preparation

Bromine-82 was selected for water and hydrocarbon tracing based on its 35.3-hour half-life and suitable chemical properties. Two compounds were irradiated using the TRIGA-PUSPATI reactor at Malaysian Nuclear Agency:

- Ammonium Bromide (NH_4Br)
- 1,4-Dibromobenzene ($\text{C}_6\text{H}_4\text{Br}_2$)

Precise irradiation timing was critical to achieve activity levels exceeding 300 mCi while accounting for decay during transport.

Transportation Process

The multi-modal transport chain included:

1. Post-irradiation cooling: 24-hour mandatory cooling period
2. Ground transport: Reactor facility to Kuala Lumpur International Airport (1 hour)
3. Air transport: KLIA to Miri, Sarawak
4. Marine transport: Bintulu to offshore platform (4 hours)

All procedures adhered to International Air Transport Association (IATA) standards, Department of Atomic Energy Malaysia (ATOM Malaysia) regulations, and International Atomic Energy Agency (IAEA) guidelines. Sources were secured in lead-shielded containers throughout transport.

Offshore Operations

Upon platform arrival, strict safety protocols were implemented including mandatory personal protective equipment and continuous monitoring. Timing coordination was critical to account for radioactive decay while maintaining operational efficiency.

Key Challenges

1. Tracer Preparation
 - Achieving optimal irradiation timing to meet activity requirements
 - Balancing production scheduling with transport logistics
 - Implementing quality control for irradiated materials
2. Transportation Logistics
 - Managing regulatory compliance across multiple transport modes
 - Coordinating timing between air and marine transport segments
 - Handling radioactive decay calculations throughout the transport chain
3. Offshore Execution
 - Implementing safety protocols in remote environments
 - Coordinating personnel and equipment for timely execution
 - Maintaining comprehensive documentation and monitoring

Lessons Learned

Preparation Phase

Establish clear protocols for tracer preparation timing with robust quality assurance procedures. Develop contingency plans for production delays to ensure operational flexibility.

Transportation Management

Enhanced coordination between transport modes is essential. Improved decay calculation procedures and strengthened relationships with regulatory authorities and transport providers significantly improve operational success.

Operational Execution

Refined safety protocols for offshore environments, improved timing coordination, and enhanced data recording procedures are critical for successful operations.

Results and Discussion

The operation was successfully completed with all regulatory requirements met. Key success factors included comprehensive pre-planning, strict regulatory compliance, effective multi-agency coordination, and robust safety management throughout all operational phases. The experience demonstrated that complex radioactive material transport to remote offshore locations is feasible when proper procedures, coordination, and safety measures are implemented. The multi-modal transport approach proved effective, though timing coordination remains critical due to the 35.3-hour half-life of Bromine-82.

Conclusion

This successful offshore radiotracer transport operation provides valuable insights for future similar applications. The experience emphasizes the importance of meticulous planning, regulatory compliance, and safety management in radioactive material transport to offshore facilities. Effective coordination between preparation, transportation, and execution phases is essential for operational success. The findings contribute to improved safety and efficiency protocols for offshore radiotracer applications, demonstrating that with proper procedures and coordination, complex radioactive source transport to remote marine platforms can be executed safely and effectively.

References

1. Mohd Amirul Syafiq Mohd Yunos, et al. (2020), "Liquid Radiotracing on HP Flare KO Drum (V-6200) at Kuantan Cluster Development Platform (KAKG-A) using Industrial Radiotracer", Confidential Report NUKLEAR MALAYSIA/L/2020/82.

Country or International Organization

Instructions

Author: ABDULRAHMAN, MohdFitri (Dr)

Co-authors: Mr DAHING, Lahasen; Dr MOHD YUNOS, MOHD AMIRUL SYAFIQ (Malaysian Nuclear Agency); Mr YAHYA, Roslan

Presenter: ABDULRAHMAN, MohdFitri (Dr)

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