Security Analysis of Disused Teletherapy Cobalt-60 Sources Transport Container Using Attack Tree Analysis Method

Harkamaya Nursetya Putra, Ester Wijayanti, Anung Muharini

Department of Nuclear Engineering and Engineering Physics, Universitas Gadjah Mada
Jl. Grafika 2, Yogyakarta 55281, Indonesia
harkamaya.n.p@mail.ugm.ac.id

1. Background and Goal

The disused sealed radioactive sources (DSRS) from the Teletherapy ^{60}Co unit are classified into intermediate-level waste (ILW) with about 10^{14} Bq of activity (A). Based on the Government Regulation of The Republic of Indonesia No. 61 of 2013, the waste must be sent to the Center for Radioactive Waste Management (PTLR) of the National Nuclear Energy Agency of Indonesia (BATAN). This process requires a transport container. However, the number of containers presently owned by PTLR is very limited, while the cost to buy a new container is high. To overcome this problem, it is necessary to develop a new transport container at a more affordable price. One of the aspects that need to be addressed in a container design is security because the waste with such a high activity has the potential to be misused. This study was conducted to analyze what threats might occur to the Teletherapy ^{60}Co DSRS during the transportation process and the security measure needed to be implemented in the transport container design to anticipate it.

2. Transport Security Level

- Refers to IAEA Safety Standards Series No. RS-G-1.9, the Teletherapy ^{60}Co DSRS is classified into category 1 sources with a specific activity value (D) of 3×10^{-2} TBq and an A/D ratio ≥ 1000.
- Based on BAPETEN's Chairman Regulation No. 6 of 2015 on Security of Radioactive Sources, the transport security level assigned to category 1 sources is enhanced security level with additional security measures.

3. Threat Assessment

- Threat assessment in this study was carried out by referring to Indonesia's 2020 criminal statistics, Global Terrorism Index (GTI) 2020, and articles reporting on security incidents in the transportation of radioactive materials in several countries.
- The transportation system considered was road transport for a single DSRS.
- The transport containers were considered as a component of the physical protection system, and hence the types of enemies considered in this study were limited to outsiders.
- The potential threat considered was limited to the theft of radioactive materials, because the security analysis was limited to the passive delay function on the transport container.

The threat assessment results:

Potential Threat	Type of Enemy		
	Terrorist	**Criminal**	**Anti-Nuclear**
Theft	Medium	High	Low
Motivation	Type of Enemy		
	Terrorist	**Criminal**	**Anti-Nuclear**
Ideological	High	Low	High
Economic	Medium	High	Low
Personal	Low	Low	Low
Capability	Type of Enemy		
	Terrorist	**Criminal**	**Anti-Nuclear**
Personnel	High	Low	Low
Weapon	High	Medium	Low
Equipment	High	Medium	Medium
Vehicle	High	Medium	Medium
Experience	High	Medium	Low
Fund	High	Low	Medium
Insider Involvement	High	Low	Low
Conclusion	High	Medium	Low

4. Target of Attack

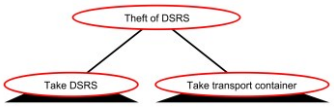
- The target is the ^{60}Co DSRS placed in the transport container and in the process of being transported to PTLR.
- The unintended consequence is the ^{60}Co DSRS being stolen.

5. Transport Security Goals

- The goal that should be achieved from the delay function in a transport security system of radioactive material at an enhanced security level with additional security measures was to provide delay after detection sufficient for response personnel to interrupt the unauthorized removal.
- Specifically, the unauthorized removal referred to in this study is the theft of ^{60}Co DSRS by outsider enemies.

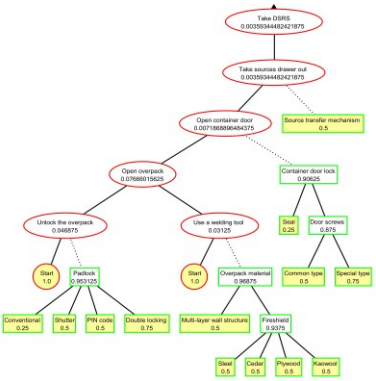
6. Attack-Defense Tree (ADTree) Analysis

- The container will be used to transport teletherapy sources without including the sources head which the ^{60}Co DSRS was kept in the sources drawer.
- The ADTree method was used to analyze how the theft of ^{60}Co DSRS was carried out and also the security elements to anticipate it.
- The top event or the main goal of the threat attack is "Theft of DSRS" which can be done through 2 scenario options of "Take DSRS" or "Take transport container".

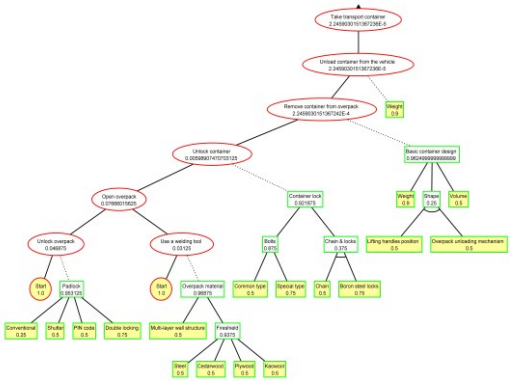


The top event of ^{60}Co DSRS theft

- The analysis was carried out with the assumption that the attack had started, so the probability of success at the initial attack node was 1.0 (100%).
- The probability value at the defense node is obtained from a qualitative assessment of the level of security elements in providing delay time.



The scenario of taking the ^{60}Co DSRS



The scenario of taking the transport container

Conversion of the verbal descriptor of the level of security into a probability value:

Verbal Descriptor of The Level of Security	**Probability Value**
Very Low	0.1
Low	0.25
Medium	0.5
High	0.75
Very High	0.9

- The analysis results have shown that the success rate of the theft of ^{60}Co DSRS at the top event node is very low with an optimistic probability value of 0.36% (0.0036).

7. Conclusions

- The potential threat to the transportation of ^{60}Co DSRS is theft which can be done through 2 scenario options:
  - taking the sources out from the container, with 0.36% probability of success; or
  - taking the container, with 0.0023% probability of success.
- The threat can be anticipated through the passive delay function of transport container design.
- The delay function can decrease the success rate of the theft of ^{60}Co DSRS to 0.36% which is categorized as very low level, and hence the container is secure.