

Radiation Dose Assessment of Consumer Products Containing Tritium

DH Cho¹, SE Han¹, GS Lim², KP Kim²

¹ Korea Institute of Nuclear safety, Korea, ² Kyung Hee University, Korea

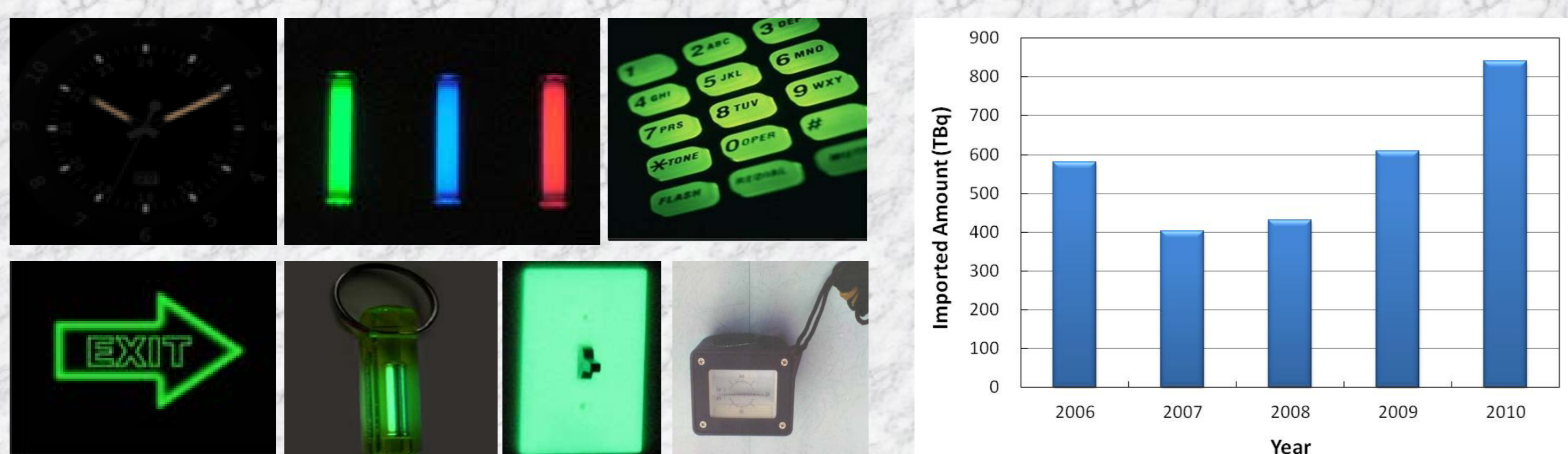
Background

❖ Consumer products:

- A manufactured product or appliance, which intentionally incorporates radionuclides and can be used by members of the public.
- (e.g.) Ionization chamber smoke detector, items with radioluminous paint, items with tritium light sources, electronic devices (lamp starters, discharge lamps), thoriated items (gas mantles, camera lenses), items incorporating uranium (tiles, tableware), etc.

❖ Consumer products containing tritium light source

- Items luminesced with radioluminous paint (timepieces and compasses).
- Items incorporating gaseous tritium light sources (GTLS) (timepieces, compasses, fishing floats, torches, telephone dials and key rings)
- GTLS: A sealed glass tube internally coated with a phosphor and filled with tritium gas.
- About 850 TBq of GTLS were imported in 2010 in Korea.



❖ Concern of radiation exposure from the consumer products:

Without special surveillance and control, consumer products are generally supplied to members of the public, who lack knowledge in radiation protection.

Objectives

- ❖ To estimate radiation dose due to consumer products containing tritium light source
- ❖ The dose assessment was performed for potential exposure scenarios, including normal uses and accidents.
- ❖ To suggest safety controls for the products

Dose Assessment Methods

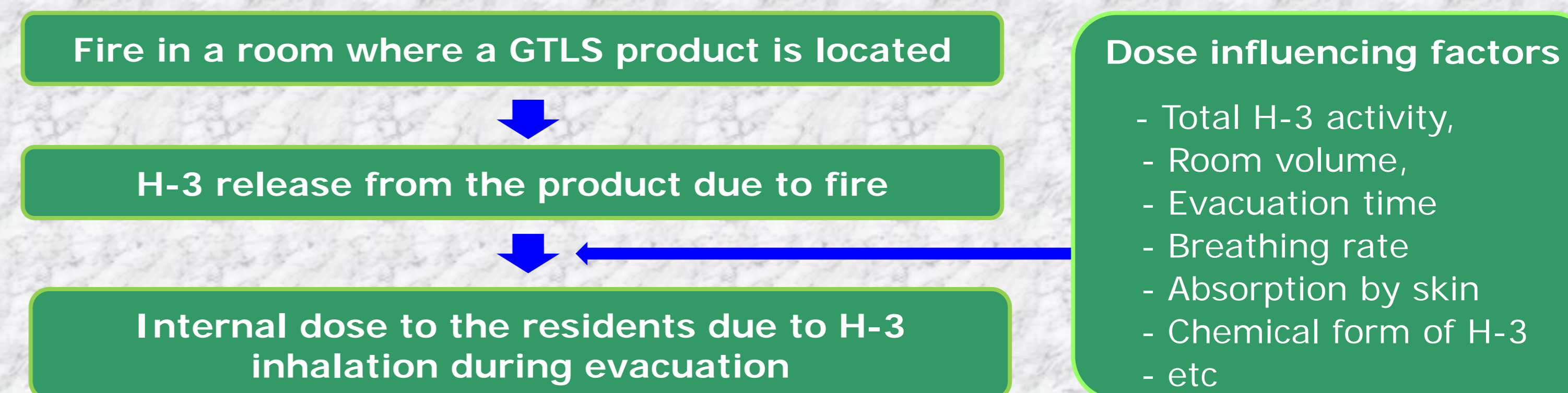
❖ **Exposure scenarios:** The exposure scenarios were categorized into public use, industrial use, and military use.

User	Exposure Scenario	Exposed Person
Public Use	Use of watch	User
	Breakage of a product in a room	Residents
	Fire in a room	Residents
	Fire in a room	Fireman for extinguishment
	Fire in a theater	Attendances
Industrial Use	Breakage of products in a storage	Worker in the storage
	Fire in a storage	Worker in the storage
	Fire in a storage	Fireman for extinguishment
	Accident during transportation	Driver
Military Use	Breakage of products in a storage	Worker in the storage
	Fire in a product storage	Worker in the storage
	Fire in a product storage	Fireman for extinguishment
	Breakage of used products in a waste storage	Worker in the storage
	Fire in a waste storage	Worker in the storage
	Breakage of a product in maintenance room	repairman

❖ Radiation dose calculation:

- Radiation doses to skin and eye lens were calculated for the use of watch.
- For the others, intake of tritium was estimated for each scenario and committed effective dose was calculated based on ICRP 66 human respiratory tract model.

❖ Example of exposure scenario and dose influencing factors

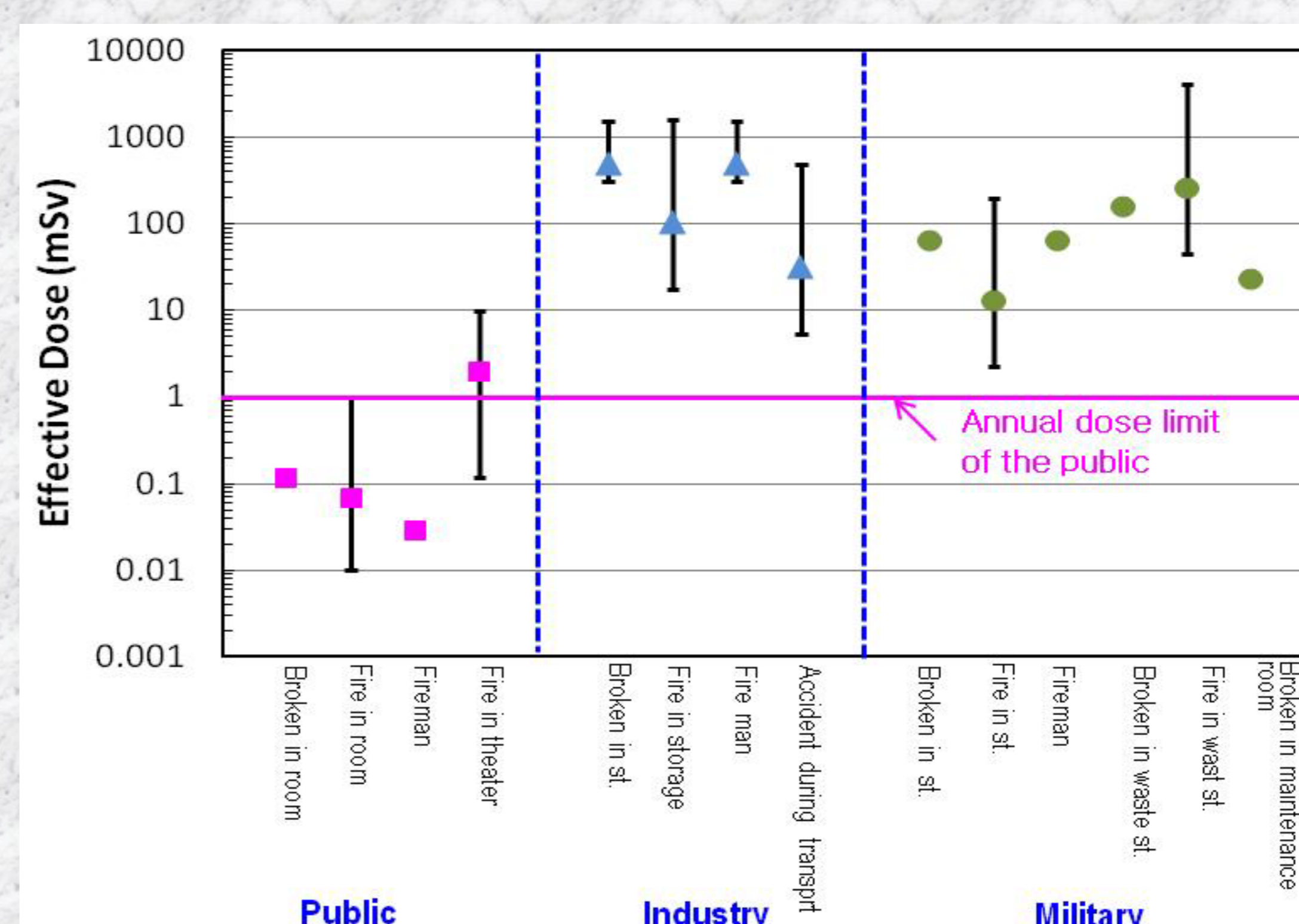


Results and Discussion

❖ Radiation dose due to use of watch containing H-3 light sources

- Dose to skin: 1.5 mSv/year
- Dose to eye lens: 2.4 uSv/year

❖ Radiation dose due to inhalation of H-3 from GTLS



- For the public use, radiation doses for most scenarios were below 1 mSv in spite of conservative dose estimation.
 - Therefore, it is considered that radiological consequences of breakage or fire of a single product is not significant.
- For industrial and military uses, dose estimations exceeded the annual dose limit to the general public for the most scenarios. Dose estimations were higher if many products were stored and damaged together. For the industrial and military use, large number of products or GTLSs are generally stored or transported together.
 - Therefore, it is necessary to establish safety control standards of consumer products containing radioactive substances.
- Many dose influencing factors contributed radiation doses.
 - Therefore, the safety control standards should be established considering the factors.

Conclusion

- ❖ This study showed that radiological consequences from any exposure scenarios of a consumer product containing tritium below exemption level were not significant.
- ❖ If plenty of products or GTLSs are involved, the radiological consequences might be significant.
- ❖ Therefore, it is necessary to establish safety control standards of consumer products containing radioactive substances
- ❖ The safety control standards may include limits of total storage activity, standards for storage volume and ventilation, limits of total transport activity, use of transport container, standards for transport vehicles, etc.

Acknowledgement

❖ This study is supported by Grant 2011-0027457 from the National Research Foundation of Korea.