

Approach for specific clearance of tritium sources inadvertently disposed of in the landfill facility at Ignalina NPP



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Keywords: Tritium source, specific clearance, landfill disposal, Ignalina nuclear power plant, decommissioning.

Introduction:

Tritium self-luminous informative signs (for the display of emergency escape routes, etc., see Fig. 1) at Ignalina NPP have been used in the past. At the Soviet Union time, the signs with initial activity of up to 2 Ci (7.4E+10 Bq) of tritium were not considered radioactive sources and, therefore, had not been managed as radioactive sources. As a result, some of the spent tritium sources could have been potentially be disposed of as non-radioactive solid waste items in the landfill facility at Ignalina NPP. In-situ investigations of the disposed of waste revealed the presence of moisture spots with an increased tritium concentration. The tritium concentration in the groundwater at the Ignalina NPP site exceeds the background values. The potential source of the tritium release might be degraded or crashed self-luminous signs. The final decommissioning plan of Ignalina NPP [1] foresees the specific clearance of the landfill facility disposed of waste, removal of regulatory control, and conversion of the landfill facility into conventional waste disposal. The specific clearance levels have been developed [2] and included into national legislation [3].



Fig. 1 The tritium self-luminous sign. Next to the sign are placed fluorescent elements (glass tubes with gaseous tritium)

Radiation safety context:

The specific clearance levels for the landfill disposed of waste at Ignalina NPP have been developed [2] considering in-bulk disposed of waste (including tritium-contaminated waste) and analysing inadvertent intrusion scenarios, deliberate intrusion scenarios, and groundwater path release scenarios. Investigations of spent luminescent devices [4] show that, to some extent, gaseous tritium oxidizes, i.e., a fraction of the tritium activity contained in the self-luminous device accumulates in the form of tritiated water. The derived specific clearance levels account for the radiological impact of tritium release and dispersion with groundwater flow [5]. However, the specific clearance levels do not take into account all radiological impacts due to tritium release into the atmosphere. Additional exposure conditions can occur in cases of degradation of leak-tightness of the disposed of signs or in cases of intrusion into the waste when actions of intruders damage the disposed of signs. Application of conditional clearance levels together with consideration of additional radiological impacts from inadvertently disposed of self-luminous signs would allow to remove the regulatory control from the waste and convert the landfill facility to a conventional waste disposal facility.

Scenarios:

Scenarios for the assessment of radiological impact due to tritium release into the atmosphere from self-luminous signs consider (see Fig. 2):

- Normal evolution of the facility. Some of the disposed of self-luminous signs can still be intact but may lose their integrity. The bounding case assumes simultaneous degradation of all disposed of self-luminous signs at the time of removal of regulatory control and bulk release of gaseous tritium;
- Intrusion into the facility, including:
 - Damage of intact self-luminous signs during excavation works. The sign is being damaged at the ground surface, and the representative member is submerged in the cloud of released gases;
 - Breaking the glass tube from a self-luminous sign while keeping it in one's hands. The tube breaks close to the face of the representative member, and all the released gaseous content is inhaled at once.

Radiological impacts:

If intact fluorescent tubes with self-luminous signs lose tightness, the tritium gas (in T₂ or HT form) will leak out, diffuse to the surface of the landfill facility, and disperse in the atmosphere, thus exposing members of the population. Tritium is a weak beta emitter, and exposure to a representative member of the population is determined by internal exposure due to the inhalation of tritium gas. Mechanical damage to the fluorescent tubes may produce debris covered with fluorescent material. Small particles of debris contaminated with tritium (in HTO form) may deposit onto the surfaces of hands and be inadvertently ingested. The representative member of the population will be internally exposed due to ingestion of tritium-contaminated dust.

Exposed representative members of the population:

- Adult;
- Adult (worker) - performing heavy physical activities;
- 1-2 years old child;
- 10 years old child - physically capable to break the glass tube.

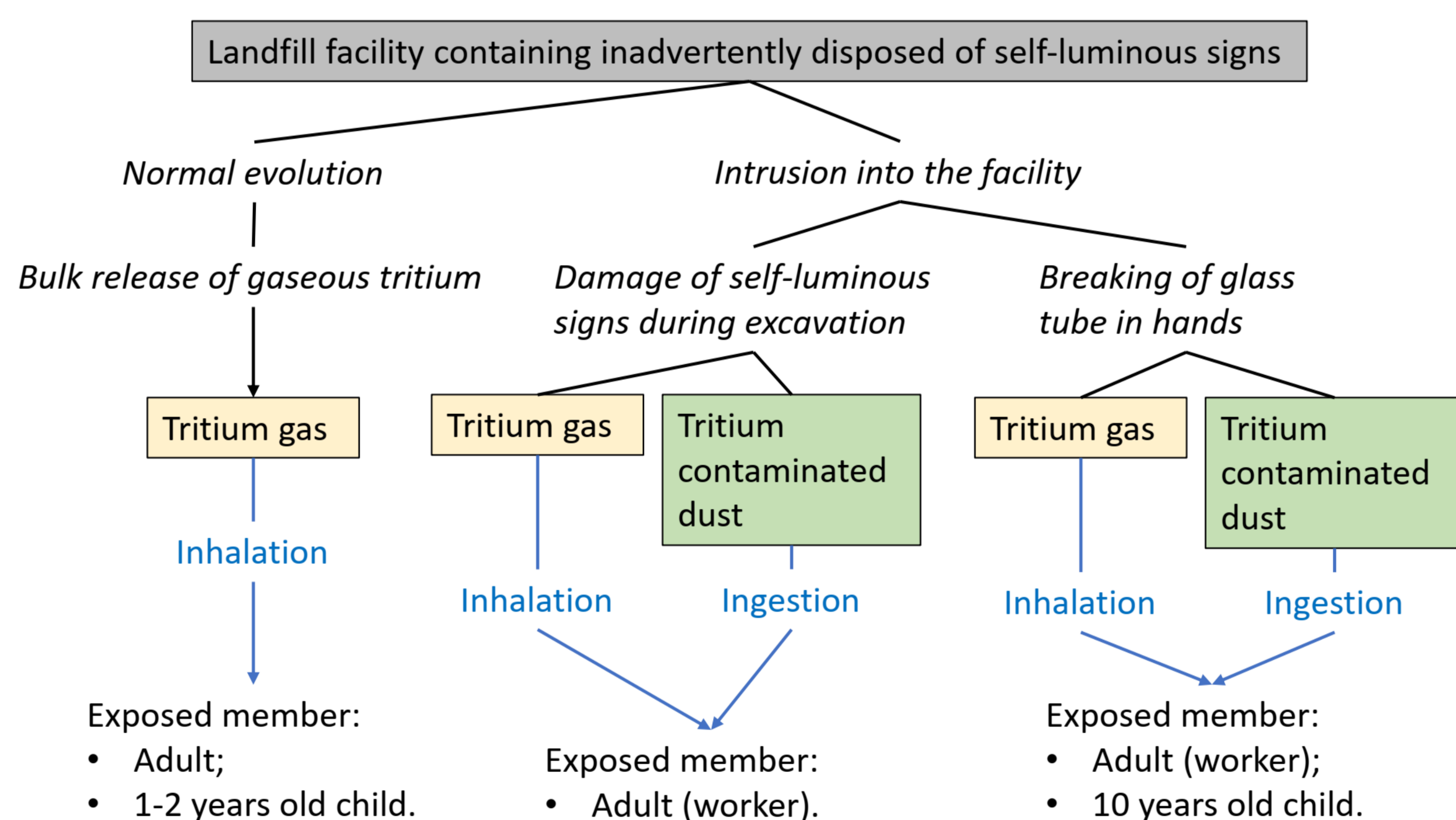
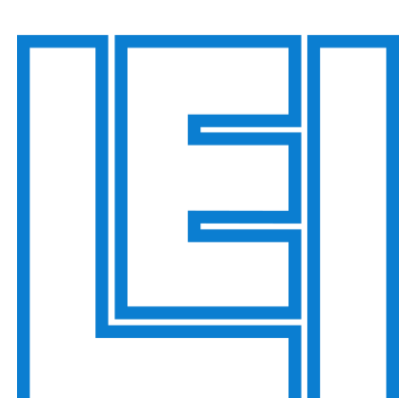


Fig. 2 Scenarios and exposure pathways due to tritium release to the atmosphere from damaged self-luminous signs

Conclusions:

- Application of conditional clearance levels for the Ignalina NPP industrial waste disposed of in the landfill facility, together with consideration of additional radiological impacts from inadvertently disposed of self-luminous signs would allow to remove the regulatory control from the waste and convert the landfill facility to a conventional waste disposal facility.



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