Life-safety targets in underground stations, continued

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INTRODUCTION

The Swedish Transport Agency and the Swedish Transport Administration have carried out two pivotal research and development projects titled "Life-safety targets in underground stations." The first report assessed the feasibility of formulating a harmonized life-safety target for platform areas, while the follow-up report in 2023 further developed and validated these initial conclusions. The goal was to lay the foundation for national legislation and improve regulatory risk control in underground stations.

Current regulations set safety design requirements for underground platforms but lack standardized life-safety targets, leading to variability in safety levels and approval processes across projects and transport modes. This research tackles both frequent, low-consequence incidents (such as suicides and falls) and rare, high-consequence events (including large fires and dangerous goods accidents).

METHODOLOGY

This study introduces a comprehensive, risk-based methodology to develop and assess safety targets for underground stations, focusing on the complexity of station design, potential accident scenarios, and passenger volume. A new risk framework is proposed that challenges traditional safety approaches for Swedish underground stations by integrating societal and individual risk metrics with assessment tools.

The methodology is structured around six key investigations, which are meant to cooperate, achieving a equivalent safety level in both ordinary underground stations and more complex facilities:

A. **Defining acceptable societal and individual risk levels**, with a unified approach to underground station safety.
B. **Developing a regulatory framework (basic standard)** aligned with proposed safety standards and assessing their applicability.
C. **Evaluating the adequacy of the basic standard** for simple platform areas, determining when it requires adaptation.
D. **Assessing catastrophic accident scenarios** (e.g., incidents involving >1,000 casualties) using quantitative methods.
E. **Cost-benefit analysis** within the ALARP (As Low As Reasonably Practicable) framework to determine the need for additional safety measures.
F. **Contextualizing safety objectives** within broader risk management systems and regulatory practices.

RESULTS AND DISCUSSION

The proposed methodology offers a new perspective on safety target formulation, emphasizing the need for a tiered approach based on station complexity. For simpler platform areas, the basic safety standard, aligns with existing safety requirements under the Swedish Planning and Building Act.

For more complex environments, the methodology employs quantitative analysis to assess potential risks and determine the need for additional measures. While traditional ALARP principles guide this analysis, the proposed methodology enhances its application by offering more robust decision-making criteria for complex underground environments.

Quantitative safety targets: The research also introduces a safety target system: with an upper limit reflecting "Safety targets in tunnels" that sets a baseline acceptable risk level for underground stations. The safety target, however, lacks a lower limit. This ensures a generally lower risk level in platform areas compared to adjacent tunnels, due to better risk management possibilities. This approach bridges the gap between tunnel and platform safety, ensuring that underground stations are not only safe but are held to a consistently high standard across diverse risk scenarios. A major innovation of the study is its focus on accidents with catastrophic potential, an area typically underexplored in current safety frameworks.

Cost benefit analysis: An advanced cost/benefit analysis methodology is incorporated to optimize safety measures against their associated costs, providing a more scientifically rigorous approach to ALARP. By assessing additional safety measures required in non-standard scenarios, this analysis ensures that resources are allocated efficiently, addressing the most pressing risks while minimizing unnecessary expenditures.

CONCLUSION

The proposed framework offers several key contributions to the field of underground station safety:

- **Scientific Innovation**: The integration of individual and societal risk measures into a unified safety target system challenges traditional risk management for Swedish underground stations by offering a more precise, scientifically grounded approach to safety assessment.
- **Targeted Safety Measures**: A more granular, quantitative safety target system provides better differentiation between varying levels of station complexity and accident risk.
- **Efficient and Cost-Effective Regulation**: The framework aligns with existing regulatory structures, ensuring its integration into current safety protocols without significant cost increases.
- **Global Relevance**: The research provides a universal approach to safety target formulation that could be adapted to other countries and transport systems, driving international harmonization in underground station safety standards.

By advancing risk assessment methodologies, challenging traditional safety frameworks, and presenting scientifically derived life-safety targets, this research paves the way for a more standardized, evidence-based approach to safety in Swedish underground stations and similar infrastructure projects.

REFERENCES

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