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Design basis threat for the use of nuclear energy and use of radiation

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RADIATION AND NUCLEAR SAFETY AUTHORITY

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1 Design basis threat is a basis for the design and assessment of a nuclear security system

101a. STUK has updated the design basis threat for the use of nuclear energy and use of radiation. The first design basis threat prepared under this method entered into force in 2013 (2/Y42217/2017).

101b. Design basis threat (DBT) is a method /1/ by which the design basis for a nuclear security system[1] is derived from the threat assessment and the potential consequences of unlawful acts or other acts that endanger nuclear or radiation safety[2].

101c. A DBT defines the threat to be used as a basis for the requirements for and for the design and evaluation of the nuclear security system that is the responsibility of the operator. The DBT contains the definition of the capabilities of the persons or groups with potential for unlawful acts or other acts that endanger nuclear or radiation safety, that are to be used as the design basis for the security system. The DBT contains relative levels of severity of the threat.

101. According to the Nuclear Energy Act (Section 7 l para 1) arrangements for security during the use of nuclear energy shall be based on threat scenarios involved, and analyses of the need for protection /2/. Therefrom it is derived in the STUK Regulation on the Security in the Use of Nuclear Energy (Y/3/2016, Section 3 para 1) that the design of security shall be based on the design basis threat, risk analyses of the activity to be secured, and protection requirements assessed on the basis thereof /3/.

102. According to the Radiation Act (859/2018, Section 67 para 1), the licensee shall protect radiation sources requiring a safety licence in their places of use and storage from illegal activity, loss and falling into the hands of unauthorised persons. These security measures shall be sufficient for the operations and the risks connected to radiation sources, and they shall constitute a coordinated entity with the activities related to radiation safety /4/.

103. In keeping with the risk-informed, graded approach nuclear security measures are applied in accordance with the potential consequences and probability of unlawful acts targeting nuclear materials or other radioactive materials or other acts endangering nuclear or radiation safety. The potential consequences depend on the properties of the facility or the material, such as the enrichment level and quantity of nuclear material and the radiation characteristics, quantity, and chemical and physical form and state of the radioactive material. While the probability of intentional acts cannot be calculated exactly, estimates of relative probabilities can be made, based on the threat assessment. According to the internationally approved Fundamental

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[1] A nuclear security system is an integrated set of nuclear security measures (such as administrative, technical, structural, and operative, related to preventive measures, detection, delay, and response) for protection of the use of nuclear energy or use of radiation from unlawful acts or other acts endangering nuclear or radiation safety[2].
[2] The composite term “nuclear and/or radiation safety”, as translated from Finnish, is to be understood in a holistic sense, encompassing nuclear security, even if the word security is not written out (“safety and security”).

Principles G and H (ACPPNM), security measures shall be based on the threat assessment and a risk-informed, graded approach /5–6/.

104. [Moved to 101a.]

105. [Moved to 101b.]

106. The requirements for the operator in the use of the DBT are presented in Chapter 3.

107. The authorities engage in the preventive and protective measures, and in preparedness and response to the threat, in their respective field of activity. With regard to threats beyond the DBT, the responsibility for prevention, protection, preparedness and response rests with the state, and the task of the operator is to assist the authorities, as feasible.

2 Development, use, and maintenance of the design basis threat

2.1 The design basis threat is based on the threat assessment and the potential consequences of unlawful acts or other acts that endanger nuclear or radiation safety

201. It is enacted in the Nuclear Energy Decree (161/1988, Section 146) that the Finnish Security Intelligence Service is responsible for specifying the threat assessment of unlawful acts targeting the use of nuclear energy /7/. The threat assessment is a description of the threat environment and the characteristics of persons and groups with potential to unlawful acts or other acts that endanger nuclear or radiation safety /8/. In addition to the national threat assessment, other authoritative analyses /such as 9 and 10/ and information on past unlawful acts targeting the use of nuclear energy and radiation and similar incidents /e.g. 11–12/ are taken into account in the development of the DBT.

202. In addition to the threat assessment, potential radiological consequences are taken as a basis for the DBT. In the screening of the threat assessment, the capabilities, motivations, and intentions of the persons or groups with potential to unlawful acts or other acts that endanger nuclear or radiation safety are considered with respect to the potential targets and consequences of the acts. Representative sets of unlawful acts and other acts that endanger nuclear or radiation safety are defined from the results of the assessment, forming the DBT. Existing security measures are not taken into account in the definition of the DBT.

203. It is enacted in the Nuclear Energy Decree (161/1988, Section 146) that the Radiation and Nuclear Safety Authority (STUK) is responsible for specifying the design basis threat, and that before confirming the design basis threat, the Radiation and Nuclear Safety Authority shall hear the Ministry of the Interior, the advisory commission referred to in the Nuclear Energy Act, Section 56 para 2, and the licensees whose nuclear security obligations may be affected by the design basis threat.

204. The DBT is used as a basis for

- regulatory requirements for nuclear security
- design of nuclear security systems
- evaluation of nuclear security systems.

2.2 The design basis threat contains progressive levels of threat, is applied in a risk-informed way, and updated as necessary

205. The threats and the capabilities included in the DBT are built into a level scheme. The highest levels contain the threats with the most serious potential consequences. For each threat, the capabilities of a person or group potentially engaging in unlawful acts or other acts that endanger nuclear or radiation safety have been defined. Each level has specific protection objectives. For nuclear facilities, the protection objectives were derived from the radiation dose constraints set in the Nuclear Energy Decree for nuclear facilities' normal operation, anticipated operational occurrences, and accidents. The levels of the DBT are applied to different classes of nuclear facilities, nuclear materials and other nuclear commodities, and the use of radiation in accordance with the magnitude of the potential consequences of unlawful acts or other acts that endanger nuclear or radiation safety.

206. The DBT structure and radiation dose constraints for and application to nuclear facilities and transport of nuclear fuel are presented in Figure 1 and the protection objectives in Appendix A1, which is classified (Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k, Nuclear Energy Act (990/1987), Section 78). The protection objectives for radiation sources, nuclear materials outside nuclear facilities and other nuclear commodities are presented in Appendix A2.

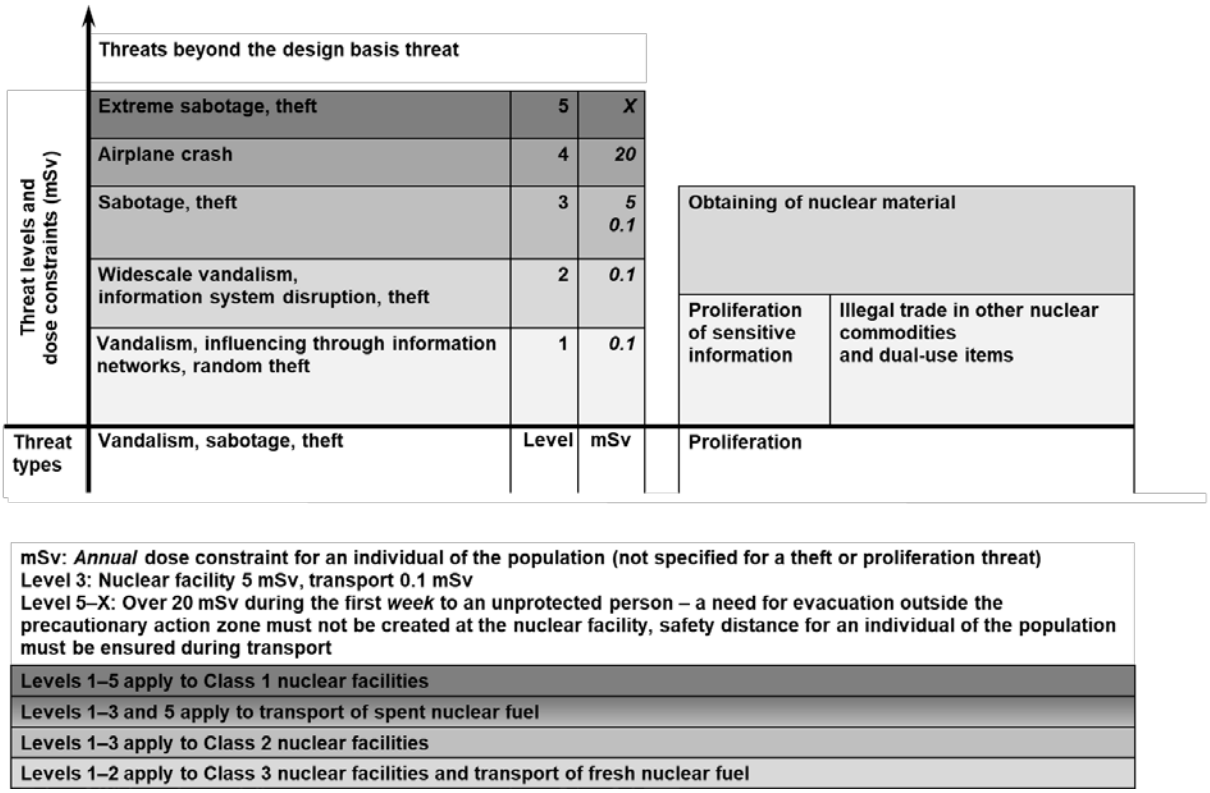

Figure 1. Structure of the design basis threat related to nuclear facilities and transport of nuclear fuel: Threats included in the DBT, their relative levels and the radiation dose constraint for an individual of the population, and how they apply to nuclear facilities and transport of nuclear fuel. Facility classes and categories of nuclear materials are specified in Guide YVL A.11, Tables 1 and 2. Class 1 nuclear facilities include nuclear power plants, Class 2 nuclear facilities include processing or final disposal facilities of high level nuclear waste or research reactors, and Class 3 nuclear facilities include processing or final disposal facilities of low or intermediate level waste.

207. The aim of including different – also very severe – levels of threat into the DBT was to ensure that the DBT would be a more robust design basis than a current threat assessment. The threat assessment cannot predict the future very well, and in particular in the case of nuclear facilities with a long operational life-expectancy this is compensated by making conservative choices in the definition of the DBT.

208. The DBTs for nuclear facilities are in Appendices B, C and D. The DBT for a uranium extraction facility (UOC production) is in Appendix E. The DBT for radiation sources, nuclear materials outside nuclear facilities and other nuclear commodities is in Appendix F. The DBT for transport of spent nuclear fuel is in Appendix G. The DBT for fresh nuclear fuel transport is included in the nuclear facility class specific appendices. These DBTs contain the definition of the capabilities of the persons/groups with potential for unlawful acts or other acts that endanger nuclear or radiation safety, that are to be used as the basis for the requirements for and design and assessment of the security system. They are classified (Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k, (990/1987), Section 78).

209. While the DBT is intended to be a relatively static design basis, beyond the present threat assessment, the need for its updating must be reviewed and it must be

updated as necessary. STUK considers the need to update the DBT regularly in connection with the threat assessment review and at other times, if required by changes in the threat assessment or operating environment. Updating of the DBT is carried out by the same procedure as the original development.

3 Requirements to the operators

3.1 Nuclear facilities

301. The licensees, licence applicants, and the operators granted with a positive decision in principle (DIP) for a nuclear facility shall use the DBT as a basis of

- design of their nuclear security system
- evaluation of their nuclear security system.

302. The licensee/applicant/operator with a positive DIP shall design the nuclear security system to be effective in countering the DBT in accordance with the protection objectives specified in the appendices to this document as effectively as is reasonably achievable.

303. The design of the nuclear security system by the licensee/applicant/operator with a positive DIP includes planning with the relevant authorities their cooperation with regard to the preventive and protective measures, preparedness and response (Y/3/2016, Section 15).

304. In connection with the construction licence application for a nuclear facility, the applicant shall submit to STUK for approval, in accordance with the Nuclear Energy Decree, Section 35, the preliminary plans for the nuclear security system. The preliminary plans shall present how the DBT has been used as a design basis for the nuclear security system and contain an assessment on how the planned system can counter the DBT in accordance with the protection objectives of the DBT as effectively as is reasonably achievable.

305. In connection with the operating licence application for a nuclear facility, the applicant shall submit to STUK for approval, in accordance with the Nuclear Energy Decree, Section 36, the plans for the nuclear security system. The plans shall contain an assessment on how the system can counter the DBT in accordance with the protection objectives of the DBT as effectively as is reasonably achievable, and present how the DBT will be used as a basis for design and evaluation of the nuclear security system during operations.

306. In the demonstration of the effectiveness of nuclear security (including information security) in accordance with the Guides YVL A.11 and YVL A.12, such as in assessments and exercises, the DBT shall be used to ensure and demonstrate the effectiveness of the nuclear security system. The licensee shall assess how well the security system fulfils the protection objectives of the DBT, assess the potential to improve and need to change security measures, and prepare an action plan to be maintained.

307. The licensee shall use the results of the DBT-based assessments and exercises in the continuous improvement of its nuclear security system.

308. STUK sets the prescriptive nuclear security requirements for nuclear facilities in its regulatory guides (e.g., YVL A.11, YVL A.12). STUK considers the DBT as a basis for the requirements.

3.2 Use of radiation, nuclear materials outside nuclear facilities, other nuclear commodities, and transport of nuclear material and nuclear waste

309. STUK sets the requirements for security in the use of radiation in medicine, industry, and research in STUK Regulation S/3/2018 /13/. The guidance on the security in the transport of radioactive materials is given in separate guides prepared in cooperation between the Ministry of Transport and Communications and STUK. STUK considers the DBT as a basis for the requirements and guidance.

310. STUK sets the requirements related to nuclear material control and accountancy for purposes of nuclear non-proliferation as well as requirements for security of the nuclear materials outside nuclear facilities and other nuclear commodities in a regulatory guide (YVL D.1). STUK considers the DBT as a basis for the requirements.

311. STUK sets the requirements for security in the transport of nuclear material and nuclear waste in a regulatory guide (YVL D.2). STUK considers the DBT as a basis for the requirements. Additionally, the relevant DBT is applied directly to the transport of nuclear fuel, as is the case with nuclear facilities.

4 The DBT application procedure for existing and new activities

401. The entry-into-force of a DBT does not affect STUK’s prior decisions. After having heard the licensee in question, STUK issues a separate decision on how the new or updated DBT will be applied to an existing nuclear facility, to a nuclear facility under construction, or to an established activity by a licensee. To new nuclear facilities the DBT is applied as such.

402. The security requirements prescribed in STUK Regulations based on the DBT are applied to all use of radiation for which a safety licence is required.

5 Appendices

1. Appendix A1. Protection objectives corresponding to threat levels included in the DBT for nuclear facilities and transport of nuclear fuel (SC IV, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
2. Appendix A2. Protection objectives for nuclear materials outside nuclear facilities and for other nuclear commodities.
3. Appendix B. Nuclear facility class specific DBT – Class 1 nuclear facility (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
4. Appendix C. Nuclear facility class specific DBT – Class 2 nuclear facility (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
5. Appendix D. Nuclear facility class specific DBT – Class 3 nuclear facility (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)

6. Appendix E. DBT of the use of nuclear energy and radiation – uranium extraction facility (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
7. Appendix F. DBT of the use of nuclear energy and radiation – radiation sources, nuclear materials outside nuclear facilities and other nuclear commodities (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
8. Appendix G. DBT of the use of nuclear energy and radiation – transport of spent nuclear fuel (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
9. Explanatory memorandum (YL&K) for appendices B–D+G (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
10. Explanatory memorandum (UTL) for appendix E (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k)
11. Explanatory memorandum (SLY) for appendix F (SC III, Act on the Openness of Government Activities (621/1999), Section 24.1 para 7 k).

6 References

1. Development, Use and Maintenance of the Design Basis Threat, IAEA Nuclear Security Series No. 10, IAEA (2009)
2. Nuclear Energy Act (990/1987)
3. STUK Regulation on the Security in the Use of Nuclear Energy (STUK Y/3/2016)
4. Radiation Act (859/2018)
5. Convention on the Physical Protection of Nuclear Material (Finnish Treaties 72/1989)
6. Act on the bringing into force of the legislative regulations of the Convention on the Physical Protection of Nuclear Material (513/2008) (Finnish Treaties 19/2016), and Government Decree on the bringing into force of the amendments to the Convention on the Physical Protection of Nuclear Material and on the entry into force of the Act on the bringing into force of the legislative regulations (338/2016) (Finnish Treaties 20/2016)
7. Nuclear Energy Decree (161/1988).
8. Threat Assessment for the use of nuclear energy and radiation – DBT, Finnish Security Intelligence Service (SC II)
9. Project number 292110-1, 15 March 2019, STUK, Technical support commission agreement 1/Y40015/2018
10. Transport safety of spent nuclear fuel, Finnish Defence Research Agency, Weapons Technology Division, TKO867, 26 March 2018 (SC III), 1/Y46204/2018
11. Interpol Analysis of Global and Finland Area Nuclear Trafficking and Terrorism, Project Geiger, Interpol, April 2010 (TL IV)
12. IAEA Incident and Trafficking Database (ITDB) 2017 Fact Sheet, Analysis Report of the Incident and Trafficking Database 2015-2016, IAEA (2018)
13. STUK Regulation on the security arrangements of radiation sources requiring a safety licence (STUK S/3/2018).