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Vital Area Identification in the Hungarian nuclear facilities

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Abstract. An important part of the design of a proper and efficient physical protection system is not just the identification of the threat and adversary capabilities, but also the set of possible targets. This identification method should be standardised in Hungary, so the evaluations of the nuclear facility operators could be repeatable by the regulatory body and it should be integrated in a complex evaluation of the physical protection systems. The aim of this paper is to present the current Hungarian situation, the legal framework and the base of a research project to list and evaluate the possible methods and tools to identify the vital areas inside a nuclear facility.

Keywords: vital are identification; nuclear security; probabilistic safety analysis, physical protection system

1 Introduction

After the attacks of 9/11 the national regulators, supervising the physical protection of the nuclear facilities, and the International Atomic Energy Agency provide guidance to the nuclear facility operators to help to identify and protect the vital safety systems and system components (SSC or shortly vital areas, VA), during the planning or the operating phase, to avoid unacceptable radiological consequences after a sabotage action. The last attacks in Paris and Brussels prove that the terrorist threat in Europe is not decreased in the last 15 years, so the evaluation and improvement of the nuclear facilities' physical protection system (PPS) still has a highlighted significance. Even a short disturbance in the operation of the safety related SSCs, whether it is intentional or not, can have a serious environmental, economical and social effect, depending on the severity of the incident. Because of it, it is worth to calculate with the occurrence of these incidents and effects during the planning phase, so not only an unaccepted event could be avoided and the cost of it cut down, but the financial, technical and human resources of the operator and the national law enforcement organisations could be optimised.

There is no uniformed Vital Area Identification (VAI) method used or approved by the regulatory in Hungary, all the analysis is done by the operators on their own way and inspected by the regulatory body separately. There is no complex vulnerability assessment programme, and the supporting software background is also missing. However, the legal background is given to introduce such tools in the national nuclear industry.

2 The basis of the vital area identification

2.1 Legal framework

The legal base of the Hungarian nuclear industry is the Act CXVI of 1996 on the atomic energy. Section 17. paragraph 1 designates the Hungarian Atomic Energy Authority (HAEA) as the main regulatory responsible for the nuclear security and section 30. paragraph 2 ensures the support of the national police as a co-authority. [1] The main control document of the nuclear security is the Government Decree 190/2011. (IX. 19.) on physical protection requirements for various applications of atomic energy, and on the corresponding system of licensing, reporting and inspection (Decree). The Decree's section 29. paragraph 1 point b states, that the license holders must identify the significant systems and system components to avoid radiological consequences. [2]

The HAEA has a right to publish guidelines to help the operators.[1] If an accepted way for identification and for vulnerability assessment is worked out, it could be instituted in this way. Section 32/B paragraph 3 of the Decree states, that if the obligant is not following the official guidelines during the planning and construction of the PPS, then the regulator will analyse and evaluate it separately and fully during the licensing process, which could cost a greater amount of time and money, if a subject related expert's opinion is needed. [2] With the help of this section the legal base is established for an introduction of a new analysing tool.

2.2 Asset Identification Methods

A comprehensive book about the vulnerability assessment of a PPS is Mary Lynn Garcia's work. Inside it she defines the asset identification as *"an evaluation of what to*

[1] It should be noted, that the HAEA always asks the opinion of the nuclear facility operators before the introduction of a new guideline.

protect by considering the value of the asset to the facility or enterprise". [3] To do that there are three main steps: specification of consequences (in case of a nuclear power plant (NPP) this could be core melting or a stop in the production), the selection of the technique which is used in the third step and the identification. [4]

The basics of an assessment is not just a criteria, but also the starting document of every physical protection systems: the design basis threat or DBT. The DBT is a restricted document, that gives information about the adversaries: number of them, weapons, tools and other equipment, vehicles, tactics, knowledge, motive, help of an insider etc. It could be valid on a national level (for all the radioactive material holders) or on a site level (it the threat of a specific installation). In Hungary, the DBT is constructed by a special workgroup led by the HAEA. In the workgroup representatives of the National Police Headquarters, the Constitution Protection Office, the Counter Terrorism Centre, the Military Security Service and the HAEA are present. [2]

The three main techniques are manual listing, logic diagrams and consequence analysis. The manual listing is a simple but still an effective way for identification. It could be used in case of theft targets and smaller, non-complex industrial places. [4] In case of an NPP, listing is not a proper stand-alone tool, but some the targets can be marked with it: the nuclear material (protected from theft) and the bigger system elements, like the reactor itself (as a sabotage target).

Logic diagrams are used in complex sites. The method uses the graph theory's decision trees. The elements (leaves) of the tree are theft or sabotage target SSCs and materials. The elements are connected with operators of AND (both have to be eliminated to sabotage a given system) and OR (only one leaf has to be eliminated to continue). [4] The advantage of this method is that all the NPPs must have a logic diagram like safety analysis, which is called Probabilistic Safety Assessment (PSA). The PSA is a tool to quantify certain events probability in a NPP using Event trees (from an initiating event shows the possible outcomes) and Fault trees (showing the connection between different SSCs in a logic diagram). The most often used criteria is the Core Damage Frequency, which gives the number of core damages in one year of operation. [5] The disadvantage of the logic diagram is that experienced experts' presence is needed during the analysis, because of the method's complexity.

The third method, the consequence analysis, is used when a list is given, but the number of the potential targets are irrationally great. In that case a screening could be used to reduce the number on the list, and most of the resources could be spent on the targets with the highest consequences. [4]

The vital area identifications usually use the logic diagrams, but with logic tree types.

2.3 Possible methods for Vital Area Identification

The VAI method is a special way for target identification, which can be used in complex sites with a well-defined DBT. One of the main researchers of this field is from the Czech Republic, from the EBIS company and from the Faculty of Military Technology in the University of Defence in Brno. During their work, they identified several possible ways to complete a VAI process.

The first one uses the Fault Trees and Event Trees from the PSA analysis, but with a different starting point. For VAI they use Initiating Events with Malicious Origin (IEMO), which could be a destruction of an SSC or for example the cut of the electricity cables of the site. [6] This method is favourable because many information is given from the PSA, but the author's experiences show that it is difficult to single out the possible IEMOs and trees with the help of the DBT.

The second method uses Attack Trees (AT), which has the same logic as the Fault Trees but more capable to represent and analyse the threat. It uses the concept of Ordered Weight Averaging, which models the uncertainty of certain events. In the tree structure, not just AND and OR operators are used, but every leaf can have several variables: Boolean type (the adversaries' ability to perform an action) and nominal type (number of attackers, execution time etc.). The method is commonly used in the field of cyber security. [6]

They also have an own method, the TARGI (TARGet Identification): the TARGI uses the ATs but simplifies the whole analysis. One point is, that the experts' help is only needed when the separate SSCs' sabotage possibility is assessed, and they don't have to take part in the whole tree analysis. The other simplification is that every leaf gets threat connected attributes (for example tools or time for a successful sabotage) and these attributes 'follow' the leaf through the whole process. At the end the sum of all these attributes will apply a Threat Agent (TA). The TA then could be compared to the DBT and any effect of a change in threat will also be easy to analyse. [6]

When the target SSCs are given a so called Protection Tree analysis is needed. During it one or more sets of targets will be made with the help of Boolean complements. These sets then will need a sufficient protection against the threat written in the DBT. [6]

2.4 Objectives of a future research project

Many methods and ways to identify the VAs of a nuclear facility is present, but still none of them is analysed for the Hungarian circumstances or selected for a national use. One objective of a research should be this. The selection is not enough, the proper manual, expert background and software support should also be an important research goal. On an international level, there is still no proper way for the description of attributes for Attack Trees. [6] It could not only help the introduction of a national method, but could also help the work of other operators, regulators and agencies. This could be another part of a future project.

3 Conclusions

The experiences of the past time show that the threat and capabilities defined in the DBT can change suddenly, which needs a rapid and efficient answer from the operators and the national agencies. With a proper VAI and vulnerability assessment method the licensees can check and present to the regulatory body their security systems in a validated way, can determine the future developments and optimize the available resources. The effects of a neighbouring unit, which is in the state of operation, construction or dismantling, could be calculated. A good analysis can show the effect of a change in the PPS, so the financial resources spent on it are justified for the management.

The result of a future research project in this topic can prove, that the nuclear sites in Hungary are well protected, can increase the reliability of the industry, decrease the fear from a nuclear emergency and raise the level of deterrence.

References

[1] *1996. évi CXVI. törvény az atomenergiáról*

[2] *190/2011. (IX. 19.) Kormányrendelet az atomenergia alkalmazása körében a fizikai védelemről és a kapcsolódó engedélyezési, jelentési és ellenőrzési rendszerről*

[3] Garcia, M. L.: *Vulnerability Assessment of the Physical Protection Systems.* Elsevier Butterworth-Heinemann. 72 p. 2006. USA

[4] Garcia, M. L.: *Vulnerability Assessment of the Physical Protection Systems.* Elsevier Butterworth-Heinemann. 382 pp. 2006. USA

[5] *Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants*. International Atomic Energy Agency. Specific Safety Guide No. 3. 215 pp. 2010. Vienna. Austria

[6] Malachovál, T. and Vintr Z.: *Vital Area Identification – State-of-the-Art.* Advances in Military Technology. Vol. 10 No. 1. 81-96 p. 2015. Brno. Czech Republic