
Insights of the Periodic Reviews Regarding the Physical Protection of Nuclear Power Plants Designed to Earlier Standards

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Abstract: Among other prerequisites for licensing a nuclear activity, the German Atomic Energy Act stipulates that the necessary physical protection against malevolent acts has to be approved before granting a license. This is required for nuclear power plants in § 7 of the Atomic Energy Act. The licenses for nuclear power plants designed to earlier standards were granted about 20 years ago and more. All NPPs are under the supervision of the Supervisory Authority in order to ensure that all conditions of the license are met during the whole plant operation period. The “Periodic Safety Review”, PSR, is designated to provide the Supervisory Authority with additional information on the safety status. One part of the PSR is the “Deterministic Security Analysis”, DSA. The subject of the DSA is the actual physical protection of a NPP.

The following document outlines the experiences gained during the evaluation of DSA reports by GRS as an external expert organisation under contract of the Supervisory Authorities.

1. INTRODUCTION

The following paragraph is formulated in INFCIRC 225/Rev. 4, “The Physical Protection Of Nuclear Material And Nuclear Facilities” [1]:

“To ensure that physical protection measures are maintained in a condition capable of meeting the State’s regulations and of effectively responding to the *design basis threat*, the State’s competent authority should ensure that evaluations are conducted by operators at nuclear facilities and for *transport*. Such evaluations, which should be reviewed by the State’s competent authority, should include administrative and technical measures. When deficiencies are identified, the State should ensure that corrective actions are taken by the operator.”

In order to ensure that all licensing conditions are met - including physical protection - all nuclear activities in Germany are under the supervision of a Supervisory Authority for the whole period a license is valid. The supervision is embedded in the Atomic Energy Act, AtG [2]. The Periodic Safety Review, PSR, is a means which provides the Supervisory Authority with additional knowledge on the safety status of a NPP. One part of the PSR is the Deterministic Security Analysis which deals with physical protection.

2. LEGAL BASIS

The supervision by government authority is obligatory for all NPPs by the Atomic Energy Act. Paragraph 19 of the AtG [2] which is titled “Government Supervision” defines the objective of supervision as guarding that there will be no violation of the law and that the operator does not fail to fulfil the licensing conditions. This paragraph also empowers the Supervisory Authority to give order to change and how to change a situation that can endanger life, health or goods by radiation as a result. The conditions which empower the Supervisory Authority to withdraw a license are also defined in the Atomic Energy Act (§ 17).

The Atomic Energy Act, AtG, in its present form does not contain the obligation to perform a PSR. Some NPPs have the requirement to perform a PSR in the license documents as a condition. The revised Atomic Energy Act, which is in the process of passing the German Federal Parliament, will make the PSR obligatory for every NPP in future.

Up to now, the PSR Guideline requires that a PSR should be performed every ten years under the license holder's own authority. A number of operators have completed a PSR following the recommendation of the Supervisory Authority.

3. THE DSA GUIDELINE

3.1. Objectives of DSA

The guidance to elaborate a Deterministic Security Analysis, DSA, is given to the license holders by part 2 of the PSR Guideline [3], the DSA Guideline. For the different existing Supervisory Authorities of the 16 federal States of the Federal Republic of Germany, the DSA Guideline provides a common basis for the assessment. In case that any external experts are consulted by the Supervisory Authority, the DSA Guideline of course provides the basis for the assessment of the DSA results.

The DSA Guideline is designated for all NPPs with a valid license. The principles are also applicable to NPPs in the phase of decommissioning. The objective of the DSA is defined as an analysis of the actual status of the plant's physical protection system and of whether the physical protection objectives are achieved.

The objective of physical protection is to establish and maintain conditions to prevent:

- theft or any other unauthorised removal of relevant quantities of nuclear materials,
- a direct release of considerable quantities of nuclear and other radioactive materials,
- the initiation of plant conditions with inadmissible radiological consequences.

3.2. Elements of DSA

The report which presents the results of a DSA should consist of 4 components:

- description of the actual status,
- evaluation of the results of the safety analysis of PSR, part 1,

- proof that defined security functions are fulfilled,
- compilation of planned measures to improve the status of physical protection.

The description of the actual status should be a complete and comprehensive presentation. It should be compact and can be built on the quotation of documents which have already been submitted to the Authority, e.g. during the licensing procedure. The information contained in this presentation of the actual status has to be sufficient to provide a conclusive and complete overview of the actual status of physical protection. The presentation should also contain the operational experience with the technical and administrative measures during the period since the last PSR. The appendix of the DSA Guideline gives a structure of a comprehensive overview, which is obligatory and covers the complete subject area of the physical protection of a NPP.

The results of the safety analysis of the PSR have to be taken into account. In case a sequence of a technical incident has been identified which cannot be sufficiently controlled or has not been taken into account during the design of the physical protection system, it has to be elaborated if additional physical protection measures are necessary or why the physical protection concept is not affected and the actual status will remain unchanged. In case additional measures are necessary, a description of the planned measures and a schedule for realisation have to be added.

The license holder has to prove that the actual physical protection measures are capable to counter the actual Design Basis Threat, DBT, [4] and are sufficient to meet the requirements of the actual standards and guidelines of physical protection in Germany. A compilation of 19 defined security functions gives guidance and serves as a tool for the evaluation. The security functions, which are defined in the DSA Guideline, represent all elements which all together represent the physical protection system of an NPP in order to meet as well the requirements of the external police as response force. On the basis of the given complete and comprehensive overview on the actual status of physical protection, the license holder describes the measures capable to fulfil the function. The basis to evaluate the measures are the actual standards and guidelines including the DBT, e.g. [4], [5].

If the proof has identified a deficiency in the system of physical protection or in fulfilling a security function, future measures can be considered in the evaluation, if there are any plans. The measures to compensate deficiencies or to improve the physical protection status have to be compiled in the DSA including the schedule for completion.

The DBT and the other requirements in force until the DSA Guideline has been passed represent the basis of the above described proof and the basis of the assessment by the Supervisory Authority. Performing the assessment, the Supervisory Authority has to apply the principle of appropriateness as well as the actual and the perceptible threat. Potential measures to compensate deficiencies have to provide a suitable, necessary and reasonable solution for every isolated case.

4. APPLICATION OF THE DSA GUIDELINE – INSIGHTS

4.1. General Situation

Up to now, 5 DSA reports have been assessed by GRS as expert organisation under contract of the Local State Supervisory Authority. 3 DSA reports are in the process of being assessed, 2 of the 3 in co-operation with the TÜV Süddeutschland as the second organisation in this field.

The DSA reports submitted by the license holders have been produced by plant personnel in charge of physical protection. The decision not to contract external manpower to prepare the report had at least two important advantages: confidentiality was better preserved and the personnel had the opportunity to reflect the whole system of physical protection, including its development.

Due to the fact that there is no legal obligation to prepare a DSA or to apply the DSA Guideline, the reports were declared as reports following the DSA Guideline. The information contained was strictly based on the documents submitted to the authority already during the licensing procedure.

4.2. Presentation of the Actual Status

The option given in the DSA Guideline to describe the actual status of physical protection of the NPP by quoting documents which have been submitted to and have been licensed by the Supervisory Authority has been widely used. In order to get a conclusive and complete overview of the actual status of physical protection, additional knowledge was helpful. The status reports are a result of a restrictive information policy, which is based on the endeavour not to start questioning the license by giving too much additional information.

This policy is understandable on the one hand. On the other hand, the license holders miss the chance to demonstrate that they have accepted the necessity of physical protection and have understood the principles and objectives. DSA reports, for which the status description is based on quotation of already submitted documents, are not very explanatory. Another opportunity has been missed: the opportunity to prepare a consensual understanding which may lead to a consensus in the evaluation. This kind of understanding is a sound basis, if it comes to the evaluation of deficiencies and if the question of appropriateness, suitability, necessity and reasonableness has to be discussed.

The analysis of the experience with operational behaviour of the technical equipment and with administrative measures during operation is handled as a summarising amendment of the presentation of the actual status. Looking into the DSA Guideline, it is formally in compliance with the wording but not with the intention. The DSA should provide additional knowledge to the Supervisory Authority. The knowledge on the operational behaviour is an extremely important feedback on all the formulated requirements and conditions in the license document and in the standards and guidelines. The experience with the administrative measures, e.g. access authorisation, particularly inside the plant buildings to vital areas against the insider threat, is an eminent feedback for the future work of the Supervisory Authorities and their experts.

Only physical protection measures which are generally accepted by the plant personnel are effective in the long run. Measures which did not demonstrate their worth during operation time lose acceptance. Therefore, the analysis of experience with the technical equipment and the administrative measures should be an integral part of the presentation of the actual status, together with the measures to compensate failures and the experience with those interim measures.

The results of the safety analysis and the possible impact on physical protection have had no consequences on the physical protection system up to now.

4.3. Security Functions

The security functions were defined with the intention to give the licensee the opportunity to choose the way proving that a function is fulfilled. It gives more flexibility to the operators for choosing the means and measures which have to be provided. It also gives more independence to the Authorities, which are not bound to judge the efficiency of various arrangements they had more or less imposed through the regulations. A security function defines a problem that has to be solved by suitable measures. 19 functions (problems) have been defined in the DSA Guideline covering all aspects of the physical protection that has to be provided by the operator of an NPP.

The basis for the evaluation by the license holders in the DSA report and for the Supervisory Authority are the DBT and the current requirements. In the following, not all 19 security functions will be explained and discussed. Only typical examples will be given to create an understanding of the principle and the potential problems.

The first example is a very clear one giving no reason for discussion: *Prevention of a forceful intrusion into the protected area by using a truck*. The assessment whether the function is given or not can be done with the information given by the German DBT document.

The second example concerns the detection at the perimeter and access control: All the functions have to be *reliable*.

A technical reliability can be described by numerical values as a result of a probabilistic calculation based on operational experience. The evaluation is clear if a certain value is required. Reliability in physical protection is, of course, a good deal of technical reliability, but the dominating factor is a human factor called Design Basis Threat, DBT. Some countries in the world have elaborated values for e.g. the probability that an intruder will be detected by an intrusion detection system. These values are used to assess the physical protection systems.

The German system does not have or use such numerical values, neither for technical measures nor for administrative ones. The suitability of all physical measures has been assessed by experts during the licensing procedure. The measures have only been licensed if they have been proven to be sufficient. The basis for the assessment are the DBT and the corresponding requirements of standards in force at that time. The question whether an intrusion detection system at the perimeter of the protected area, which has been carried out for e.g. more than 20 years by a patrolling guard service, is reliable enough to fulfil the defined security function, cannot be answered by comparing given numerical values. The DBT has not been changed concerning the intrusion detection since granting the license for the existing system. What has been changed during the past 20 years is the reliability of technical intrusion detection systems, but this does not help in the assessment if the old system is reliable or not.

A similar question is generated by an access control system, which for 20 years has been based on face-to-face identification during badge exchange at the counter and not at the turnstile via video camera. Can such a system be evaluated today as reliable?

An answer is not given here in this paper, but has to be given in the expertise on the DSA report. There are several good reasons to accept these security functions as fulfilled, but there are also several reasons not to accept them. Different experts may come to different conclusions in their assessment. The technical progress and the increasing cost for guards may help to improve the situation in these cases. In order to get a new license in our days, an intrusion detection system of course has to be a technical system, and access control has to include identification at the turnstile directly.

The next example given here is function 7, which is about the intrusion delay: *Forceful attackers have to be prevented from intruding into the buildings containing inner or vital areas during the response time of the police as the external response force*.

The walls, doors and hatches of NPPs belonging to the more recent generation of NPPs have undergone a certain qualification procedure to prove that they provide sufficient delay.

The basis of this qualification was the DBT, actions by the guard service were not taken into consideration. The reason is very simple: the efficiency of a fighting guard cannot be expressed in minutes of delay, guards are only authorised to use their weapons under certain conditions, the police holds the monopoly of using power and the guards are kept as a back up argument to counter credible attacks beyond the DBT.

The walls of buildings containing inner or vital areas of NPPs designed to earlier standards have not undergone the same qualification procedure, because the DBT was different from now concerning forceful intrusion attempts. To prove that this function is fulfilled in the reports of NPPs designed to earlier standards, the solution was that the delay provided by the structural barrier should be supported by the retarding resistance of the guard service.

This could be a realistic situation in the case an attack really happens. Guards will hopefully never wait and watch until the hole is in the wall. Having in mind the principles to change a given situation on the basis of appropriateness, suitability, necessity and reasonableness, this might be a solution for isolated cases.

But it is big change in philosophy. The additional component is already used in the design. A structural barrier can be qualified by technical means, e.g. on the basis of the DBT. The result can be expressed by a number of minutes representing the delay. This is not possible for the efficiency of a guard in a situation of combat. How many minutes can be provided by the guards? Using the guards as an additional element in the barrier system in order to provide a sufficient intrusion delay means that a lot of difficult questions have to be answered and it would be very difficult to achieve a common assessment among more than 10 different Supervisory Authorities and their contracted experts. There is also a clear requirement repeated recently by the police organisation that technical and structural measures are the first choice in the physical protection measures provided by the operator.

With this background the first step can only be a practical intrusion test of representative structures using the means and explosives of the actual DBT. There are several walls built in a so-called sandwich mode which have not been tested before but promise a good result. The result will be a number of minutes which will provide a sound basis to evaluate the actual situation. A potential departure from the required intrusion delay time will provide a basis to decide on compensatory measures which would be suitable, necessary and reasonable and follow the principle of appropriateness.

5. CONCLUSIONS

The DSA Reports is a means for the Supervisory Authority to get additional knowledge on the actual status of the physical protection of NPPs. The DSA reports submitted up to now were focussed more on the intention to identify the deficiencies in the physical protection of NPPs designed to earlier standards and to find a way to initiate a sufficient compensation. From the operators/license holders point of view the reports were focussed more on the intention to demonstrate a solid licensed status by quoting submitted documents instead of explaining that the objectives and principles of physical protection are accepted and how they are adopted.

In the reports as well as in the DSA Guideline the analysis of the experience with the physical protection measures during the passed operation period should be more emphasised. The results of particularly this analysis are important for the physical protection of all NPPs in Germany. Due to the fact that there is a number of different Supervisory Authorities and more than one expert organisation in contract there are some obstacles to place the result to all parties disposal.

In order to elaborate common answers to all problems identified during the assessment, a common advisory group consisting of experts and representatives of the Supervisory Authorities and the Police should be installed in the future.

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