Security Barriers in the Physical Protection Concept of Nuclear Facilities In Switzerland

B. Wieland

Swiss Federal Office of Energy, CH 3003 Berne, Switzerland

ABSTRACT: The presentation describes the structural security measures – security zones and barriers - used for the physical protection of nuclear facilities in Switzerland, especially nuclear power plants. Part 1 deals with the concept of security zones and barriers: arrangement and functions of security zones and barriers, requirements on the level of resistance of security barriers, allocation of buildings, systems and installations to security zones in nuclear facilities. Part 2 deals with examples concerning requirements, construction and inspection of the various security barriers, and describes the development of special components for security barriers.

1 SECURITY ZONES AND BARRIERS CONCEPT

The physical protection concept of nuclear facilities in Switzerland is based on the design basis threat defined by the security authority, using the safety requirements stipulated by the relevant authorities as fundamental criteria. In order to have a well-balanced and effective protection concept, structural, technical, organisational and administrative aspects need to be carefully harmonised.

1.1 Arrangement and functions of security zones and barriers

The security zones and barriers of a nuclear facility are arranged according to the principles of defence in depth. The idea is that any intruders would have to overcome a series of security barriers that represent an increasing degree of resistance the further they penetrate.

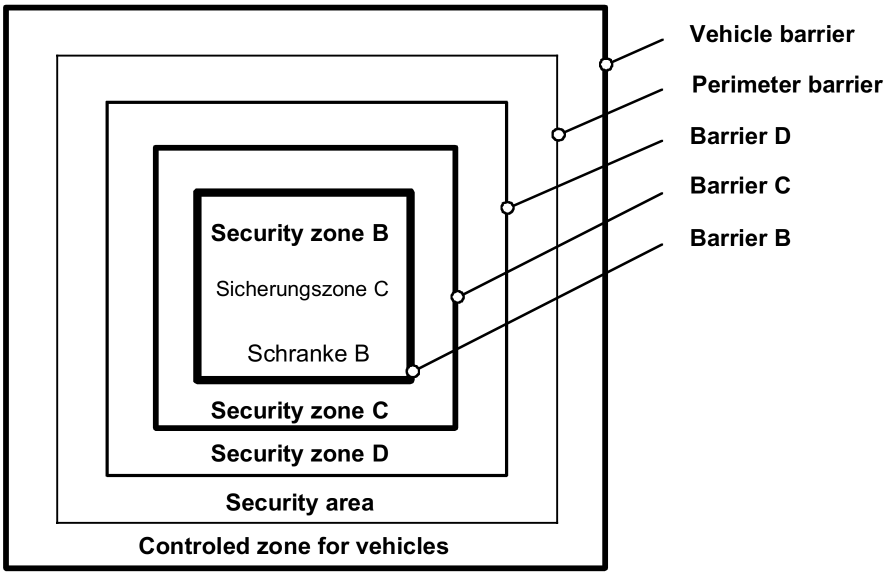
The various security barriers and zones perform the following functions:

- The vehicle barrier protects against relevant attacks and hampers unauthorised transport of heavy equipment into the controlled access zone for vehicles.

- The perimeter barrier surrounds the security area, detects intruders, identifies the location of the attack and triggers the alarm.

- Security barriers D, C and B provide increasingly higher levels of resistance towards the interior, and protect and surround each zone containing safety systems and equipment in accordance with the requirements on the protection of these systems laid down by the safety and security authorities.

(The designation of barriers is based on the classification used in Germany. In view of the different protection concept applied in Switzerland, barrier A is not used.)
The arrangement of security zones and barriers is based on the following model:



Security zone arrangement

Security barriers are required to meet the following general requirements:

Security systems (e.g. central alarm stations, guard houses, etc.) that permit or control access to security zones must be located behind a barrier with the same level of resistance that is required for the protection of the corresponding zone.

At access points through a given security barrier, the barrier's level of resistance must be maintained (lock gate principle). If by way of exception it is necessary to deviate from or deactivate this method, access must be controlled in a manner, which achieves the same level of protection.

If due to local circumstances one or more barriers have to be combined, the necessary level of resistance must be assured.

1.2 Requirements on the level of resistance of security barriers

Requirements on the various security barriers depend partly on the risk assessments, i.e. assumptions concerning potential intruders and their means of attack, and partly on the degree of protection or resistance against attack the respective barriers are required to provide. Risk assessments and requirements concerning the protection to be provided are specified by the security authority.

In their risk assessment, the authority specifies the nature of the threat or threats against which the facility needs to be protected. It contains details regarding the number of potential attackers, their intentions and methods, as well as the means of attack they can be expected to deploy. In this way, operators of nuclear facilities are able to plan and implement suitable counter-measures. All information relating to risk assumptions is of course classified and accessible to only a very small group of users. In general it is assumed that intruders might to some extent be assisted by internal staff, would be thoroughly prepared and possess the necessary equipment and technical information about the facility (and the security system). The equipment could or would include means of transport, firearms, mechanical and thermal attack equipment, explosives, climbing equipment, communication equipment, incapacitation agents and tools and special know-how for gaining access to IT systems.

The level of resistance security barriers are required to provide against potential attackers is defined as a resistance time, i.e. a given security barrier must be able to resist a defined type of attacker using a defined means of attack for a specified period of time. The accumulative resistance time of barriers D, C and B must be greater than the time the security corps – in Switzerland, the special unit of the police force of the canton concerned – requires after the alarm has been raised in order to reach the site and take the necessary action to overcome the intruders.

1.3 Allocation of buildings, systems and installations to security zones

Equipment, systems or installations in nuclear facilities, the sabotage of which – alone or in combination, based on analysis – could lead to unacceptable radiological consequences, have to be located in security zones. The allocation of equipment to security zones depends on the consequences of malevolent acts considered in the context of the design basis threat, and has to be carried out by safety experts in close co-operation with physical protection specialists. In Switzerland, a set of guidelines prepared by the relevant safety and security authorities describes the allocation of buildings, systems and installations to security zones in nuclear power plants. The highest security requirements apply to buildings, systems and installations in security zone B, to which the emergency system designed to remove heat from the reactor in case of emergency, all supply installations for securing the function of this system as well as the containment system and integrated pressure-bearing components of the steam generation system, are allocated.

All systems for securing emergency cooling and removal of heat from the reactor, including the emergency power system, are allocated to security zone C.

The operations complex, including the central control room as well as external installations for the supply of cooling water and electrical switching gear, are allocated to zone D.

2 EXAMPLES CONCERNING REQUIREMENTS, IMPLEMENTATION AND INSPECTION OF SECURITY BARRIERS

2.1 Drive-through prevention

As described in the text above, the aim of drive-through prevention is to protect the facility against attacks with vehicles and block the transport of heavy arms or explosives into the security zone. Here, the measures taken to prevent drive-through attacks must be sufficient to bring any vehicles attempting to unlawfully break through a security barrier to a standstill, in accordance with the requirements laid down by the safety and security authorities concerning vehicle category, weight and speed.

The nature and characteristics of the existing terrain are major factors in the area of drive-through prevention, so it is essential to take these fully into account when defining the drive through prevention concept. If the terrain does not provide the necessary protection, additional measures need to be taken, e.g. installation of certificated barriers.

Drive-through barriers: Bollards and concrete elements

The necessary drive-through protection can be attained with the aid of mobile or fixed elements that may be installed outside or inside the perimeter of the facility, or even form an integral part of the perimeter. Here it is not only essential that the barriers themselves meet the specified requirements, it is also important that they are linked together and anchored in the ground in a way that ensures they are able to withstand the anticipated impact, and this needs to be established through calculations or by conducting physical tests.

In special situations, provisional measures may also be taken, e.g. temporary use concrete elements or steel barriers. However, it is also essential to ascertain that any such provisional measures meet the specified requirements in full. Special care should be taken to ensure that provisional barriers are firmly joined together so that they cannot simply be pushed aside. The resistance time for drive-through prevention must also be maintained after any collision that may occur between an assault vehicle and the barrier.

2.2 Perimeter barrier

The purpose of a perimeter barrier is to detect intruders, identify the location of the intrusion and raise the alarm. Although a perimeter barrier is not allocated a resistance time, it nonetheless has to offer a certain amount of physical protection, e.g. by preventing intruders from breaking through, climbing over, crawling under, tunnelling, flattening or bypassing it.

Perimeter barrier

The perimeter usually consists of an outer and an inner fence, while the space in between is empty and thus does not provide any cover for would-be intruders.

The key element of a perimeter barrier is surveillance, which needs to be secured through two systems that operate independently of one another, supplement one another in a suitable manner, and cover the entire area either singly or in combination with one another. For example, if an optical surveillance system (e.g. video cameras) is installed that may not function sufficiently when visibility is poor, it is important to supplement it with another system that functions well regardless of weather conditions or time of day. Options here include radar or infrared systems, or ground-based devices that react to pressure or are triggered inductively.

Since the efficient operation of such systems often greatly depends on local conditions, it is important to adapt them to the specific circumstances and test them on location before they are definitively installed.

2.3 Security barriers (D, C and B)

D, C and B security barriers form the central defence components in the structural security concept of a nuclear facility. In the event of an assault, these barriers have to prevent intruders from reaching the security zones, or at least sufficiently slow them down so that the response force has time to reach the site and take the necessary action to protect the facility.

The resistance time allocated for this purpose to each component of each security barrier (walls, doors, windows, etc.) has to be confirmed in the form of an official certificate or certified by an accredited authority. The criterion here is that it is not possible for an intruder to break through the barrier within the prescribed time using the relevant means of attack. In Switzerland, the respective tests are frequently carried out by the Swiss Technology Institute Concerning Security (+fasif) in Thun.

As already mentioned, the requirements on each category of security barrier differ and the barriers have to be able to resist increasingly powerful means of attack from the outside for increasing periods of time, but the procedures used for testing the resistance time are essentially the same for each category. The authority carrying out the applicable tests, which is already familiar with the construction plans and/or components of each barrier, chooses the tools or materials it considers the most likely to be used in an attack, specifies the test procedure and when the signal is given, launches its attack on the barrier or component. The length of time required in order to destroy the component concerned, or at least create an opening large enough for a human being to pass through, is then recorded. The size of an aperture large enough for a person to pass through is defined in European standards as follows: rectangle, 400 mm x 250 mm; oval, 400 mm x 300 mm; circle with a diameter of 350 mm.

Attack on security components

2.4 Special problems relating to security barriers

Safety barriers do not consist solely of solid walls that make it relatively easy to attain the prescribed resistance time. Many barriers have to be equipped with doors, windows, ventilation shafts, etc. large enough for a human being to pass through. This means that certain design and construction problems have had to be overcome through joint efforts involving specialists of research institutions and manufacturers, as well as operators and the relevant authorities.

In Switzerland these combined efforts recently led to the design and production of a special grid that has been installed in a nuclear facility to enhance the security of an insufficiently protected window in barrier D so that it meets the corresponding requirements without blocking off too much light. Another joint project that has been realised in recent years concerns the design of grids for the ducted cooling system of a hall for the dry storage of spent fuel elements and vitrified high-level waste, which meet the requirements of category C security barriers while ensuring the necessary air flow.

An especially interesting project was recently initiated in association with the planned upgrading of the security installations in an ageing nuclear facility. The aim here is to develop prefabricated elements that are ready to install and meet the resistance time requirements for category D security barriers without interfering with the existing structural components. The specifications included a maximum weight per square metre as well as an acceptable price per unit. This joint project has meanwhile led to the production of a prototype that meets almost all the defined requirements. The solution that has been developed concerns an element constructed in sandwich form. The various layers consist of different materials that possess in combination the properties that provide the required resistance to the various forms of attack carried out in tests.

3 CONCLUDING REMARKS

The physical protection of nuclear facilities is both highly complex and costly, especially with respect to the installation of structural and technical security measures upgraded facilities. It is often the case that solutions have to be specially developed and implemented to meet the specific needs of the facility concerned, and this means that off-the-shelf solutions are neither suitable nor readily available. As a consequence, the already costly security measures become even more expensive. Projects concerning the security measures of new facilities and the upgrading of existing ones are therefore associated with very high costs, and in view of this, operators are often very unwilling to accept such plans, and in some cases even oppose or reject them.

With respect to the conception of security installations and measures, closer co-operation between operators, manufacturers and the relevant authorities at both the national and international levels would give rise to more widespread understanding for the measures that need to be taken, as well as lead to a larger market and thus to less expensive solutions. This would contribute towards the maintenance of the very high standards that are called for in the area of physical protection of nuclear facilities.