Radiation and Nuclear Safety Authority Regulation on the Technical Safety Requirements for the Processing and Storage of Nuclear Fuel

Content

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In accordance with the Radiation and Nuclear Safety Authority's decision, it is issued, by virtue of Section x of the Nuclear Energy Act (xx/yyyy):

Chapter 1: Scope and definitions

1 Scope

This regulation applies to:

1) The storage of nuclear fuel in nuclear power plants and other nuclear facilities, as well as the processing measures used in connection with nuclear fuel.

2) The transfer of nuclear fuel in areas that are subject to movement or access restrictions.

3) The processing of spent nuclear fuel for final disposal, excluding the closure of the disposal package.

4) The processing of packaged, spent nuclear fuel prior to its final disposal.

5) The design, construction, and operation of the aforementioned activities and the facilities and systems required by them.

2 Definitions

For the purposes of this regulation:

1) *early release* shall refer to a release requiring protection of the population in the early phase of an accident at a nuclear facility (five hours from the beginning of the accident);
2) *initiating event* shall refer to representative events that lead to operational disruptions or accidents;
3) *physical separation* shall refer to the separation of systems, structures, or components by adequate barriers or placement (distance, positioning, etc.) or combinations thereof;
4) *diversity principle* shall refer to ensuring functionality through systems or components that operate on different principles;
5) *separation principle* shall refer to physical and functional separation;
6) *final heat sink* shall refer to such part of a nuclear facility's environment that has a very high heat absorption capacity when compared to the heat

transferred from the nuclear installation to it;

7) *redundancy principle* shall refer to the implementation of alternative systems, structures and components so that any one of them can perform the required function, regardless of the operational status or faults of the others;
8) *operational occurrence* shall refer to an anticipated operational occurrence as referred to in section X of the Government Decree on Nuclear Facilities;
9) *postulated accident* shall refer to the Class 1 postulated accident and Class 2 postulated accident as referred to in section X of the Government Decree on Nuclear Facilities;
10) *design extension condition DEC A2* shall refer to that another fault or combination offaults identified as significant occurs as the cause or an additional fault in an accident;
11) *design extension condition DEC A3* shall refer to a rare external event;
12) *accident* shall refer to a postulated accident, a design extension condition or a severe accident;
13) *large release* shall refer to a release of radioactive substances that necessitates extensive protective actions for the population or extensive and long-term restrictions on the use of land and water areas;
14) *functional separation* shall refer to functional independence. Functional separation also includes electrical separation and the separation of data processing;
15) *safe state* shall refer to a state of a nuclear facility which can be maintained for an extended period and in which the subcriticality and decay heat removal of the nuclear fuel is secured, and there are no significant releases from the plant into the environment;
16) *safety function* shall refer to a function to ensure the safety of a plant or operation aimed at preventing or mitigating the radiation impacts on employees and the public of normal operation, operational occurrences and accidents;
17) *common cause failure* shall refer to the failure of two or more structures, systems, or devices due to the impact of the same single cause;
18) *single failure* shall refer to a failure as a result of which the system, device, or structure is unable to perform the function specified for it;
19) *non-irradiated nuclear fuel* shall refer to nuclear fuel that has not been irradiated in a reactor core;
20) *irradiated nuclear fuel* shall refer to spent nuclear fuel, as specified in section 5, subsection 29 of the Nuclear Energy Act, as well as nuclear fuel that has been

irradiated in a reactor core and is intended to be returned to the reactor core after removal.

Chapter 2: Defence-in-depth safety principle, and the preclusion of events through design solutions

3 Defence-in-depth safety principle

SYT-5586 - The design of the storage and processing of irradiated nuclear fuel in accordance with section 73, subsection 2 of the Nuclear Energy Act shall comply with the defence-in-depth safety principle, which shall include the following levels.

SYT-5587 - At defence-in-depth level 1, failures and occurrences shall be prevented by designing the nuclear facility in a way that ensures its steady operation and by focusing on high-quality solutions in design, construction, manufacturing, and operational measures.

SYT-5584 - At defence-in-depth level 2, the consequences of failures and occurrences shall be controlled by means of restrictive measures, and these shall be reliably prevented from developing into accidents.

SYT-5585 - At defence-in-depth level 3a, postulated accidents shall be managed so that the release of radioactive materials is limited to a minimal level.

SYT-5582 - At defence-in-depth level 3b, design extension conditions shall be managed in a way that the development of accidents into serious accidents can be reliably prevented.

SYT-6237 - At defence-in-depth level 4, it is not necessary to prepare separate systems for managing severe nuclear fuel damage, as such damage shall be prevented in practice.

SYT-5583 - At defence-in-depth level 5, the consequences of an accident shall be mitigated by limiting the population's radiation exposure in situations where radioactive substances are introduced to the environment due to the processing or storage of irradiated fuel.

SYT-5579 - The defence levels shall be as independent from one another as reasonably possible. The loss of several defence levels due to a common cause shall be rendered unlikely.

4 Preclusion of events through design, and the prevention of early or large releases

SYT-5673 - Serious damage to nuclear fuel, in which the fuel loses the geometry required for cooling, shall be precluded through design solutions.

SYT-5670 - The possibility of criticality shall be precluded through structural design solutions.

SYT-5671 - Design solutions shall be used to practically prevent events that would lead to large or early releases. The expected frequency of early releases shall be under 1*10-7/a. The expected frequency of large releases shall be under 5*10-7/a.

SYT-5668 - However, any individual events leading to large or early releases shall not be excluded from the design process solely on the basis of its low frequency; instead, measures that are reasonably possible shall be taken to prevent the release.

Chapter 3: Determination of a nuclear facility's design principles, initiating events, and classification of events

5 Identifying initiating events

SYT-5666 - Internal and external events threatening the storage and processing of nuclear fuel, including illegal and other deliberate actions that endanger safety, shall be systematically identified. In addition to individual events, possible consequential events, simultaneous interdependent events, and combinations of relatively frequent independent events should also be assessed.

SYT-5667 - For the planning of safety functions for the storage and processing of nuclear fuel, it is necessary to systematically select initiating events according to subsection 1 representing identified events that may threaten the integrity of nuclear fuel or the integrity of other confinement barriers or otherwise lead to the spread of radioactive substances.

6 Classification of initiating events

SYT-5644 - Events leading to operational disruptions and postulated accidents in the storage and processing of nuclear fuel shall be systematically classified according to their frequency, in accordance with the classification presented in sections x and x of the Government Decree on Nuclear Facilities.

SYT-5645 - For the purpose of designing the storage and processing of nuclear fuel, it is necessary to systematically identify events considered design extension conditions, as referred to in the Government Decree on Nuclear Facilities. These are classified into two categories:

- DEC A2; the reason for or additional failure associated with an accident is a failure or combination of failures (significant combination of failures)
- DEC A3; rare external event

7 Events affecting several nuclear facilities

SYT-5643 - If several nuclear facilities are located on the same site, any events that could affect several of these facilities simultaneously shall be identified. Simultaneous incidents and accidents shall be taken into account in the design of the facilities.

SYT-5640 - A failure or accident in the storage or processing of nuclear fuel shall not result in an accident in a reactor or at another nuclear facility located on the same site.

8 Preparing for failures

SYT-6241 - When designing the storage and processing of nuclear fuel, preparations shall be made for failures that may manifest as a failure to act when required or as incorrect actions.

SYT-6239 - The consequences of the initiating event and failure shall be identified and addressed in the design as part of the initiating event or original failure.

9 Failures and their consequences

SYT-5638 - Where possible, the implementation of safety functions should utilise systems or components that, in the event of their failure, will still remain optimal for ensuring safety.

Chapter 4: Tolerance level of a nuclear facility in the event of operational disruptions and accidents, and self-sufficiency of a nuclear facility

10 Post-disruption or post-accident state

SYT-5599 - In case of operational disruptions, anticipated accidents, and design extension conditions, the nuclear facility shall be reliably brought to a safe state using the nuclear facility's safety functions.

11 Self-sufficiency of a nuclear facility

SYT-5598 - The facility site shall have sufficient material resources and other material capabilities so that the safety functions required for the storage of nuclear fuel can be carried out without external replenishments in the event of disruptions and accidents, until external replenishments or other necessary arrangements can be implemented, for a minimum period of seven days. The sufficient length of this period shall be justified, taking into account the situation, the location of the facility site and the access routes, the availability of replenishments and arrangements, and other necessary resources.

SYT-5595 - The systems used to implement safety functions shall be permanently installed.

Chapter 5: Safety functions and their verification

12 General requirements for safety functions

SYT-5592 - Safety functions shall utilise safety features that require no external power source, as far as reasonably practicable.

SYT-5593 - Storage and processing facilities shall be fitted with systems that monitor events related to design extension conditions, provide information on the current state of nuclear fuel, and operate without an external power supply.

SYT-5608 - The impacts of joint failures on the nuclear facility's safety shall remain minor.

SYT-5606 - Damage to nuclear fuel during processing and storage shall be prevented with a great level of certainty.

SYT-5607 - When storing and processing nuclear fuel, the transfer of heavy or otherwise hazardous objects shall be avoided in areas where dropping said objects or any other erroneous actions could damage the nuclear fuel or any safety-critical structures or components.

13 Safety of nuclear fuel processing

SYT-5604 - In the case of nuclear fuel processing systems that do not fall under the category of lifting and transfer equipment systems, said systems shall be able to withstand individual failures in the case of safety functions used to prevent irradiated fuel damage or

other significant radiation exposures.

SYT-5602 - In all situations, it shall be possible to transfer nuclear fuel to a safe location.

14 Criticality safety

SYT-5600 - The storage, processing, and transfer of nuclear fuel shall be planned in such a way that, when a storage location is full of nuclear fuel, the effective growth factor (keff) does not exceed 0.95 in normal conditions or usage disruptions, or 0.98 in other design basis situations, taking into account any uncertainties.

SYT-5601 - When designing the criticality safety of nuclear fuel storage, consideration shall be given to situations where water or other possible moderator materials could enter the storage. The nuclear fuel shall remain subcritical in such situations.

15 Decay heat removal during the storage of irradiated nuclear fuel

SYT-5700 - When storing irradiated nuclear fuel in water basins, the related decay heat removal systems shall follow the principles of redundancy, separation and diversity to ensure heat removal.

SYT-5699 - The cooling of stored spent fuel shall be able to withstand individual failures.

SYT-5698 - When storing irradiated nuclear fuel in water basins, the related pool structures, pipe connections, connections to other basins, water volume, and nuclear fuel cooling system shall be designed in a way that:

a) the maximum amount of nuclear fuel with the highest decay heat generation can be cooled in all situations;
b) the coolant in the nuclear fuel storage pool shall not boi during normal operation and anticipated operational occurrences;
c) Inadvertent draining of the storage pool or excessive lowering of the water level to a level that would jeopardize the cooling of the nuclear fuel or the necessary radiation protection are not possible;
d) the storage basin’s structures can withstand loads under normal conditions, operational disruptions, and accidents.

SYT-5697 - If external control or power sources are required for the decay heat removal of stored irradiated nuclear fuel, these shall be implemented in accordance with the diversity principle. The design of a diversity principle-compliant system does not have to be single-failure

tolerant.

SYT-5694 - The design of the cooling of irradiated nuclear fuel shall provide a secondary ultimate heat sink for decay heat removal in the event of unavailability of the primary ultimate heat sink. The secondary ultimate heat sink does not have to be single-failure tolerant.

16 Decay heat removal during the packaging of spent nuclear fuel for final disposal

SYT-5710 - The processing plant for spent nuclear fuel shall be designed in such a way that the maximum intended amount of nuclear fuel with the highest decay heat generation can be cooled in all situations.

17 Preventing the spread of radioactive substances

SYT-6243 - Functions designed to limit the spread of radioactive materials in the event of a breakdown or malfunction in the equipment or structures containing them shall be implemented in a way that, despite any single failures:

1. the radiation exposure of an employee does not exceed three tenths of the effective dose limit for a category A radiation worker, as defined in section 13, subsection 1 of the Government Decree on Ionising Radiation (1034/2018);
2. the limitation of the potential exposure of the population, as specified in section X of the Government Decree on Nuclear Facilities, is met in the event of an operational occurrence.

Chapter 6: Preparedness for internal and external events

18 Internal events

SYT-5689 - Preparedness for internal events shall follow the defence-in-depth principle in order to prevent events, reduce their likelihood, and prevent or mitigate their consequences. An single failure or deviation from the procedure or instruction for preparing for internal events shall not lead to the uncontrolled spread of an event’s consequences.

19 External events

SYT-5687 - External events shall be accounted for in the design, placement, and protection of systems, structures, and equipment as well as transport connections.

SYT-6244 - In the design of the processing and storage of irradiated nuclear fuel, provision

shall be made for collisions involving aeroplanes, so that the consequences of a collision with a small aircraft can be controlled as a class-2 postulated accident, and a collision with a large commercial aircraft can be controlled as a DEC A3 design extension condition.

SYT-5684 - The nuclear facility shall be capable of being brought into a safe state in the event of a design-based earthquake. The facility is able to carry out the safety functions necessary to control the aftermath of the earthquake, regardless of any single failures in the necessary equipment, so that the acceptability criteria for a class-2 postulated accident are met.

Chapter 7: Transfers of irradiated nuclear fuel in areas subject to movement or access restrictions

20 Transfer and final disposal packaging for irradiated nuclear fuel

SYT-5709 - The packaging or final disposal packaging used in the transfer of irradiated nuclear fuel shall meet the following criteria:

a) the nuclear fuel remains subcritical;
b) the decay heat removal of the nuclear fuel has been ensured;
c) the packaging absorbs radiation in such a way that no special radiation protection measures are required during processing;
d) structural integrity, leak-tightness, and the aforementioned characteristics are preserved during transfers, even in the event of a packaking drop or other occurrences.

SYT-5707 - The inspection and condition monitoring of the packaging used in the transfer shall be ensured so that it meets the requirements presented in subsection 1 during use.

21 Approval of transfer packaging for irradiated nuclear fuel

SYT-5706 - The application for the approval of transfer packaging shall include the following:

a) the design and testing documentation of the packaging;
b) manufacturing control material;
c) a description of the packaging's criticality safety and decay heat removal;
d) the radiation-absorbing properties of the packaging;
e) a description of the packaging's structural sustainability;
f) a copy of the certificate of approval issued by a foreign authority, if available.

Chapter 8: Technical arrangements for storage and processing of nuclear fuel

22 General requirements

SYT-5702 - The nuclear fuel's storage conditions shall be designed in such a way that the condition of nuclear fuel elements, scaffolds, basins, and containers does not materially deteriorate during the planned storage period.

SYT-5683 - The storage and processing of nuclear fuel shall include preparations for nuclear fuel elements or rods that are damaged or leaking radioactive materials.

SYT-5681 - The capacity of the irradiated nuclear fuel storage facility shall be designed in such a way that the reactor core can be drained from nuclear fuel while still allowing for the inspection, maintenance, and repair of the storage facilities.

SYT-5682 - The condition and ageing of spent fuel storage containers or unpackaged nuclear fuel elements shall be monitored to ensure their continuous integrity, and spent nuclear fuel shall also be monitored for any changes in its properties and storage conditions. Where monitoring is not possible, it shall be demonstrated with great certainty that the properties of the nuclear fuel do not deteriorate during storage in such a way that it would prevent the further processing of said nuclear fuel.

23 Special arrangements for water basin storage

SYT-5703 - When storing nuclear fuel in water basins, the maintenance of the water's chemical conditions shall comply with Chapter 14 of the Radiation and Nuclear Safety Authority's regulation on the technical safety requirements for nuclear power plants.

SYT-5680 - The storage basins used for nuclear fuel shall include systems for detecting leakages. These shall make it possible to locate the leakage with sufficient precision for repair purposes.

24 Special arrangements for dry storage

SYT-5675 - The storage location shall include systems for detecting leakages.

25 Preparedness for the repair and repackaging of spent nuclear fuel and final disposal packaging

SYT-5674 - Arrangements shall be in place for the repair of final disposal packages or the repackaging of spent nuclear fuel.

SYT-5690 - It shall be possible to safely package and dispose of damaged or leaking nuclear fuel.

Chapter 9: Control rooms or control points in nuclear facilities

26 Nuclear facility status monitoring

SYT-5626 - The facility's site shall feature a centralised control point for monitoring the storage of irradiated nuclear fuel and for controlling the necessary safety functions.

SYT-5625 - The facility's site shall feature a centralised control point for monitoring the processing and packaging of irradiated nuclear fuel, and for controlling the necessary safety functions.

SYT-5622 - In normal use, the storage of irradiated nuclear fuel can also be monitored and controlled from an external control point not located at the site, if an equivalent level of safety can be achieved from said external control point in relation to the monitoring and control at the site. Guidance for the implementation of safety functions necessary for reaching a safe state shall be carried out on-site.

SYT-5623 - Any incidents and accidents at the nuclear facility shall be detected reliably and in a timely manner.

SYT-5620 - The operation of the monitoring and observation systems shall be verified through inspections at the nuclear facility.

Chapter 10: Automation and instrumentation

27 Monitoring the state and environment of a nuclear facility

SYT-5657 - Comprehensive and reliable instrumentation for normal operation and for the

detection and management of operational occurrences and accidents shall be provided for the storage and processing of nuclear fuel and for monitoring the status and environment of the nuclear facility.

SYT-5658 - Status information shall be transmitted to control points or other premises necessary for the control and management of the nuclear facility.

SYT-5655 - The short-term safety functions required for operational disruptions and accidents shall be able to activate automatically.

28 Initiation of safety functions

SYT-5653 - The automatic or manual measures used in case of operational disruptions and accidents for restoring the nuclear facility to a safe state shall remain available regardless of any individual failures in the necessary equipment.

SYT-5654 - The monitoring and control of irradiated nuclear fuel storages shall comply with the diversity principle.

SYT-5649 - The instrumentation and automation systems responsible for safety functions shall be designed in such a way that any failures do not hinder safety.

Chapter 11: Electricity

29 Power supply

SYT-5648 - If the secure storage of irradiated nuclear fuel requires an external power supply, two separate, independent network connections from the external power grid shall be provided to manage and prevent operational disruptions and accidents.

SYT-5660 - Systems shall be in place for the supply of internal electrical power that can be used, regardless of the external power grid, to carry out the safety functions necessary during operational occurrences and postulated accidents and for monitoring the status of the facility. This internal electrical power supply forms part of the safety function to be implemented.

SYT-5659 - In the event of the loss of long-term external power supply, a primary source of

power shall be in place for securing safety functions and monitoring the status of the facility, even if it is not needed within the self-sufficiency period referred to in section 11.

30 Protection against electrical interference

SYT-5661 - The frequency and voltage fluctuations caused by failures in the nuclear facility's electrical equipment and the external power grid shall not compromise safety functions during normal conditions, expected operational disruptions, or accidents. In particular, control and protection devices associated with the distribution and supply of power to safety functions shall be designed to prevent failures due to electrical disturbances by withstanding overvoltages up to twice the maximum expected during extreme interference from the external power grid.

SYT-5663 - Electrical systems shall be equipped with reliable protection devices that can remove a faulty device or part of the power grid from use in all planned power grid connection situations.

SYT-5665 - Electrical and automation systems, including their cabling, used to perform safety functions at the nuclear facility shall be reliably protected against electromagnetic interference. Electrical and automation equipment and their cabling shall be designed and installed in a way that they do not themselves cause any harmful electromagnetic disturbances in their operating environment.

SYT-5664 - Any sources of electromagnetic interference at the nuclear facility shall be identified and managed throughout the nuclear facility's service life.

Chapter 12: Air conditioning and ventilation

31 General requirements for air conditioning and ventilation

SYT-5637 - Ventilation and filtration systems shall be placed in rooms where radioactive materials may be released into the atmosphere. They shall fulfil the following requirements:

1) reduce the concentration of radioactive substances in the atmosphere of the facility's premises;
2) prevent the spread of radioactive materials to other premises;
3) restrict the release of radioactive substances into the environment.

SYT-5630 - In nuclear fuel processing and storage premises, the ventilation and air-conditioning systems shall maintain and secure the conditions under which the systems, equipment, and structures vital for the safety of the facility remain in working order and function properly in accordance with their design principles.

SYT-5629 - The separation of ventilation and air-conditioning systems shall be implemented in accordance with section 19 "Separation of systems providing safety functions" of the regulation "Technical safety requirements for a nuclear power plant". The exhaust ducts of the subsystems in controlled areas may be connected outside the safety quadrants just before the exhaust pipe, if the ducts are equipped with sufficient smoke and fire separation.

32 Maintaining safe working conditions

SYT-5631 - Working conditions in rooms where personnel are present during operational disruptions, accidents, and internal and external events shall be safe without the use of special equipment. The functions used to maintain the necessary conditions shall be carried out in accordance with the requirements for operational disruptions or accidents.

SYT-5634 - The rooms where personnel are present during operational disruptions, accidents, and internal and external events shall be fitted with closing devices and filtration equipment. Concentrations of radioactive and toxic substances shall be reliably detectable.

SYT-5633 - The supply air centres and systems of buildings housing the nuclear facility's safety-classified subsystems shall be designed and located in such a way that it is unlikely that any combustible, toxic, or otherwise hazardous substances can spread to them. It shall be possible to detect and prevent the spread of harmful substances to the facility’s premises.

33 Ventilation and air conditioning zones and air pressure differences

SYT-5635 - The nuclear facility’s buildings and their premises shall be divided into zones with predefined and verifiable air pressure differences, so that the directions of air flows are in the direction of less clean areas in terms of their radiation safety.

SYT-5624 - Air flows shall be dimensioned so that the concentrations of radioactive substances in the premises’ indoor air can be kept sufficiently low in any premises where work is carried out. The necessary periods of presence shall be taken into account in the dimensioning process.

SYT-5618 - The exhaust air from controlled areas shall be directed using ventilation ducts, through the exhaust pipe into the environment.

Chapter 13: Various provisions

34 Maintenance and testing in normal use

SYT-5610 - The systems used to implement safety functions shall be designed in such a way that their operational condition can be tested or otherwise verified during the facility's service life in a way that closely mimics their operational situations and the operating conditions for which they are designed. Where possible, the tests should involve the entire scope of the safety function.

35 Safety and earthquake classification

SYT-5614 - The following are subject to the Radiation and Nuclear Safety Authority's regulation on the technical safety requirements for nuclear power plants: the principles of safety classification, safety classes 2, 3, 4, and the EYT, as well as the classification of structures, buildings, and equipment, systems containing radioactive substances, and the earthquake classification.

36 Record keeping

SYT-5575 - Records shall be kept for nuclear fuel, including its characteristics and the details and properties of the packaging used for processed or stored fuel, or of unpackaged fuel elements.

SYT-5576 - Each nuclear fuel element, nuclear fuel package, or unpackaged nuclear fuel element shall be identifiable.

SYT-5589 - The records shall be stored and kept up to date throughout the storage period (in particular taking into account the condition and storage conditions of the waste).

Chapter 14: Entry into force and transitional provisions

37 Entry into force

This regulation enters into force on X X 202X and will remain valid until further notice.