

Radiation and Nuclear Safety Authority Regulation on the Technical Safety Requirements of a Nuclear Power Plant

Content

| | |
|---|----|
| Regulation on the Technical Safety Requirements of a Nuclear Power Plant..... | 1 |
| Chapter 1: Scope and definitions | 4 |
| Section 1 Scope of application..... | 4 |
| Section 2 Definitions | 4 |
| Chapter 2: Defence-in-depth safety principle and exclusion of events through design solutions . | 6 |
| Section 3 Defence-in-depth safety principle | 6 |
| Section 4 Prevention of early or large releases in practice through design solutions | 7 |
| Chapter 3: Definition of the design basis of a nuclear power plant, initiating events and their classification | 8 |
| Section 5 Identification and selection of initiating events | 8 |
| Section 6 Classification of events | 8 |
| Section 7 Events affecting several nuclear facilities | 9 |
| Section 8 Preparedness for faults | 9 |
| Section 9 Limitation of the consequences of faults | 9 |
| Chapter 4: Target states of the nuclear power plant during operational occurrences and accidents, and the facility's self-sufficiency | 9 |
| Section 10 Controlled and safe state after an operational occurrence or accident..... | 9 |
| Section 11 Controlled and safe state following a severe reactor accident | 10 |
| Section 12 Self-sufficiency of the nuclear power plant..... | 10 |
| Chapter 5: Redundancy, diversity and separation of safety functions | 11 |
| Section 13 Reactivity control in operational occurrences and postulated accidents | 11 |
| Section 13a Reactivity control in design extension condition DEC | 11 |
| Section 13b Reactivity control in a safe state | 12 |
| Section 13c General requirements for reactivity control..... | 12 |
| Section 14 Cooling and decay heat removal in operational occurrences and design extension conditions..... | 12 |
| Section 14a Decay heat removal in design extension conditions..... | 13 |
| Section 15 Other cooling and decay heat removal requirements..... | 14 |
| Section 16 Prevention of the dispersion of radioactive substances | 14 |
| Section 17 Management of severe reactor accidents | 14 |
| Section 18 System-level independence of safety functions | 15 |

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

| | |
|---|----|
| Section 19 Separation of systems implementing safety functions..... | 15 |
| Section 20 Other requirements for safety functions | 16 |
| Chapter 6: Preparedness for internal and external events | 16 |
| Section 21 Internal events..... | 16 |
| Section 22 External events..... | 16 |
| Chapter 7: Reactor and nuclear fuel | 16 |
| Section 23 Reactor behaviour | 16 |
| Section 24 Normal use of nuclear fuel and operational occurrences | 17 |
| Section 25 Design limits and acceptance criteria for nuclear fuel | 17 |
| Section 26 Criticality safety | 17 |
| Chapter 8: Reactor cooling systems | 18 |
| Section 27 General objective | 18 |
| Section 28 Pipes designed to remain intact..... | 18 |
| Section 29 Leakage monitoring of the reactor cooling system and the pipes designed to remain intact | 19 |
| Section 30 Pressure control and overpressure protection | 19 |
| Section 31 Redundancy and diversity of overpressure protection | 20 |
| Chapter 9: Containment function | 20 |
| Section 32 Containment..... | 20 |
| Section 33 Containment isolation | 21 |
| Section 34 Containment pressure control..... | 21 |
| Chapter 10: Automation and instrumentation | 22 |
| Section 35 Monitoring of the state of the nuclear power plant | 22 |
| Section 36 Limitation functions..... | 22 |
| Section 37 Protection automation and controls for a controlled state | 23 |
| Section 38 Controls for a safe state | 23 |
| Section 39 Controls for severe reactor accidents | 23 |
| Section 40 Other requirements for instrumentation and automation systems | 24 |
| Chapter 11: Nuclear power plant control rooms | 24 |
| Section 41 Control rooms..... | 24 |
| Section 42 Separation of control rooms and control systems | 25 |
| Section 43 Consideration of human factors in the control room..... | 25 |
| Chapter 12: Electrical systems and electrical disturbances..... | 25 |
| Section 44 Verification of electrical power supply | 25 |
| Section 45 Protection against electrical disturbances | 26 |

| | |
|--|----|
| Chapter 13: Air conditioning and ventilation..... | 27 |
| Section 46 General requirements for air conditioning and ventilation | 27 |
| Section 47 Maintenance of safe working conditions | 27 |
| Section 48 Ventilation and air-conditioning zones and pressure differences..... | 28 |
| Chapter 14: Chemistry | 28 |
| Section 49 Design basis for chemical conditions | 28 |
| Section 50 Chemical parameters important for safety | 29 |
| Section 51 Control of chemical conditions..... | 29 |
| Chapter 15: Testability, maintainability and condition monitoring | 29 |
| Section 52 Testing and maintenance in normal operation | 29 |
| Section 53 Continuous condition monitoring..... | 30 |
| Section 54 Provisions for repairs and maintenance in accident situations | 30 |
| Chapter 16: Safety classification and seismic classification | 30 |
| Section 55 Principles of safety classification | 30 |
| Section 56 Safety class 2 functions | 31 |
| Section 57 Safety class 3 functions..... | 31 |
| Section 58 Safety class 4 functions..... | 32 |
| Section 59 Safety classification of nuclear fuel, the reactor cooling system and the heat transfer system associated with the cooling system | 33 |
| Section 60 Safety classification of the containment and the structures ensuring subcriticality..... | 33 |
| Section 61 Support structures, protective structures and buildings..... | 33 |
| Section 62 Safety classification of equipment and structures containing radioactive substances, and of functions preventing the spread of radioactive substances | 34 |
| Section 63 Seismic classification..... | 34 |
| Section n Entry into force and transitional provision | 35 |

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

Section 1 Scope of application

This regulation applies to the technical safety requirements for light-water cooled nuclear power plants. Provisions on nuclear fuel storage facilities and the processing of nuclear fuel at a nuclear power plant are laid down in the Radiation and Nuclear Safety Authority Regulation on the Processing and Storage of Nuclear Fuel (Y/x/20xx).

Section 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 a representative event that leads to an operational occurrence or an accident;
3. "physical separation" shall refer to the separation of systems, structures or components by sufficient barriers, layout (distance, positioning) or combinations thereof;
4. "diversity principle" shall refer to ensuring functions through systems or devices that operate on different principles or are otherwise dissimilar;
5. "separation" shall refer to physical and functional separation;
6. "controlled state" shall refer to the state of a nuclear power plant in which the reactor is subcritical for a long period, or the reactor power is at a safe and stable level required for the management of an operational occurrence; and where the decay heat removal of the reactor is secured, and there are no significant releases from the nuclear power plant into the environment;
7. "ultimate heat sink" shall refer to a part of the environment of a nuclear facility with a very high capacity to absorb heat compared with the heat transferred there from the nuclear facility;
8. "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;
9. "operational occurrence" shall refer to an anticipated operational occurrence as referred

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

- to in section X of the Government Decree on Nuclear Facilities;
10. "postulated accident" shall refer to a Class 1 postulated accident and a Class 2 postulated accident as referred to in section X of the Government Decree on Nuclear Facilities;
 11. "design extension condition" shall refer to the extension of a postulated accident as referred to in section X of the Government Decree on Nuclear Facilities;
 12. "design extension condition DEC A1" shall refer to a common cause failure of a safety class 2 system intended for the management of a postulated accident, combined with an operational occurrence or a Class 1 postulated accident;
 13. "design extension condition DEC A2" shall refer to that another fault or combination of faults identified as significant occurs as the cause or an additional fault in an accident;
 14. "design extension condition DEC A3" shall refer to a rare external event;
 15. "accident" shall refer to a postulated accident, a design extension condition or a severe accident;
 16. "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;
 17. "functional separation" shall refer to functional independence. Functional separation also includes electrical separation and the separation of data processing;
 18. "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;
 19. "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;
 20. "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;
 21. "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;
 22. "severe reactor accident" shall refer to an accident in a light-water cooled reactor in which a significant portion of the fuel in the reactor loses its original structure;
 23. "controlled state in a severe reactor accident" shall refer to the state of a nuclear power plant following a severe reactor accident, in which the removal of decay heat from the reactor core, its remains or the containment is secured, recriticality is no longer a risk, and there is no significant release of fission products from the reactor core or its remains;

24. "safe state in a severe reactor accident" shall refer to the state of a nuclear power plant following a severe reactor accident, in which the conditions for a controlled state are met and, in addition, the internal pressure within the containment is so low that any leakage is minimal, even if the containment is not leakproof.

Chapter 2: Defence-in-depth safety principle and exclusion of events through design solutions

Section 3 Defence-in-depth safety principle

SYT-3094 - The defence-in-depth safety principle of a nuclear power plant in accordance with section 73(2) of the Nuclear Energy Act shall include the following levels.

1. At defence-in-depth level 1, failures and disturbances shall be prevented by designing the nuclear power plant to behave in a stable manner and by ensuring high quality in design, construction, manufacture and operation.
2. At defence-in-depth level 2, the consequences of failures and disturbances shall be managed, and their escalation into accidents shall be reliably prevented.
3. At defence-in-depth level 3a, postulated accidents shall be managed by equipping the nuclear power plant with highly reliable safety functions so that the release of radioactive substances beyond the barriers is limited to a minimal level. At defence-in-depth level 3b, design extension conditions shall be managed using safety functions complementary to Level 3a, ensuring that the escalation of the accident situation into a severe reactor accident or a significant increase in releases is reliably prevented.
4. At defence-in-depth level 4, severe reactor accidents shall be managed by equipping the nuclear power plant with special safety functions that limit the release of radioactive substances into the environment so that the necessary protective measures are limited in both their impact and duration.
5. At defence-in-depth level 5, the consequences of an accident shall be mitigated by limiting the radiation exposure of the population in a situation in which a significant amount of radioactive substances is released from the nuclear power plant into the environment.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3096 - The release of radioactive substances from the reactor into the environment shall be limited by successive barriers.

SYT-3095 - The defence-in-depth levels shall be as independent from each other as is possible in practice. The loss of multiple defence levels for the same reason shall be unlikely. The failure or malfunction of a function, system, device or structure belonging to a specific defence-in-depth level shall not compromise the implementation of safety functions at subsequent defence-in-depth levels. The independence of defence-in-depth level 4 from the other levels shall be stronger than the independence between the other defence-in-depth levels.

SYT-3394 - It shall be possible to manage minor operational occurrences at a nuclear power plant through limitation functions. In extensive operational occurrences, safety functions intended for managing postulated accidents may also be used, provided that limitation functions cannot be reasonably implemented by practical measures, and the criteria otherwise intended for managing operational occurrences are met.

Section 4 Prevention of early or large releases in practice through design solutions

SYT-3097 - Design solutions for a nuclear power plant shall in practice prevent events or accident sequences that would result in large or early releases of radioactive substances, as referred to in section 46(1) of the Nuclear Energy Act and in section 4(2-4) of the Government Decree on Nuclear Facilities.

SYT-3103 - Preparedness for an individual event or accident sequence leading to a large or an early release shall not be excluded from the design solely based on its low frequency. Instead, measures shall be taken that are reasonably possible to prevent the release.

SYT-5158 – The expected value of the large release frequency shall be less than $5 \cdot 10^{-7}/a$. The expected value of the early release frequency shall be less than $1 \cdot 10^{-7}/a$.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Chapter 3: Definition of the design basis of a nuclear power plant, initiating events and their classification

Section 5 Identification and selection of initiating events

SYT-3258 - Internal and external events that pose a threat to the nuclear power plant, including unlawful and other deliberate actions endangering safety, shall be systematically identified. In addition to individual events, possible consequential events, simultaneous interdependent events and combinations of relatively frequent independent events shall be considered.

SYT-3098 - For the design of the safety functions of a nuclear power plant, representative initiating events shall be systematically selected from the events identified pursuant to subsection 1, which may threaten the integrity of the fuel or other barriers, or otherwise result in the dispersion of radioactive substances.

Section 6 Classification of events

SYT-3099 - The initiating events leading to operational occurrences and postulated accidents shall be systematically divided, based on their frequency of occurrence, into categories in accordance with sections x and x of the the Government Decree on Nuclear Facilities.

SYT-3100 - The initiating events to be addressed in the design as design extension conditions, as referred to in section x of the the Government Decree on Nuclear Facilities, along with the associated failure assumptions, shall be systematically identified and categorised as follows:

* DEC A1: a common cause failure of a safety class 2 system intended for the management of a postulated accident, combined with an operational occurrence or a safety class 1 postulated accident

* DEC A2: another failure or failure combination identified as significant (*significant combination of failures*) occurs as the cause or an additional failure in an accident

* DEC A3: a rare external event

SYT-4142 - Situations that may lead to a severe reactor accident, as well as phenomena related to a severe reactor accident, shall be systematically identified.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Section 7 Events affecting several nuclear facilities

SYT-3132 - If several nuclear facilities or reactors are located in close proximity, events that may affect more than one facility or reactor shall be identified. Simultaneous operational occurrences and accident situations shall be taken into account in the design.

SYT-4725 - An operational occurrence or accident in one reactor or nuclear facility shall not lead to an accident in another reactor or nuclear facility.

Section 8 Preparedness for faults

SYT-3377 - The design of a nuclear power plant shall account for faults that may occur as a lack of response in a demand situation or as erroneous operation.

SYT-3376 - The consequences of the initiating event and the failure shall be identified and addressed in the design as part of the initiating event or the original failure.

Section 9 Limitation of the consequences of faults

SYT-3517 - An anticipated failure of an individual device or part of an automation system, which is either unclassified in terms of safety or included in safety class 4, shall not result in the need to start systems designed for the management of postulated accidents. The requirement may be waived if its implementation cannot be reasonably achieved through practical measures, and safety is not compromised as a result.

Chapter 4: Target states of the nuclear power plant during operational occurrences and accidents, and the facility's self-sufficiency

Section 10 Controlled and safe state after an operational occurrence or accident

SYT-3133 - It shall be possible to reliably bring the nuclear power plant into a *controlled state* by means of safety functions in the event of operational occurrences, postulated accidents and design extension conditions. Achieving a controlled state also involves maintaining the controlled state, which shall be able to continue until the facility can be brought to a safe state.

SYT-3136 - It shall be possible to reliably bring the nuclear power plant into a *safe state* by means of safety functions in the event of operational occurrences, postulated accidents and

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

design extension conditions. In addition, in the safe state of a nuclear power plant, the reactor shall be subcritical with a high degree of certainty and the amount of exergy stored in the coolant shall be minimal.

SYT-3135 - Following operational occurrences, postulated accidents and design extension conditions, the nuclear power plant shall be brought to a state in which the removal of nuclear fuel from the reactor is possible.

SYT-3263 - A reactor shutdown system based on control elements shall be capable of shutting down the reactor even if the control element with the greatest reactivity effect is left outside the reactor core.

Section 11 Controlled and safe state following a severe reactor accident

SYT-3138 - It shall be possible to reliably bring the nuclear power plant into a *controlled state of a severe reactor accident* by means of safety functions for the management of a severe reactor accident. It shall be possible to maintain the controlled state in a severe reactor accident until the facility can be brought into a safe state in a severe reactor accident.

SYT-3147 - It shall be possible to reliably bring the nuclear power plant into a *safe state in a severe reactor accident* by means of safety functions.

Section 12 Self-sufficiency of the nuclear power plant

SYT-3139 - The facility site shall have sufficient material reserves and other material capabilities so that the necessary safety functions can be implemented without external replenishments in the event of operational occurrences and accidents until the external replenishments or other necessary arrangements can be implemented, for a minimum period of seven days. The adequacy of the period shall be justified, taking into account the event, the location of the facility site and the access routes, the availability of replenishments and arrangements, and other necessary resources.

SYT-3233 - Each reactor in the nuclear power plant shall have reactor-specific safety functions for reactivity management and decay heat removal. The reactor containment and control rooms or systems, structures or components supporting the operation of safety functions may be shared, provided it can be demonstrated that faults do not spread between reactors through common system structures or components. It shall be possible to carry out the functions

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

required by each reactor in the event of a simultaneous disturbance or accident situation of the reactors if necessary.

SYT-3465 - The systems implementing safety functions shall be permanently installed.

Chapter 5: Redundancy, diversity and separation of safety functions

Section 13 Reactivity control in operational occurrences and postulated accidents

SYT-3264 - During operational occurrences, it shall be possible to limit reactor power or, if necessary, shut down the reactor into a controlled state, regardless of a single failure of any device required for this purpose.

SYT-3265 -It shall be possible to shut down the reactor quickly into a controlled state and keep it subcritical in postulated accidents, regardless of the single failure of any device required for this purpose. The primary reactor shutdown system required for the shutdown function shall be as independent of external power sources as possible. If a very short-term return to criticality cannot be prevented by reasonable practical measures, the increase in the reactor's fission power shall be minimal.

Section 13a Reactivity control in design extension condition DEC

SYT-3266 - It shall be possible to shut down the reactor in a controlled state in a manner that implements the diversity principle:

1. in operational occurrences where there is a common cause failure in the reactor's primary shutdown system; and
2. in operational occurrences and Class 1 postulated accidents where there is a common cause failure in another system required for the shutdown function.

Functions implementing the diversity principle shall be carried out regardless of any single fault in any necessary equipment unless it can be demonstrated that increasing redundancy will have only a minor impact on safety. Redundancy may be applied partly to a function if this can be justified on safety grounds.

SYT-3267 - It shall be possible to shut down the reactor in a controlled state in the event of accidents involving a significant combination of failures (DEC A2) and in the event of rare

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

external events (DEC A3).

Section 13b Reactivity control in a safe state

SYT-3268 - It shall be possible with a high degree of certainty to bring the reactor into a subcritical and safe state with a function referred to in either section 13(2) or section 13a in normal operation and following operational occurrences and accident situations other than severe reactor accidents. In normal operation and in the event of an operational occurrence, and in postulated accidents, it shall be possible to carry out the function regardless of any single failure in any equipment required for it. In design extension conditions the failure criterion required of the functions needed for a safe state and a controlled state are the same.

SYT-6032 - The shutdown system implementing the diversity principle shall be capable of bringing the reactor to a safe state unless the primary shutdown system can be repaired in the controlled state of the nuclear power plant.

Section 13c General requirements for reactivity control

SYT-3263 - A reactor shutdown system based on control elements shall be capable of shutting down the reactor even if the control element with the greatest reactivity effect is left outside the reactor core.

SYT-6037 - In nuclear power plants using a neutron absorber dissolved in a coolant, the concentration of the neutron absorber shall be reliably controlled. In normal operation and in the event of an operational occurrence and a postulated accident, it shall be possible to perform the function despite the individual failure of any equipment required for it. In design extension conditions DEC functions required for a safe state are required to have the same fault criterion as for a controlled state.

Section 14 Cooling and decay heat removal in operational occurrences and design extension conditions

SYT-3273 - It shall be possible to cool the nuclear fuel in the reactor or remove decay heat from the reactor and the containment during operational occurrences, regardless of any single fault in any necessary equipment, into a controlled state and, if necessary, into a safe state.

SYT-3270 - It shall be possible to remove decay heat from the reactor and the containment during postulated accidents, regardless of any single failure in any necessary components, into

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETS CENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

a controlled state and a safe state. In a safe state, the exergy of the reactor cooling systems and the containment shall be minimal.

Section 14a Decay heat removal in design extension conditions

SYT-3271 - It shall be possible to remove decay heat from the reactor and the containment into a controlled state during operational occurrences or Class 1 postulated accidents, regardless of a common cause failure in any necessary system, through a function that implements the diversity principle. Functions implementing the diversity principle shall be carried out regardless of any single fault in any necessary equipment unless it can be demonstrated that increasing redundancy will have only a minor impact on safety. Redundancy may be applied partly to a function if this can be justified on safety grounds.

In the event of a common cause failure, there is no need to have a separate decay heat removal system complying with the diversity principle if all the following conditions are met:

1. the continuous operation of the decay heat removal system does not require active equipment, control or external power, and the start-up of the decay heat removal function implements the redundancy and diversity principles.
2. if material replenishments are required to maintain the operation of the decay heat removal system, the systems implementing them shall comply with section 18(2).
3. the operation of the decay heat removal function has been proven to be reliable with a very high degree of certainty;
4. the other defence-in-depth levels of the nuclear power plant have been robustly implemented.

SYT-3276 - It shall be possible to carry out the decay heat removal of the reactor and the containment to a safe state in connection with a design extension condition DEC A1, regardless of any single failure of any necessary equipment unless it can be demonstrated that increasing redundancy has only a minor impact on safety. In a safe state, the exergy of the reactor cooling systems and the containment shall be minimal.

SYT-3464 - It shall be possible to remove decay heat from the reactor and the containment to a controlled and safe state during accidents involving a significant combination of faults (DEC A2) and during rare external events (DEC A3). In a safe state, the exergy of the reactor cooling systems and the containment shall be minimal.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Section 15 Other cooling and decay heat removal requirements

SYT-3272 - It shall be possible to remove decay heat from the reactor during normal operation, including during a nuclear power plant outage, regardless of a single failure in any necessary component.

SYT-3274 - Following an accident, decay heat removal shall meet the same requirements as the maintenance of a safe state during the accident in question until the nuclear fuel is removed from the reactor, or the reactor is returned to normal operation.

SYT-3372 - Interruptions in the use of the ultimate heat sink shall be prepared for in accordance with the principle of diversity if the primary ultimate heat sink is the sea, a lake, a river or the atmosphere. The use of a secondary ultimate heat sink may be prepared for as a DEC A3 event if decay heat removal to the primary ultimate heat sink implements the principle of diversity.

SYT-3584 - If decay heat removal is based on a coolant circulated within the containment, its long-term functionality shall be ensured despite any impurities formed that may be released into the containment as a result of an accident.

Section 16 Prevention of the dispersion of radioactive substances

SYT-3583 - Functions designed to limit the dispersion of radioactive substances in the event of failure or malfunction of components or structures containing them shall be carried out regardless of the individual fault so that:

1. the potential exposure of a worker is no more than 3 tenths of the effective dose limit for a category A radiation worker as defined in section 13(1) of the Government Decree on Ionising Radiation (1034/2018);
2. the limit on the potential exposure of the population in the event of an operational occurrence, as defined in Section X of the Government Decree on Nuclear Facilities, is met.

Section 17 Management of severe reactor accidents

SYT-3269 - The safety functions required to achieve a controlled state in a severe reactor accident shall be carried out regardless of any single fault in any necessary components unless it can be demonstrated that increasing redundancy has only a minor impact on safety.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3390 - In the event of a severe reactor accident, the reactor or its remains shall end up in a subcritical state, and it shall be possible to stabilise and cool any resulting core melt that may be generated.

SYT-3569 - If functions that are not independent of those implemented at other defence-in-depth levels are used to achieve a safe state in a severe reactor accident, it shall be possible to repair them to restore their functionality.

Section 18 System-level independence of safety functions

SYT-3563 - For systems implementing safety functions in operational occurrences and accidents, a self-sufficiency period shall be defined so that material replenishments or external supplementary energy supply can be reliably implemented before the need arises.

SYT-3379 - Systems implementing additions to safety functions required in operational occurrences and accidents shall function reliably. System design shall account for single failures according to the requirements of the safety function unless it can be demonstrated that such faults will be detected and can be corrected before the systems are needed. After the self-sufficiency period defined above in Section 12 for the nuclear power plant, replenishments may be delivered through other arrangements.

Section 19 Separation of systems implementing safety functions

SYT-3140 - To prevent the spread of faults, the subsystem chains implementing the redundancy principle shall be functionally and physically separated from one another in a safety-appropriate way.

SYT-3142 - The subsystem chains shall primarily be located in separate buildings or otherwise in separate rooms.

SYT-3143 - The spread of internal events between spaces containing different subsystems shall be reliably prevented.

SYT-3141 - In spaces where, for compelling reasons, several parts of different subsystems performing the same safety function are located, separation by distance and protective structures shall be applied where possible. In addition, the prevention, detection and management of internal events in these spaces shall be particularly effective and reliable.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Section 20 Other requirements for safety functions

SYT-3374 - Where possible, systems or devices used to implement safety functions shall be such that they assume a state favourable to safety in the event of failure.

Chapter 6: Preparedness for internal and external events

Section 21 Internal events

SYT-3303 - In preparing for internal events, the defence-in-depth safety principle shall be observed, aiming to prevent such events, reduce their probability, and prevent or mitigate their consequences. A single fault or a deviation from the procedure or instructions in preparing for an internal event shall not lead to an uncontrolled spread of the consequences of the event.

Section 22 External events

SYT-3489 - External events shall be prepared for through the design, placement and protection of systems, buildings, structures and equipment, as well as access routes.

SYT-3278 - It shall be possible to bring the nuclear power plant into a safe state in the event of a design-basis earthquake. It shall be possible to implement the safety functions required to control the consequences of an earthquake despite any single failure in any necessary equipment so that the acceptance criteria for a Class 2 postulated accident are met.

The containment shall maintain leak-tightness.

SYT-6047 - In the design of a nuclear power plant, an aircraft collision shall be prepared for so that the consequences of a small aircraft collision are managed as a Class 2 postulated accident and the collision of a large commercial aircraft is managed as a design extension condition DEC A3.

Chapter 7: Reactor and nuclear fuel

Section 23 Reactor behaviour

SYT-3234 - The inherent behaviour of the reactor shall be stable. In particular, the combined effect of physical feedback shall be such that it suppresses the increase in reactor power.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3235 - Possible reactivity increases shall be limited so that they do not cause sudden and widespread failure of barriers.

Section 24 Normal use of nuclear fuel and operational occurrences

SYT-3170 - The geometry, durability and materials of nuclear fuel, control elements and other components of the reactor core shall be compatible with the intended reactor operation, handling and storage, and the further processing or final disposal of spent nuclear fuel.

SYT-3171 - Changes in the geometry, structure or materials of nuclear fuel, control elements and other components of the reactor core during planned reactor operation or in connection with operational occurrences shall not compromise reactor shutdown or the coolability of the fuel.

SYT-3172 - The likelihood of nuclear fuel damage as a result of an operational occurrence shall be low.

Section 25 Design limits and acceptance criteria for nuclear fuel

SYT-3177 - In postulated accidents and design extension conditions, the nuclear fuel, control elements and other components of the reactor core shall remain in place and retain their structure so that reactor shutdown and the long-term cooling of the nuclear fuel are ensured, and the removal of the fuel from the reactor is possible.

SYT-3178 - In Class 1 postulated accidents, no more than one per cent of the nuclear fuel may lose its integrity so that radioactive substances are released from the fuel. In Class 2 postulated accidents, the corresponding proportion may not be more than ten per cent.

SYT-3181 - To ensure fuel integrity, design limits for nuclear fuel and control elements shall be defined, and they shall not be exceeded during normal operation, operational occurrences, postulated accidents or design extension conditions. To ensure the integrity of nuclear fuel, the determination of design limits shall also take transport, further processing, storage and final disposal into account. The limits shall be based on experimental results and include adequate safety margins.

Section 26 Criticality safety

SYT-3183 - In an open reactor, the possibility of criticality shall be very low.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änästranden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3184 - In a closed reactor, the unintentional criticality of nuclear fuel shall be prevented primarily through technical solutions.

SYT-5217 - The reactor monitoring systems shall be able to detect any approaching criticality.

Chapter 8: Reactor cooling systems

Section 27 General objective

SYT-4211 - To ensure the cooling of the nuclear fuel, the possibility of damage to the reactor pressure vessel or other components of the reactor cooling system shall be very low unless the consequences of the damage can be shown to be controllable.

SYT-4787 - The possibility of damage to the reactor cooling system shall be low so that situations threatening the integrity of the nuclear fuel and the containment are rare.

SYT-5210 - The likelihood of damage to the system transferring heat from the reactor's cooling system during normal operation shall be low so that the transfer of heat in a controlled manner and the prevention of the spread of radioactive substances outside the containment are not compromised.

Section 28 Pipes designed to remain intact

SYT-4212 - The possibility of a rapid rupture of the largest pipe in the reactor cooling system and the main steam pipe of the pressurised water reactor plant shall be prepared for:

1. by designing the facility and its safety functions so that a sudden and complete rupture of the pipe is managed as a Class 2 postulated accident;
2. by limiting the size of the leak caused by the rupture using break limiters and designing the facility and its safety functions so that a rupture limited by break limiters is managed as a Class 2 postulated accident; however, the consequences of a sudden and complete rupture of the pipe shall be managed so that no early or large release occurs; or
3. by designing the pipe in accordance with requirements aimed at reducing the probability of a rupture to a very low level (*a pipe designed to remain intact*); in this case, the design basis of the facility, its systems and equipment does not need to account for sudden and complete ruptures of such pipes; however, the consequences

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

of a sudden and complete pipe rupture shall be managed so that no early or large release occurs.

SYT-4213 - Piping designed to be uninterrupted shall meet the requirements of section 21 of the Radiation and Nuclear Safety Authority regulation on the structures and equipment of a nuclear facility (Y/XX/202X). In addition, monitoring during operation shall ensure that the piping continues to meet the required standards.

SYT-4215 - If the large pipes of the reactor cooling system or the main steam pipes of the pressurised water reactor plant are designed to remain intact, the sudden and complete rupture of a related pipe, or a 10 per cent leak from a pipe designed to remain intact, shall serve as the design basis for the safety functions of the facility's postulated accident, depending on which of the two has more severe consequences.

Section 29 Leakage monitoring of the reactor cooling system and the pipes designed to remain intact

SYT-4220 - Procedures and systems shall be in place for the detection of leaks in the reactor cooling system.

SYT-5115 - If the exclusion of pipe breaks from the design basis, in accordance with section 28(1), item 3 of the requirement, is based on the "Leak Before Break" principle, the leak monitoring shall meet the following conditions:

1. the accuracy of the leak detection shall be such that any potential small leaks can be detected, and the facility can be brought into a safe state before the leak develops into a complete rupture;
2. it shall be possible to locate the leak;
3. leak monitoring shall be implemented in two ways that adhere to the diversity principle.

Section 30 Pressure control and overpressure protection

SYT-4221 - The pressure control of the reactor cooling system shall be designed so that, during normal operation and operational occurrences, the cooling of the nuclear fuel is ensured, and the design pressure of the reactor cooling system is not exceeded.

SYT-4222 - The reactor cooling system and the steam generator of the pressurised water reactor or other equivalent heat exchangers shall be equipped with adequate safety devices so

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

that the exceedance of the design pressure of the protected component is limited to 10 per cent in postulated accidents and to 20 per cent in extended postulated accidents.

Section 31 Redundancy and diversity of overpressure protection

SYT-4223 - The implementation of overpressure protection shall comply with the redundancy principle, ensuring that the function is carried out even if one quarter of the capacity of the safety devices other than the reactor's fire extinguishing system has failed. In postulated accidents, the overpressure protection shall also occur, even if it is triggered by the second signal from the reactor protection system.

SYT-4224 - Overpressure protection shall be implemented in accordance with the diversity principle.

SYT-5161 - In a boiling water reactor, either reactor shutdown or the overpressure protection of the reactor cooling system shall be achieved, even if one of the two fails.

Chapter 9: Containment function

Section 32 Containment

SYT-4374 - A nuclear power plant shall have structures or buildings which, individually or in combination:

1. limit the releases of radioactive substances during normal use, operational occurrences and accidents;
2. protect the reactor against external events caused by natural phenomena and human activities; and
3. serve as biological protection against radiation during normal operation, operational occurrences and accidents.

SYT-4376 - Containment refers to a combination of the structures and buildings mentioned in subsection 1. The containment shall be leak-tight during normal operation, operational occurrences and postulated accidents. An uncontrolled increase in leakage from the containment and loss of structural integrity during design extension conditions and severe

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

reactor accidents shall be reliably prevented.

SYT-4377 - If the containment shall be made non-leak-tight because of maintenance work, it shall be possible to restore leak-tightness within a timeframe that allows the effective limitation of releases caused by operational occurrences and accidents during the maintenance work. If it is impossible to restore the leak-tightness for structural reasons, the possibility of events leading to an early or large release shall be minimal during the period of non-leak-tightness.

SYT-4380 - The possibility of containment bypass during operational occurrences and accidents shall be low.

Section 33 Containment isolation

SYT-4381 - The containment shall have an isolation function. It shall be possible to close the valves, the openings required for the transport of personnel and materials, and other penetrations involved in the isolation function of the containment reliably and in a timely manner.

SYT-4382 - The devices involved in the isolation of the containment, as well as their control functions, shall comply with the principles of redundancy and diversity. The isolation valves of the containment shall meet the following requirements:

1. each pipe that penetrates the pressure interface of the containment and is connected to the primary coolant or the gas compartment of the containment shall be equipped with at least two consecutive isolation valves that are independent of each other;
2. the consecutive isolation valves shall be positioned so that there is at least one valve inside and outside the containment;
3. each pipe that penetrates the pressure boundary of the containment and is not connected to the primary coolant or the gas compartment of the containment shall be equipped with at least one isolation valve located outside the containment.

Deviations from these principles may be made if justified by the reliability of other necessary safety functions, or if the deviating solution does not have a significant impact on the leak-tightness of the containment.

Section 34 Containment pressure control

SYT-4390 - The pressure control of the containment during accidents shall not be based on the release of a gas mixture containing radioactive substances into the environment. Situations in which the release of gases into the environment is permitted include:

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

1. achieving a safe state in a severe reactor accident by releasing non-condensable gases into the environment during the late phase of the accident, when the activity level of the containment airspace has significantly decreased;
2. plant types in which the gas to be removed from the containment does not contain significant amounts of radioactive substances;
3. the operation of the filtered pressure suppression concept as a backup system in situations in which other means designed for pressure relief or decay heat removal are unavailable.

SYT-4387 - A containment based on the pressure suppression concept shall be designed to ensure that an accident involving the loss of the pressure suppression function will not lead to the loss of containment structural integrity.

Chapter 10: Automation and instrumentation

Section 35 Monitoring of the state of the nuclear power plant

SYT-3340 - Comprehensive and reliable instrumentation shall be in place for monitoring the state of the nuclear power plant during normal operation, as well as for detecting and managing operational occurrences and accidents.

SYT-5159 - The data measured by the monitoring instrumentation of the nuclear power plant shall be transmitted to control rooms and other rooms necessary for the control and management of the nuclear facility.

SYT-5163 - The monitoring of the state of the nuclear power plant during operational occurrences, postulated accidents, design extension conditions (DEC A1) and severe reactor accidents shall be ensured despite any single failure in any necessary equipment.

SYT-3392 - The monitoring of the state of the safety functions required in the event of operational occurrences and accidents during normal operation shall be carried out regardless of any single failure in any necessary equipment.

Section 36 Limitation functions

SYT-3345 - The nuclear power plant shall be equipped with limitation automation that, in operational occurrences, performs actions either automatically or with operator assistance to restore the nuclear power plant's state within normal operation limits, or to mitigate the

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

consequences of the occurrence and prevent an accident.

Section 37 Protection automation and controls for a controlled state

SYT-3346 - The nuclear power plant shall be equipped with a protection system that controls the safety functions required in postulated accidents. The protection system shall meet the requirements for redundancy in accordance with the safety functions it implements. Safety functions required for design extension conditions may be controlled from the protection system if a common cause failure does not prevent the protection system functioning

SYT-3344 - There shall be two alternative physical parameters for initiating the key safety functions of the protection system. If it is impossible to define two different physical parameters for identifying an event that requires the initiation of a safety function, the measurement of the single parameter used for identification shall employ two different measurement principles or another solution that implements the diversity principle.

SYT-3347 - To prepare for a common-cause failure in the protection system (DEC A1), the nuclear power plant shall be equipped with a backup protection system that implements the diversity principle. The backup protection system shall meet the redundancy requirements associated with the safety functions it performs.

SYT-3570 - The actions of operators required to bring the nuclear power plant into a controlled state during operational occurrences, postulated accidents and design extension conditions shall comply with the redundancy requirements applicable to the safety function in question.

Section 38 Controls for a safe state

SYT-3342 - The automatic or operator actions required to bring the nuclear power plant into a safe state during operational occurrences, postulated accidents and design extension conditions (DEC A1) shall be fulfilled despite any single fault.

Section 39 Controls for severe reactor accidents

SYT-3348 - The necessary controls for a controlled state in severe reactor accidents shall be implemented in a separate system in accordance with section 17(1) of the requirement.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Section 40 Other requirements for instrumentation and automation systems

SYT-3375 - A failure direction favourable to safety shall be defined for the tasks of instrumentation and automation systems that implement safety functions.

SYT-3393 - Bus-based connections from the protection system to other systems shall be made unidirectional so that data transfer is physically possible only outwards from the protection system.

SYT-5507 - Wireless controls shall not be connected to the automation systems controlling the nuclear power plant.

SYT-5469 - The operating parameters describing the state of the nuclear power plant, as well as the control commands of the systems, shall be recorded.

Chapter 11: Nuclear power plant control rooms

Section 41 Control rooms

SYT-3286 - The nuclear power plant shall have a central operating site (*main control room*) from which the facility can be directed to a safe state during normal operation, operational occurrences, postulated accidents and design extension conditions. In a severe reactor accident, it shall be possible to bring the facility into a controlled state from the main control room.

SYT-3287 - The nuclear power plant shall have an *emergency control room* from which the nuclear power plant can be controlled when the main control room is unavailable. It shall be possible to bring the nuclear power plant into a safe state by means of controls and measures outside the main control room if the availability of the main control room cannot be restored.

SYT-3289 - In addition to the main control room, the nuclear power plant can be monitored and controlled in normal operation from a *remote control room* outside the site if an equivalent level of safety can be achieved from the remote control room compared with the monitoring and control on the facility site. Controls implemented by operators to carry out safety functions during operational occurrences and accidents to bring the facility into a controlled and safe state shall be performed at the facility site in accordance with subsections 1 and 2.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

Section 42 Separation of control rooms and control systems

SYT-5199 - The user interfaces of the main control room and the emergency control room shall be directly connected to the internal data transfer of the nuclear power plant automation.

SYT-3336 - The emergency control room shall be independent of the main control room. Independence shall be achieved through functional and physical separation.

SYT-3339 - If several nuclear power plants or reactors are controlled from one control room, their control systems shall be reliably separated to prevent the spread of faults. It shall be possible to clearly identify the controlled nuclear power plant or reactor in the control room. User interfaces for normal operations may be common.

SYT-3337 - The hierarchy between the control systems of the control rooms shall be defined so that the nuclear power plant can only be controlled from one control location at a time.

Section 43 Consideration of human factors in the control room

SYT-3338 - It shall be possible to reliably detect disturbances and accidents at the nuclear power plant. The operation of the systems that monitor the state of the facility and issue alarms about it shall be verified through monitoring visits at the nuclear power plant.

SYT-3288 - The safety functions required at short notice during operational occurrences and accidents shall be initiated automatically. There shall be sufficient time for consideration and implementation for actions to be performed in control rooms and locally, and it shall be possible to perform these actions safely.

SYT-5209 - Control rooms and other spaces in which personnel shall remain during operational occurrences, accidents, and internal or external events shall be equipped with effective lighting for use under such conditions.

Chapter 12: Electrical systems and electrical disturbances

Section 44 Verification of electrical power supply

SYT-3383 - To manage and prevent operational occurrences and accidents, two grid connections from the external power grid shall be provided for the supply of external electric

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

power.

SYT-3384 - The nuclear power plant shall have systems that ensure the supply of electric power to safety functions and facility state monitoring during operational occurrences, postulated accidents and design extension conditions independently of the external power grid. The internal electric power supply shall meet the redundancy requirements applicable to the safety functions it performs.

SYT-3385 - The implementation of the internal electric power supply and the power distribution systems for safety functions shall comply with the diversity principle. The internal electric power supply that implements the diversity principle shall meet the redundancy requirements applicable to the safety functions it performs.

SYT-6163 - Internal electrical power supply to control a severe reactor accident shall be reliably implemented and meet the requirements for redundancy of the safety functions it performs.

SYT-3387 - The nuclear power plant shall have an internal primary power supply in case of long-term loss of external power supply, even if there is no need for internal power supply within the self-sufficiency period referred to in section 12(1).

Section 45 Protection against electrical disturbances

SYT-3386 - Frequency and voltage fluctuations caused by faults in the electrical equipment of the nuclear power plant and by the external grid shall not compromise safety functions during normal operation, operational occurrences or accidents.

SYT-5949 - Failure of the power supply for the safety functions necessary in severe reactor accidents and failure of the control and protection devices of power sources as a result of an electrical disturbance shall be prevented:

1. by dimensioning the components to withstand twice the overvoltage a disturbance originating from the facility's main generator or the external power grid can be expected to be in an extreme case; or
2. by preventing the transfer of an electrical disturbance to the equipment through reliable isolation from the facility's independent supply network.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3575 - Electrical systems shall be equipped with reliable protection devices that separate the faulty equipment or section of the power network in all planned grid connection situations.

SYT-3576 - The electrical and automation systems implementing safety functions at the nuclear power plant, along with their cabling, shall be reliably protected against the effects of electromagnetic interference and overvoltage of atmospheric origin. Electrical and automation devices, along with their cabling, shall be designed and installed so that they do not cause harmful electromagnetic interference in their operating environment.

SYT-3579 - The sources of electromagnetic interference at the nuclear power plant shall be identified, and information about them shall be maintained throughout the service life of the facility.

Chapter 13: Air conditioning and ventilation

Section 46 General requirements for air conditioning and ventilation

SYT-4344 - Rooms in which radioactive substances may be released into the airspace shall be equipped with ventilation and air-conditioning systems whose purpose is to:

1. reduce the concentration of radioactive substances contained in the air of the rooms;
2. limit the spread of radioactive substances to other rooms;
3. limit the release of radioactive substances into the environment.

SYT-4345 - Ventilation and air-conditioning systems shall maintain and ensure conditions within the nuclear power plant's premises that allow systems, structures and components important for the facility's safety to remain intact and function reliably in accordance with their design basis.

SYT-4347 - The separation of ventilation and air-conditioning systems shall comply with section 19. The exhaust ducts of subsystems in the controlled area may be connected just before the ventilation stack, provided that the ducts are equipped with sufficient smoke and fire separation.

Section 47 Maintenance of safe working conditions

SYT-4348 - The working conditions shall be safe without special equipment in rooms where

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

personnel are required to remain during operational occurrences, accidents, and internal or external events. The functions that maintain the working conditions shall be carried out in accordance with the requirements of operational occurrences or accidents.

SYT-5096 - Rooms where personnel shall remain during operational occurrences, accidents, and internal and external events shall be equipped with isolating and filtering devices. It shall be possible to reliably detect radioactive and toxic substances.

SYT-4351 - The intake air centres and supply air systems of buildings containing safety-classified subsystems in the nuclear power plant shall be designed and located so that the spread of any flammable, toxic or otherwise hazardous substances to them is unlikely. It shall be possible to detect and prevent the spread of harmful substances to the premises of the facility.

Section 48 Ventilation and air-conditioning zones and pressure differences

SYT-4349 - The buildings and rooms of the nuclear power plant shall be divided into zones between which predefined and verifiable pressure differences shall be maintained so that the directions of airflows are from cleaner areas towards less clean areas in terms of radiation safety.

SYT-4340 - Airflows shall be dimensioned so that the concentrations of radioactive substances in the indoor air of the facility's premises where work is carried out can be kept sufficiently low. The necessary lengths of stay shall be taken into account in the dimensioning.

SYT-4352 - Exhaust air from the controlled area shall be directed in a controlled manner to the environment through ventilation ducts and the ventilation stack.

Chapter 14: Chemistry

Section 49 Design basis for chemical conditions

SYT-4263 - The chemical conditions of the nuclear power plant and the systems that maintain them shall be designed to prevent the corrosion of the materials of the structures and devices serving as containment barriers, and the deterioration of materials caused by the conditions

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

across all operational states.

SYT-4264 - The chemical conditions of the nuclear power plant shall be such that they limit the formation, migration and reattachment of products activated in the reactor's neutron flux onto the internal surfaces of pipes, valves and devices in all operational states of the facility.

SYT-4265 - The design of chemical conditions shall prevent, through technical and administrative means, impurities that accelerate corrosion or increase radiation doses from accessing the surfaces of structures and devices that serve as barriers.

Section 50 Chemical parameters important for safety

SYT-4269 - Operational state-specific parameters important for safety, as well as their limit values, shall be determined for the management of chemical conditions and the migration of radioactive substances. The parameters shall be determined so that deviations from the design basis for chemical conditions, as specified in section 49, can be detected with high probability before the deviation has significant safety consequences.

Section 51 Control of chemical conditions

SYT-4266 - For the control of chemical conditions, instrumentation and sampling arrangements shall be in place to comprehensively determine the state of the water chemistry conditions in a timely manner.

SYT-4274 - Where technically feasible, continuous measuring equipment shall be available for monitoring parameters important for safety.

Chapter 15: Testability, maintainability and condition monitoring

Section 52 Testing and maintenance in normal operation

SYT-3381 - The nuclear power plant and its systems implementing safety functions shall be designed so that maintenance operations can be carried out in a facility operating mode in which the system to be maintained or all of its subsystems is not required. If there is no such facility mode, maintenance shall be prepared for by increasing redundancy or by other means that achieve the required failure tolerance of the system.

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

SYT-3382 - The systems implementing safety functions shall be designed so that their operability during the service life of the facility can be tested or otherwise verified as close as possible to the operating situations and operating conditions for which they have been designed. As far as possible, the tests shall be carried out throughout the safety function.

SYT-4379 - The pressure resistance, leak-tightness and operability of the structures and equipment involved in ensuring the containment's leak-tightness and isolation function and their maintenance over the service life of the nuclear power plant shall be demonstrated reliably.

Section 53 Continuous condition monitoring

SYT-3560 - The protection system shall monitor the validity of its input and output messages, as well as its internal operation, and shall issue alerts in the event of faults.

SYT-3573 - Faults that prevent the operation or compromise the performance of internal backup power supply systems shall be sought to be detected and located using condition monitoring systems with a set of alarms.

Section 54 Provisions for repairs and maintenance in accident situations

SYT-4837 - The long-term maintenance of the nuclear power plant's safe state and a safe state in a severe reactor accident during disturbance and accident situations shall be prepared for by means of systematic arrangements so that the necessary repairs, maintenance or other measures can be carried out.

SYT-4865 - The nuclear power plant shall have access to spare parts [and equipment] so that the requirement set out in subsection 1 is fulfilled. In addition, there shall be spare parts for functions that are designed to be repaired during disturbance and accident situations.

Chapter 16: Safety classification and seismic classification

Section 55 Principles of safety classification

SYT-4405 - The safety classification and seismic classification of the nuclear power plant's systems, structures and components shall be based on deterministic methods. Classifications

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

shall be assessed and, if necessary, supplemented based on probabilistic risk analysis.

SYT-4406 - The systems, structures and equipment of the nuclear power plant shall be classified into safety classes 1, 2, 3, 4 and class EYT (non-nuclear safety) based on their significance for safety.

SYT-4408 - The safety classification of a system shall be based on the main function it performs. In addition, systems containing radioactivity as referred to in subsection 2 and 3 of section 62 shall be classified at least in safety class 4.

SYT-4410 - A functional and structural class shall be determined for devices. The functional safety class of a device is determined depending on the function in which it participates. The structural safety class of a device is determined based on the consequences of the loss of its integrity. Different parts of a complex device may fall into different safety classes.

SYT-4411 - The safety classification of structures shall be based on the safety significance of the functions they support or their significance as containment barriers.

SYT-4412 - The boundary between safety classes within a system, or between systems, shall be determined so that damage or failure in a lower safety class does not affect the implementation of the safety function. The separation at the class boundary shall be reliable.

SYT-4453 - The classification principles may be deviated from if justified by the special characteristics of the facility or its parts, and if the deviation has a minor impact on safety.

Section 56 Safety class 2 functions

SYT-4415 - Safety class 2 includes:

1. safety functions necessary for the controlled state of the nuclear power plant in postulated accidents
2. leak monitoring of a pipe designed to remain intact
3. containment function in postulated accidents.

Section 57 Safety class 3 functions

SYT-4426 - Safety class 3 includes those functions of a nuclear power plant that:

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånästränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

1. cool the spent nuclear fuel in an open reactor or in a fuel storage facility;
2. are required to limit the consequences of operational occurrences (limitation functions);
3. are required for the controlled state of the nuclear power plant in design extension conditions DEC A1 in accordance with the diversity principle;
4. are required to achieve a safe state of the nuclear power plant in postulated accidents and design extension conditions DEC A1;
5. are required to achieve a controlled state in a severe reactor accident;
6. may, in the event of failure in the handling of nuclear fuel or in the lifting of heavy loads, cause damage to structures or devices important for safety so that the safety function performed by the structure or equipment may be lost, cause damage to spent nuclear fuel, or other significant radiation exposure;
7. are required for activity monitoring processes or the monitoring of the facility's releases;
8. perform functions referred to in section 10(3) and section 11 of the Radiation and Nuclear Safety Authority's regulation (Y/X/20xx) concerning the radiation protection of workers at a nuclear facility;
9. are necessary for monitoring the condition of safety functions in safety class 2 during normal operation;
10. are required to maintain conditions in control rooms, emergency preparedness centres or other similar essential premises during accident situations;
11. the operation of the safety functions of safety class 2 and 3 is maintained by the systems referred to in section 18 within the timeframe specified for the self-sufficiency of the nuclear power plant.

Section 58 Safety class 4 functions

SYT-4427 - Safety class 4 includes those functions of a nuclear power plant that:

1. are required to bring the plant into a controlled and safe state in design extension conditions DEC A2 and DEC A3.
2. are required to bring the nuclear power plant into a safe state in the event of a severe reactor accident.
3. are required to protect safety functions and components important for safety against internal and external events
4. are required for monitoring the state of safety functions other than those in safety class 2 during normal operation

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

5. maintain the operation of safety functions after the self-sufficiency period
6. are required to monitor radiation, surface contamination or radioactivity present in the facility, equipment, workers, releases or the environment, or to produce information important for public radiation safety in an emergency situation;
7. are required for the cooling of stored radiated nuclear fuel based on the diversity principle or for transferring heat from stored radiated nuclear fuel to a secondary ultimate heat sink;
8. are required for seismic monitoring.

Section 59 Safety classification of nuclear fuel, the reactor cooling system and the heat transfer system associated with the cooling system

SYT-4423 - Nuclear fuel shall be classified in safety class 1.

SYT-4413 - Pipes designed to remain intact, as well as those parts of the reactor cooling system or a system transferring heat from the reactor cooling system during normal operation for which the probability of rupture shall be extremely low, shall be classified in safety class 1.

SYT-4447 - Parts of the reactor cooling system and systems transferring heat from the reactor cooling system during normal operation for which disconnection has been prepared as an operational occurrence or a postulated accident, and which cannot be reliably isolated from the reactor or the main heat exchangers of the reactor cooling system using isolation devices, shall be classified in safety class 2.

Section 60 Safety classification of the containment and the structures ensuring subcriticality

SYT-4854 - The containment shall be classified in safety class 2 primarily for its contribution to preventing the spread of radioactive substances (section 32(1), item 1).

SYT-5415 - Structures whose damage may pose a risk of uncontrolled chain reactions shall be classified in safety class 2.

Section 61 Support structures, protective structures and buildings

SYT-5419 - The essential support structures of the reactor and its cooling system shall be classified in safety class 2

SYT-4421 - Buildings and structures that protect and maintain the integrity of systems

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Address | Jokiniemenkuja 1, 01370 Vantaa | Änäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

implementing safety class 2 and 3 functions or ensure the physical separation of their subsystem chains shall be classified in safety class 3.

SYT-5420 - Buildings and structures that protect and maintain the integrity of systems implementing safety class 4 functions shall be classified in safety class 4.

SYT-4428 - Piping supports, brackets and cable supports shall be classified in the same class as the supported system.

Section 62 Safety classification of equipment and structures containing radioactive substances, and of functions preventing the spread of radioactive substances

SYT-4940 - Devices and structures containing very large amounts of radioactive substances shall be classified in safety class 3.

SYT-4939 - Devices and structures containing more than minor amounts of radioactive substances shall be classified in safety class 4;

SYT-4941 - Functions and structures that limit the dispersion of radioactive substances in the event of failure or malfunction of the equipment or structures containing them shall be classified in safety class 3 as follows:

1. the radiation exposure of a worker shall not exceed 3 tenths of the effective dose limit for a category A radiation worker as defined in section 13(1) of the Government Decree on Ionising Radiation (1034/2018).
2. the limit on the potential exposure of the population in the event of an operational occurrence, as defined in Section X of the Government Decree on Nuclear Facilities, is met.

Section 63 Seismic classification

SYT-4430 - Systems, structures and components required to meet the requirement of section 22(2) shall be classified in seismic category S1. These shall be traceable to identify the systems, structures and components needed to control the consequences of DEC A3 earthquakes and aircraft collision vibrations.

SYT-4438 - Structures and components whose operability and integrity are not essential for the implementation of safety functions, but which may have impacts depending on system interface

STUK

SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite | Adress | Jokiniemenkuja 1, 01370 Vantaa | Ånäsgränden 1, 01370 Vanda
Address | Jokiniemenkuja 1, 01370 Vantaa, FINLAND
Puh. | Tfn. | Tel. | (09) 759 881, +358 9 759 881 | www.stuk.fi

or location or impacts arising from other reasons on operations or integrity related to the safety of seismic category S1 systems, shall be classified in seismic category S2A.

SYT-4443 - Components and structures other than those classified in seismic category S1 and S2A shall be classified in seismic category S2B.

SYT-4442 - For devices and structures of seismic categories S1 and S2A, the characteristics shall be determined that they shall maintain during and after a load situation caused by an earthquake.

Section n Entry into force and transitional provision

This regulation shall enter into force on X X 202X and shall remain valid until further notice.