

SSR-2/1 (Rev. 1) 「原子力発電所の安全：設計」 仮訳

<p>SSR-2/1 (Rev. 1)</p> <p>IAEA Safety Standards</p> <p>for protecting people and the environment</p>	<p>原子力発電所の安全・設計 IAEA 安全基準</p> <p>人と環境を防護するために</p>	<p>Safety of Nuclear Power Plants: Design</p>	<p>Specific Safety Requirements</p> <p>No. SSR-2/1 (Rev. 1)</p> <p>IAEA International Atomic Energy Agency</p>	<p>個別安全要件</p> <p>No. SSR-2/1 (Rev. 1)</p> <p>IAEA International Atomic Energy Agency</p>
--	---	---	---	---

<p>2.11. The design for safety of a nuclear power plant applies the safety principle that practical measures must be taken to mitigate the consequences for human life and health and for the environment of nuclear or radiation accidents (Principle 8 of the Fundamental Safety Principles [1]). Plant event sequences that could result in high radiation doses or in a large radioactive release have to be ‘practically eliminated’³ and plant event sequences with a significant frequency of occurrence have to have no, or only minor, potential radiological consequences. An essential objective is that the necessity for off-site protective actions to mitigate radiological consequences be limited or even eliminated in technical terms, although such measures might still be required by the responsible authorities.</p>	<p>の確立があり、また、おそらく、必要に応じて事業者による支援を受けての適切な当局による所外の防護措置の確立もある。</p> <p>2.11. 原子力発電所の安全設計は、原子力事故又は放射線の事故時に人の生命及び健康並びに環境に対する影響を緩和するため実現可能な対策が取られなければならないという安全原則を適用する（基本安全原則[1]の原則8）。これは、高い放射線被ばく量又は大量の放射性物質の放出をもたらす可能性のある発電所事象連鎖は「実質的に排除」⁴されなければならぬことである。発電所事象シーケンスは、発生頻度の高い発電所事象シーケンスは、放射線の影響の可能性が無いかほんの僅かだけでなければならぬことである。本質的な目的は、放射線の影響を緩和するための所外の防護措置、これは権限を有する当局によって要求されるであろうが、この措置の必要性を限定するか又は技術的に排除されることがある。</p>
<h2>THE CONCEPT OF DEFENCE IN DEPTH</h2> <p>2.12. The primary means of preventing accidents in a nuclear power plant and mitigating the consequences of accidents if they do occur is the application of the concept of defence in depth [1, 5, 6]. This concept is applied to all safety related activities, whether organizational, behavioural or design related, and whether in full power, low power or various shutdown states. This is to ensure that all safety related activities are subject to independent layers of provisions, so that if a failure were to occur, it would be detected and compensated for or corrected by appropriate measures. Application of the concept of defence in depth throughout design and operation provides protection against anticipated operational occurrences and accidents,</p>	

³ The possibility of certain conditions arising may be considered to have been ‘practically eliminated’ if it would be physically impossible for the conditions to arise or if these conditions could be considered with a high level of confidence to be extremely unlikely to arise.

⁴ ある状態が発生する可能性が実質的に排除されたとみなされるのは、そのような状態が生じるこが物理的に不可能な場合又はそのような状態が極めて発生しにくいものであることが高いレベルの信頼度で考えられる場合である。⁵ An ‘early radioactive release’ in this context is a radioactive release for which off-site protective actions would be necessary but would be unlikely to be fully effective in due time. A ‘large radioactive release’ is a radioactive release for which off-site protective actions that are limited in terms of lengths of time and areas of application would be insufficient for the protection of people and of the environment.

including those resulting from equipment failure or human induced events within the plant, and against consequences of events that originate outside the plant.

2.13 Paragraph 3.31 of the Safety Fundamentals [1] states that:

“Defence in depth is implemented primarily through the combination of a number of consecutive and independent levels of protection that would have to fail before harmful effects could be caused to people or to the environment. If one level of protection or barrier were to fail, the subsequent level or barrier would be available.... The independent effectiveness of the different levels of defence is a necessary element of defence in depth.”

There are five levels of defence:

- (1) The purpose of the first level of defence is to prevent deviations from normal operation and the failure of items important to safety. This leads to requirements that the plant be soundly and conservatively sited, designed, constructed, maintained and operated in accordance with quality management and appropriate and proven engineering practices. To meet these objectives, careful attention is paid to the selection of appropriate design codes and materials, and to the quality control of the manufacture of components and construction of the plant, as well as to its commissioning. Design options that reduce the potential for internal hazards contribute to the prevention of accidents at this level of defence. Attention is also paid to the processes and procedures involved in design, manufacture, construction, and in-service inspection, maintenance and testing, to the ease of access for these activities, and to the way the plant is operated and to how operating experience is utilized. This process is supported by a detailed analysis that determines the requirements for operation and maintenance of the plant and the requirements for quality management for operational and maintenance practices.

のとすることである。深層防護の概念を設計と運転の全体にわたつて適用することは、発電所内の設備の故障による事象、又は人間起因の事象を含め運転時に予想される事象及び事故に対して並びに発電所に起因する事象の影響に対して、防護を用意することになる。

2.13. 基本安全原則[1]の 3.31 項は以下のように述べている。

「深層防護は、それらが機能し損なったときにはじめて、人又は環境に対する有害な影響が引き起され得るような、多数の連続しかつ独立した防護レベルの組み合わせによって主に実現される。ひとつつの防護のレベル又は障壁が万一機能し損なつても、次のレベル又は障壁が機能する。異なる防護レベルの独立した有効性が、深層防護の不可欠な要素である。」

5 つの防護階層がある。

- (1) 第 1 の防護階層の目的は、通常運転から逸脱と安全上重要な機器等の故障を防止することである。この目的は、品質管理及び適切で実証された工学的手法に従つて、発電所が健全でかつ保守的に立地、設計、建設、保守及び運転されるという要件を導き出す。これらの目標を満たすため、適切な設計規格と材料の選定、機器の製造と発電所の建設における品質管理、さらにその試運転に十分な注意が払われる。内的危険要因の可能性を低減する設計上の選択は、この防護階層での事故の防止に寄与する。設計、製造、建設及び供用中検査、保守及び試験に係わるプロセスと手順への注意、このような活動のための立入りの容易さへの注意、並びに発電所の運転の方針及び運転経験の利用方法への注意も払われる。このプロセスは、発電所の運転及び保守に対する要件と、運転行為及び保守行為に対する品質管理に対する要件を決定する詳細な分析により支えられる。

<p>(2) The purpose of the second level of defence is to detect and control deviations from normal operational states in order to prevent anticipated operational occurrences at the plant from escalating to accident conditions. This is in recognition of the fact that postulated initiating events are likely to occur over the operating lifetime of a nuclear power plant, despite the care taken to prevent them. This second level of defence necessitates the provision of specific systems and features in the design, the confirmation of their effectiveness through safety analysis, and the establishment of operating procedures to prevent such initiating events, or otherwise to minimize their consequences, and to return the plant to a safe state.</p>	<p>(2) 第2の防護階層の目的は、発電所で運転時に予期される事象が事故状態に拡大することを防止することである。これは、想定起因事象が、それらを防知し管理することである。このためにもかわらず、原子力発電所の運転寿命中に発生する可能性があるという事実を認識したものである。この第2の防護階層では、設計で特定の系統と仕組みを備えること、それらの有効性を安全解析により確認すること、さらにそのような起因事象を防止するか、そもそもなければその影響を最小に留め、その発電所を安全な状態に戻す運転手順の確立を必要とする。</p>
<p>(3) For the third level of defence, it is assumed that, although very unlikely, the escalation of certain anticipated operational occurrences or postulated initiating events might not be controlled at a preceding level and that an accident could develop. In the design of the plant, such accidents are postulated to occur. This leads to the requirement that inherent and/or engineered safety features, safety systems and procedures be capable of preventing damage to the reactor core or preventing radioactive releases requiring off-site protective actions and returning the plant to a safe state.</p>	<p>(3) 第3の防護階層では、非常に可能性が低いことではあるが、ある予期される運転時の事象又は想定起因事象が拡大して前段の階層で制御できないこと、また、事故に進展しうるかもしないことが想定される。発電所の設計では、そうした事故が生じるものと仮定する。その結果、固有の及び／又は工学的な安全の仕組み、安全系及び手順が原子炉の炉心への損傷の防止又は所外防護措置を必要とする放射能放出の防止及び発電所を安全な状態に戻すことができるという要件に行き着く。</p>
	<p>(4) The purpose of the fourth level of defence is to mitigate the consequences of accidents that result from failure of the third level of defence in depth. This is achieved by preventing the progression of such accidents and mitigating the consequences of a severe accident. The safety objective in the case of a severe accident is that only protective actions that are limited in terms of lengths of time and areas of application would be necessary and that off-site contamination would be avoided or minimized. Event sequences that would lead to an early radioactive release or a large radioactive release⁵ are required to be 'practically eliminated'⁶</p>

⁵ An 'early radioactive release' in this context is a radioactive release for which off-site protective actions would be necessary but would be unlikely to be fully effective in due time. A 'large radioactive release' is a radioactive release for which off-site protective actions that are limited in terms of lengths of time and areas of application would be insufficient for the protection of people and of the environment.

⁶ The possibility of certain conditions arising may be considered to have been 'practically eliminated' if it would be physically impossible for the conditions to arise or if these conditions

	要求される ⁸ 。
(5) The purpose of the fifth and final level of defence is to mitigate the radiological consequences of radioactive releases that could potentially result from accidents. This requires the provision of adequately equipped emergency response facilities and emergency plans and emergency procedures for on-site and off-site emergency response.	(5) 最後となる第5の防護階層の目的は、事故に起因して発生しうる放射性物質の放出による放射線の影響を緩和することである。こねには、十分な装備を備えた緊急時対応施設の整備と、所内と所外の緊急事態の対応に対する緊急時計画と緊急時手順の整備が必要である。
2.14. A relevant aspect of the implementation of defence in depth for a nuclear power plant is the provision in the design of a series of physical barriers, as well as a combination of active, passive and inherent safety features that contribute to the effectiveness of the physical barriers in confining radioactive material at specified locations. The number of barriers that will be necessary will depend upon the initial source term in terms of the amount and isotopic composition of radionuclides, the effectiveness of the individual barriers, the possible internal and external hazards, and the potential consequences of failures.	2.14. 原子力発電所に対して深層防護を実施することに関する側面は、所定の場所に放射性物質を閉じ込める際の物理的障壁の有効性に寄与する能動的、受動的及び固有の安全の仕組みの組み合わせと同様に、一連の物理的障壁の設計における対策である。必要となる障壁の数は、放射性核種の量と同位体成分で表した初期のソースターム、個々の障壁の有効性、起こりうる内的及び外的危険要因、並びに障壁が損傷した場合の影響の大きさに依存する。
MAINTAINING THE INTEGRITY OF DESIGN OF THE PLANT THROUGHOUT THE LIFETIME OF THE PLANT	
2.15. The design, construction and commissioning of a nuclear power plant might be shared between a number of organizations: the architect-engineer, the vendor of the reactor and its supporting systems, the suppliers of major components, the designers of electrical systems, and the suppliers of other systems that are important to the safety of the plant.	2.15. 原子力発電所の設計、建設及び運転は、多数の組織間で分担されることがある。例えば建築技術者、原子炉とその補助設備の供給者、主要機器の供給者、電気系統の設計者及び発電所の安全上重要なその他の系統の供給者である。
2.16. The prime responsibility for safety rests with the person or organization responsible for facilities and activities that give rise to radiation risks (i.e. the operating organization) [1]. In 2003, the International Nuclear Safety Advisory Group suggested that the operating organization could set up a formal process to maintain the integrity of design of the plant could be considered with a high level of confidence to be extremely unlikely to arise.	2.16. 安全に対する主要な責任は、放射線リスクを生じる施設及び活動に責任を有する個人又は組織（すなわち、事業者）にある[1]。2003年に国際原子力安全グループ INSAG は、事業者は発電所設計の健全性をこの文脈において「早期の放射性物質の放出」とは、発生すれば、所外の防護措置は必要であるが所定の時間では全く効果が現れそうにない放射性物質の放出である。「大量の放射性物質の放出」とは、適用する時間の長さと場所が限定した所外の防護措置では人及び環境を防護するには十分でない放射性物質の放出である。