ASAMPSA_E SEVENTH FRAMEWORK PROGRAMME	Advanced Safety Assessment Methodologies: extended PSA	EURATOM

"NUCLEAR FISSION "

Safety of Existing Nuclear Installations

Contract 605001

Bibliography on the defense in depth (DiD) approach for nuclear safety

Reference ASAMPSA_E

Technical report ASAMPSA_E / WP30 / D30.1 / 2016-29

Reference IRSN PSN/RES/SAG/2016-00247

Andreas Wielenberg (ed.) and the ASAMPSA_E consortium partners

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Summary :

The report proposes an overview of existing standards and publications on the defense in depth concept for nuclear safety.

This report is a deliverable of the project ASAMPSA_E. It contents some view of the publications available until 2014.

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Bogdanov	Dimitar	TUS
Ivanov	Ivan	TUS
	Kaleychev	TUS
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SUMMARY

This report is a bibliography on references related to the concept of defence-in-depth (DiD), particularly in the field of nuclear reactor safety. In addition, selected publications on the application of DiD outside of the field of nuclear reactor safety are referenced. For each reference, the main data of the publication, an assignment of key words, a short summary of the relation to DiD and, if applicable, a link to an internet resource for the document is provided.

The bibliography report aims at covering all the major sources of regulatory documents and texts related to DiD in nuclear reactor safety for major international organisation on nuclear reactor safety and regulators in the Europe, North America, and selected Asian countries. In order to manage the scope of the work, more recent publications have received precedence by the authors, outdated versions or superseded documents might not be included in this report. Since there are a lot of publications on the concept on DiD in a number of contexts, producing a comprehensive listing beyond the context of regulatory publications was not possible for this publication. There are, therefore, a lot of textbooks, publications in scientific journals, conference contributions, etc. related to the concept of DiD, which are not included into this report. Their omission is due to the constraints for the production of this report and is in no way intended as a negative statement on either their relevance or their technical quality.

Publications after 2014 are not reflected in this report.

CONTENT

GLOSSARY

DBA	Design basis accident
DiD	Defense in depth
NPP	Nuclear power plant
PSA	Probabilistic safety assessment
RR	Research reactor

1 INTRODUCTION

This bibliography provides an overview over original sources, which define the concept of defense in depth (DiD) in nuclear safety or which describe and provide further insights on the adequate realization and verification of DiD. The bibliography encompasses regulatory documents, industry standards, topical reports and other sources. Selected sources on the definition and adequate realization of DiD outside of nuclear safety will be given as well. The main focus of the bibliography is set to sources related for regulatory authorities and other official national bodies as well as industry organisations. For other types of publications, this bibliography can only give a selection of original sources due the wide field of publications related to DiD in the field of nuclear safety. Thus, this report is not able to provide a complete overview over all publications related to DiD.

To the extent possible, this bibliography give short annotations on the relevance of each publication with respect to DiD, some keywords and – if available, a link to an online version of the publication in addition to the citation.

The outline of this report is as follows. In section 2, the most important definitions of DiD in nuclear safety are shortly referred. In section 3, regulatory documents related to DiD and its implementation from international organisations as well as national regulators are listed. Section 4 is dedicated to the respective nuclear industry standards. Selected standards on DiD in industries other than nuclear are collected in section 5. The final section 6 is dedicated to topical reports related to DiD and its adequate realization in nuclear safety.

2 DEFINITION OF DEFENSE IN DEPTH

2.1 HISTORICAL DEVELOPMENT

The concept of defense in depth (DiD) has been developed originally as a tactic and/or strategic defensive approach to an attacker in the military, dealing with slowing down his progression against a target, over a period of time, using different and successive layers such as fortifications, army troops and field works, rather than concentrating all strengths on a single defensive line.

This concept has then been translated into a number of other fields, including reliability engineering, chemical industry safety and Information Technology (IT) security, but most prominently into nuclear safety. For that field, the DiD concept has been the principal deterministic defensive approach, implemented in a Nuclear Power Plant (NPP), since the first experiment of the controlled nuclear fission chain reaction in 1942, at the University of Chicago by the Enrico Fermi's group (although the first use of the term of defense in depth has been in the early 1970s [282]).

A review of the history of the term indicates that there is no commonly accepted or preferred definition; typically, the definition of DiD was created consistent with the intended use of the term and generally made by example.

Historical records indicate that DiD was considered to be a concept, an approach, a principle or a philosophy, as opposed to being a regulatory requirement per se. Moreover, they indicate the evolution of the term from a narrow application to the multiple barrier concept to an expansive application as an overall safety strategy.

At the beginning, the DiD was seen just as a set of redundant and diverse independent physical barriers (generally three: e.g. the cladding, the reactor vessel and the containment), to provide protection of people and

environment against the release of radioactive materials from the reactor. One influential reference in the use of the DiD concept in nuclear safety is certainly the study WASH-1250 in the early 1970s [341].

Progressively, the concept has been developed in order to constitute a holistic approach to nuclear safety; the idea of lines of defense, previously intended as physical barriers, has been enveloped in a more general one, referred to all the actions, systems and structures aimed to prevent and/or mitigate the hazard of radiation exposure and/or its consequences.

In the late 1970s and 1980s, the concept of DiD has been further strengthened by the consolidation of Probabilistic Risk Assessment (PRA) or Probabilistic Safety Assessment (PSA) methods, improving the protection against a wide variety of transients, anticipated operational occurrences and severe accidents.

The entire development of the concept of DiD in nuclear safety is summarized in INSAG-10 [212] and the WENRA report Safety of new NPP Designs [282]. A summary of the development of the DiD concept in the United States, which has then influenced a number of other countries and the international community, is given by Sorensen [343]. The embedding of DiD into a "proposed risk management regulatory Framework" is one of the topics of e.g. NUREG-2150 [351].

2.2 CURRENT DEFINITION

The current definition of DiD in the field of nuclear safety is found in publications of the International Atomic Energy Agency (IAEA). The basic definition of DiD is given in the IAEA Fundamental Safety Principles SF-1 [1] as follows:

"*The primary means of preventing and mitigating the consequences of accidents is 'defence in depth'. 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.*

Defence in depth is provided by an appropriate combination of:

- *An effective management system with a strong management commitment to safety and a strong safety culture.*
- *Adequate site selection and the incorporation of good design and engineering features providing safety margins, diversity and redundancy, mainly by the use of:*
  - *Design, technology and materials of high quality and reliability;*
  - *Control, limiting and protection systems and surveillance features;*
  - *An appropriate combination of inherent and engineered safety features.*
- *Comprehensive operational procedures and practices as well as accident management procedures.*"

[2], p. 13f

The definition of DiD is further refined by the IAEA with respect to the safety of nuclear power plants in SSR-2/1 as follows.

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

Application of the concept of defence in depth in the design of a nuclear power plant provides several levels of defence (inherent features, equipment and procedures) aimed at preventing harmful effects of radiation on people and the environment, and ensuring adequate protection from harmful effects and mitigation of the consequences in the event that prevention fails. The independent effectiveness of each of the different levels of defence is an essential element of defence in depth at the plant and this is achieved by incorporating measures to avoid the failure of one level of defence causing the failure of other levels. 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.

(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 else to minimize their consequences, and to return the plant to a safe state.

(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 provided that are capable of preventing damage to the reactor core or significant off-site releases and returning the plant to a safe state.

(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. The most important objective for this level is to ensure the confinement function, thus ensuring that radioactive releases are kept as low as reasonably achievable.

(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 accident conditions. This requires the provision of an adequately equipped emergency control centre and emergency plans and emergency procedures for on-site and off-site emergency response.

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 amount and isotopic composition of radionuclides, the effectiveness of the individual barriers, the possible internal and external hazards, and the potential consequences of failures."

[3], p. 6-8

3 NUCLEAR REGULATION ON DEFENSE IN DEPTH AND ITS ADEQUATE REALIZATION

3.1 INTERNATIONAL ORGANIZATIONS

3.1.1 INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

1. IAEA, "Convention on Nuclear Safety" from 17 June 1994, INFCIRC/449
   http://www.iaea.org/Publications/Documents/Infcircs/Others/infcirc449.pdf
   Annotation: Legal requirement to apply DiD for nuclear installation
   Keywords: definitions, law, IAEA
2. IAEA, "Fundamental Safety Principles", Safety Fundamentals No. SF-1, November 2006
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1273_web.pdf
   Annotation: Fundamental nuclear safety principles, current definition of DiD
   Keywords: definitions, regulation, IAEA
3. IAEA, "Safety of Nuclear Power Plants: Design", Specific Safety Requirements No. SSR-2/1, January 2012
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1534_web.pdf
   Annotation: Safety principles and requirements for NPP, detailed current definition of DiD for NPP, generic requirements for an adequate realization of DiD. To achieve the highest level of safety that can reasonably be achieved in the design of a nuclear power plant, measures shall be taken to do the following, consistent with national acceptance criteria and safety objectives.
   Keywords: definition, NPP, regulation, requirements, IAEA

4. IAEA, Safety of Nuclear Power Plants: Commissioning and Operation. Specific Safety Requirements, No SSR-2/2. July 2011.
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1513_web.pdf
   Annotation: The safety of a nuclear power plant is ensured by means of proper site selection, design, construction and commissioning, and the evaluation of these, followed by proper management, operation and maintenance of the plant. In a later phase, a proper transition to decommissioning is required. The organization and management of plant operations ensures that a high level of safety is achieved through the effective management and control of operational activities.
   Keywords: IAEA, Safety, commissioning, operation, procedures, DID.
5. IAEA, "Safety of Research Reactors", Safety Requirements No. NS-R-4, June 2005
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1220_web.pdf
   Annotation: Safety principles and requirements for research reactors (RR), detailed definition of DiD for RR, generic requirements for an adequate realization of DiD
   Keywords: definition, RR, regulation, requirements, IAEA
6. IAEA, "Safety of Nuclear Fuel Cycle Facilities", Safety Requirements No. NS-R-5, November 2008
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1336_web.pdf
   Annotation: Safety principles and requirements for fuel cycle facilities (other than NPP and RR), detailed definition of DiD for fuel cycle facilities, generic requirements for an adequate realization of DiD
   Keywords: definition, fuel cycle, regulation, requirements, IAEA
7. IAEA, "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Interim Edition", General Safety Requirements Part 3, No. GSR Part 3 (Interim), November 2011
   http://www-pub.iaea.org/MTCD/publications/PDF/p1531interim_web.pdf
   Annotation: Safety principles and requirements for radiation sources, definition of DiD for radiation sources
   Keywords: definition, sources, regulation, requirements, IAEA
8. IAEA, "Disposal of Radioactive Waste", Specific Safety Requirements No SSR-5, April 2011
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1449_web.pdf
   Annotation: Safety principles and requirements for the disposal of radioactive waste, definition of DiD for waste disposal
   Keywords: definition, disposal, regulation, requirements, IAEA
9. IAEA, "Safety Assessment for Facilities and Activities", General Safety Requirements Part 4, No. GRS Part 4, May 2009
   http://www-pub.iaea.org/MTCD/publications/PDF/Pub1375_web.pdf
   Annotation: Requirements on performing safety assessments for nuclear facilities, including the assessment of an adequate realization of DiD
   Keywords: regulation, requirements, IAEA
10. IAEA, "Governmental, Legal and Regulatory Framework for Safety", General Safety Requirements Part 1, No. GSR Part 1, September 2010
    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1465_web.pdf

Annotation: Consideration of DiD in safety assessments by the regulatory body

Keywords: regulation, requirements, IAEA

11. IAEA, "Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors", Specific Safety Guide No. SSG-22, November 2012

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1547_web.pdf

    Annotation: Requirements and recommendation on performing safety assessments for RR, consideration of DiD in safety assessments

    Keywords: requirements, RR, IAEA

12. IAEA, "Predisposal Management of High Level Radioactive Waste", Safety guide, No. WS-G-2.6, April 2003

    http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1151_web.pdf

    Annotation: Activity levels for HLW are significantly higher than those for most other types of radioactive waste. In order to provide an acceptable level of protection, the concept of defence in depth should be applied in the design and operation of a facility for the predisposal management of HLW.

    Keywords: IAEA, waste, disposal, safety, regulations.

13. IAEA, "Storage of radioactive waste", Safety guide No WS-G-6.1, November 2006

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1254_web.pdf

    Annotation: In designing a facility, a defence in depth approach should be adopted, as Appropriate for the given situation. Credit can often be taken for the performance of the waste form in the design of the package and in the design of the storage facility.

    Keywords: IAEA, waste, facility, storage, design.

14. IAEA, "Arrangements for Preparedness for a Nuclear or Radiological Emergency", Safety guide, No GS-G-2.1, May 2007.

    http://www-pub.iaea.org/mtcd/publications/pdf/pub1265_web.pdf

    Annotation: The approaches for developing the capability to respond to a nuclear or radiological emergency differ depending on the characteristics of the emergency. DID level is interrelated to the preconditions, arrangement and preparedness for situations of radiological emergency.

    Keywords: IAEA, accidents, management.

15. IAEA, Safety Assessment for the Decommissioning of Facilities Using Radioactive Material. Safety guide, No WS-G-5.2. December 2008.

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1372_web.pdf

    Annotation: Decommissioning should be conducted using the defence in depth principle for safety appropriate to the degree of hazard.

    Keywords: IAEA, decommissioning, safety, assessment, DID.

16. IAEA, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, General Safety guide No GSG-2. May 2011.

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1467_web.pdf

    Annotation: Fully integrated system of guidance is necessary for taking consistent protective actions and other response actions in an emergency that will best ensure public safety.

    Keywords: IAEA, facilities, safety, accidents, assistance, emergency plans.

17. IAEA, The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste. General Safety guide No GSG-3. March 2013.
    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1576_web.pdf
    Annotation: The safety requirements for the predisposal management of radioactive waste require that a safety case, together with the necessary supporting safety assessment, be developed and undertaken for each facility or activity
    Keywords: IAEA, predisposal, waste, safety, DID.
18. IAEA, Decommissioning of Nuclear Power Plants and Research Reactors. Safety Guide, No WS-G-2.1. October 1999.
    http://www-pub.iaea.org/MTCD/publications/PDF/P079_scr.pdf
    Annotation: The objective of this Safety Guide is to provide guidance to national authorities, including regulatory bodies, and operating organizations to ensure that the decommissioning process for nuclear power plants and research reactors is conducted in a safe and environmentally acceptable manner.
    Keywords: IAEA, plant, decommissioning, DID.
19. IAEA, Fire Safety in the Operation of Nuclear Power Plants. Safety Guide, No. NS-G-2.1 July 2000.
    http://www-pub.iaea.org/mtcd/publications/pdf/pub1091_web.pdf
    Annotation: Operational experience gained from incidents in nuclear power plants around the world has continued to demonstrate the vulnerability of safety systems to fire and its effects. Considerable developments have taken place in recent years in the design of and regulatory requirements for fire safety in operating nuclear power plants, resulting in substantial improvements at many plants.
    Keywords: IAEA, fire, risk, measures, DID.
20. IAEA, Software for Computer Based Systems Important to Safety in Nuclear Power Plants, Safety guide No. NS-G-1.1. September 2000.
    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1095_scr.pdf
    Annotation: Computer based systems are of increasing importance to safety in nuclear power plants as their use in both new and older plants is rapidly increasing. They are used both in safety related applications, such as some functions of the process control and monitoring systems, as well as in safety critical applications, such as reactor protection or actuation of safety features. The dependability of computer based systems important to safety is therefore of prime interest and should be ensured.
    Keywords: IAEA, computer, software, safety, design, DID
21. IAEA, Instrumentation and Control Systems Important to Safety in Nuclear Power Plants. Safety Guide No. NS-G-1.3, March 2002.
    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1116_scr.pdf
    Annotation: This Safety Guide provides general guidance on I&C systems important to safety which is broadly applicable to many nuclear power plants. More detailed requirements and limitations for safe operation specific to a particular plant type should be established as part of the design process. The guidance is focused on the design principles for systems important to safety that warrants particular attention, applied to both the design of new I&C systems and the modernization of existing systems. Guidance is provided on how design principles should be applied, on the basis of a method of classifying

systems by their importance to safety.

Keywords: IAEA, instrumentation, control, systems, deign, DID.

22. IAEA, Review and Assessment of Nuclear Facilities by the Regulatory Body. Safety guide No. GS-G-1.2 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1128_scr.pdf

    Annotation: The Safety Guide covers the review and assessment of submissions in relation to the safety of nuclear facilities such as: enrichment and fuel manufacturing plants; nuclear power plants; other reactors such as research reactors and critical assemblies; spent fuel reprocessing plants; and facilities for radioactive waste management, such as treatment, storage and disposal facilities.

    Keywords: IAEA, facilities, safety, critical, regulatory, DID.

23. IAEA, Documentation for Use in Regulating Nuclear Facilities. Safety guide No. GS-G-1.4, August 2002. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1132_scr.pdf

    Annotation: The document provides recommendations for regulatory bodies and operators on the documentation to be prepared for regulatory processes for nuclear facilities, and on how to ensure that such documentation is of sufficient quality and provides correct information in an appropriate way to serve its intended purpose.

    Keywords: IAEA, documentation, regulation, DID.

24. IAEA, Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants. Safety guide No. NS-G-2.6. August 2002.

    http://www-pub.iaea.org/mtcd/publications/pdf/pub1136_scr.pdf

    Annotation: The Safety Guide covers the organizational and procedural aspects of MS&I. It does not give detailed technical advice in relation to particular items of plant equipment, nor does it cover inspections made for and/or by the regulatory body.

    Keywords: IAEA, maintenance, procedures, inspection, DID.

25. IAEA, Seismic Design and Qualification for Nuclear Power Plants. Safety guide No. NS-G-1.6. November 2003.

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1158_web.pdf

    Annotation: This Safety Guide is applicable to the design of land based stationary nuclear power plants with water cooled reactors to withstand site specific earthquakes regardless of the severity of the earthquake ground motion or the risk posed to individual plant items, provided that the recommendations concerning site exclusion criteria in relation to the hazard are met.

    Keywords: IAEA, design, qualification, seismic, DID.

26. IAEA, External Events Excluding Earthquakes in the Design of Nuclear Power Plants. Safety guide No. NS-G-1.5. November 2003.

    http://www-pub.iaea.org/MTCD/publications/PDF/Pub1159_web.pdf

    Annotation: The Safety Guide is applicable to the design and safety assessment of items important to the safety of land based stationary nuclear power plants with water cooled reactors. It covers the safety of new nuclear power plants in relation to the DBEEs.

    Keywords: IAEA, external, events, assessment, DID.

27. IAEA, Format and Content of the Safety Analysis Report for Nuclear Power Plants. Safety guide No. GS-G-4.1. May 2004.

http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1185_web.pdf

Annotation: The Safety Guide is intended primarily for use with land based stationary thermal nuclear power plants but it may, in parts, have a wider applicability to other nuclear facilities. The particular contents of the SAR will depend on the specific type and design of the nuclear power plant proposed, and this will determine how sections as in this Safety Guide are included in the SAR.

Keywords: IAEA, SAR, content, documentation, analysis, DID.

28. IAEA, Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants. Safety guide No. NS-G-1.7. September 2004.

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1186_web.pdf

Annotation: The objective of this Safety Guide is to provide recommendations and guidance to regulatory bodies, nuclear power plant designers and licensees on design concepts for protection against internal fires and explosions in nuclear power plants.

Keywords: IAEA, facility, fire, protection, DID.

29. IAEA, Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants. SAFETY GUIDE No. NS-G-1.9. September 2004.

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1187_web.pdf

Annotation: This Safety Guide applies primarily to land based stationary nuclear power plants with water cooled reactors designed for electricity generation or in other applications for heat production (such as district heating or desalination). It is recognized that for other reactor types, including innovative developments in future systems, some parts of the Safety Guide may not be applicable or may need some judgment in their interpretation.

Keywords: IAEA, reactor, coolant, design, DID.

30. IAEA, Design of Reactor Containment Systems for Nuclear Power Plants. Safety guide No. NS-G-1.10. September 2004.

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1189_web.pdf

Annotation: This Safety Guide is mainly based on the experience derived from the design and operation of existing reactors, and it applies to the most common types of containment. It also includes some general recommendations for features that would be used in new nuclear power plants for dealing with a severe accident.

Keywords: IAEA, design, containment, DID.

31. IAEA, Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants. Safety Guide. No. NS-G-1.11. September 2004.

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1191_web.pdf

Annotation: This Safety Guide, which supplements the Safety Requirements publication on the Safety of Nuclear Power Plants: Design, was prepared under the IAEA's programme for establishing Safety Requirements and Safety Guides applicable to land based stationary thermal neutron nuclear power plants. Examples provided in this Safety Guide pertain to light water reactor plants; however, the recommendations provided in this Safety Guide are generally applicable to other types of plant with thermal neutron reactors.

Keywords: IAEA, hazards, explosion, design, DID.

32. IAEA, Design of the Reactor Core for Nuclear Power Plants. Safety Guide. No. NS-G-1.12. April 2005. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1221_web.pdf
Annotation: The objective of this Safety Guide is to make recommendations concerning safety features for incorporation into the design of the reactor core for a nuclear power plant. The Safety Requirements publication on Safety of Nuclear Power Plants: Design establishes general safety requirements for design.
Keywords: IAEA, design, core, DID

33. IAEA, A system for the feedback of experience from events in nuclear installations. Safety Guide. No. NS-G-2.11. May 2006.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1243_web.pdf
Annotation: The objective of this Safety Guide is to provide guidance for the establishment of an operational experience feedback system for managing operational experience on a national basis. It brings together common elements that typically constitute an effective system at the national level.
Keywords: IAEA, events, experience, feedback, DID

34. IAEA, Deterministic Safety Analysis for Nuclear Power Plants. Specific Safety Guide No. SSG-2. December 2009.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1428_web.pdf
Annotation: This Safety Guide provides recommendations and guidance on the use of deterministic safety analysis and its application to nuclear power plants in compliance with the IAEA's Safety Requirements publications on Safety of Nuclear Power Plants: Design and Safety Assessment for Facilities and Activities.
Keywords: IAEA, safety, analysis, DID

35. IAEA, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants. Specific Safety Guide No. SSG-3. April 2010.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1430_web.pdf
Annotation: This Safety Guide addresses the necessary technical features of a Level 1 PSA and applications for nuclear power plants, on the basis of internationally recognized good practices. The scope of a Level 1 PSA addressed in this Safety Guide includes all operational conditions of the plant (i.e. full power, low power and shutdown) and all potential initiating events and potential hazards, namely: (a) internal initiating events caused by random component failures and human error, (b) internal hazards (e.g. internal fires and floods, turbine missiles) and (c) external hazards, both natural (e.g. earthquake, high winds, external floods) and of human-induced (e.g. airplane crash, accidents at nearby industrial facilities).
Keywords: IAEA, PSA, Level 1, analysis, DID

36. IAEA, Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants. Specific Safety Guide No. SSG-4. May 2010.
http://www-pub.iaea.org/mtcd/publications/pdf/pub1443_web.pdf
Annotation: This Safety Guide addresses the necessary technical features of a Level 2 PSA for nuclear power plants in relation to its application, with emphasis on procedural steps and the essential elements of the PSA rather than on details of the modelling methods, since modelling is considered to be well documented in the relevant literature. This Safety Guide includes all the steps in the Level 2 PSA process up to, and including, the determination of the detailed source terms that would be required as input into

a Level 3 PSA.

Keywords: IAEA, PSA, Level 2, analysis, DID

37. IAEA, Licensing Process for Nuclear Installations. Specific Safety Guide No. SSG-12. October 2010.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1468_web.pdf
Annotation: This Safety Guide supplements and provides recommendations on meeting the requirements relating to authorization by the regulatory body.
Keywords: IAEA, installation, licensing, regulatory, DID
38. IAEA, Storage of Spent Nuclear Fuel. Specific Safety Guide No. SSG-15. February 2012.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1503_web.pdf
Annotation: This Safety Guide covers spent nuclear fuel storage facilities that may be either collocated with other nuclear facilities (such as a nuclear power plant, research reactor or reprocessing plant) or located on their own sites. However, it is not specifically intended to cover the storage of spent nuclear fuel as long as it remains a part of the operational activities of a nuclear reactor or a spent fuel reprocessing facility.
Keywords: IAEA, spent, fuel, storage, DID
39. IAEA, Establishing the Safety Infrastructure for a Nuclear Power Programme. Specific Safety Guide No. SSG-16. December 2011.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507_Web.pdf
Annotation: The scope of this Safety Guide covers all the relevant IAEA safety requirements to be incorporated into an effective safety infrastructure for the first three phases of a nuclear power programme. The recommendations are presented for ease of use in the form of 200 actions.
Keywords: IAEA, nuclear, programme, infrastructure, DID
40. IAEA, Volcanic Hazards in Site Evaluation for Nuclear Installations. Specific Safety Guide No. SSG-21. October 2012.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1552_web.pdf
Annotation: This Safety Guide is intended to be used mainly in the site selection and evaluation process for new nuclear installations. It may also be used for existing nuclear installations for a retrospective assessment of the volcanic hazards external to the installation that may affect it.
Keywords: IAEA, hazard, evaluation, volcanic, DID
41. IAEA, The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste. General safety Guide No. GSG-3. March 2013.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1576_web.pdf
Annotation: The objective of this Safety Guide is to provide recommendations for development and review of the safety case and supporting safety assessment for facilities and activities dealing with the predisposal management of radioactive waste and spent fuel storage facilities. It summarizes the most important considerations in assessing and demonstrating the safety of facilities and activities, and documents the steps that should be followed in developing the safety case and performing the safety assessment.
Keywords: IAEA, safety, assessment, predisposal, radioactive, waste, DID

42. IAEA, Periodic Safety Review for Nuclear Power Plants. Specific safety Guide No. SSG-25. March 2013. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1588_web.pdf

Annotation: This Safety Guide deals with PSR for an operating nuclear power plant. PSR is a comprehensive safety review of all important aspects of safety, carried out at regular intervals, typically every ten years. In addition, a PSR may be used in support of the decision making process for licence renewal or long term operation, or for restart of a nuclear power plant following a prolonged shutdown.

Keywords: IAEA, review, license, permission, DID

43. IAEA, Safety Classification of Structures, Systems and Components in Nuclear Power Plants, Specific Safety Guide No. SSG-30, May 2014

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1639_web.pdf

Annotation: Recommended classification scheme is in line with DiD, safety functions at all level of DiD should be investigated and classified

Keywords: IAES, regulation, safety classification, SSC, NPP

3.1.2 EUROPEAN NUCLEAR SAFETY REGULATORS GROUP (ENSREG)

By June 2014, ENSREG has not published regulatory level documents related to DiD.

3.1.3 WESTERN EUROPEAN NUCLEAR REGULATORS ASSOCIATION (WENRA)

44. WENRA, "WENRA Safety Reference Levels for Existing Reactors, Update in Relation to Lessons Learned from TEPCO Fukushima Dai-ichi Accident", 24 September 2014
    http://www.wenra.org/media/filer_public/2014/09/19/wenra_safety_reference_level_for_existing_reactors_september_2014.pdf
    Annotation: Requires application of DiD for the safety of NPP, includes design extension conditions into DiD concept, draft version
    Keywords: NPP, regulation, requirements, WENRA
45. WENRA, "Radioactive Waste Disposal Facilities Safety Reference Levels", draft report, October 2012
    http://www.wenra.org/media/filer_public/2012/11/19/v0_draft_disposal_report.pdf
    Annotation: Requires application of DiD for the safety of disposal facilities, requirements on the adequate implementation of DiD for disposal facilities, draft version ‘
    Keywords: disposal, regulation, requirements, WENRA

3.2 NATIONAL REGULATION

3.2.1 EU COUNTRIES

3.2.1.1 Belgium

No documents have been identified for this report.

3.2.1.2 Bulgaria

46. Act of Safe Use of Nuclear Energy, Promulgated in the State Gazette No. 63/28.06 2002, last amended in the SG No. 66, 26.06.2013, and SG No. 68/02.08.2013.
    http://www.bnra.bg/en/documents-en/legislation/lows/zbiae2012-en.pdf
    Annotation: The act requires application of the concept "Defense in depth'' and all practical efforts to the prevention of the accidents and mitigates their consequences (Chapter One, Article 3).
    Keywords: act, requirements, safety, Bulgaria
47. Regulation for ensuring the safety of NPPs, Published SG, No.66 of 30 July 2004, amended SG No. 46 of 12 June 2007, and amended SG No. 53 of 10 June 2008, and amended SG No. 5 of 19 January 2010.
    http://www.bnsa.bas.bg/en/documents-en/legislation/regulations/reg-safnpp-en.pdf
    Annotation: The regulation specifies the basic criteria and rules for the safety of nuclear power plants based on the defense in depth concept.
    Keywords: regulation, requirements, safety, Bulgaria

48. Regulation on Safety during Decommissioning of Nuclear Facilities, Adopted by Ordinance of the Council of Ministers No. 204 from 05.08.2004, promulgated in the State Gazette No. 73 from 20.08.2004
http://www.bnsa.bas.bg/en/documents-en/legislation/regulations/reg-decnf-en.pdf
Annotation: The regulation sets the basic issues of safety during decommissioning of nuclear facilities, ensuing from the specifics of the activities during decommissioning, in respect of implementation of the defense in depth concept.
Keywords: regulation, requirements, safety, Bulgaria
49. Regulation on Ensuring the Safety of Research Nuclear Installations, Adopted with CM Decree No231of 2 September 2004, Published in State Gazette, Issue 80 of 14 September 2004.
http://www.bnsa.bas.bg/en/documents-en/legislation/regulations/reg-rr-en.pdf
Annotation: The regulation specifies basic criteria and rules for the safety of research nuclear installations based on the defense in depth concept.
Keywords: regulation, Research Nuclear Installations, Bulgaria
50. Regulation on Safety of Spent Fuel Management (Available in Bulgarian language only), Adopted by the Council of Ministers No196 from 02.08.2004, promulgated in the State Gazette No76 from 30 August 2013.
http://www.bnsa.bas.bg/bg/documents/legislation/regulations/reg_safspfuel.pdf
The regulation defines matters related to the technical safety, fire safety, physical protection, and emergency planning and preparedness of the spent fuel management facilities to the extent that follows from the defense in depth concept.
Keywords: regulation, Spent Fuel Management, Bulgaria
51. BNRA, Safety Guide, Use of PSA to Support the Safety Management of Nuclear Power Plans, PP-10/2011.
http://www.bnsa.bas.bg/en/documents-en/legislation/manuals/rr-06-2010-en.pdf
Annotation: This guide reviewed the PSA scope, includes the stages of NPP design and operation, respectively the different NPP operational states (full power, low power and shutdown state) and all potential initiating events and hazards in respect of application of the defense in depth concept.
Keywords: guide, Nuclear Power Plants, Bulgaria
52. BNRA, Safety Guide, Deterministic Safety Assessment, PP-5/2010
http://www.bnsa.bas.bg/en/documents-en/legislation/manuals/rr-05-2010-en.pdf
Annotation: The guide contains the directions for the safety assessment in respect of the implementation of the defense in depth concept. The guide is directly applicable to NPPs, and other nuclear facilities.
Keywords: guide, Nuclear Power Plants, Bulgaria
53. BNRA, Safety Guide, Structure and Contents of a NPP Decommissioning Plan, PP-2/2010
http://www.bnsa.bas.bg/en/documents-en/legislation/manuals/rr-02-2010-en.pdf
Annotation: The guide considers the main aspects of the planning, application and implementation of the defense in depth and protection until the final release of the nuclear facility site from regulatory control.
Keywords: guide, Nuclear Power Plants, Bulgaria
54. BNRA, Safety Guide, Safe Operation of Nuclear Power Plants, PP-10/2011
http://www.bnsa.bas.bg/en/documents-en/legislation/manuals/rr-10-2010-en.pdf
Annotation: The guide covers only part of the issues related to direct management of the safety during operation at plant or unit level in respect of the defense in depth concept.

55. BNRA, Safety Guide Draft, Classification of SSCs of NPPs, BNRA-RG-XX, 2012 (Available in Bulgarian language only).
    http://www.bnsa.bas.bg/bg/documents/legislation/manuals/draft-rr-1012.pdf
    Annotation: The guide gives the main aspects on classification of SSCs of NPPs based on the defense in depth concept.

3.2.1.3 Czech Republic

56. SUJB, Decree No. 195/1999 Coll., Regulation No. 195/1999 Sb. of the State Office for Nuclear Safety of August 21, 1999 on Requirements on Nuclear Installations for Assurance of Nuclear Safety, Radiation Protection and Emergency Preparedness.
    http://www.sujb.cz/fileadmin/sujb/docs/legislativa/vyhlasky/R195_99.pdf
    Annotation: The decree gives also requirements for the defense in depth concept.
    Keywords: regulation, requirements, Czech Republic
57. State Office for Nuclear Safety (SUJB), Safety Guide JB-1.7, "Selection and Evaluation of the Design Basis and Beyond Design Basis Events and Risks for Nuclear Power Plants" (available in Czech language only), December 2010
    http://www.sujb.cz/fileadmin/sujb/docs/dokumenty/publikace/G2-EF-final_udalosti_a_rizika_PUBLIKACE.pdf
    Annotation: The guide addresses the evaluation of accidents based on the defense in depth concept.
    Keywords: guide, Czech Republic

3.2.1.4 Finland

58. STUK YVL A.7, "Probabilistic risk assessment and risk management of a nuclear power plant", 15 November 2013.
    http://www.finlex.fi/data/normit/41813-YVL_A.7e.pdf
    Annotation: General PRA requirements in Finland, PRA Scope, license application PRA documentations
    Keywords: PRA, requirements, Finland
59. STUK YVL A.2, "Site for a nuclear facility", 15 November 2013.
    http://www.finlex.fi/data/normit/41786-YVL_A.2e.pdf
    Annotation: Site requirements, external hazards affecting site selection, releases of radioactive substances and radiation safety of the surrounding population
    Keywords: site requirements, external hazards, site selection, Finland
60. STUK YVL A.5, "Construction and commissioning of a nuclear facility", 2 June 2014.
    http://www.finlex.fi/data/normit/41780-YVL_A.5e.pdf
    Annotation: Guide applies to the construction of new nuclear facilities and to modifications to operating nuclear facilities
    Keywords: requirements, risk management, Finland
61. STUK YVL A.6, "Conduct of operations at a nuclear power plant", 15 November 2013.
    http://www.finlex.fi/data/normit/41795-YVL_A.10e.pdf
    Annotation: Principles and basic requirements for the conduct of operations

Keywords: operation, requirements, emergency operating procedures, Finland

62. STUK YVL A.10, "Operating experience feedback of a nuclear facility", 15 November 2013.
    http://www.finlex.fi/data/normit/41795-YVL_A.10e.pdf
    Annotation: Criteria and requirements for operating experience feedback
    Keywords: event analysis, investigation, requirements, Finland
63. STUK YVL B.3, "Deterministic safety analyses for a nuclear power plant", 15 November 2013.
    http://www.finlex.fi/data/normit/41745-YVL_B.3e.pdf
    Annotation: Guide applies to deterministic safety analyses for licensing of new nuclear power plants, plant modifications of operating nuclear power plants and periodic plant safety assessments.
    Keywords: deterministic safety analysis, events, radiation dose analysis, requirements, Finland
64. STUK YVL B.1, "Safety design of a nuclear power plant", 15 November 2013.
    http://www.finlex.fi/data/normit/41774-YVL_B.1e.pdf
    Annotation: This guide applies to the design of a nuclear power plant and its systems important to safety.
    Keywords: defence-in-depth, safety design, requirements, safety function, documentation, Finland
65. STUK YVL B.7, "Provisions for internal and external hazards at a nuclear facility", 15 November 2013.
    http://www.finlex.fi/data/normit/41791-YVL_B.7e.pdf
    Annotation: Criteria and requirements for internal and external hazards
    Keywords: Hazard, design, hazard curve, requirements, Finland
66. STUK YVL B.8, "Fire protection at a nuclear facility", 15 November 2013.
    http://www.finlex.fi/data/normit/41792-YVL_B.8e.pdf
    Annotation: Criteria and requirements for fire hazard protection, deterministic fire hazard analyses
    Keywords: Fire, design, hazard, analysis, defence- in-depth, requirements, fire PRA, Finland
67. STUK YVL 7.2, "Assessment of radiation doses to the population in the environment of a nuclear power plant", 23 January 1997.
    http://www.finlex.fi/data/normit/9591-YVL7-2e.pdf
    Annotation: general requirements for assessing radiation doses and analysis methods
    Keywords: dose assessment, requirements, Finland
68. STUK YVL 7.3, "Calculation of the dispersion of radioactive releases from a nuclear power plant", 23 January 1997.
    http://www.finlex.fi/data/normit/9592-YVL7-3e.pdf
    Annotation: general requirements to assess the dispersion of radioactive discharges in the atmosphere
    Keywords: dispersion, dose calculation, requirements, Finland
69. STUK YVL 7.5, "Meteorological measurements of a nuclear power plant", 28 May 2003.
    http://www.finlex.fi/data/normit/22460-YVL7-5e.pdf
    Annotation: general requirements for the meteorological measurement system
    Keywords: meteorology, requirements, Finland

3.2.1.5 France

In France many formal documents and guides deal with the concept of DiD (most of them are available only in French).

70. Décret n°2007-1557 du 2 novembre 2007 relatif aux installations nucléaires de base (INB)
71. Loi n°2006-686 du 13 juin 2006 relative à la transparence et à la sécurité en matière nucléaire ("loi TSN")
72. Technical guidelines for the design and construction of the next generation of nuclear power plants with pressurized water reactors - Adopted during the GPR/German experts plenary meetings held on October 19th and 26th 2000 (this document indicate the role of PSA in the verification of DiD)
73. Libman I (1996) Elements of nuclear safety
74. French Stress Tests Report
75. Les règles fondamentales de sûreté (RFS) et guides relatifs aux réacteurs à eau pressurise (REP) publiés par l'ASN
76. Décret n° 2007-1557 du 2 novembre 2007 modifié relatif aux installations nucléaires de base et au contrôle, en matière de sûreté nucléaire, du transport de substances radioactives
77. Arrêté du 7 février 2012 modifié fixant les règles générales relatives aux installations nucléaires de base.

3.2.1.6 Germany

Basic documents:

78. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, "Sicherheitsanforderungen an Kernkraftwerke vom 22. November 2012", BAnz AT 24 January 2013 B3
http://www.bfs.de/de/bfs/recht/rsh/volltext/3_BMU/3_0_1_1112.pdf
Annotation: Basic nuclear safety rules for German NPP, defines concept of DiD and requirements for an adequate implementation thereof. Extends to technical requirements.
Keywords: definitions, NPP, regulation, requirements, Germany
79. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, "Interpretationen zu den 'Sicherheitsanforderungen an KKW vom 22. November 2012'", BAnz AT 10 December 2013 B4)
http://www.bfs.de/de/bfs/recht/rsh/bmu
Annotation: Detailed technical requirements on the adequate realization of DiD for NPP, specifically related to the reactor core, the pressure boundary and the containment, instrumentation and control, power supply, civil engineering structures, fuel element storage, emergency preparedness, and radiation protection
Keywords: regulation, NPP, requirements, Germany

Supplementary documents:

80. Bundesministerium des Innern, "Sicherheitskriterien für Kernkraftwerke vom 21. Oktober 1977", BAnz. 1977, No. 206
http://www.bfs.de/de/bfs/recht/rsh/volltext/3_BMU/3_1.pdf
Annotation: Replaced by "Sicherheitskriterien an Kernkraftwerke vom 22. November 2012"
Keywords: definitions, NPP, regulation, requirements, Germany, outdated
81. Bundesministerium des Innern, "Interpretationen zu den 'Sicherheitskriterien für Kernkraftwerke' vom 17. Mai 1979", BMBl. 1979, No. 13, p. 208
http://www.bfs.de/de/bfs/recht/rsh/volltext/3_BMU/3_50.pdf
Annotation: Replaced by "Interpretationen zu den 'Sicherheitskriterien an Kernkraftwerke vom 22.

November 2012'"

Keywords: NPP, regulation, requirements, Germany, outdated

82. Bundesministerium des Innern, "Interpretationen zu den 'Sicherheitskriterien für Kernkraftwerke' vom 28. November 1979", BMBl. 1980, No. 5, p. 90

    Annotation: Replaced by "Interpretationen zu den 'Sicherheitskriterien an Kernkraftwerke vom 22. November 2012'"

    Keywords: NPP, regulation, requirements, Germany, outdated

83. Bundesministerium des Innern, "Interpretationen zu den 'Sicherheitskriterien für Kernkraftwerke' vom 2. März 1984", BMBl. 1984, No. 13, p. 208

    Annotation: Replaced by "Interpretationen zu den 'Sicherheitskriterien an Kernkraftwerke vom 22. November 2012'"

    Keywords: NPP, regulation, requirements, Germany, outdated

84. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, "Grundlagen zur Periodischen Sicherheitsüberprüfung" version December 1996, BAnz. 1997, No. 232a

    http://www.bfs.de/de/bfs/recht/rsh/volltext/3_BMU/3_74_1.pdf

    Annotation: Basic guides for the PSR, requiring to check the adequate realization of DiD in the PSR

    Keywords: NPP, regulation, Germany

85. Kerntechnischer Ausschuss, "Auslegung der Reaktorkerne von Druck- und Siedewasserreaktoren, Teil 1: Grundsätze der thermohydraulischen Auslegung", KTA 3101.1, November 2012

    http://www.kta-gs.de/d/regeln/3100/3101_1_2012_11.pdf

    Annotation: Technical guidelines for core design taking into account defense in depth

    Keywords: NPP, guideline, requirements, Germany

86. Kerntechnischer Ausschuss, "Auslegung der Reaktorkerne von Druck- und Siedewasserreaktoren, Teil 2: Neutronenphysikalische Anforderungen an Auslegung und Betrieb des Reaktorkerns und der angrenzenden Systeme", KTA 3101.2, November 2012

    http://www.kta-gs.de/d/regeln/3100/3101_2_2012_11.pdf

    Annotation: Technical guidelines for core design into account defense in depth

    Keywords: NPP, guideline, requirements, Germany

3.2.1.7 Lithuania

No documents have been identified for this report.

3.2.1.8 Netherlands

The Netherlands currently uses as technical guides adaptations of IAEA safety guides (NVR – Nucleaire Veiligheidsregels). A list of references is included on p. 151ff in the following publication.

Ministry of Economic Affairs, "Convention on Nuclear Safety (CNS) National Report of the Kingdom of the Netherlands for the Sixth Review Meeting in April 2014, July 2013 (http://www.government.nl/documents-and-publications/reports/2013/07/01/convention-on-nuclear-safety-sixth-review-meeting-in-april-2014.html).

The NVR documents are not available on the internet.

3.2.1.9 Romania

87. NSN-02, Norma de securitate nucleară privind proiectarea şi construcţia centralelor nuclearoelectrice, 2010
    http://www.cncan.ro/assets/NSN/nsn02.pdf
    Annotation: Nuclear safety general requirements concerning design and construction of NPP, taking into account defense-in-depth
    Keywords: NPP, requirements, Romania
88. NSN-08, Norma privind evaluările probabilistice de securitate nucleară pentru centralele nuclearoelectrice, 2006
    http://www.cncan.ro/assets/NSN/nsn-8.pdf
    Annotation: Requirements for the PSA development and guidance in using the results in design and operation of a NPP. It reffers to level 1 and level 2 PSA.
    Keywords: PSA, requirements, NPP, Romania
89. NSN-11, Norma privind sistemul de răcire la avarie a zonei active pentru centralele nuclearoelectrice de tip CANDU, 2006
    http://www.cncan.ro/assets/NSN/nsn11.pdf
    Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning emergency core cooling system of CANDU
    Keywords: CANDU, requirements, Romania
90. NSN-12, Norma privind sistemul anvelopei pentru centralele nuclearoelectrice de tip CANDU, 2005
    http://www.cncan.ro/assets/NSN/nsn12.pdf
    Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning containment system of CANDU
    Keywords: CANDU, requirements, Romania
91. NSN-13, Norma privind sistemele de oprire rapidă pentru centralele nuclearo-electrice de tip CANDU, 2005
    http://www.cncan.ro/assets/NSN/nsn-13.pdf Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning shutdown systems of CANDU
    Keywords: CANDU, requirements, Romania

3.2.1.10 Spain

No publications have been identified for this report.

3.2.1.11 Sweden

92. **SSM FS 2008:1**, Swedish Radiation Safety Authority " The Swedish Radiation Safety Authority's Regulations and General Advice concerning Safety in Nuclear Facilities'", 30 January 2009 http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Forfattning/Engelska/SSMFS-2008-1E.pdf

Annotation: Basic nuclear safety rules for Swedish NPP, defines concept of DiD and requirements for an adequate implementation thereof. Extends to technical requirements

Keywords: regulation, NPP, requirements, Sweden

93. **SSM FS 2008:17**, Swedish Radiation Safety Authority "Regulations and General Advice concerning the Design and Construction of Nuclear Power Reactors", 30 January 2009
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Forfattning/Engelska/SSMFS-2008-17E.pdf
Annotation: Detailed technical requirements on the adequate realization of DiD for NPP
Keywords: regulation, NPP, requirements, Sweden
94. **SKI Report 2008:33**, Swedish Radiation Safety Authority "Risk-informed assessment of defence-in-depth, LOCA example, Phase 1: Mapping of conditions and definition of quantitative measures for the defence in depth levels", Rev 0, February 2008
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Sakerhet-vid-karnkraftverken/2008/2008-33-Risk-informed-assessment-of-defence-in-depth-LOCA-example.pdf
Annotations: The report discussed the development of the PSA-methodology towards an assessment of DID levels. This research activity have included: 1) mapping of conditions that should be considered for the defence in depth levels, and 2) definition of those quantitative measures that should be used for the defence in depth levels. The work has been limited to loss-of-coolant-accidents (LOCA) and DID levels 1 and 2, i.e., prevention of abnormal operation and failures and control of abnormal operation and detection of failures. Examples are chosen both from power operation LOCAs and LOCAs during cold shutdown.
Keywords: Defence in depth, LOCA, risk-informed
95. **SSM FS 2009:13e**, Swedish Radiation Safety Authority "2009 assessment of radiation safety in the Swedish Nuclear Power Plants", April 2009
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Sakerhet-vid-karnkraftverken/2009/SSM-Rapport-2009-13e.pdf
Annotations: Basic Defence-in-depth Principle, discussed premises and evaluation criteria, general requirements for Swedish NPPs
Keywords: Defence in depth, events, radiation protection, requirements, Sweden
96. **SKI Report 2006:15e**, "Safety and Radiation Protection at Swedish Nuclear Power Plants 2005", May 2006
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Sakerhet-vid-karnkraftverken/2006/SKI-Rapport-2006-15e.pdf
Annotations: Basic Defence-in-depth Principle, discussed premises and evaluation criteria, general requirements for Swedish NPPs
Keywords: Defence in depth, radiation protection, requirements, Sweden
97. **SKI Report 2004:04**, "Dependency Defence and Dependency Analysis Guidance", Volume 1: Summary and Guidance (Appendix 1-2), October 2003.
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/SKI_import/040524/025d368c4452b1a0c0c44f09d8ef681c/2004_04_Vol1.pdf

Annotations: How to analyse and protect against dependent failures. Summary report of the Nordic Working group on Common Cause Failure Analysis.

Keywords: Defence, Dependent failures, Common cause failure, PSA

98. **SKI Report 2004:04**, "Dependency Defence and Dependency Analysis Guidance", Volume 2: Appendix 3-8, October 2003.
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/SKI_import/040524/d49b0d6eaac890a045fcbb3b24b1f76e/2004_04_Vol2.pdf
Annotations: How to analyse and protect against dependent failures. Summary report of the Nordic Working group on Common Cause Failure Analysis.
Keywords: Defence, Dependent failures, Common cause failure, PSA
99. **SKIFS 2004:1** "The Swedish Nuclear Power Inspectorate's Regulations concerning Safety in Nuclear Facilities", November 18, 2004.
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Forfattning/Karnteknik/2004/skifs2004-1-eng.pdf
Annotations: The Swedish Nuclear Power Inspectorate's General Recommendations concerning the Application of the Regulations (SKIFS 2004:1) concerning Safety in Nuclear Facilities with comments on certain paragraphs.
Keywords: Regulations, Safety, Sweden, applicability, definitions
100. **SKIFS 2004:2** "The Swedish Nuclear Power Inspectorate's Regulations concerning the design and construction of Nuclear Power reactors", November 18, 2004.
http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Forfattning/Karnteknik/2004/skifs2004-2-eng.pdf
Annotations: The Swedish Nuclear Power Inspectorate's General Recommendations concerning the Application of the Regulations (SKIFS 2004:2) concerning the Design and Construction of Nuclear Power Reactors with comments on certain sections.
Keywords: Regulations, Safety, Sweden, applicability, definitions, design, construction, recommendations

3.2.1.12 Slovakia

101. UJD, Act no. 541/2004 on Peaceful use of nuclear energy (Atomic Act) of 09.09.2004
http://www.ujd.gov.sk/files/legislativa/zakony/AA_541-2004_014.pdf
Annotation: Basic Slovak regulation, regulate conditions of the peaceful use of nuclear energy
Keywords: Regulation, Requirements, Slovakia

3.2.1.13 Slovenia

102. SNSA, Ionising Radiation Protection And Nuclear Safety Act, Official Gazette of the Republic of Slovenia, No. 102/2004 of 21.09.2004
http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Zakonodaja/SlovenskiPredpisi/ZVISJV_angl esko_besedilo__consolidated_text__koncni_za_objavo.pdf
Annotation: Basic Slovenian regulation, regulate ionising radiation protection and the implementation of nuclear safety measures

Keywords: Regulation, Requirements, Slovenia

103. SNSA, Rules on radiation and nuclear safety Factors (JV5), Official Gazette of the Republic of Slovenia No. 92/2009 of 16.11.2009
http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Zakonodaja/SlovenskiPredpisi/PodzakonskiAkti/ang_prevodi/JV5_za_objavo.pdf
Annotation: Basic Slovenian regulation, entails definition of DiD, include DiD in the design principles, requires consideration of DiD in SSC categorization and fire-protection
Keywords: Regulation, Requirements, Design, SSC, Slovenia

104. SNSA, (Regulation on operational safety of radiation and nuclear facilities (JV9), No. 85/2009 of 30.10.2009
http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Zakonodaja/SlovenskiPredpisi/PodzakonskiAkti/ang_prevodi/JV9_za_objavo.pdf
Annotation: Basic Slovenian regulation, requires compliance of PSA with DiD,
Keywords: Regulation, Requirements, PSA, Slovenia

3.2.1.14 United Kingdom of Great Britain and Northern Ireland

105. ONR, "Safety Assessment Principles for Nuclear Facilities, 2006 Edition", Revision 1, January 2008
http://www.onr.org.uk/saps/saps2006.pdf
Annotation: Basic UK regulation, entails definition of DiD, requires application of DiD to all nuclear facilities
Keywords: Facilities, regulation, requirements, ONR, UK

106. ONR, "Limits and Conditions for Nuclear Safety (Operating Rules)", T/AST/035 – Issue 3, August 2011
http://www.onr.org.uk/operational/tech_asst_guides/tast035.pdf
Annotation: Guidance on evaluating the acceptability of limits and conditions for the operation of NPPs with regard to an adequate implementation of DiD
Keywords: NPP, regulation, ONR, UK

107. ONR, "Nuclear Lifting Operationg", Technical Assessment Guide T/AST/056 Issue 002, December 2011
http://www.onr.org.uk/operational/tech_asst_guides/tast056.pdf
Annotation: Guidance on the review of the safety case for lifting equipment, specifically referencing a demonstration of DiD
Keywords: NPP, regulation, systems, ONR, UK

108. ONR, "Guidance on the Purpose, Scope and Quality of a Nuclear Site Security Plan (NSSP)", Technical Assessment Guide CNS-TAST-GD-001 Revision 0, January 2013
http://www.onr.org.uk/operational/tech_asst_guides/cns-tast-gd-001.pdf
Annotation: Guidance on the review of a nuclear site security plan, specifically stating that security arrangements should demonstrate DiD
Keywords: Facilities, regulation, security, ONR, UK

109. ONR, "Integrity of Metal Components and Structures", Technical Assessment Guide NS-TAST-GD-016 Revision 4, March 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-016.pdf

Annotation: Guidance on evaluation the safety demonstration for structures and components made from metal, specifically references application of DiD concept to structures and components safety cases.
Keywords: Facilities, regulation, structures, components, ONR, UK

110. ONR, "Fundamental Principles", Nuclear Safety Technical Assessment Guide NS-TAST-GD-004, Revision 4", April 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-004.pdf
Annotation: Explanations for fundamental safety principles of ONR, includes relation to DiD
Keywords: Facilities, regulation, ONR, UK

111. ONR, "Internal Hazards", Nuclear Safety Technical Assessment Guide NS-TAST-GD-014 Revision 3, April 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-014.pdf
Annotation: Guidance on evaluating the safety demonstration for internal hazards, requires the application of DiD concept to internal hazards
Keywords: Facilities, regulation, hazards, ONR, UK

112. ONR, "Criticality Safety", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-041-Revision 3, April 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-041.pdf
Annotation: Guidance on reviewing the safety case related to criticality safety, requires application of double contingency principle as one means of DiD
Keywords: NPP, regulations, systems, ONR, UK

113. ONR, "Civil Engineering", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-017-Revision 3, May 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-017.pdf
Annotation: Guidance on reviewing the safety relevant civil structures for nuclear facilities, specifically mentions application of DiD for flooding and encourages use for other hazard defences.
Keywords: Facilities, regulation, hazards, ONR, UK

114. ONR, "Essential Services", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-019-Revision 2, May 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-019.pdf
Annotation: Guidance on reviewing safety cases for safety related support systems including power supply, references application of DiD
Keywords: Facilities, regulation, systems, ONR, UK

115. ONR, "Heat Transport Systems", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-037-Revision 2, May 2013
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-037.pdf
Annotation: Guidance on the review of the safety case for heat transport systems, specifically references the adequate realization of DiD, e.g. for setting certain limits.
Keywords: Facilities, regulation, systems, ONR, UK

116. ONR, "The Purpose, Scope, and Content of Safety Cases", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-051 Revision 4, July 2013

http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-051.pdf

Annotation: Guidance on the review of safety cases, specifically requiring a demonstration of adequate realization of DiD

Keywords: Facilities, regulation, ONR, UK

117. ONR, "Diversity, Redundancy, Segregation and Layout of Mechanical Plant", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-036-Revision 2, April 2014

http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-036.pdf

Annotation: Guidance on reviewing the safety submissions of mechanical systems in the lifecycle of a facility, specifically requires as primary objective the demonstration of adequate defence in depth and gives good practices with regard to redundancy, diversity, etc.

Keywords: Facilities, regulation, systems, ONR, UK

118. ONR, "Decommissioning", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-026-Revision 3, May 2013

http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-026.pdf

Annotation: Guidance on reviewing safety cases for the decommissioning of plants or processes, included specific reference to the adequate demonstration of DiD for decommissioning activities

Keywords: Facilities, regulation, decommissioning, ONR, UK

119. ONR, "Guidance on the Demonstration of ALARP (As Low As Reasonably Practicable)", Nuclear Safety Technical Assessment Guide, NS-TAST-GD-005-Revision 6, September 2013

http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-005.pdf

Annotation: Guidance on evaluation ALARP demonstrations, defines adequate realization of DiD as one aspect to be considered.

Keywords: Facilities, regulation, ALARA, ONR, UK

3.2.2 JAPAN

120. "Act on the regulation of nuclear source material, nuclear fuel material and reactors", revision November 2013, enforce March 2014

http://www.nsr.go.jp/english/library/data/related_act_140301-02.pdf

Annotation: Revised regulation law to the NPPs and nuclear materials after Fukushima Dai-ichi accident

Keywords: law, regulation, nuclear source material, nuclear fuel material, NPP, Japan

121. "Enforcement of the New Regulatory Requirements for Commercial Nuclear Power reactors", Nuclear Regulatory Authority, July 2013

http://www.nsr.go.jp/english/e_news/data/13/0912.pdf

Annotation: Basic regulatory concepts of Nuclear Regulatory Authority for the NPPs after Fukushima Dai-ichi accident

Keywords: basic concepts, regulation, NPP, Japan

122. "Outline of New Regulatory Requirements (Design Basis)", , Nuclear Regulatory Authority, April 2013

http://www.nsr.go.jp/english/data/new_regulatory_requirements1.pdf

Annotation: new regulatory requirements of design basis to the NPPs after Fukushima Dai-ichi accident

Keywords: requirements, design basis, NPP, Japan

123. "Outline of new Regulatory Requirements for light water nuclear power plants (Severe accident measures)", Nuclear Regulatory Authority, April 2013

http://www.nsr.go.jp/english/data/new_regulatory_requirements3.pdf

Annotation: new regulatory requirements of severe accidents to the NPPs after Fukushima Dai-ichi accident

Keywords: requirements, severe accident, NPP, Japan

124. "Outline of new Regulatory Requirements for light water nuclear power plants (Earthquakes and tsunamis)",Nuclear Regulatory Authority, April 2013

http://www.nsr.go.jp/english/data/new_regulatory_requirements2.pdf

Annotation: new regulatory requirements against external hazards, especially for earthquake and tsunami, to the NPPs after Fukushima Dai-ichi accident

Keywords: requirements, external hazards, earthquake, tsunami, NPP, Japan

3.2.3 UNITED STATES OF AMERICA

125. U.S.NRC 10 CFR, "Part 50 – Domestic licensing of production and utilization facilities, §50.48, Fire Protection", August 2007

http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0048.html

Annotation: It is required to maintain fire protection DiD within a NPP

Keywords: NPP, requirements, fire, USA, NRC

126. U.S.NRC 10 CFR, "Part 50 – Domestic licensing of production and utilization facilities, §50.69, Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors", November 2004

http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0069.html

Annotation: It is required to maintain DiD within a NPP

Keywords: NPP, requirements, regulation, PRA, NRC

127. U.S.NRC 10 CFR, "Part 70 – Domestic licensing of special nuclear materials, §70.64, Requirements for new facilities or new processes at existing facilities", July 2013

http://www.nrc.gov/reading-rm/doc-collections/cfr/part070/part070-0064.html

Annotation: Facility and system design is required to be based on DiD principle

Keywords: Requirements, design, facilities, levels, NRC

128. U.S.NRC 10 CFR, "Part 73 – Physical protection of plants and materials, §73.54, Protection of digital computer and communication systems and networks", March 2009

http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0054.html

Annotation: DiD is required to be applied and maintained within a NPP to provide cybersecurity

Keywords: NPP, requirements, cybersecurity, NRC

129. U.S.NRC 10 CFR, "Part 73 – Physical protection of plants and materials, § 73.55, Requirements for physical protection of license activities in nuclear power reactors against radiological sabotage", July 2012

http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0055.html
Annotation: It is required to provide physical protection through a DiD security approach
Keywords: NPP, requirements, regulation, NRC

130. U.S.NRC 10 CFR, "Part 100 – Reactor site criteria, §100.1, Purpose", December 1996
http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0055.html
Annotation: It is required to carry out a DiD approach with regard to reactor siting
Keywords: Requirements, siting, NRC

131. U.S.NRC, "Policy Statement for the Operations of Nuclear Power Plants; Policy Statement", August 1986
http://www.nrc.gov/reading-rm/doc-collections/commission/policy/51fr30028.pdf
Annotation: Requires a DiD approach to prevent accidents and mitigate their consequences
Keywords: NPP, Policy Statement, regulatory, NRC

132. U.S.NRC, "Policy Statement on the Regulation of Advanced Reactors", October 2008
http://www.nrc.gov/reading-rm/doc-collections/commission/policy/73fr60612.pdf
Annotation: Requires to incorporate a DiD approach for advanced reactors
Keywords: NPP, Policy Statement, regulatory, advanced reactor, NRC

133. U.S.NRC, "Policy Statement on the Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities", August 1995
http://www.nrc.gov/reading-rm/doc-collections/commission/policy/60fr42622.pdf
Annotation: The expanded use of PRA in safety assessment will continue to support the DiD
Keywords: NPP, Policy Statement, regulatory, PRA, NRC

134. U.S. NRC, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition", NUREG-0800, as updated
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/
Annotation: Review plan with multiple references to DiD and its application, contains [135], regularly updated.
Keywords: NPP, regulation, standard, NRC, USA

135. U.S. NRC, "NUREG-0800, Standards Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, Chapter 19: Use of Probabilistic Risk Assessment in Plant-Specific, Risk-Informed Decisionmaking: General Guidance", November 2002
http://pbadupws.nrc.gov/docs/ML0232/ML023250195.pdf
Annotation: Definition of DiD and considerations; DiD is required to be maintained within the risk-informed regulation
Keywords: NPP, regulation, standard, PRA, RIDM, NRC, USA

136. U.S. NRC, "An Approach for Using Probabilistic Risk Assessment in Risk Informed Decisions on Plant-Specific Changes to the Licensing Basis", Regulatory Guide 1.174, November 2002
http://www.nrc.gov/reading-rm/doc-collections/reg-guides/power-reactors/rg/01-174/
Annotation: Guidance on how to address DiD when plant changes have to be made
Keywords: NPP, regulation, RIDM, PRA, NRC, USA

137. U.S. NRC, "An Approach for Plant-specific, Risk-informed Decisionmaking: Technical Specifications", Regulatory Guide 1.177 Revision 1, May 2011

http://pbadupws.nrc.gov/docs/ML1009/ML100910008.pdf

Annotation: Guidance on using risk-information for the assessment of technical specifications in conjunction with DiD considerations

Keywords: NPP, regulation, RIDM, PRA, NRC, USA

138. U.S. NRC, "Fire Protection for Nuclear Power Plants", Regulatory Guide 1.189, Revision 2, October 2009
http://pbadupws.nrc.gov/docs/ML0925/ML092580550.pdf
Annotation: Guidance on DiD for fire protection systems for NPP
Keywords: NPP, regulation, systems, NRC, USA

139. U.S.NRC, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors", Regulatory Guide 1.183, July 2000
http://pbadupws.nrc.gov/docs/ML0037/ML003716792.pdf
Annotation: Guidance on the use of PRA to evaluate how much DiD is necessary
Keywords: NPP, regulation, Regulatory Guide (RG), PRA, NRC, USA

140. U.S. NRC, "Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-water Nuclear Power Reactors", Regulatory Guide RG 1.195, May 2003
http://pbadupws.nrc.gov/docs/ML0314/ML031490640.pdf
Annotation: Guidance on performing radiological consequence analysis, with discussion of the relation to DiD
Keywords: NPP, regulation, NRC, USA

141. U.S. NRC, "Guidelines for Categorizing Structures, Systems, and Compontents in Nuclear Power Plants according to their Safety Significance", Regulatory Guide RG 1.201 Revision 1, May 2006
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML061090627
Annotation: Guidance on the safety classicification of SSC, includes justification in terms of DiD with reference to NEI 00-04, draft 0, report [347], endorsed by NRC
Keywords: NPP, regulation, systems, NRC, USA

142. U.S. NRC, "Risk-informed, Performance-based Fire Protection for Existing Light-water Nuclear Power Plants", Regulatory Guide RG 1.205, Revision 1, December 2009
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML092730314
Annotation: Guidance on fire protection systems for NPP, specifically discusses the application of DiD in that respect
Keywords: NPP, regulation, systems, NRC, USA

143. U.S. NRC, "Cyber Security Programs for Nuclear Facilities", Regulatory Guide RG 5.71, January 2010
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML090340159
Annotation: Application of DiD to IT security for nuclear facilities
Keywords: Facilities, regulation, security, IT, NRC, USA

144. U.S. NRC, "NUREG-1614, FY 2008-2013 Strategic Plan", Volume 4, February 2008
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1614/v4/index.html
Annotation: Defines DiD and describes its importance within risk-informed analysis
Keywords: NPP, regulation, strategic plan, risk-informed, NRC

145. U.S.NRC, "SECY 2009-0056, Staff Approach Regarding a Risk-Informed and Performance-Based Revision on Defense-in-Depth for Future Reactors", April 2009
http://pbadupws.nrc.gov/docs/ML0903/ML090360197.pdf
Annotation: Develops a Policy Statement on DiD for future reactors
Keywords: NPP, regulation, risk-informed, NGNP, NRC

146. U.S.NRC, "NUREG-1860, Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing", December 2007
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1860/
Annotation: DiD and risk-informed, performance-based structure for future reactors
Keywords: NPP, regulation, risk-informed, NRC

147. ACRS, U.S.NRC, "Letter Reports, The Role of Defense in Depth in a Risk-Informed Regulatory System", May 1999
http://www.nrc.gov/reading-rm/doc-collections/acrs/letters/1999/4621827.html
Annotation: Discusses the role of DiD within the risk-informed regulation

148. Keywords: NPP, regulatory, risk-informed, NRC

3.2.4 CANADA

149. GD337, Guidance for the Design of New Nuclear Power Plants, September 2012 (draft)
http://www.cnsc-ccsn.gc.ca/eng/pdfs/Draft_GD/DRAFT-GD-337-Guidance-for-the-Design-of-New-Nuclear-Power-Plants-September-18-2012_e.pdf
Annotation: Guidance on safety requirements for application of defence-in-depth concept
Keywords: NPP, guide, requirements, Canada

150. RD/GD-369, Licence Application Guide - Licence to Construct a Nuclear Power Plant, August 2011
http://www.cnsc-ccsn.gc.ca/pubs_catalogue/uploads/August-2011-RDGD-369-Licence-Application-Guide-Licence-to-Construct-a-Nuclear-Power-Plant_e.pdf
Annotation: Guideline for defence-in-depth provisions of the design, and requirements to evaluate/ demonstrate their efficiency
Keywords: NPP, guide, requirements, Canada

151. REGDOC-2.4.1, Deterministic Safety Analysis, May 2014
http://www.cnsc-ccsn.gc.ca/pubs_catalogue/uploads/REGDOC-2-4-1-Deterministic-Safety-Analysis-eng.pdf
Annotation: Requirements and guidance for the preparation and presentation of a deterministic safety analysis, including the selection of events to be analyzed, acceptance criteria, safety analysis methods, safety analysis documentation, and the review and update of safety analysis. To the extent practicable, this document is technology-neutral.
Keywords: safety, analysis, requirements, NPP, Canada

152. REGDOC-2.4.2, Probabilistic Safety Assessment (PSA) for Nuclear Power Plants, May 2014
http://www.cnsc-ccsn.gc.ca/pubs_catalogue/uploads/REGDOC-2-5-2-Design-of-Reactor-Facilities-Nuclear-Power-Plants-eng.pdf

Annotation: Requirements and guidance for the PSA for a licence to construct or operate an NPP. It includes amendments to reflect lessons learned from the Fukushima accident.

Keywords: PSA, analysis, requirements, NPP, Canada

153. REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants, May 2014

http://www.cnsc-ccsn.gc.ca/pubs_catalogue/uploads/REGDOC-2-5-2-Design-of-Reactor-Facilities-Nuclear-Power-Plants-eng.pdf

Annotation: criteria pertaining to the safe design of new water-cooled NPPs. It specifies a set of comprehensive design requirements (general design requirements and system specific requirements) and guidance, and multiple levels of defence promoted in design considerations. To the extent practicable, the requirements and guidance are technology-neutral with respect to water-cooled reactors

Keywords: design, requirements, NPP, DiD

154. Regulatory Document R-8, Atomic Energy Control Board, Requirements for Shutdown Systems for CANDU Nuclear Power Plants, February 1991

http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/R-8E.pdf

Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning shutdown systems

Keywords: CANDU, requirements, Canada

155. Regulatory Document R-7, Atomic Energy Control Board, Requirements for Containment Systems for CANDU Nuclear Power Plants, February 1991

http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/R-7E.pdf

Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning containment systems

Keywords: CANDU, requirements, Canada

156. Regulatory Document R-9, Atomic Energy Control Board, Requirements for Emergency Core Cooling Systems for CANDU Nuclear Power Plants, February 1991

http://nuclearsafety.gc.ca/pubs_catalogue/uploads/R-9E.pdf

Annotation: Basic, design, operating (normal and accident conditions) and testing requirements concerning ECCS

Keywords: CANDU, requirements, Canada

3.2.5 RUSSIA

157. "General provisions on ensuring safety of nuclear power plants" PNAE-G01-011-97, NP-001-97, OPB-88/97 («Общие положения обеспечения безопасности атомных станций», ПНАЭ Г-01-11-97, НП-001-97, ОПБ-88/97), approved by Decree GAN Russia №9 dated 14 November 1997 (document under review).

Annotation: This document establishes objectives, goals and main safety criteria, basic principles and the technical and organizational measures aimed at achieving safety.

http://ohranatruda.ru/ot_biblio/normativ/data_normativ/8/8253/index.php

Keywords: NPP, safety criteria, safety principles, Russia.

158. "Nuclear safety Rules for Reactor Installations of Nuclear Power Plants" NP-082-07 (Правила ядерной безопасности реакторных установок атомных станций (НП-082-07)) approved By Decree Federal Service for Environment, Technology and Nuclear Supervision №4 dated 10 November 2007 http://russgost.ru/catalog/item45718

    Annotation: These rules establish general requirements for the design, features, conditions which shall be taken into account in the design, construction, commissioning, operation and decommissioning of nuclear power plants.

    Keywords: NPP, rules, nuclear safety, Russia.

159. "Requirements to Contents of Safety Analysis Report of Nuclear Power Plants with WWER Reactors" NP-006-98 (PNAE G-01-036-95 1998) (Требования к содержанию отчета по обоснованию безопасности АС с реактором типа ВВЭР), approved by Decree GAN Russia №7 dated 03 May 1995) http://en-doc.ru/np-006-98

    Annotation: This document provides requirements to the content and structure of the Safety Analysis Report of the plants with WWER reactor.

    Keywords: NPP, safety analysis, design substantiation, Russia.

3.2.6 UKRAINE

160. "General provisions on NPP's safety" NP 306.2.141-2008 (Загальні положення безпеки атомних станцій (НП 306.2.141-2008)), approved SNRIU by order No. 162 dated 19 November 2007 (registered Ministry of Justice under No. 56/14747 dated 25 January 2008).

    http://zakon1.rada.gov.ua/laws/show/z0056-08

    Annotation: This document establishes requirements and criteria safety of nuclear power plants, and basic technical and organizational measures for their realization, protection personnel of nuclear power plants, population and environmental environment from potential radiation exposure.

    Keywords: NPP, general provisions, safety criteria, safety principles, Ukraine.

161. "Nuclear Safety Rules for NPPs with water pressurized reactors" NP 306.2.145-2008 (Правила ядерної безпеки реакторних установок атомних станцій з реакторами з водою під тиском (НП 306.2.145-2008)), approved SNRIU by order No.73 dated 15 April 2008 (registered Ministry of Justice under No. 512/15203 dated 09 June 2008).

    http://zakon1.rada.gov.ua/laws/show/z0512-08

    Annotation: Rules establish general requirements for the design, characteristics, operating conditions of reactors which should be taken into account in the design, construction, commissioning, operation and decommissioning of nuclear power plants.

    Keywords: NPP, rules, nuclear safety, Ukraine.

162. "Requirements for Safety Assessments of NPPs" NP 306.2.162-2010 (Вимоги до оцінки безпеки атомних станцій, НП 306.2.162-2010), approved SNRIU by order No. 124 dated 22 September 2010 (registered Ministry of Justice under No. 964/18259 dated 21 October 2010).

    http://zakon1.rada.gov.ua/laws/show/z0964-10?test=XX7MfyrCSgkyYm3IZi2zpAEpHI4S6s80msh8Ie6

    Annotation: This document establishes main goals and components of the safety evaluation nuclear power

plants and determine the relationship between safety assessments report at different stages of the life cycle of a nuclear power plant.

Keywords: NPP, safety assessment, safety review report, Ukraine.

163. "General requirements for long-term operation of NPP based on Periodic Safety Review Result" NP 306.2.099-2004 (Загальні вимоги до продовження експлуатації АЕС у понад проектний строк за результатами здійснення періодичної оцінки безпеки (НП 306.2.099-2004)), approved SNRIU by order No.181 dated 26 November 2004 (registered Ministry of Justice under No. 1587/10186 dated 15 December 2004).

http://zakon1.rada.gov.ua/laws/show/z1587-04

Annotation: Regulations establishes requirements for long-term operation of NPP based on Periodic Safety Review Result.

Keywords: NPP, long-term operation, periodic safety review, ageing, Ukraine.

164. "Requirement on Content and Structure of the Safety Assessment Report for commissioning NPP with WWER" (KND-306.302-96). (Требования к содержанию отчета по анализу безопасности АС с реакторами типа ВВЭР на стадии выдачи разрешения на ввод в эксплуатацию (КНД 306.302-96)).

Annotation: Regulatory guide define the structure and content of the Safety Analysis Report NPP with WWER pressurized water at the stage of issuing a license for commissioning.

Keywords: commissioning NPP, safety analysis, design substantiation, Ukraine.

165. "Requirement on Content and Structure of the Safety Assessment Report for operating NPP with WWER" (RD95). (Требования к содержанию отчета по анализу безопасности действующих на Украине энергоблоков АЭС с реакторами типа ВВЭР" (РД95)

Annotation: Regulatory guide define the structure and content of the Safety Analysis Report NPP operating in Ukraine NPPs with WWER.

Keywords: operating NPP, safety analysis, design substantiation, Ukraine.

166. "Requirements for structure and content of Periodic Safety Review Report for operating NPPs" SOY-N - YAEK 1.004:2007 (Вимоги до структури та змісту Звіту з періодичної переоцінки безпеки енергоблоків діючих АЕС (СОУ-Н ЯЕК 1.004:2007)), approved Ministry of Energy by order No.262 dated 30 May 2007

Annotation: Branch standard approved by the regulatory body. Standard defines the structure and content of the Periodic Safety Review Report for operating NPPs.

Keywords: NPP, branch standard, PSAR, safety factors, Ukraine.

3.2.7 SWITZERLAND

167. Schweizerische Eidgenossenschaft, "Kernenergiegesetz (KEG) vom 21. März 2003" as amended, January 2009

http://www.admin.ch/opc/de/classified-compilation/20010233/index.html

Annotation: Swiss nuclear law, requires application of DiD for nuclear safety

Keywords: law, Switzerland

168. Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation (UVEK), "Verordnung über die Gefährdungsannahmen und die Bewertung des Schutzes gegen Störfälle in Kernanlagen vom 17.

Juni 2009

http://www.admin.ch/opc/de/classified-compilation/20090231/200908010000/732.112.2.pdf

Annotation: Basic Swiss regulation on the safety case for nuclear facilities, requires adequate implementation of DiD

Keywords: Facilities, regulation, Switzerland

169. HSK, "Anforderungen für die Anwendung von sicherheitsrelevanter rechnerbasierter Leittechnik in Kernkraftwerken", HSK-R-46/d, April 2005

http://static.ensi.ch/1314007330/r046_d.pdf

Annotation: Requirements for the realization of DiD with respect to I&C

Keywords: NPP, regulation, requirements, Switzerland

170. ENSI, "Spezifische Auslegungsgrundsätze für geologische Tiefenlager und Anforderungen an den Sicherheitsnachweis", ENSI-G03/d, April 2009

http://static.ensi.ch/1313766360/g03_d.pdf

Annotation: Requires the application of DiD for final disposal sites

Keywords: regulation, disposal, Switzerland

171. ENSI, "Periodische Berichterstattung der Kernanlagen", ENSI-B02/d, April 2014

http://static.ensi.ch/1396273257/b02-rev-04_final_web.pdf

Annotation: Requires reporting on limitation conditions with reference to the affected levels of DiD

Keywords: regulation, requirements, Switzerland

172. ENSI, "Meldungen der Kernanlagen", ENSI-B03/d, März 2012

http://static.ensi.ch/1330602059/ensi_b03_rev3.pdf

Annotation: Requires reporting and assessment of operating events with regard to their impact on DiD

Keywords: regulation, requirements, Switzerland

173. ENSI, "Ausbildung, Wiederholungsschulungen und Weiterbildung von Personal", ENSI-B10/d, Oktober 2010

http://static.ensi.ch/1313764024/richtlinie_b10.pdf

Annotation: DiD concept is covered in the training of nuclear facility staff

Keywords: regulation, Switzerland

174. HSK, "Periodische Sicherheitsüberprüfung von Kernkraftwerken", HSK-R-12/d, October 1997

http://static.ensi.ch/1314012285/r048_d.pdf

Annotation: Requires to check the adequate realization of DiD within the PSR for NPP

Keywords: NPP, regulation, requirements, Switzerland

175. HSK, "Sicherheitstechnische Anforderungen an den Brandschutz in Kernanlagen", HSK-R-50/d, March 2003

http://static.ensi.ch/1314012863/r050d.pdf

Annotation: Requires application of DiD to fire safety for nuclear facilities

Keywords: regulation, requirements, Switzerland

Draft regulation

176. ENSI, "Periodische Sicherheitsüberprüfung von Kernkraftwerken", draft ENSI-A03/d, January 2014

http://static.ensi.ch/1391425728/ensi-a03_d_externe_anhoerung_final.pdf

Annotation: Update of HSK-R-12, requires to check the adequate realization of DiD within the PSR for

NPP.

Keywords: NPP, regulation, requirements, Switzerland

177. ENSI, “Systematische Sicherheitsbewertungen des Betriebs von Kernanlagen”, draft ENSI-G08/d, January 2014

http://static.ensi.ch/1391425730/ensi-g08_externe_anhoerung_final.pdf

Annotation: Requires to perform safety assessments with reference to the affected levels of DiD, strengths and weaknesses with respect to DiD have to be assessed

Keywords: regulation, requirements, Switzerland

4 NUCLEAR INDUSTRY STANDARDS ON REGULATION ON DEFENSE IN DEPTH AND ITS ADEQUATE REALIZATION

4.1 INTERNATIONAL ORGANIZATIONS

Specific documents by WANO or on the European Utility requirements haven't be identified for this report.

4.2 NATIONAL/VENDOR STANDARDS

Documents from Japan and Russia are referenced below. Documents from further states, like France, South Corea, UK, and USA haven't be identified for this report.

4.2.1 JAPAN

178. Fundamentals and Objectives of Nuclear Safety, AESJ-SC-TR005:2012, June 2013 (Japanese)
http://www.aesj.or.jp/sc/s-list/tr005-2012_op.pdf
Annotation: Atomic Energy Society of Japan (AESJ), referring the Safety Fundamentals of IAEA (SF-1) and implementing the experience of Fukushima Dai-ichi accident, discussed their own fundamentals and objectives of nuclear safety. Also AESJ continues to discuss DiD focusing on the basic concept to be recognized, and objective trees of DiD in IAEA Safety Report Series No.46, considering the experience of Fukushima Dai-ichi accident.
Keywords: safety fundamentals, technical report, AESJ, Japan

4.2.2 RUSSIA

A comprehensive list of the standards (GOST, etc.) concerning the design, manufacturing, monitoring of the equipment. Several standards are presented below as for example

179. "Rules for design and safe operation of pressurized vessels" PB 03-576-03 (Правила устройства и безопасной эксплуатации сосудов,работающих под давлением (ПБ 03-576-03) approved by the Decree of Russian Gosgortechnadzor № 91 dated 11 June 2003.
www.inversiya.com/files/pb-03-576-03sosud.doc
Annotation: Rules establish requirements for the design, production, reconstruction, adjustment, installation, repair, maintenance and operation of vessels diagnosis, tanks, drums, cylinders, pressure chambers operating pressurized.
Keywords: rules, design, vessels, pressurized, tank, Russia.
180. "Equipment for monitoring radiation environment. General requirements" GOST 29074-91 (Аппаратура контроля радиационной обстановки. Общие требования ГОСТ 29074-91)
http://www.gosthelp.ru/gost/gost10248.html
Annotation: This standard applies to newly developed and modernized radiation monitoring equipment designed to control the parameters describing radiation environment, radiation hazardous and radiation-sensitive objects.
Keywords: requirements, radiation monitoring equipment, Russia.

181. "General requirements to reactor I&C" GOST 26843-86 (Реакторы ядерные энергетические. Общие требования к системе управления и защиты ГОСТ 26843-86)
http://www.gosthelp.ru/text/GOST2684386Reaktoryyadern.html
Annotation: Sstandard applies to the I&C of nuclear power reactors in nuclear power plants.
Keywords: NPPs, I&C, Russia.

182. "Reliability in techniques. Contents and general rules of reliability requirements assignment GOST 27003-90" (Надежность в технике. Состав и общие правила задания требований по надежности)
http://allgosts.info/standarts/gost-27003-90
Annotation: This standard applies to all types of products and establishes the composition, procedures and general rules specify reliability requirements.
Keywords: rules, technical, design documentation, Russia

5 SELECTION OF NON-NUCLEAR STANDARDS AND TOPICAL REPORTS ON DEFENSE IN DEPTH AND ITS ADEQUATE REALIZATION

The following standards and (mainly) topical reports related to the use of a DiD approach to provide safety and security in non-nuclear sectors, mainly for the chemical industry (including oil & gas) and information technology (as basic technology for different applications). It is worthwhile to note that in most non-nuclear sectors, the DiD principle has been explicitly applied much later than in nuclear industry, where both deterministic and probabilistic safety assessment approaches were well developed and accepted.

5.1 CHEMICAL INDUSTRY

183. IEC 61511, "Functional safety – Safety instrumented systems for the process industry sector. Part 1: Framework, definitions, system, hardware and software requirements. Part 2: Guidelines for the application. Part 3: Guidance for the determination of the required safety integrity levels". 2003
http://webstore.iec.ch/Webstore/webstore.nsf/ArtNum_PK/31845!openDocument
Annotation: It introduces the concepts of "protection layer", subject to independence, diversity, physical separation and provides an informative annex (F) on the Layer of Protection Analysis
Keywords: Functional safety, Protection layer, LOPA

184. OSHA, "29 CFR 1910.119 Appendix C", February 2013
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9763
Annotation: Provides chemical industry safety standards and guidelines for the PSM; defines levels functions and standards on the basis of the DiD principle (even though is neither stated nor defined)
Keywords: PSM, lines of defense

185. CCPS/AIChE, "Guidelines for Safe Automation of Chemical Process", 1993
Annotation: Definition of LOPA process. Chemical industry recognizes the DiD principle, better conceptualized within the nuclear industry, under the name of *layers of protection* and thereby Layers Of Protection Analysis (LOPA)
Keywords: Independent Provision Layer (IPL), LOPA, criteria, CCPS

186. AMEY VECTRA Limited, "Lines of Defense/Layers of Protection Analysis in the COMAH context", 1999
http://www.hse.gov.uk/research/misc/vectra300-2017-r02.pdf
Annotation: Description of standardized methods and techniques, based on DiD, to provide process safety
Keywords: COMAH, Great Britain, ALARP, Lines Of Defense (LOD), LOPA, Layer of protection

187. HONEYWELL, "An integrated Approach to Safety: Defense in Depth", 2010
https://www.honeywellprocess.com/library/marketing/whitepapers/Integrated-Safety-WhitePaper.pdf
Annotation: Integrated approach to provide safety through the implementation of defensive layers (or levels); the approach relies on DiD concept (even though is mentioned only in the title)
Keywords: Layers of protection, structured approach, risk

188. Wei, C, et al, "Layer of protection analysis for reactive chemical risk assessment", 2008
http://www.sciencedirect.com/science/article/pii/S0304389408009898

Annotation: Definition and explanation of LOPA methodology

Keywords: risk analysis, HAZOP, LOPA, IPL, PFD

189. Summers, A E, "Introduction to layers of protection analysis", 1996
http://www.sciencedirect.com/science/article/pii/S0304389403002425
Annotation: Overview on LOPA approach: utility, requirements and benefits
Keywords: LOPA, IPL, protection layers, CCPS, risk mitigation

190. Dowell III, A M, "Layer of protection analysis for determining safety integrity level", 1998
http://www.sciencedirect.com/science/article/pii/S0019057898000184
Annotation: Guidelines on LOPA as an effective method to determine the required SIL
Keywords: LOPA, SIL, CCPS, IPL, PFD

191. Bridges, W B, et al, "Key Issues with Implementing LOPA", 2010
http://www.p-i-i-i.com/_downloads/Issues_with_Use_of_LOPA_Perspective_from_an_Originator_of_LOPA.pdf
Annotation: Definition of LOPA: problems and benefits
Keywords: LOPA, IPL, layer of protection

192. Dowell III, A M, et al, "Layer of Protection Analysis: Generating Scenarios Automatically from HAZOP Data", 2005
http://www.researchgate.net/publication/229459647_Layer_of_protection_analysis_Generating_scenarios_automatically_from_HAZOP_data
Annotation: Development of LOPA scenarios from HAZOP
Keywords: LOPA, IPL, PFD, Safeguard, risk reduction

193. Saleh, J H, et al, "Safety in the mining industry and the unfinished legacy of mining accidents: Safety levers and defense-in-depth for addressing mining hazards, 2011
http://www.sciencedirect.com/science/article/pii/S0925753511000701
Annotation: Definition of DiD and application in the mining industry as a systematic approach to safety
Keywords: mining, multiple lines of defense, prevention

5.2 INFORMATION TECHNOLOGY

194. ISO/IEC 27002:2013, "Information technology — Security techniques — Code of practice for information security controls"
https://www.iso.org/obp/ui/#iso:std:iso-iec:27002:ed-2:v1:en
Annotation: it is a reference for selecting controls within the process of implementing an Information Security Management System (ISMS) based on ISO/IEC 27001. Control selection also depends on the manner in which controls interact to provide defence in depth
Keywords: Security, control selection, Information technology

195. ISO/IEC 27033-2:2012, "Information technology — Security techniques — Network security — Part 2: Guidelines for the design and implementation of network security".
https://www.iso.org/obp/ui/#iso:std:iso-iec:27033:-2:ed-1:v2:en

Annotation: it provides guidelines for organizations to plan, design, implement and document network security; part 2 provides guidelines for the design and implementation of network security, including defence in depth as design principle

Keywords: Information Security, design principle, defence in depth

196. ITSEAG, "Defence in depth", Trusted Information Sharing Network for Critical Infrastructure Protection, 2008

http://www.tisn.gov.au/Documents/SIFTD-I-D+-+Full+-++15+Oct+2008+-+1.pdf

Annotation: Requirements for the development of Information technology security through a DiD approach

Keywords: security, protection, Information technology

197. DCSSI, "In Depth Defence applied to Information Systems", 2004

http://www.ssi.gouv.fr/archive/en/confidence/documents/methods/mementodep-V1.1_en.pdf

Annotation: Definition of DiD for Information Systems security

Keywords: security, uncertainty, Information Systems

198. US Department of Homeland Security, "Recommended Practice: Improving Industrial Control Systems Cybersecurity with Defense-In-Depth Strategies, October 2009

https://ics-cert.us-cert.gov/sites/default/files/recommended_practices/Defense_in_Depth_Oct09.pdf

Annotation: The DiD strategy to provide cybersecurity within industrial control systems

Keywords: Cybersecurity, threat, vulnerability

199. Oakwood Systems Group, "Defense in Depth: Strategies for Information Security", 2007

http://www.oakwoodsys.com/collaboration/Documents/Defense%20in%20Depth%20-%20Strategies%20for%20Information%20Security.pdf

Annotation: Requires a DiD approach

Keywords: OSI Network model, multi-layered approach, risk tolerance

200. SANS Institute, "Improving Defense in Depth for NASA's Mission Network, 2001

https://www.sans.org/reading-room/whitepapers/infosec/improving-defense-in-depth-nasas-mission-network-599

Annotation: DiD security approach used in NASA's Missions Network; DiD improvements needed to enhance security

Keywords: NASA, security, network

201. SANS Institute, "Defense in Depth: An Impractical Strategy for a Cyber World", 2011

http://www.sans.org/reading-room/whitepapers/assurance/defense-depth-impractical-strategy-cyber-world-33896?show=defense-depth-impractical-strategy-cyber-world-33896&cat=assurance

Annotation: DiD historical development; definition of DiD and Defense in Breadth in IS security

Keywords: IT Security, Defense in Breadth

202. NSA, SNAC, " The Case for Using Layered Defenses to Stop Worms", 2004

http://www.nsa.gov/ia/_files/support/WORMPAPER.pdf

Annotation: Overview on defensive technologies that together set up the DiD

Keywords: Layered, defensive solution, vulnerability

203. Farn, K J, et al, " A study on e-Taiwan information system security classification and implementation" 2007

http://www.researchgate.net/publication/223251398_A_study_on_eTaiwan_information_system_security_classification_and_implementation

Annotation: Implementation of DiD to provide IS security

Keywords: IS, cyberspace, security

5.3 OTHER SECTORS

204. US Department of Homeland Security, " National Strategy for Aviation Security", March 2007
https://www.fas.org/irp/offdocs/nspd/nspd-47.pdf
Annotation: Requires layered defensive measures to provide aviation security; DiD concept is not developed in Aviation sector
Keywords: Aviation, airspace, security, September 2001, layered
205. NASA Safety System Handbook, "System Safety Framework and Concepts for Implementation", Volume 1, November 2011
http://www.hq.nasa.gov/office/codeq/doctree/NASASP2010580.pdf
Annotation: DiD concept is not developed in space sector, probably because of difficulties to implement high levels of redundancy in this field.
Keywords: safety, space, risk
206. Cointet, A, "Defense In Depth: Modeling Defense Elements for a Transport System", CSER, 2005
http://www.learningace.com/doc/1576678/dde1edd11e9b0bc5577d058b16bf6a56/15
Annotation: The DiD concept in transport systems: definition and implementing methodology
Keywords: Transport, RATP, risk assessment, lines of defense
207. Sklet, S, "Comparison of some selected methods for accident investigation", April 2004
http://www.sciencedirect.com/science/article/pii/S0304389404000834
Annotation: Quotation of DiD in accident investigation
Keywords: Accident investigation, safety, barriers
208. Reason J, "Human error, New York: Cambridge University Press", 1990
Annotation: Defences, barriers and safeguards according to a "system approach" for human error problem
Keywords: human error, Swiss cheese model, barriers

6 TOPICAL REPORTS ON DEFENSE IN DEPTH AND ITS ADEQUATE REALIZATION

6.1 INTERNATIONAL ORGANIZATIONS

6.1.1 IAEA

The International Atomic Energy Agency (IAEA) issues different documents related to nuclear related technologies, application of "nuclear" materials, nuclear governance, etc. Concerning DiD, the relevant documents are related to design, construction, commissioning, operation and decommissioning of NPPs and nuclear material treatment

facilities. Safety requirements and guides are already covered in section 3.1.1. Some important statements on the DiD concept have been made by the IAEA advisory group INSAG. Other important sources of information are the Safety Reports Series and the Technical Documents series "TECDOC". Some publications are related directly to requirements for DiD and a large number of publications are related to the topics of DiD in different aspects: design, operation, fuel handling, main equipment assessment - for reactor, steam generators, etc. Other documents as part of the DiD concept make a border between different levels of the DiD "pyramid".

As a generalizing statement it can be concluded that the documents issued by the IAEA after the Fukushima Daiichi accident are more explicative and more detailed towards improvement of DiD. The general review of the documents has shown the necessity of a review of the principles for DiD application – especially site evaluations and external hazards impact on the nuclear facilities.

209. IAEA, "IAEA Safety Glossary, Terminology Used in Nuclear Safety and Radiation Protection 2007 Edition", June 2007
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1290_web.pdf
Annotation: Definition of DiD, terminology in IAEA safety standards, collection of specific terminology, scope of 'protection and safety' and coverage of 'nuclear security', explanations the meanings of technical terms and references
Keywords: miscellaneous, definition, terminology, IAEA

210. IAEA Nuclear Security Series No. 13. Recommendations. Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5). January 2011
http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1481_web.pdf
Annotation: This publication applies to the physical protection of nuclear material, including its physical protection during transport, and of nuclear facilities against malicious acts.
Keywords: IAEA, physical protection, radioactive, material, facilities, DiD.

6.1.1.1 INSAG

211. INSAG, "The Safety of Nuclear Power Plants", Safety Series No. 75-INSAG-5, January 1992
Annotation: Topical report on the safety of nuclear facilities, includes role of DiD
Keywords: definitions, reports, facilities, IAEA, INSAG

212. INSAG, "Defence in Depth in Nuclear Safety", INSAG-10, June 1996
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1013e_web.pdf
Annotation: Topical report developing the concept of DiD in nuclear safety
Keywords: definitions, report, IAEA, INSAG

213. INSAG, "Basic Safety Principles for Nuclear Power Plants 75-INSAG-3 Rev. 1", INSAG-12, October 1999
http://www-pub.iaea.org/MTCD/publications/PDF/P082_scr.pdf
Annotation: Topical report developing safety principles for NPP including the application and adequate realization of DiD, update of INSAG 3.
Keywords: definitions, requirements, report, IAEA, INSAG

6.1.1.2 IAEA Safety Reports Series

214. IAEA, Accident Analysis for Nuclear Power Plants, Safety Report Series No. 23, November 2002.
http://www-pub.iaea.org/mtcd/publications/pdf/Pub1131_scr.pdf
Annotation: The report is a practical guidance for performing accident analyses. The report covers all the steps required to perform accident analyses, including selection of initiating events.
Keywords: report, IAEA, Nuclear Power Plants

215. IAEA, Review of Probabilistic Safety Assessments by Regulatory Bodies, Safety Report Series No. 25, November 2002.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1139_scr.pdf
Annotation: This report covers the review of Level 1, 2 and 3 PSAs for event sequences occurring in all modes of plant operation (including full power, low power and shutdown).
Keywords: report, IAEA, PSAs, Regulatory Bodies

216. IAEA, Accident Analysis for Nuclear Power Plants with Pressurized Heavy Water Reactors, Safety Report Series No. 29, 2003.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1161_web.pdf
Annotation: The objective of the present report is to provide specific guidance for accident analysis for NPPs with PHWRs, taking into account the specific design features of these reactors, presents specific criteria applicable for different initiating events.
Keywords: report, IAEA, Nuclear Power Plants, Accident Analysis

217. IAEA, Accident Analysis for Nuclear Power Plants with Pressurized Water Reactors, Safety Report Series No. 30, November 2003.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1162_web.pdf
Annotation: The report covers all the steps required for accident analyses, i.e. selection of initiating events and acceptance criteria, selection of computer codes and modelling assumptions, preparation of input data and presentation of the calculation results.
Keywords: report, IAEA, Nuclear Power Plants

218. IAEA, Implementation of Accident Management Programmes in Nuclear Power Plants, Safety Report Series No. 32, March 2004.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1167_web.pdf
Annotation: This report focuses on the fourth level of defence in depth, including the transitions from the third level and into the fifth level. This report focuses on SAMGs.
Keywords: report, IAEA, Nuclear Power Plants,

219. IAEA, Safety Considerations in the Transition from Operation to Decommissioning of Nuclear Facilities, Safety Report Series No. 36, 2004
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1184_web.pdf
Annotation: The report provides information to help in ensuring safe management of the transition from the operational phase to the beginning of implementation of the decommissioning strategy for nuclear facilities in respect of implementation of the defense in depth concept.
Keywords: report, IAEA

220. IAEA, Assessment of Defense in Depth in Nuclear Power Plants, Safety Report Series No. 46, February 2005
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1218_web.pdf
Annotation: The report describes a method for assessing the defence in depth capabilities of an existing plant, including both its design features and the operational measures taken to ensure safety. The five levels of defense in depth are covered.
Keywords: report, IAEA, Nuclear Power Plants, Defense in Depth

221. IAEA, Safety of New and Existing Research Reactor Facilities in Relation to External Events, Safety Report Series No. 41, March 2005.
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1209_web.pdf
Annotation: This publication provides guidance for conducting a safety evaluation of new and existing research reactors in relation to the hazards posed by external events.
Keywords: report, IAEA, Research Reactors

222. IAEA, Assessment of Defence in Depth for Nuclear Power Plants, Safety Report Series No. 46, February 2005
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1218_web.pdf
Annotation: The present publication describes a method for assessing the defence in depth capabilities of an existing plant, including both its design features and the operational measures taken to ensure safety. A systematic identification of the required safety provisions for the siting, design, construction and operation of the plant provides the basis for assessing the comprehensiveness and quality of defence in depth at the plant.
Keywords: IAEA, safety, Defence in depth, power, plants.

223. IAEA, Development and Review of Plant Specific Emergency Operating Procedures, Safety Report Series No. 48, February 2006
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1226_web.pdf
Annotation: This report focuses on the emergency operating procedures (EOPs) that are an important component of DiD concept for NPPs, presents the details of the steps necessary to develop or upgrade EOPs and implementation of EOPs at an individual plant, provides general guidance for the review of EOPs.
Keywords: report, IAEA, Nuclear Power Plants, EOPs

224. IAEA, Best Estimate Safety Analysis for Nuclear Power Plants: Uncertainty Evaluation, Safety Report Series No. 52, August 2008
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1306_web.pdf
Annotation: The safety report covers all the steps required for accident analyses (i.e. selection of initiating events and acceptance criteria, selection of computer codes and modelling assumptions, preparation of input data and presentation of the calculation results).
Keywords: report, IAEA, Nuclear Power Plants

225. IAEA, Accident Analysis for Nuclear Power Plants with Modular High Temperature Gas Cooled Reactor, Safety Report Series No. 54, April 2008
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1318_web.pdf

Annotation: This report provides specific guidance on conducting accident analyses of nuclear power plants with modular HTGRs, taking into account specific design, operational and safety features. The report contains details of initiating events and overviews of the safety aspects of events that could lead to fuel failure and potential activity release.

Keywords: report, IAEA, Nuclear Power Plants

226. IAEA, Safety Analysis for Research Reactors, Safety Report Series No. 55, August 2008
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1321_web.pdf
Annotation: This publication covers all steps in performing the safety analysis of a research reactor. It focuses on analysing transients and accidents as a part of the safety analysis. The five levels of the defense in depth are illustrated.
Keywords: report, IAEA, Research Reactors

227. IAEA, Approaches and Tools for Severe Accident Analysis for Nuclear Power Plants, Safety Report Series No. 56, October 2008
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1327_web.pdf
Annotation: This publication provides a description of factors important to severe accident analysis, an overview of severe accident phenomena and the current status in their modelling, categorization of available computer codes, and differences in approach for various applications of severe accident analysis. The report covers both the in-vessel and ex-vessel phases of severe accidents.
Keywords: report, IAEA, Nuclear Power Plants

228. IAEA, Safety Assessment for Decommissioning, Safety Report Series No. 77, June 2013
http://www-pub.iaea.org/MTCD/publications/PDF/Pub1604_web.pdf
The report presents a systematic methodology for the evaluation and demonstration of safety during decommissioning in respect of DID. The methodology is intended to assist operators and technical support specialists in planning and undertaking decommissioning activities for all types of facility.
Keywords: report, IAEA, decommissioning

229. IAEA, "Safety Reassessment for Research Reactors in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant", Safety Report Series No. 80, March 2014
http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1615_web.pdf
Annotation: The objective of this publication is to provide a set of suggestions and methods, on the basis of current international good practices, for performing safety reassessment for research reactors, taking into consideration the available feedback from the Fukushima Daiichi accident. Information is also provided on the use of relevant IAEA safety standards in performing such a safety reassessment. This publication is intended for use by operating organizations, regulatory bodies, design organizations and other authorities involved in the safety of research reactors.
Keywords: IAEA, safety, reassesment, Fukushima, research, reactors

6.1.1.3 IAEA TECDOC Series

230. IAEA-TECDOC-1366. Considerations in the development of safety requirements for innovative reactors: Application to modular high temperature gas cooled reactors. August 2003.
file:///C:/Users/DB/Downloads/SafReqte_1366_web.pdf

Annotation: To apply the defence in depth screening approach, this report considered the three fundamental safety functions (control of reactivity, core heat removal, and confinement of radioactive materials), and the challenges to the performance of these functions. Provisions identified are mainly based on design features of current PBMR and GT-MHR concepts, and are identified to illustrate the process for assessing MHTGR concepts.

Keywords: IAEA, innovative, gas cooled, reactors, DiD.

231. IAEA-TECDOC-1487 Advanced nuclear plant design options to cope with external events. February 2006.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1487_web.pdf

Annotation: In line with the abovementioned developments, the objectives of this report are the following:

(1) Through direct cooperation with the designers of advanced NPPs, to define, collate and present the state-of-the art in design features and approaches used to protect plants from external event impacts, making a focus on NPPs with evolutionary and, when possible, innovative designs; (2) Reflecting best practices achieved in Member States, to provide a technical and information background to assist designers of advanced NPPs in defining a consistent strategy regarding selected design and site evaluation issues in relation to extreme external events; (3) To bring to the attention of designers of advanced NPPs the recently updated IAEA safety guides and other publications on issues of plant protection from external event impacts; to collect comments on their applicability to NPPs with evolutionary and innovative reactors; to identify safety and technological issues and proposals for their resolution; and to outline future challenges and potential contribution of the IAEA.

Keywords:

232. IAEA-TECDOC-1451 Innovative small and medium sized reactors: Design features, safety approaches and R&D trends Final report of a technical meeting held in Vienna, 7–11 June 2004. Edition May 2005.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1451_web.pdf

Annotation: Fifteen experts nominated by the IAEA Member States: Argentina, Brazil, China, India, Indonesia, Japan, France, the Republic of Korea, South Africa, the Russian Federation, the United Kingdom, and the United States of America attended the meeting, submitted papers and delivered the presentations covering about 30 designs of innovative SMRs.

Keywords: IAEA, small, reactors, innovative, safety.

233. IAEA-TECDOC-1502. Authorization of nuclear power plant control room personnel: Methods and practices with emphasis on the use of simulators. July 2006.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1502_web.pdf

Annotation: The purpose of the document is to provide practical information on the methods and practices used by Members States for the authorization of control room personnel by the regulatory body or other entity designated by a State in order to ensure plant safety and the availability of competent personnel for nuclear power plant operation.

Keywords: IAEA, authorization, control room, personnel, methods.

234. IAEA-TECDOC-1511. Determining the quality of probabilistic safety assessment (PSA) for applications in nuclear power plants. July 2006.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1511_web.pdf

Annotation: The detailed IAEA PSA procedures mentioned above (Refs [2-4]) mainly concentrate on general features and content of PSAs. In these publications, a limited consideration is given to the particular features of PSA conditioned by specific PSA applications. It should be also mentioned that a number of approaches and techniques described in these procedures, in particular in the Level-1 PSA procedure (see Ref. [2]), have been further developed, so the present publication takes into account the current state of the art regarding various aspects related to PSA methodologies.

Keywords: IAEA, quality, probabilistic, safety, assessment, DiD.

235. IAEA-TECDOC-1577. Strategy for Assessment of WWER Steam Generator Tube Integrity. December 2007.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1577_web.pdf

Annotation: In this technical document WWER tube integrity means that the tubes are capable of performing their intended safety functions consistent with the licensing basis, including applicable regulatory requirements.

Keywords: IAEA, assessment, tube, stem generator, integrity.

236. IAEA-TECDOC-1578. Computational Analysis of the Behaviour of Nuclear Fuel Under Steady State, Transient and Accident Conditions. December 2007.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1578_web.pdf

Annotation: The objective of this publication is to establish a set of conceptual and formal methods and practices for performing fuel behaviour analysis in water reactors under design basis accident (DBA) conditions. These suggested methods and practices are based on current good practices around the world. This publication applies to the analysis of the fuel condition both inside and outside the core and covers all steps in performing the analysis,

Keywords: IAEA, computational, analysis, behavior, fuel, accident.

237. IAEA-TECDOC-1590. Application of Reliability Centred Maintenance to Optimize Operation and Maintenance in Nuclear Power Plants. May 2007.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1590_web.pdf

Annotation: This TECDOC describes the principles of RCM, some practical examples for its application in NPPs, key requirements for its implementation, experience in its application and examples of the practical benefits.

Keywords: IAEA, reliability, maintenance, DiD

238. IAEA-TECDOC-1650. Good Practices in Heavy Water Reactor Operation. June 2010.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1650_web.pdf

Annotation: The NPP Report (The Annual CNSC Staff Report on the Safety Performance of the Canadian Nuclear Power Industry) is a public pronouncement on the safety performance of power reactor licensees in Canada and serves to demonstrate to stakeholders how the CNSC fulfils its mandate of ensuring that NPP operation poses no unreasonable risk to the health, safety and security of Canadians and their environment and respects international obligations on the peaceful use of nuclear energy. The goal of the CNSC is to produce a report that is transparent, clear, concise and timely. In the spirit of continuous improvement, the CNSC is constantly looking for ways to improve the NPP Report as a communication product.

Keywords: IAEA, good practices, safety performance, Canada, Heavy Water Reactor.

239. IAEA-TECDOC-1653. Best practices in the management of an operating experience programme at nuclear power plants. August 2010.
http://www-pub.iaea.org/MTCD/Publications/PDF/te_1653_web.pdf
Annotation: This publication has been developed to provide advice, assistance and good practices in the management of the OE programme to nuclear utilities, individual nuclear plants, regulatory organizations and other related institutes. It is recognized that alternative means may exist and that organizations might effectively achieve this overall performance objective without meeting some or part of the specific criteria, attributes or practices described in the present publication.
Keywords: IAEA, management, operating, experience, plants.

240. IAEA-TECDOC-1657, Design Lessons Drawn from the Decommissioning of Nuclear Facilities. May 2011.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1657_web.pdf
Annotation: The objective of this document is to review lessons learned from decommissioning as reported in international publications and forums and to derive from these the features that can feedback into new designs. A structured approach is proposed to provide a meaningful introduction of justified design features so that those persons or organizations might take responsibility for implementation. The intention is that the logic behind the proposed changes should also be easily understood by potential owners of new facilities so that they can discuss the relevant points with suppliers and designers.
Keywords: IAEA, design, lessons, facilities. DiD.

241. IAEA-TECDOC-1661. Mitigation of Hydrogen Hazards in Severe Accidents in Nuclear Power Plants. July 2011.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1661_Web.pdf
Annotation: The main objective of the present publication is to contribute to the implementation of relevant IAEA Safety Standards, in particular regarding two requirements. Performing computational analysis of severe accidents, and notably all problems related to hydrogen sources, hydrogen distribution, hydrogen combustion, hydrogen control and mitigation measures. Development and implementation of accident management programmes in NPPs, notably of those measures which are aimed at mitigation of hydrogen in the reactor containments.
Keywords: IAEA, mitigation, hydrogen, hazard, severe, accident.

242. IAEA-TECDOC-1668. Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: Steam Generators. November 2011.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1668_web.pdf
Annotation: This IAEA-TECDOC documents current practices for the assessment and management of ageing of the following types of steam generators used in water cooled nuclear power plants: (a) vertical tube sheet boiling steam generators, commonly known as ‘recirculating vertical U tube steam generators’ (b) vertical/tube sheet superheated steam generators, commonly known as ‘once through steam generators,’ and (c) horizontal/collector boiling steam generators used in WWER reactors.
Keywords: IAEA, assessment, ageing, management, steam generators.

243. IAEA-TECDOC-1677. Natural Circulation Phenomena and Modelling for Advanced Water Cooled Reactors. March 2012.
http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1677_web.pdf

Annotation: As part of the IAEA's overall effort to foster international collaborations that strive to improve the economics and safety of future water cooled nuclear power plants, an IAEA Coordinated Research Project (CRP) was started in early 2004. This CRP, entitled Natural Circulation Phenomena, Modelling and Reliability of Passive Safety Systems that Utilize Natural Circulation, focuses on the use of passive safety systems to help meet the safety and economic goals of a new generation of nuclear power plants. This CRP has been organized within the framework of the IAEA Department of Nuclear Energy's Technical Working Groups for Advanced Technologies for Light Water Reactors and Heavy Water Reactors (the TWG-LWR and the TWG-HWR) and has provided an international cooperation on research work underway at the national level in several IAEA Member States.

Keywords: IAEA, natural, circulation, modeling, passive.

244. IAEA-TECDOC-1705. Passive Safety Systems in Advanced Water Cooled Reactors (AWCRs) Case Studies A Report of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) . September 2013.

http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1705_web.pdf

Annotation: This report presents the results from the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) collaborative project (CP) on Advanced Water Cooled Reactor Case Studies in Support of Passive Safety Systems (AWCR), undertaken under the INPRO Programme Area C. INPRO was launched in 2000 — on the basis of a resolution of the IAEA General Conference (GC(44)/RES/21) — to ensure that nuclear energy is available in the 21st century in a sustainable manner, and it seeks to bring together all interested Member States to consider actions to achieve innovation.

Keywords: IAEA, passive, advanced, water, reactors, DiD.

6.1.2 ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT/ NUCLEAR ENERGY AGENCY (OECD/NEA)

245. CSNI, "Integrated Assessment of Level 1 and Level 2 PSA Results for Internal and External Events", NEA/CSNI/R(97)21, April 1998

http://www.oecd-nea.org/nsd/docs/1997/csni-r1997-21.pdf

Annotation: PSA results for defence levels (DiD)

Keywords: NPP, Topical report, PSA, NEA, CSNI

246. CSNI, "Passive System Reliability – a Challenge to Reliability Engineering and Licensing of Advanced Nuclear Power Plants, Proceedings of an International Workshop hosted by the Commissariat à l'Energie Atomique (CEA) held in Cadarache, France 4th-6th March 2002", NEA/CSNI/R(2002)10, June 2002

http://www.oecd-nea.org/nsd/docs/2002/csni-r2002-10.pdf

Annotation: Discussion of DiD issues related to passive (safety) systems

Keywords: NPP, topical report, workshop, passive systems, NEA, CSNI

247. CSNI, "Implementations of Severe Accident Management Measures, Summary and Conclusions of A Workshop organized in Villigen, Switzerland in Collaboration with KKB, KKL, PSA and EDF/SEPTEN, 10-13 September 2001", NEA/CSNI/R(2002)12, July 2002

http://www.oecd-nea.org/nsd/docs/2002/csni-r2002-12.pdf

Annotation: Justification of severe accident management by DiD principle

Keywords: NPP, topical report, workshop, severe accident, NEA, CSNI

248. CSNI, "The Use and Development of Probabilistic Safety Assessment in NEA Member Countries", CSNI/NEA/R(2002)18, July 2002

http://www.oecd-nea.org/nsd/docs/2002/csni-r2002-18.pdf

Annotation: Relation between deterministic and probabilistic assessments and use of PSA for DiD assessment, updated version is [263]

Keywords: NPP, topical report, PSA, NEA, CSNI

249. CNSI, "PSA-based Event Analysis", CSNI Technical Opinion Papers No. 6, NEA No. 4409, December 2004

http://www.oecd-nea.org/nsd/reports/2004/nea4409-PSA.pdf

Annotation: Use of PSA to quantify the availability of remaining lines of defence (DiD) in event analysis

Keywords: NPP, topical report, PSA, NEA, CNSI

250. CSNI, "CNSI Technical Opinion Papers No. 7: Living PSA and its Use in the Nuclear Safety Decision-making Process, No. 8: Development and Use of Risk Monitors at Nuclear Power Stations", NEA No. 4411, February 2005

http://www.oecd-nea.org/nsd/reports/2005/nea4411-PSA-risk-monitors.pdf

Annotation: Use of a living PSA and risk monitors in decision making, includes discussions on relevance to the DiD concept

Keywords: NPP, topical report, Living PSA, risk monitor, decision making, NEA, CSNI

251. OECD/NEA, "Nuclear Regulatory Decision Making", NEA No. 5356, March 2005

http://www.oecd-nea.org/nsd/reports/2005/nea5356-decision.pdf

Annotation: Role of DiD concept in regulatory decision making, subsumed into [257].

Keywords: Facilities, topical report, decision making, NEA, CNRA

252. OECD/NEA, "The Safety of the Nuclear Fuel Cycle", NEA No. 3588, October 2005

http://www.oecd-nea.org/nsd/pubs/2005/3588-safety-nuclear-fuel-cycle.pdf

Annotation: Application of DiD concept to fuel cycle facilities

Keywords: Fuel cycle, topical report, NEA

253. OECD/NEA, "Regulatory Challenges in Using Nuclear Operating Experience", NEA No. 6159, February 2006

http://www.oecd-nea.org/nsd/reports/2006/nea6159-operating-experience.pdf

Annotation: Discusses, amongst others, application of DiD concept to operating experience evaluation

Keywords: NPP, topical report, OPEX, NEA

254. OECD/NEA, "Nuclear Power Plant Operating Experiences from the IAEA/NEA Incident Reporting System 2005 – 2005", NEA No. 6150, May 2006

http://www.oecd-nea.org/nsd/reports/2006/nea6150-irs.pdf

Annotation: Impact of operating experience events with regard to DiD and lessons learnt

Keywords: NPP, topical report, IRS, OPEX, NEA

255. CSNI, "Use and Development of Probabilistic Safety Assessment", NEA/CSNI/R(2007)12, November 2007

http://www.oecd-nea.org/nsd/docs/2007/csni-r2007-12.pdf

Annotation: Relation between deterministic and probabilistic assessments and use of PSA for DiD

assessment, updated version is [263].

Keywords: NPP, topical report, PSA, NEA, CSNI

256. OECD/NEA, "The Regulatory Goal of Assuring Nuclear Safety", NEA No. 6273, February 2008
http://www.oecd-nea.org/nsd/reports/2008/nea6273-goal.pdf
Annotation: Discussion of the role of DiD in regulatory decision making, subsumed into [257].
Keywords: Facilities, topical report, decision making, NEA, CNRA

257. CSNI, "Defence in Depth of Electrical Systems and Grid Interaction, Final DIDELSYS Task Group Report", NEA/CSNI/R(2009)10, November 2009
http://www.oecd-nea.org/nsd/docs/2009/csni-r2009-10.pdf
Annotation: Investigation of DiD for electrical power supply systems
Keywords: NPP, topical report, electrical power supply, DIDELSYS, NEA, CSNI

258. CSNI, "Probabilistic Risk Criteria and Safety Goals", NEA/CSNI/R(2009)16, December 2009
http://www.oecd-nea.org/nsd/docs/2009/csni-r2009-16.pdf
Annotation: Discussion of the relationship of probabilistic risk criteria and DiD
Keywords: NPP, topical report, PSA, criteria, decision making, NEA, CSNI

259. CSNI, "Recommendations on Assessing Digital System Reliability in Probabilistic Risk Assessments of Nuclear Power Plants", NEA/CSNI/R(2009)18, December 2009
http://www.oecd-nea.org/nsd/docs/2009/csni-r2009-18.pdf
Annotation: Includes discussion of the relation of digital I&C design and reliability and DiD
Keywords: NPP, topical report, digital I&C, NEA, CSNI

260. OECD/NEA, "Improving Nuclear Regulation, NEA Regulatory Guidance Booklets Volumes 1-14", NEA No. 6905, May 2011
http://www.oecd-nea.org/nsd/docs/2011/cnra-r2011-10.pdf
Annotation: Discussion of the role of DiD in regulatory decision making
Keywords: Facilities, topical report, decision making, NEA, CNRA

261. OECD/NEA, "Nuclear Power Plant Operating Experiences from the IAEA/NEA Incident Reporting System 2009 – 2011", NEA No. 7120, December 2012
Annotation: Describes operating experience with degradations of DiD
Keywords: NPP, topical report, IRS, OPEX, NEA

262. CSNI, "Ageing Management of Nuclear Fuel Cycle Facilities", CSNI Technical Opinion Paper No. 15, December 2012
http://www.oecd-nea.org/nsd/docs/2012/6990-top-15.pdf
Annotation: Discusses the relation of ageing effects and respective ageing management on the implementation of DiD.
Keywords: Facilities, ageing, topical report, NEA, CNSI

263. CSNI, "Use and Development of Probabilistic Safety Assessment, An Overview of the Situation at the End of 2010", NEA/CSNI/R(2012)11, January 2013
http://www.oecd-nea.org/nsd/docs/2012/csni-r2012-11.pdf
Relation between deterministic and probabilistic assessments and use of PSA for DiD assessment
Keywords: NPP, topical report, PSA, NEA, CSNI

264. CSNI, "A Joint Report on PSA for New and Advanced Reactors", NEA/CSNI/R(2012)17, February 2013
http://www.oecd-nea.org/nsd/docs/2012/csni-r2012-17.pdf
Annotation: Use of PSA for assessing DiD (for new and advanced reactors)
Keywords: NPP, topical report, PSA, NEA, CSNI

265. CSNI, "Defence in Depth of Electrical Systems", CSNI Technical Opinion Paper No. 16, May 2013
http://www.oecd-nea.org/nsd/docs/2013/7070-top-16.pdf
Annotation: Recommendations on improving the realization of DiD for electrical power supply systems for NPP, requirements on power supply systems by levels of DiD
Keywords: NPP, topical report, electrical systems, independence, DIDELSYS, NEA, CSNI

266. CSNI, "Safety Assessment of Fuel Cycle Facilities – Regulatory Approaches and Industry Perspectives, OECD/NEA Workshop Toronto, Canada, 27-29 September 2011, NEA/CSNI/R(2012)4, July 2013
http://www.oecd-nea.org/nsd/docs/2012/csni-r2012-4.pdf
Annotation: Discussion on safety assessments with reference to DiD
Keywords: Facilities, topical report, workshop, NEA, CSNI

267. OECD/NEA, "The Fukushima Daiichi Nuclear Power Plant Accident OECD/NEA Nuclear Safety Response and Lessons Learnt", NEA No. 7161, September 2013
http://www.oecd-nea.org/pub/2013/7161-fukushima2013.pdf
Annotation: Discussion of DiD in light of Fukushima Daiichi accident, enhancements for implementation of DiD
Keywords: NPP, topical report, Fukushima, OECD, NEA

268. CSNI, "Updated Knowledge Base for Long Term Cooling Reliability", NEA/CSNI/R(2013)12, December 2013
http://www.oecd-nea.org/nsd/docs/2013/csni-r2013-12.pdf
http://www.oecd-nea.org/nsd/docs/2013/csni-r2013-12-add1.pdf
Annotation: Includes discussion of DiD aspects of long-term cooling reliability in light of operating events
Keywords: NPP, topical report, cooling systems, NEA, CNSI

6.1.3 ENSREG

Generally, ENSREG references cover different fields of nuclear safety for NPPs, including general aspects of DiD, as well as specific aspects regarding lesson learned from the Fukushima-Daiichi accidents. In a lot of documents, are internal initiating events as well (external) hazard events are discussed. However, combinations between hazards and combinations with internal events are not specifically addressed. Some specific aspects for the peer review process and good practices in NPPs in European countries are reported. The references represents the European experience regarding nuclear safety and some specific aspects.

269. ENSREG, "Stress Tests Performed on European Nuclear Power Plants, Peer Review Report", April 2012
http://www.ensreg.eu/sites/default/files/EU%20Stress%20Test%20Peer%20Review%20Final%20Report_0.pdf
Annotation: Discussion of specific improvements of plant safety features with reference to DiD. Description of the peer review process, the European plants assessment for earthquakes, flooding and

other extreme weather conditions, the European plants assessment on severe accident management, etc.
Keywords: NPP, topical reports, ENSREG

270. ENSREG, "ENSREG National Action Plans Workshop Summary Report", June 2013
http://www.ensreg.eu/sites/default/files/HLG_p(2013-24)_120%20Final%20NAcP%20Workshop%20Summary%20Report.pdf
Annotation: Proposal for specific improvements related to DiD. Overview of the EU stress tests process and of the national action plans. In this workshop the participating countries reported their analyses of safety margins under extreme natural hazards. Measures to further increase the robustness, and the determination of safety margins beyond design basis was discussed, etc.
Keywords: NPP, topical reports, ENSREG

271. ENSREG, "EU Peer Review Report on the Taiwanese Stress Tests", November 2013
http://www.ensreg.eu/sites/default/files/EU%20Peer%20Review%20of%20the%20Taiwanese%20Stress%20Tests.pdf
Annotation: Proposals for specific improvement related to DiD
Keywords: NPP, topical reports, ENSREG

272. ENSREG, "Transparency of "Peer Review of National Action Plans", Working Paper", 2013.
http://www.ensreg.eu/sites/default/files/HLG_p%282013-23%29_125%20ENSREG_Transparency_of_Peer_Review_of_National_Action_Plans_-_Working_Paper.pdf
Annotation: Objective, the principles and the ENSREG actions in correspondence to nuclear safety for the peer review of national action plans.
Keywords: NPP, Working paper, ENSREG

273. ENSREG, "Report of the European Nuclear Safety Regulators Group", July 2009.
http://www.ensreg.eu/sites/default/files/HLG_p%282013-24%29_117%20ENSREG_REPORT_2013.pdf
Annotation: Activities of the ENSREG group, major conclusions, recommendations and their contribution to the continuous enhancement of nuclear safety in all EU Member States
Keywords: NPP, Report, ENSREG

274. ENSREG, "Transparency of "Stress Tests", Transparency aspects in the implementation, reporting and follow-up of the "stress tests", Working Paper", 2011.
http://www.ensreg.eu/sites/default/files/HLG_p%282011-16%29_80%20Working%20Paper%20-%20Transparency%20of%20Stress-Tests.pdf
Annotation: Need of risk, safety assessment and stress tests in correspondence to accident in Japan and subsequent measures in NPPs
Keywords: NPP, Working paper, ENSREG

275. ENSREG, "Declaration of ENSREG. EU 'Stress test' specifications", 2011.
http://www.ensreg.eu/sites/default/files/EU%20Stress%20tests%20specifications_0.pdf
Annotation: Definition "stress tests", the process to perform the stress tests and their dissemination, as well peer review process.
Keywords: NPP, Declaration, ENSREG

276. ENSREG, "Post-Fukushima accident. Compilation of recommendations and suggestions. Peer review of stress test performed on European nuclear power plants", 2012.

http://www.ensreg.eu/sites/default/files/Compilation%20of%20Recommendationsl_0.pdf

Annotation: The summary of the main compilation of recommendations and suggestions in result to peer review of stress tests performed on European nuclear power plants. Also initiating events, consequences and hazards and DiD' need and application are discussed.

Keywords: NPP, topical reports, ENSREG

277. ENSREG, "Post-Fukushima accident, Bulgaria, Stress Test performed on European nuclear power plants, Peer review country report", 2012.

http://www.ensreg.eu/sites/default/files/Country%20Report%20BG%20Final.pdf

Annotation: The good practice in Bulgaria in correspondence to safety in NPPs. The measures in Kozloduy NPP in compliance with the licensing and Bulgarian national regulations on nuclear energy and radiation safety and the deterministic as well as the probabilistic assessment studies

Keywords: NPP, Peer review country report, ENSREG

278. ENSREG, "Post-Fukushima accident, France, Stress Test performed on European nuclear power plants, Peer review country report", 2012.

http://www.ensreg.eu/sites/default/files/Country%20Report%20FR%20Final.pdf

Annotation: The good practice in France in correspondence to safety in NPPs, the program for improvement of nuclear safety in the plant by implementing of new safety relevant features, etc.

Keywords: NPP, Peer review country report, ENSREG

279. ENSREG, "Post-Fukushima accident, United Kingdom, Stress Test performed on European nuclear power plants, Peer review country report", 2012.

http://www.ensreg.eu/sites/default/files/Country%20Report%20UK%20Final.pdf

Annotation: The good practice in United Kingdom in correspondence to safety in advanced gas cooled reactors and Magnox reactors, etc.

Keywords: NPP, Peer review country report, ENSREG

280. ENSREG, "Post-Fukushima accident, Sweden, Stress Test performed on European nuclear power plants, Peer review country report", 2012.

http://www.ensreg.eu/sites/default/files/Country%20Report%20SE%20Final.pdf

Annotation: The good practice in Sweden in correspondence to safety in NPPs. A good example is that after the Three Mile Island accident, the Swedish government decided that all Swedish NPPs should be capable of withstanding to a core melt accident without any casualties or ground contamination of importance to the population.

Keywords: NPP, Peer review country report, ENSREG

281. ENSREG, "Post-Fukushima accident, Germany, Stress Test performed on European nuclear power plants, Peer review country report", 2012.

http://www.ensreg.eu/sites/default/files/Country%20Report%20DE%20Final.pdf

Annotation: The good practice in Germany in correspondence to safety in NPPs. Some of the general strong points for the German NPPs have been identified. Also during the peer review process, some areas for improvement have been identified - monitoring system for hydrogen, severe accident management, etc.

Keywords: NPP, Peer review country report, ENSREG

6.1.4 WENRA

282. WENRA, "Safety of new NPP designs" report, March 2013
http://www.wenra.org/media/filer_public/2013/08/23/rhwg_safety_of_new_npp_designs.pdf
Annotation: Discussion of DiD concept and its development, requirements on the application of DiD to new reactor design
Keywords: NPP, definition, requirements, topical report, WENRA

283. WENRA, "WENRA statement on safety objectives for new nuclear power plants", November 2010
http://www.wenra.org/media/filer_public/2012/11/05/wenra_statementonsafetyobjectivesfornewnuclearpowerplants_nov2010.pdf
Annotation: Includes development of DiD concept for new NPP
Keywords: NPP, requirements, topical report, WENRA

284. WENRA, "Safety Objectives for New Power Reactors", December 2009
http://www.wenra.org/media/filer_public/2012/11/05/rhwg_report_newnpp_dec2009.pdf
Annotation: Discussion of the development of DiD concept for new NPP, requirements on DiD for new NPP
Keywords: NPP, requirements, topical report, WENRA

285. WENRA, "Harmonization of Reactor Safety in WENRA Countries", January 2006
http://www.wenra.org/media/filer_public/2012/11/05/rhwg_harmonization__report_final.pdf
Annotation: Includes application of DiD concept to NPP safety
Keywords: NPP, topical report, WENRA

6.1.5 EUROPEAN TECHNICAL SAFETY ORGANISATIONS NETWORK (ETSON)

286. ETSON, "Safety Assessment Guide", January 2013
http://www.etson.eu/Downloads/ETSON_SAGdef1302.pdf
Annotation: Assessing the implementation of DiD as one aim for safety assessments for nuclear facilities
Keywords: topical report

287. ETSON, "Technical Safety Assessment Guide, Event Review and Precursor Analysis", January 2013
http://www.etson.eu/Downloads/ETSON_TSAG_ERPAdef3101.pdf
Annotation: Event analysis entails assessment of impact on DiD
Keywords: topical report

288. ETSON: "Technical Assessment Guide, Deterministic Severe Accident Analysis", January 2013
http://www.etson.eu/Downloads/ETSON_TSAG_DSAAdef3101.pdf
Annotation: Assess severe accident capabilities with respect to DiD
Keywords: topical report

289. ETSON, "Technical Safety Assessment Guide, Human and Organisational Factors in Nuclear Facilities Design and Modification Process", January 2013
http://www.etson.eu/Downloads/ETSON_HOFdef3101.pdf

Annotation: Human and organisational factors contribute to the reliability of DiD lines of defense

Keywords: topical report

290. ETSON, "Position Paper of the Technical Safety Organisations: Research Needs in Nuclear Safety for Gen 2 and Gen 3 NPPs", October 2011

http://www.etson.eu/Downloads/ETSON_TSO%20paper%20final.pdf

Annotation: Further strengthening of DiD concept as driver for research needs and activities

Keywords: topical report

6.1.6 FORO IBEROAMERICANO DE ORGANISMOS REGULADORES RADIOLÓGICOS Y NUCLEARES (FORO)

Documents by FORO haven't been identified for this report.

6.1.7 ASIAN NUCLEAR SAFETY NETWORK (ANSN)

By June 2014, ANSN has not published documents related to DiD.

6.2 NATIONAL ORGANIZATIONS

6.2.1 EU COUNTRIES

6.2.1.1 Belgium

No publications have been identified for this report.

6.2.1.2 Bulgaria

291. BNRA, European "Stress Tests" for NPPs, National Report of Bulgaria, December 2011

http://www.bnsa.bas.bg/en/documents-en/conventions-en/report-en/finalstresstests-kozloduy-en.pdf

Annotation: The report contains measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Bulgaria

292. BNRA, European "Stress Tests" Kozloduy NPP, National Action Plan of Bulgaria, December 2012

http://www.bnsa.bas.bg/en/nuclear-facilitie/stress-tests/kozloduy/action-plan-bg-en.pdf

Annotation: The action plan contains measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Bulgaria

293. BNRA, European "Stress Tests" Kozloduy NPP, National Action Plan of Bulgaria, January 2014

http://www.bnsa.bas.bg/en/nuclear-facilitie/stress-tests/kozloduy/nacp-bg-rev.-jan-2014-en.pdf

Annotation: The upgraded version of the National action plan contains new measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Bulgaria

294. BNRA, Republic of Bulgaria, Sixth National Report under the Convention of Nuclear Safety, Sofia, 2013

http://bnsa.bas.bg/en/documents-en/conventions-en/report-en/cns-vi-bulgaria.pdf

Annotation: The report includes the regulatory practices in updating the legislative framework, licensing, establishment of regulatory guides, assessment and analyses of safety, inspection activities, measures and improvements in respect of DiD.

Keywords: report, convention, safety, Bulgaria

295. ENSREG, "Post-Fukushima accident, Bulgaria, Stress Test performed on European nuclear power plants, Peer review country report", 2012

http://www.ensreg.eu/sites/default/files/Country%20Report%20BG%20Final.pdf

Annotation: The good practice in Bulgaria in correspondence to safety in NPPs. The measures in Kozloduy NPP in compliance with the licensing and Bulgarian national regulations on nuclear energy and radiation safety and the deterministic as well as the probabilistic assessment studies.

Keywords: NPP, Peer review country report,-Bulgaria, ENSREG

6.2.1.3 Czech Republic

296. State Office for Nuclear Safety (SUJB), "Post Fukushima National Action Plan (NAcP) on Strengthening Nuclear Safety of Nuclear Facilities in the Czech Republic", Revision 1, July 2013

http://www.sujb.cz/fileadmin/sujb/docs/aktualne/Czech_National_Action_Plan_rev1_final_pub.doc

Annotation: Measures and improvements related to strengthen of the DiD

Keywords: action plan, measures, Czech Republic

297. State Office for Nuclear Safety (SUJB), "Evaluation of Safety and Safety Margins in the light of the accident of the NPP Fukushima", National Report on „Stress Tests", NPP Dukovany and NPP Temelín, Czech Republic, Revision 1, March 2012

https://www.sujb.cz/fileadmin/sujb/docs/dokumenty/National_Report_Revision_1_for_web_1.pdf

Annotation: Safety review of NPP with description of levels of defense (DiD)

Keywords: national report, stress test, Czech Republic

298. Czech Republic, "Extraordinary National Report under the Convention on Nuclear Safety", February 2012

http://www.sujb.cz/fileadmin/sujb/docs/zpravy/narodni_zpravy/CZ_NR_2012.pdf

Annotation: Description of the level of nuclear safety, including DiD issues, from the viewpoint of their resistance against selected extreme phenomena in the Czech Republic

Keywords: national report, Czech Republic

6.2.1.4 Finland

No topical reports have been identified for this report.

6.2.1.5 France

No topical reports have been identified for this report.

6.2.1.6 Germany

299. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, "EU Stresstest National Report of Germany", January 2012

http://www.ensreg.eu/sites/default/files/EU_Stress_test_national_report_Germany.pdf
Annotation: Discussion of development of DiD concept in Germany, potential improvements related to DiD for NPP
Keywords: NPP, topical report, Germany

300. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, "Convention on Nuclear Safety, Report by the Government of the Federal Republic of Germany for the Fifth Review Meeting in April 2011", August 2010
http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-201101264835/1/BfS_2010_Convention_Nuclear_Safety.pdf
Annotation: Implementation of DiD in German regulatory framework
Keywords: topical report, Germany

301. Bundesamt für Strahlenschutz (BfS), "Die Katastrophe im Kernkraftwerk Fukushima nach dem Seebeben vom 11. März 2011, Beschreibung und Bewertung von Ablauf und Ursachen", March 2012
http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-201203027611/3/BfS-SK-18-12-Bericht_Fukushima_Korr-20120523.pdf
Annotation: Discussion of DiD issues for the Fukushima Daiichi accidents
Keywords: NPP, topical report, Germany

302. Reaktorsicherheitskommission (RSK), "RSK Empfehlung Gestaffeltes Sicherheitskonzept", expert opinion from 08/09/2005
http://www.rskonline.de/downloads/sicherheitskonzept.pdf
Annotation: Definition of defense in depth, requirements on the adequate realisation of DiD for NPP
Keywords: definition, requirements, topical report, Germany

303. Reaktorsicherheitskommission (RSK), "Nutzung von Freihaltepositionen im Brennelementlagerbecken des Kernkraftwerks Stade", expert opinion from 01/02/2001
http://www.rskonline.de/downloads/snstade.pdf
Annotation: Assessment of fuel storage safety issues with respect to DiD
Keywords: NPP, topical report, Germany

304. Reaktorsicherheitskommission (RSK), "Weiterleitungsnachricht der GRS 2000/13 Fehlerbedingte sekundärseitige Lastabsenkung und nicht erfolgter Stabeinwurf im Gemeinschaftskraftwerk Neckar, Block 1 (GKN-1) am 10.05.2000", expert opinion from 13/12/2001
http://www.rskonline.de/downloads/snlastabsenkung131201.pdf
Annotation: Assessment of operating experience events with respect to DiD
Keywords: NPP, topical report, Germany

305. Reaktorsicherheitskommission (RSK), Strahlenschutzkommission (SSK), "Gemeinsame Stellungnahme der RSK und der SSK betreffend BMU-Fragen zur Fortschreibung der Endlager-Sicherheitskriterien", expert opinion from 05-06/12/2012
http://www.rskonline.de/downloads/sicherheitskritendlagerrskssk.pdf
Annotation: Recommends application of DiD concept to final disposal site
Keywords: disposal, topical report, Germany

306. Reaktorsicherheitskommission (RSK), "Grundsätzliche Anforderungen an die Maßnahmen zur Verhinderung unzulässiger Radiolysegasreaktionen", expert opinion from 10/07/2003
http://www.rskonline.de/downloads/empradiolysegas.pdf
Annotation: Recommendation for the protection against radiolysis gas accumulation with respect to DiD
Keywords: NPP, topical report, Germany
307. Reaktorsicherheitskommission (RSK), "Anforderungen an den Nachweis der Notkühlwirksamkeit bei Kühlmittelverluststörfällen mit Freisetzung von Isoliermaterial", expert opinion from 22/07/2004
http://www.rskonline.de/downloads/stnsumpf.pdf
Annotation: Recommendation on safety demonstration for NPP taking into account sump clogging with respect to DiD
Keywords: NPP, topical report, Germany
308. Reaktorsicherheitskommission (RSK), "Einstufung von 'VO-Ereignissen' in die Sicherheitsebenen des gestaffelten Sicherheitskonzepts und Konzept für die Neubestimmung von Vorsorgemaßnahmen (VM)", expert opinion from 06/10/2005
http://www.rskonline.de/downloads/snvovm.pdf
Annotation: Recommendation on preventive measures for selected initiating events based on DiD classification
Keywords: NPP, topical reports, Germany
309. Reaktorsicherheitskommission (RSK), "Auswirkungen fortgeschrittener Kernbeladungen auf das Reaktivitätsverhalten des Reaktorkerns und seiner Reaktivitätsstellglieder", expert opinion from 10/08/2008
http://www.rskonline.de/downloads/kernbeladreaktivitaet.pdf
Annotation: Recommendations on advanced core fuel loading patterns with respect to assessments for the different DiD levels
Keywords: NPP, topical report, Germany
310. Reaktorsicherheitskommission (RSK), "RSK-Stellungnahme zum Synthesebericht des BfS 'Konzeptionelle und sicherheitstechnische Fragen der Endlagerung radioaktiver Abfälle – Wirtsgesteine im Vergleich'", expert opinion from 13/09/2006
http://www.rskonline.de/downloads/stsynthesebericht.pdf
Annotation: Recommendation on DiD for disposal sites
Keywords: disposal, topical report, Germany
311. Reaktorsicherheitskommission (RSK), "Kühlmittelverluststörfälle mit Freisetzung von Isoliermaterial und anderen Stoffen in Druckwasserreaktoren – Ablösung der Ablagerungen auf den Sumpfsieben", expert opinion from 13/03/2018
http://www.rskonline.de/downloads/sumpfsiebe.pdf
Annotation: Update to [307]; recommendation on safety demonstration for NPP taking into account sump clogging with respect to DiD
Keywords: NPP, topical report, Germany
312. Reaktorsicherheitskommission (RSK), "Anforderungen an die Bestimmungen der Mindestschichtbesetzung in Kernkraftwerken zur Gewährleistung einer sicheren Betriebsführung"

http://www.rskonline.de/downloads/snschichtbesetzung.pdf

Annotation: Minimum requirements of shift staff numbers with regard to DiD concept

Keywords: NPP, topical report, Germany

313. Reaktorsicherheitskommission (RSK), Strahlenschutzkommission (SSK), "Rahmenempfehlungen für die Planung von Notfallschutzmaßnahmen durch Betreiber von Kernkraftwerken", expert opinion from 14/10/2010 and 03/11/2010

http://www.rskonline.de/downloads/rahmenempfehlungnotfallschutzmanahmen.pdf

Annotation: Emergency planning and relation to DiD concept

Keywords: NPP, topical report, Germany

314. Reaktorsicherheitskommission (RSK), "Regelung zu Anlagenzuständen nach Eintritt eines Störfalls", expert opinion from 07/07/2011

http://www.rskonline.de/downloads/epanlage3rsk439hp.pdf

Annotation: Application of DiD concept to plant states after an incident/accident

Keywords: NPP, topical report, Germany

315. Reaktorsicherheitskommission (RSK), "Stellungnahme zum Kerntechnischen Regelwerk Entwurfsfassung Rev. E", expert opinion from 01/03/2012

http://www.rskonline.de/downloads/epanlage1rsk445hp.pdf

Annotation: Comments on DiD concept within new German nuclear regulatory guidance

Keywords: NPP, topical report, Germany

316. Reaktorsicherheitskommission (RSK), "'Netzstabilität' Rückwirkungen von Stabilitätsproblemen im deutschen Stromnetz auf elektrische und leittechnische Einrichtungen von Kernkraftwerken und Sicherstellung der notwendigen elektrischen Energieversorgung dieser Anlagen aus dem Netz", expert opinion from 13/12/2012

http://www.rskonline.de/downloads/epanlage1rsk453hp.pdf

Annotation: Recommendations related to electrical power supply of NPP based on DiD

Keywords: NPP, topical report, Germany

317. Reaktorsicherheitskommission (RSK), "RSK-Verständnis der Sicherheitsphilosophie", expert opinion from 29/08/2013, BAnz AT 05/12/2013 B4

http://www.rskonline.de/downloads/epanlagersk460homepage05122013.pdf

Annotation: Definition and requirements on DiD for NPP

Keywords: definition, NPP, requirements, topical report, Germany

318. Internationale Länderkommission Kerntechnik (ILK), "ILK-Stellungnahme zur Sicherheit der Kernenergienutzung in Deutschland", ILK-03 D, July 2000

http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/03.pdf

Annotation: Definition of DiD concept for NPP

Keywords: definition, NPP, topical report, Germany

319. Internationale Länderkommission Kerntechnik (ILK), "ILK-Empfehlungen zur Nutzung von Probabilistischen Sicherheitsanalysen im atomrechtlichen Genehmigungs- und Aufsichtsverfahren", ILK-04 D/E, May 2001

http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/04.pdf

Annotation: Use probabilistic methods to assess adequate implementation of DiD

Keywords: NPP, topical report, Germany

320. Internationale Länderkommission Kerntechnik (ILK), "ILK-Stellungnahme zu Anforderungen bei Betriebstransienten mit Ausfall der Schnellabschaltung (ATWS)", ILK-21 D, March 2005
http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/20.pdf
Annotation: Discussion of ATWS scenarios related to DiD
Keywords: NPP, topical report, Germany

321. Internationale Länderkommission Kerntechnik (ILK), "ILK-Empfehlungen an ein zeitgemäßes Allgemeines Kerntechnisches Regelwerk in Deutschland", ILK-22 D, Juli 2005
http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/22.pdf
Annotation: DiD concept as element of a modern nuclear regulatory framework
Keywords: topical report, Germany

322. Internationale Länderkommission Kerntechnik (ILK), "ILK-Empfehlungen zur Weiterentwicklung der Periodischen Sicherheitsüberprüfungen in Deutschland, ILK-27 D, November 2006
http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/27.pdf
Annotation: Evaluation of deviations from regulatory requirements in the PSR with respect to DiD
Keywords: NPP, topical report, Germany

323. Internationale Länderkommission Kerntechnik (ILK), "ILK-Stellungnahme zur Festlegung von Betriebszeiten für Kernkraftwerke in Deutschland", ILK-23 D, September 2005
http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/23.pdf
Annotation: Safety improvements in German NPP related to DiD
Keywords: NPP, topical report, Germany

324. Internationale Länderkommission Kerntechnik (ILK), "Grundlegende Sicherheitsanforderungen für Kernkraftwerke (Beilage zu ILK-31)", September 2008
http://www.stmuv.bayern.de/umwelt/reaktorsicherheit/ilk/doc/31_beilage.pdf
Annotation: Definition of DiD concept for NPP
Keywords: definition, requirements, topical report, Germany

6.2.1.7 Lithuania

No publications have been identified for this report.

6.2.1.8 Netherlands

325. EPZ, "Complementary Safety Margin Assessment", final report, October 2011
http://www.rijksoverheid.nl/onderwerpen/kernenergie/documenten-en-publicaties/rapporten/2011/11/02/final-report-complementary-safety-margin-assessment.html
Annotation: Safety review of Borssele NPP with description of levels of defense (DiD)
Keywords: NPP, topical report, stress test, Netherlands

326. Ministry of Economic Affairs, Agriculture, and Innovation (EL&I), "Netherlands' National Report on the post-Fukushima Stress Test for the Borssele Nuclear Power Plant", December 2011
http://www.rijksoverheid.nl/onderwerpen/kernenergie/documenten-en-

publicaties/rapporten/2013/09/09/the-safety-of-borssele-nuclear-power-station.html

Annotation: Safety review of Borssele NPP with description of levels of defense (DiD)

Keywords: NPP, topical report, stress test, Netherlands

327. Borssele Benchmark Committee, "The Safety of Borssele Nuclear Power Station, Frist Report of the Borssele Benchmark Committee", September 2013

http://www.rijksoverheid.nl/onderwerpen/kernenergie/documenten-en-publicaties/rapporten/2013/09/09/the-safety-of-borssele-nuclear-power-station.html

Annotation: Safety review of Borssele NPP discussing DiD issues

Keywords: NPP, topical report, Netherlands

6.2.1.9 Romania

328. Romania CNCAN-National Report on the Implementation of the Stress Tests, December 2011

http://www.cncan.ro/assets/stiri/ROMANIA-National-Report-on-NPP-Stress-Tests-December-2011.pdf

Annotation: Implementation of DiD in NPP design; examples of CANDU design features relevant for each level of defence-in-depth

Keywords: NPP, topical reports, Romania

329. Romania National Report under the Convention on Nuclear Safety, Sixth Revision, August 2013

http://www.cncan.ro/assets/stiri/Romanian-Report-for-the-CNS-6th-Edition.pdf

Annotation: Overview of the principles stated in the Nuclear Safety Policy of Cernavoda NPP, and of the means by which they are implemented; CANDU design features relevant for each level of defence-in-depth

Keywords: NPP, CANDU, topical reports, Romania

330. Cernavoda NPP Units 1& 2, Romania, Safety Features of Candu 6 Design and Stress Test Summary Report

http://www.cne.ro/Up/files/downloads/pdf/SafetyFeaturesOfCANDUDesign_CNECernavoda.pdf

Annotation: Behaviour of the plant and the remaining levels of defence-in-depth for some initiating events; defence-in depth approach to severe accidents

Keywords: NPP, CANDU, topical reports, Romania

6.2.1.10 Spain

No publications haven been identified for this report.

6.2.1.11 Sweden

331. Sweden´s sixth national report under the Convention of Nuclear Safety, Ministry of the Environment, Ds 2013:56, Stockholm 2013

https://www.riksdagen.se/sv/Dokument-Lagar/Utredningar/Departementsserien/Swedens-sixth-national-report_H1B456/?text=true

Annotation: Swedish National report

Keywords: Sweden, Nuclear safety

332. ENSREG, Peer review country report, Sweden

http://www.oecd-nea.org/nsd/fukushima/documents/CountryPeerReviewReportSwedenFinal.pdf

Annotation: Peer review after Fukushima, post-Fukushima measures

Keywords: Sweden, Fukushima

333. OECD, NEA Nuclear Legislation in OECD and NEA Countries

http://www.oecd-nea.org/pub/2013/7161-fukushima2013.pdf

Annotation: General guidance

Keywords: Nuclear safety, Sweden, Fukushima

334. SSM, European stress tests Sweden Dec 2011

http://www.oecd-nea.org/nsd/fukushima/documents/Sweden_ST_Final_National_Report.pdf

Annotation: Swedish regulator post-Fukushima report

Keywords: stress test, Fukushima, Sweden

6.2.1.12 Slovakia

No publications have been identified for this report.

6.2.1.13 Slovenia

335. SNSA, European "Stress Tests" for NPPs, Peer review country report-Slovenia, 2011

http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Novice/CountryReportSIFinal.pdf

Annotation: The report contains measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Slovenia

336. SNSA, European "Stress Tests" for NPPs, Slovenian national report on nuclear stress tests - final report, December 2011

http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Novice/Slovenian_Stress_Test_Final_Report.pdf

Annotation: The report contains measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Slovenia

337. SNSA, Slovenian Post-Fukushima national action plan, December 2012

http://www.ursjv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Porocila/NacionalnaPorocila/Slovenian_National_Post_Fukushima_Action_Plan_01.pdf

Annotation: The action plan contains measures and potential improvements related to the realization of the defense in depth concept.

Keywords: report, measures, safety, Slovenia

6.2.1.14 United Kingdom of Great Britain and Northern Ireland

338. Weightman, M., et al., "Japanese Earthquake and Tsunami: Implications of the UK Nuclear Industry, Final Report", ONR-FR-REP-11-2002 Revision 2, September 2011

http://www.onr.org.uk/fukushima/final-report.pdf

Annotation: Analysis of the Fukushima Daiichi accident with discussion of DiD issues and a reflection on

the UK regulatory framework, including the DiD concept

Keywords: NPP, topical report, Fukushima, ONR, UK

6.2.2 JAPAN

339. Nuclear Safety commission of Japan, "Severe accident measures for light water nuclear power plants –Concept of defence in depth-", September 2012 (Japanese)
http://www.nsr.go.jp/archive/nsc/info/20120910_41.pdf
Annotation: Former regulatory commission, Nuclear Safety commission of Japan, discussed severe accident measures in terms of defence in depth.
Keywords: severe accident, NPP, Japan
340. Nuclear and Industrial Safety Agency, "Fundamental concept of regulation to the severe accident measures for light water nuclear power plants –Current discussion-", August 2012 (Japanese)
http://www.meti.go.jp/press/2012/08/20120827001/20120827001-2.pdf
Annotation: Former regulatory body of Nuclear and Industrial Safety Agency discussed regulations of severe accident measures in terms of defence in depth.
Keywords: severe accident, NPP, Japan

6.2.3 UNITED STATES OF AMERICA

341. U.S. Atomic Energy Commission, "The Safety of Nuclear Power Reactors (Light Water Cooled) and Related Facilities", WASH-1250, July 1973
http://pbadupws.nrc.gov/docs/ML1214/ML12143A280.pdf
Annotation: Definition of DiD concept for NPP and other facitilites.
Keywords: Facilities, topical report, definition, NRC, USA
342. Haskin, F. E., A. L. Camp, "Perspectives on Reactor Safety", NUREG/CR-6042, March 1994
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML072740014
Annotation: Reactor Safety Course material of the NRC training centre, containing the definition of DiD as well as a description of the development of US regulation with references to DiD
Keywords: NPP, topical report, definition, NRC, USA
343. Sorensen, J. N., "Historical Notes on Defense in Depth", Memorandum to the US NRC Advisory Committee on Reactor Safeguards, October 1997
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML082740322
Annotation: Summary of the historical development of the concept of DiD as applied to NPP in the US, references original sources from late 1960s and early 1970s.
Keywords: NPP, topical report, definition, NRC, USA
344. Powers, D. A., "The Role of Defense in Depth in a Risk-Informed Regulatory System", letter to S. A. Jackson, Chairwoman of U.S. NRC, 19 May 1999, including
Sorensen, J. N. et al.: "On the Role of Defense in Depth in Risk-informed Regulation", paper at PSA '99, August 1999
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML091280427

Annotation: Discussion of the role of DiD in a risk-informed regulatory regime

Keywords: NPP, topical report, RIDM, NRC, USA

345. Sorensen J. N., "Safety Culture: A Survey of the State-of-the-Art", NUREG-1756, January 2002
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML020520006
Annotation: Discussion of DiD as an aspect of safety culture
Keywords: Facilities, safety culture, NRC, USA

346. Haskin, F. E., A. L. Camp, S. A. Hodge, D. A. Powers, "Prespectives on Reactor Safety", NUREG/CR-6042, Revision 2, March 2002
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML091250169
Annotation: Reactor Safety Course material of the NRC training centre, containing the definition of DiD as well as a description of the development of US regulation with references to DiD. Update of [342].
Keywords: NPP, topical report, definition, NRC, USA

347. Nuclear Energy Institute, "10 CFR 50.69 SSC Categorization Guideline", NEI 00-04 (rev. 0), July 2005
http://pbadupws.nrc.gov/docs/ML0529/ML052910035.pdf
Annotation: Safety Classification of SSC, specifically using DiD considerations
Keywords: NPP, topical reports, systems, USA

348. U.S. NRC, "Defense-in-Depth and Diversity Supporting Basis Including Single Failure References and Risk-Informing Activities, January 2008
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML080300379
Annotation: Compilation of references to DiD in US regulatory framework
Keywords: NPP, topical report, NRC, USA

349. Wood et al., "Diversity Strategies for Nuclear Power Plant Instrumentation and Control Systems", NUREG/CR-7007, February 2010
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML100760207
Annotation: Discussion of DiD and diversity for I&C systems
Keywords: NPP, topical report, I&C, NRC, USA

350. U.S.NRC, Recommendations for Enhancing Reactor Safety in the 21st Century, July 2011
http://pbadupws.nrc.gov/docs/ML1118/ML111861807.pdf
Annotation: The Near Term Task Force review of insights from the Fukushima Dai-ichi accident, including 12 recommendations to be discussed in the near future
Keywords: NPP, Fukushima, NTTF, DiD, safety requirement, safety improvement

351. U.S.NRC, "NUREG-2150, A Proposed Risk Management Regulatory Framework", April 2012
http://pbadupws.nrc.gov/docs/ML1210/ML12109A277.pdf
Annotation: Proposes a holistic risk management regulatory framework. Probably the most up to date document on DiD and its evolution
Keywords: NPP, regulatory, risk-informed, RMTF, NRC, USA

352. U.S. NRC, "NRC Glossary of Terms: Nuclear Power and Radiation", December 2013
http://www.nrc.gov/reading-rm/basic-ref/glossary/full-text.html
Annotation: Definition of DiD
Keywords: definition, NRC, USA

353. U.S. NRC, U.S. Nuclear Regulatory Commission staff recommendation for the disposition of recommendation 1 of the Near-Term Task Force report , SECY-13-0132, December 2013
http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2013/2013-0132scy.pdf
http://pbadupws.nrc.gov/docs/ML1333/ML13337A461.pdf
Annotation: Discussion on enhancement of DiD concept in nuclear regulation framework
Keywords: NPP, Fukushima, topical report, NTTF, RMTF, DiD, NRC, USA

354. INL, "Next Generation Nuclear Plant Defense-in-Depth Approach", December 2009
https://inlportal.inl.gov/portal/server.pt/document/98000/next_generation_nuclear_plant_defense-in-depth_approach_pdf
Annotation: Innovative definition of DiD; it requires that DiD is adequately achieved in all NPP activities
Keywords: NPP, NGNP, PRA, risk-informed, INL, USA

6.2.4 CANADA

355. Canadian National Report for the Convention on Nuclear Safety -Sixth Report, August 2013
http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/Canadian-National-Report-for-Convention-on-Nuclear-Safety-Sixth-Report-ENG.pdf
Annotation: Implementation of DiD in NPP design (for the currently operating NPPs and for potential new-build projects); specific CANDU design features related to defence in depth
Keywords: CANDU, topical reports, Canada

356. Canadian National Report for the Second Extraordinary Meeting of the Convention on Nuclear Safety, May 2012
http://www.nuclearsafety.gc.ca/eng/pdfs/Reports/convention-on-nuclear-safety/May-2012-Canadian-National-Report-for-the-2nd-Extraordinary-Meeting-of-the-Convention-on-Nuclear-Safety_e.pdf
Annotation: Findings of Canada's national post-Fukushima review and the actions being pursued to further enhance the safety of NPPs
Keywords: NPP, topical reports, Canada

6.2.5 RUSSIA

357. State Atomic Energy Corporation ROSATOM, "Action Programme of Russian Authorities and Organizations Concerned in Implementation of the IAEA Action Plan on Nuclear Safety", 2013.
http://en.gosnadzor.ru/international/Post-Fukushima/Russian%20Action%20Programme%20on%20NS%20Realization%2003_2014+Rosatom,%20Emercom,Rospotrebnadzor.doc
Annotation: This document contains Russian action programme concerning implementation of the IAEA Action Plan on nuclear safety.
Keywords: action plan, safety assessment, nuclear safety, Russia.

358. GOSNADZOR, "Actions to Enhance Stability of Operating Russian NPPs against Natural and Man-induced Effects", 2012
http://en.gosnadzor.ru/international/Post-

Fukushima/Actions%20to%20Enhance%20Stability%20of%20Operating%20Russian%20NPPs.doc

Annotation: Includes general overview of the short-term, medium-term and long-term measures to enhance the stability of the nuclear plants against natural and man-induced effects.

Keywords: NPP, safety measures, natural and man-induced effects, Russia.

359. GOSNADZOR, "Enhancing Stability of Russian Research Nuclear Reactors against Natural and Man-induced Impacts"

http://en.gosnadzor.ru/international/Post-Fukushima/Enhancing%20Stability%20of%20Russian%20Research%20Nuclear%20Reactors.doc

Annotation: Includes general overview of the enhancing stability of Russian Research Nuclear Reactors against natural and man-induced impacts.

Keywords: Research Nuclear Reactors, natural and man-induced effects, Russia.

6.2.6 UKRAINE

360. SNRIU. National Report of Ukraine. Stress-Test Results, 2011.

http://www.snrc.gov.ua/nuclear/doccatalog/document?id=171796

Annotation: Report describes the stress test results for the operating NPPs (Zaporizhzhya NPP, Khmelnitsky NPP, Rivne NPP and South Ukraine NPP) and decommissioning Chornobyl NPP.

Keywords: NPP, stress test, results, Ukraine.

361. SNRIU. National Action Plan according to Stress-Tests results, 2013

www.snrc.gov.ua/nuclear/doccatalog/document?id=211021

Annotation: National Action Plan includes measures to improve safety that have been identified by the results of "stress tests" and to ensure effective control by the SNRIU, as well as the implementation of the recommendations of peer review results of "stress tests" Ukraine NPPs.

Keywords: NPP, SNRIU, ENSREG, Action Plan, stress test, Ukraine.

362. SNRIU Board Resolution No.15 «On safety criteria and requirements for construction of new NPP units in the light of the Fukushima accident» dated 20 November 2012.

http://www.snrc.gov.ua/nuclear/en/publish/article/203192

Annotation: The document provides general approach to reinforce of the safety criteria and requirements for construction of new NPP units in the light of the Fukushima accident.

Keywords: safety criteria, safety function, hazards, Ukraine.

363. SNRIU Board Resolution No.14 «On implementation of measures identified upon stress tests at operating NPPs of Ukraine» dated 20 November 2012.

http://www.snrc.gov.ua/nuclear/en/publish/article/203127

Annotation: Documents provides overview of the progress in implementation of measures identified upon stress tests at operating NPPs of Ukraine

Keywords: stress test, safety measures, action plan, NPP, Ukraine.

6.2.7 SWITZERLAND

364. HSK, “Stellungnahme der HSK zur Sicherheit der schweizerischen Kernkraftwerke bei einem vorsätzlichen Flugzeugabsturz”, HSK-AN-4626, March 2003
http://static.ensi.ch/1312876660/fla-bericht_maerz03.pdf
Annotation: Results of the evaluation of Swiss NPP’s protection against intentional airplane crash with reference to DiD.
Keywords: NPP, topical report, airplane crash, ENSI

365. HSK, “KKW Beznau I: Sicherheitstechnische Stellungnahme zur Periodischen Sicherheitsüberprüfung”, HSK 14/816, November 2004
http://static.ensi.ch/1314202065/gus30_11_04_d.pdf
Annotation: Assessment of PSR for Beznau I NPP, including an assessment of DiD realization
Keywords: NPP, topical report, PSR, ENSI

366. HSK, “Sicherheitstechnische Stellungnahme zur Periodischen Sicherheitsüberprüfung des Kernkraftwerks Mühleberg”, HSK 11/1100, November 2007
http://static.ensi.ch/1314202963/psu_muehleberg_2007.pdf
Annotation: Assessment of PSR for Mühleberg NPP, including an assessment of DiD realization
Keywords: NPP, topical report, PSR, ENSI

367. ENSI, “Sicherheitstechnische Stellungnahme zur Periodischen SIcherheitsüberprüfung des Kernkraftwerks Leibstadt”, ENSI 12/1300, August 2009
http://static.ensi.ch/1314200440/psue_kkl-2009.pdf
Annotation: Assessment of PSR for Leibstadt NPP, including an assessment of DiD realization
Keywords: NPP, topical report, PSR, ENSI

368. ENSI, “EU Stress Test Swiss National Report, ENSI Review of Operators’ Reports”, December 2011
http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf
Annotation: Includes specific measure and potential improvements related to DiD
Keywords: NPP, topical report, Switzerland

369. ENSI, “Lessons Learned und Prüfpunkte aus den kerntechnischen Unfällen in Fukushima”, Dezember 2011
http://static.ensi.ch/1323964357/fukushima_lessons-learned_web.pdf
Annotation: Description of Lessons learned from the analysis of the Fukushima Dai-ichi accident, including reference to improvements related to DiD
Keywords: NPP, topical report, Fukushima, ENSI

370. ENSI, “Ereignisabläufe Fukushima Dai-ichi und Daini infolge des Tohoku-Chihou-Taiheiyou-Oki Erdbebenbens vom 11.03.2011”, Revision 1, Dezember 2011
http://static.ensi.ch/1323964819/fukushima_ablauf.pdf
Annotation: Description and analysis of Fukushima Dai-ichi accident with references to DiD issues
Keywords: NPP, topical report, Fukushima, ENSI

371. ENSI, “Sicherheitstechnische Stellungnahme zur Periodischen Sicherheitsüberprüfung 2008 des Kernkraftwerks Gösgen”, ENSI 17/1350, August 2012
http://static.ensi.ch/1345723091/psue-kkg-2008-web.pdf

Annotation: Assessment of PSR for Gösgen NPP, including an assessment of DiD realization

Keywords: NPP, topical report, PSR, ENSI

372. ENSI, "Sicherheitstechnische Stellungnahme zum Langzeitbetrieb des Kernkraftwerks Mühleberg, ENSI 11/1700, December 2012
http://static.ensi.ch/1356025580/lto-kkm-2012-web.pdf
Annotation: Assessment of long term operation safety of Mühleberg NPP with respect to realization of DiD
Keywords: NPP, topical report, LTO, ENSI

373. ENSI, "Sicherheitstechnische Stellungsnahme zur Periodischen Sicherheitsüberprüfung 2010 des Kernkraftwerks Mühleberg", ENSI-AN 11/1864, December 2013
http://static.ensi.ch/1386840299/ensi_stellungnahme_periodische_sicherheitsueberpruefung_muehleberg_2010.pdf
Annotation: Assessment of PSR for Mühleberg NPP, including an assessment of DiD realization
Keywords: NPP, topical report, PSR, ENSI

6.3 OTHER AUTHORS

374. BEL V, BfS, CSN, ISTeC, ONR, SSM, STUK, "Licensing of Safety Critical Software for Nuclear Reactors, Common Position of Seven European Nuclear Regulators and Authorised Technical Support Organisations", revision 2013,
http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-2013022210309/1/BfS_2013_Common_position_2013_revision.pdf
Annotation: Application of DiD concept to software based I&C for NPP
Keywords: NPP, topical report

375. Bohn, T. (ed.), "Handbuchreihe Energie, Band 10: Kernkraftwerke", Technischer Verlag Resch/Verlag TÜV Rheinland, 1986
Annotation: Definition of DiD and explanation of related safety features of NPP
Keywords: NPP, textbook, design, Germany

376. Lorenzo Chierici,"Defense-in-Depth: state of the art and evolution in safety assessment", Master's Thesis, March 2014
Annotation: Definition and evolution of DiD through the years within nuclear industry. Definition of DiD in other sectors such as chemical industry, IT, transport systems, etc.
Keywords: NPP, evolution, chemical, IT, critical infrastructure

377. Fleming, K. N., F. A. Silady, "A Risk Informed Defense-in-Depth Framework for Existing and Advanced Reactors", Summary of the Workshop on Key Issues related to the Licensing of Future Non-Light Water Reactors, November 2002
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML023220138
Annotation: Development of DiD concept in the US and discussion of relation to risk information and RIDM
Keywords: Facilities, definition, RIDM, USA

378. Fleming, K. N., "US Design Certification, Defense-in-Depth Approach for the Pebble Bed Modular Reactor", December 2006
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML063470549
Annotation: Description of safety concept for PBMR reactor design in light of DiD
Keywords: NPP, topical report, USA

379. Fischer-Appelt, K. et al., "Entwicklungen im Bereich von Regeln und Richtlinien im Hinblick auf Sicherheitsanforderungen bei der Endlagerung von hochradioaktiven Abfällen", May 2010
http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-201005282240/3/BfS_2010_RESFOR3210.pdf
Annotation: DiD requirements for final disposal sites
Keywords: disposal, topical report, Germany

380. Toyoshi Fuketa, "Proposed Regulatory Requirement in Japan", U.S. NRC Regulatory Information Conference, March 2013
http://www.nsr.go.jp/english/data/20130313presen.pdf
Annotation: Outline of new Japanese regulatory requirements in terms of DiD
Keywords: requirement, NPP, Japan

381. Greene, S. R., "The Canaray, the Ostrich, and the Black Swan: a Historical Perspective on our Understanding of BWR Severe Accidents and their Mitigation", Nuclear Technology Vol. 186 (2014), p. 115ff
Annotation: References DiD concept with respect to Fukushima Daiichi accident, discusses consequences
Keywords: NPP, topical report, SAMG, Fukushima

382. Mönig, J, et al, "Vorläufige Sicherheitsanalyse für den Standort Gorleben, Sicherheits- und Nachweiskonzept", GRS-277, Juni 2012
http://www.grs.de/sites/default/files/pdf/GRS-277.pdf
Annotation: Application of DiD to final disposal safety demonstration
Keywords: disposal, requirements, topical report, Germany

383. Pershagen, B., "Light Water Reactor Safety", Pergamon Press, 1989
Annotation: Summarizes DiD as design principles for NPP
Keywords: NPP, textbook, definition

384. Peters, O.H., A. Meyna (ed.), "Handbuch der Sicherheitstechnik, Band 1", Carl Hanser Verlag, 1985
Annotation: Summarizes DiD as a design principle for NPP
Keywords: NPP, textbook, definition, Germany

385. Whitehead, D. W., C. S. Potter, S. L. O'Connor, "Nuclear Power Plant Security Assessment Technical Manual", SAND2007-5591, September 2007
http://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML072620172
Annotation: Discussion of Protection in Depth (DiD translated to security) for NPP
Keywords: NPP, topical report, security, USA