**Draft Safety Guide DS482 “Design of Reactor Containment Structure and Systems for Nuclear Power Plants”**

**(Version dated 2016-08-31)**

**Status: STEP 8 − Submission to the Member States for comments**

Note: Underlined are those to be added in the text. ~~Crossed out~~ are those to be deleted in the text.

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|  | COMMENTS BY REVIEWERReviewer: **Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)** (with comments of GRS and RSK) Page 1 of 20Country/Organization: **Germany** Date: 2016-12-23 | RESOLUTION |
| Rele-vance | Comment No. | Para/Line No. | Proposed new text | Reason | Accepted | Accepted, but modified as follows | Rejected | Reason for modification/rejection |
| 3 | 1 | 1.4 | The objective of this Safety Guide is to make recommendations on the implementation and fulfillment of SSR-2/1 Revision 1 requirements relevant for the containment structures and containment systems [3]. | * Typing error SSR-2/1
* Harmonize text with regard to chapter termed „containment structures and containment systems“ in SSR-2/1and add missing reference.
 |  |  |  |  |
| 2 | 2 | 1.6 | This Safety Guide addresses the functional aspects of the containment and major systems associated to the containment for the management of energy, radionuclides and combustible gases. Consideration is given to the definition of the design basis for the containment and associated systems, in particular to aspects affecting the structural design, the reliability and the independence of systems that do not belong to the same level of defence. Consideration is given also to the definition of design extension conditions (accidents without and with core melting) and the additional and specific safety features to be implemented to mitigate the consequences of such accidents. | The SG does not only address major systems of the containment, it addresses both - the containment and associated systems.It should be made clear that the OBJECTIVE for new NPPs now is to include requirements for DBA and DEC. |  |  |  |  |
| 2 | 3 | 1.9 | Section 3 provides recommendations to the design basis of the containment and associated systems including considerations for design extension conditions. Section 4 provides specific recommendations for the design of the containment structures and associated systems including considerations for design extension conditions. | Clarification |  |  |  |  |
| 2 | 4 | 2.4, second bullet | “- For design basis accidents and design extension conditions without significant fuel degradation, …- For design extension conditions with significant fuel degradation ~~accident with core melting~~, the …” | The term “design extension conditions without significant fuel degradation” covers all aspects (severe accidents not related to the core or to fuel melt), this term should consistently used throughout the text (already in the next bullet). |  |  |  |  |
| 3 | 5 | 2.13 | The containment is designed to protect structures, systems and components (SSCs) housed … | Clarification; abbreviations should be explained. |  |  |  |  |
| 3 | 6 | 3.1 | … to meet the requirements 1 to 3 of SSR-2/1 Rev.1 [3] and GSR Part 2 requirements [6]. | Typing error SSR-2/1 and missing reference |  |  |  |  |
| 3 | 7 | 3. | **3. DESIGN BASIS OF CONTAINMENT STRUCTURES, SYSTEMS AND COMPONENTS** | To make it clear, that the containment is meant and not other SSCs. |  |  |  |  |
| 3 | 8 | 3.20 | The autonomy of systems designed for the energy management, the control of radionuclides and the management of combustible gases inside the ~~Primary~~ containment during accident conditions should be longer than the time necessary prior to crediting off-site support services. | It seems not necessary to limit this requirement only to systems within the “primary” containment. If reasons exist, the term “primary containment” needs to be defined beforehand. |  |  |  |  |
| 2 | 9 | 3.21 | The following recommendations provide guidance to practically eliminate ~~prevent~~ an early radioactive release or a large radioactive release from the containment in case of an accident (Requirement 5.21A [3]). | To make it clear, that releases from the containment are meant. |  |  |  |  |
| 2 | 10 | 3.22 | Structures, systems and components (SSCs) ultimately necessary to prevent an early radioactive release or a large radioactive release from the containment refer in particular … | To make it clear, that releases from the containment are meant. |  |  |  |  |
| 2 | 11 | 3.21 & 3.22 | - | The paras 3.21 & 3.22 are located under the subchapter “EXTERNAL EVENTS, but contain general information related to SSC and the prevention of radioactive releases from the containment. They should be moved up to the subchapter GENERAL. |  |  |  |  |
| 2 | 12 | 3.23 | SSCs ultimately necessary to practical eliminate an early radioactive release or a large radioactive release from the containment should be protected against ~~For~~ external flooding. This would mean that either all the structures hosting ~~the above~~~~mentioned~~ such systems are located at an elevation higher than the one derived from the site hazardevaluation, or adequate engineered safety features (such as water tight doors etc.) should be in placeto protect these structures and ensure that mitigating actions can be maintained.~~:~~ | In case paras 3.21 & 3.22 are moved up to subchapter GENERAL the para 3.23. should be changed as follows |  |  |  |  |
| 2 | 13 | 3.30 - 3.33 | - | The paras 3.30 & 3.33 are located under the wrong headline ACCIDENT CONDITONS. They should be moved further down to the subchapter CODES AND STANDARDS where similar requirements are already defined. |  |  |  |  |
| 2 | 14 | 3.31 | To the extent practicable, codes and engineering rules that are used for design should be documented, validated and, in the case of new codes, developed according to up to date knowledge and recognized standards for quality assurance. Users of the codes should be qualified and trained with respect to the operation and limits of the code and with respect to the assumptions made in the design. [21] | References to the relevant paras of DS491 should be made. This is also true for para 3.40, 3.41, 3.43, 3.45 |  |  |  |  |
| 2 | 15 | 3.35 | For the performances of the containment structures and systems, design basis accident conditions should be defined ~~calculated~~ taking into account | Clarification |  |  |  |  |
| 2 | 16 | 3.36 | - | 3.36 should be moved up to subchapter GENERAL, as it is a general requirement. |  |  |  |  |
| 2 | 17 | 3.39 | Calculation performed to assess conditions imposed by DECs may be less conservative than those imposed by design basis accidents provided that margins be still sufficient to cover uncertainties. Performing sensitivity analyses could also be useful to identify the key parameters. [21] | References to the relevant paras of DS491 should be made. This is also true for para 3.40, 3.41, 3.43, 3.45. |  |  |  |  |
| 3 | 18 | 3.43 | - Loss of wet well / heat sink (BWR); | Typing error |  |  |  |  |
| 2 | 19 | 3.49 | „~~For containment with a small free volume for which~~ In case venting the containment would be necessary to preserve the integrity of the containment, its use should not lead to an early or a large radioactive release (see Requirement 6.28A).“ | This should not only be recommended for containment with a small free volume. |  |  |  |  |
| 2 | 20 | 3.49, new bullet | * The venting system should not fail due to combustible gas effects.
 | Clarification. |  |  |  |  |
| 2 | 21 | 3.53 | Furthermore, design limits should be specified for each containment structure and associated system ~~system as well as for each structure and component within each system.~~ Limits should be applied … | Sentence was not clear. Design limits are to be applied for each containment structure and associated system, right? |  |  |  |  |
| 2 | 22 | 3.56 | Energy management (for pressure andtemperature control, and for containment heat removal) and control of radionuclides in the event of design basis accidents | Explanation what energy management means would be helpful. |  |  |  |  |
| 2 | 23 | 3.63. | Additional safety features should have an adequate reliability to contribute to the practical elimination of conditions that could lead to an early radioactive release or to a large radioactive release. | Should be moved down to the subchapter for “Safety features implemented to mitigate the consequences of an accident with core melting“ as such releases are to be expected not in case of no significant core degradation. |  |  |  |  |
| 2 | 24 | 3.67 | ~~Components~~ Additional safety systems and specific safety features necessary to mitigate the consequences of an accident with core melting should be capable of being supplied by any of the available power sources. | Use same wording as in 3.68 respectively in 3.62 and 3.63. Not only components are required for DEC. |  |  |  |  |
| 3 | 25 | 3.68 | Additional safety systems and specific safety features necessary | Use same wording as in 3.62 and 3.63 |  |  |  |  |
| 2 | 26 | 3.69 | Recommendations related to the reliability of the system with regard to the effects of internal or external hazards and environmental conditions are addressed in paragraphs 3.3, 3.4 and ~~3.11~~ 3.25 respectively. | 3.25 seem to be more appropriate than 3.11 for systems used in accidents with core melt. |  |  |  |  |
| 1 | 27 | 3.73 & 3.76 | ~~Conditions~~ Plant states arising in case of postulated core melt accidents under DEC that could lead to an early radioactive release or a large radioactive release are required to be practically eliminated by design (see Requirement 20/5.31). Under consideration of the estimate of the probability that such conditions will occur, additional design provisions to practically eliminate such conditions are to be taken.~~3.76. Core melting accidents should be postulated as Design Extension Conditions despite of design provisions taken to prevent such conditions and of the estimate of their probability to~~~~occur.~~ | So far requirement 3.76 and 3.97 are contrary. Proposal to modify and combine 3.73 and 3.76 and have in mind what is said in 3.97: “PSA can be used to demonstrate the practical elimination of conditions that could lead to an early radioactive release or …” |  |  |  |  |
| 3 | 28 | 4.7, 4.8 |  | There should be a link (footnote?) to the definition of “secondary” containment as given in 4.97. |  |  |  |  |
| 2 | 29 | 4.18 | The design pressure should not be lower than the value of the peak pressure that would be generated by the design basis accident with the most severe release of mass of material and energy and increased by at least 10%. | Some countries require larger margins. |  |  |  |  |
| 2 | 30 | 4.20 | * The potential input from the secondary system (PWR) to cover for effects e.g. due to subsequent steam generator tube ruptures in case of LOCA
 | German requirements ask for taking into account (for PWRs) the secondary coolant mass and energy content of one steam generator, when calculating the pressure and temperature load in the containment volume. The potential input from the secondary system (PWR) should be mentioned, at least to cover for effects e. g. due to subsequent steam generator tube ruptures in case of LOCA. |  |  |  |  |
| 2 | 31 | 4.47 | In this strategy, the heat from the molten core is removed through the wall of the reactor pressure vessel. This requires e.g. the reactor cavity to be flooded sufficiently to remove the heat produced. ~~at least to a level above the location of the molten~~~~core.~~ Mechanical and thermal loads in the walls of the cavity should be considered. Features should be included to remove the heat from the cavity and to avoid ~~its~~ the pressurization of the cavity and the containment. | Is it always the case that flooding the cavity to a level above the location of melt is sufficient? A more general recommendation would be better. Pressurization of the cavity is one item, but in general the containment is meant. |  |  |  |  |
| 2 | 32 | 4.48 | The structures of the cavity should be considered as items ultimately necessary to enable external cooling of the RPV and to avoid RPV failure, melt release into the containment and possibly large radionuclide releases in case of containment failure; ~~and~~ consequently they should be such that design margins are adequate to deal with seismic loads exceeding SL-2. | It is not clear, why in case of in-vessel retention the cavity structure avoids large releases. Clarification could be provided by some additional explanations as proposed. |  |  |  |  |
| 2 | 33 | 4.49 | In this strategy, the containment should be equipped with an ex-vessel retention structure (core catcher ~~or wet cavity for BWR~~) or another measure dedicated to contain and cool the molten core outside of the vessel. | As far as it is known, research results do not always confirm that a wet cavity might be sufficient to cool the melt coming out of the RPV in a BWR. Example should be deleted and formulated in another way. |  |  |  |  |
| 2 | 34 | 4.53 | The core catcher or any other measure should be considered as items ultimately necessary to enable melt retention and cooling in the containment and thereby avoiding large releases in case of containment failure; ~~and~~ consequently it should be such that design margins are adequate to deal with seismic loads exceeding SL-2. | Modification recommended in case comment to 4.49 is taken further.It is not clear, why in case of in-vessel retention the cavity structure avoids large releases. Clarification could be provided by some additional explanations as proposed. |  |  |  |  |
| 2 | 35 | Page 34 | STRUCTURAL DESIGN OF ASSOCIATED SYSTEMS | To make it clear, that associated systems to the containment are meant. |  |  |  |  |
| 2 | 36 | 4.54 | For the structural design of systems associated to the containment ~~systems~~, a set of representative loads and load combinations, as well as a set of adequate engineering criteria, should be established by a similar procedure as for the containment structures, with account taken of all the relevant accident conditions. | To make it clear, what is meant. |  |  |  |  |
| 3 | 37 | 4.56 | During normal plant operation, a ventilation system should be operated to maintain the pressure and temperature in the containment within the limits specified for normal operation. ~~More detailed recommendations are given in [10].~~ | [10] makes reference to NS-G-1.5 which covers “External Events Excluding Earthquakes in the Design of NPP”. The reference does not contain any relevant information with regard to “control of pressure and temperature”. Should be deleted. |  |  |  |  |
| 2 | 38 | 4.66, 4.67 | Complex hydraulic and pressure transients occur when steam and gases are vented into the suppression pool water, either from the dry well or through steam discharge from RPV. *The hydraulic response of and loads imposed to the pressure suppression pool in the different plant states should be determined and considered for design.* The design of the dry and wet wells and connection features should be such that the hydraulic responses and the dynamic loads can be reliably determined by analysis and tests. | The last two sentences of 4.66 should be combined with 4.67. |  |  |  |  |
| 2 | 39 | 4.80 | For containment with a steel shell, heat released in the containment under accident conditions can be removed passively through the steel shell. A secondary and outside envelopeis needed and is designed to remove heat by providing a natural circulation path for air (the chimney effect). Additional systems may be designed to enhance the heat removal by adding water to the outer side of the containment. ~~Containment spray is implemented by spraying of the outside of the steel shell.~~ | The requirement is very design specific but does not cover main designs as AP1000 or CAP1400. Such designs use passive water flow from an elevated storage down along the outside of the containment; an external spray is not used. Text should be adopted as proposed. |  |  |  |  |
| 2 | 40 | 4.82 | Where passive containment cooling is adopted, the following aspects should be considered:~~• The entire system should be qualified and validated by means of tests and analyses.~~ | Why it is only for passive systems requested that the entire system should be validated by means of tests and analyses? This is an overall requirement and does not necessarily be mentioned here. |  |  |  |  |
| 3 | 41 | 4.83 | Containment structure and systems should be designed to meet the objectives for preventing and limiting the radiological release specified for the different plant states as indicated in ~~2.1~~ 2.4. | Wrong reference to para 2.1; 2.4. provides basic requirements with regard to radionuclides.  |  |  |  |  |
| 3 | 42 | Page 40 | **Secondary ~~containment~~ confinement** | The head line should be made conform to the wording used in the text thereafter. Secondary confinement is used in the text.  |  |  |  |  |
| 2 | 43 | 4.97 | Secondary confinement is in some designs an arrangement, in which the primary containment is completely or partially enclosed within a secondary envelope. The purpose of the secondary envelope in such designs is not to take over the functions of the primary containment should it fail but to allow for the potential collection of leaks from the primary containment and for a filtered release via the vent stack. In addition, it can provide increased protection against external hazards.When such a design option is implemented, the secondary ~~containment~~ confinement structure is also often designed as the shielding structure of the containment. | Not in all new NPPs the secondary confinement has the functions as defined in 4.97 - 4.103. E.g. in AP1000, CAP1400 the secondary confinement is used for passive containment cooling. Wording should be adopted.Use same wording everywhere. |  |  |  |  |
| 2 | 44 | 4.112 | In general, a single system is not sufficient for reducing the concentrations ofradionuclides, and multiple systems should be employed. Examples of methods used for the reduction of airborne radionuclides in water cooled reactors of extant and new designs are:• Deposition on surfaces;• Spray systems;• Pressure suppression pools;• Ventilation and venting systems. | These are only examples of measures to reduce airborne radionuclides. Other exists as the enhanced convection of the gas flows in the containment as adopted by the EPR. Therefore “Examples of …” should be added.For consistency between headline and text, venting systems should be mentioned here as well.  |  |  |  |  |
| 2 | 45 | 4.122 | Where containment venting systems are installed, the system should be designed to minimize the release of radionuclides to the environment [4]. The system design could include a filtering system such as sand, multi-venturi scrubber systems, HEPA or charcoal filters, or a combination of these. HEPA, sand or charcoal filters may not be necessary if the ~~air~~ released gas flow is scrubbed in a water pool. | It is not only air what is released.  |  |  |  |  |
| 2 | 46 | 4.124 | Hydrogen and oxygen are generated during normal operation of a plant as a result of the radiolysis of water in the core. In accident conditions (e.g. during a LOCA, or to a larger extent during an accident with core melting), combustible gases (hydrogen and carbon monoxide) might be released into the containment atmosphere. | Better to mention (hydrogen and carbon monoxide) |  |  |  |  |
| 2 | 47 | 4.125 | • Metal–water reactions ~~in the~~ of core components and RPV internals; | The metal water reaction does not take place only in the core; it is extended even further after melt relocation. If core components are mentioned, absorber materials are included as well. Modified wording would take this into account. |  |  |  |  |
| 3 | 48 | 4.125 | ~~•~~ All these contributions should be evaluated. | Remove the dot; this is a separate sentence. |  |  |  |  |
| 2 | 49 | 4.126 | The amount of combustible gases generated and typical release rates into the containment should be calculated for normal operation, LOCA and design extension conditions. The uncertainties in the various possible mechanisms for generation should be taken into account by the use of adequate margins. ~~If the amount of hydrogen expected to be generated by metal–water reactions is estimated on the basis of the assumption of total oxidation, uncertainty evaluation may be not necessary.~~ | For the management of combustible gases not only the total amount of gases is important, as well the release rate into the containment. The last sentence should be deleted, as it is not precise enough - what does “total oxidation” mean - of what? |  |  |  |  |
| 2 | 50 | 4.128 | ~~Additional hydrogen production due to molten core concrete interaction should be estimated.~~ | This can be deleted, as it is included already in 4.125 and 4.126. |  |  |  |  |
| 2 | 51 | 4.129 | Threats to the containment structures are reactor technology and design dependent but usually refer to a risk of over pressurization caused by a large production of non-condensablegases or by different combustion phenomena, e.g. a fast deflagration or detonation of a combustible gas. | Global combustion may as well happen, not just fast deflagrations or detonations. Wording could be adopted as proposed. |  |  |  |  |
| 2 | 52 | 4.129 | … However, in case measures to inert the containment are applied ~~for~~ ~~inert containment~~ (e.g. as applied for some BWR) the risk of hydrogen combustion ~~explosion~~ is ~~low~~ practically excluded due to the presence of inert gas and the absence of oxygen in normal power operation and accident situations. | The containment of a BWR is not inert by itself, active measures are implemented to inert the containment. This needs to be corrected. |  |  |  |  |
| 2 | 53 | 4.129 | … For non-inert containment (PWR, PHWR, BWR) generally characterized by a large free inner volume, the primary threat in the short term is the risk of strong hydrogen combustion challenging the containment integrity ~~explosion~~ due to potential high local hydrogen concentration. | It must not be necessarily an explosion, global combustions or other events may challenge the containment integrity as well.  |  |  |  |  |
| 2 | 54 | 4.130 | To identify a need for the installation of special features to control combustible gases, an assessment of the threats to the containment should be made. The assessment should coverGeneration phenomena (see 4.125), release rates, transport and mixing of combustible gases in the containment, combustion phenomena (diffusion flames, deflagrations and detonations) and the consequent thermal and mechanical loads. | A link to 4.125 should be made. Release rates are as well important. |  |  |  |  |
| 2 | 55 | 4.131 | The contribution of non-combustible gases should be taken into account for combustion calculations ~~ignition~~ and containment over pressurization. | The sentence does not make sense. Probably non-condensable gases are meant and “combustion calculations” not “combustion ignition”. |  |  |  |  |
| 2 | 56 | 4.132 | Leaks and releases of combustible gases from the containment should also be taken into account when evaluating the threats both to environment and connected or surrounding buildings (e.g. secondary confinement, penetration buildings or auxiliary buildings hosting safety equipment). To identify a need for the installation of special features to control combustible gases in connected or surrounding buildings, an assessment of the threats to such buildings should be made (see 4.130).  | Here the secondary confinement should especially be mentioned, in which hydrogen would be “stored” if leaking from the containment. What may happen was shown in Fukushima. Therefore the need for analyses for the installation of special features to control combustible gases there should be required. |  |  |  |  |
| 2 | 57 | 4.135 and 1. sentence of 4.136 | Systems for the prevention of hydrogen combustions challenging the containment integrity should be provided. The efficiency of the systems should be such that global and local hydrogen concentrations are low enough to preclude combustions challenging the containment integrity.~~, e.g. hydrogen removal, deliberate ignition, homogenization or inertin~~g ~~should be provided~~. | Not the systems should be mentioned, the goal of the implementation of such measures need to mentioned here first. The first sentence of 4.136 should be added for clarification.Examples are to be deleted here as they follow in 4.136.  |  |  |  |  |
| 2 | 58 | 4.136 | ~~Design~~ Provisions to be implemented ~~in the design~~ for achieving this goal under DBA and accident conditions are, for example, an enhanced naturalmixing capability of the containment atmosphere coupled with a sufficiently large free volume, passive autocatalytic recombiners and/or igniters suitably distributed in the containment, or aninert containment. | Efficiency or efficacy? Efficacy was used at another place (3.49).“Design provisions” could be misunderstood, as accident conditions must be included. |  |  |  |  |
| 2 | 59 | 4.137 | *~~Removal~~*~~4.137. Passive means such as passive autocatalytic recombiners and/or active means such as igniters should be provided for burning/removing hydrogen.~~ | It is not clear what the intention is - should in all new plants such devices being implemented or are other measures possible instead of? What are the requirements for an implementation?Proposal - to be deleted, as no new information is provided ; example is given already under 4.136. |  |  |  |  |
| 2 | 60 | 4.138 | *~~Homogenization~~*~~4.138. The containment design either should incorporate active means (such as sprays and mixing fans qualified for operation in a combustible gas mixture) or should facilitate the action of mechanisms (such as large volume dispersion or natural circulation) to enhance the uniform mixing of the containment atmosphere within and between compartments. This is to ensure that local hydrogen concentrations do not reach detonation limits following an accident.~~ | As for 4.137 - it is not clear what the intention is - should in all new plants such devices being implemented or are other measures possible instead of? What are the requirements for an implementation?To be deleted, as the option of HOMOGENIZATION is just one option to be implemented. The text reads as it is requested for all NPPs; example is given already under 4.136. |  |  |  |  |
| 2 | 61 | 4.139 | *~~Inerting~~*~~4.139. One possible way to avoid combustion is to inert the containment atmosphere during reactor operation (usually with nitrogen). This is mainly applicable to a small containment.~~ | To be deleted, as no new information is provided; example is given already under 4.136. |  |  |  |  |
| 2 | 62 | 4.176 | Ageing effects should be evaluated in the selection and design of types of concrete [16]. An appropriate ageing management program should be developed.” | Should also be added for the other materials listed on the following pages. |  |  |  |  |
| 2 | 63 | 4.191 | To support the implementation of the defence in depth concept, ~~and~~ to enhance the reliability of the containment systems, and to obtain essential information on the plant that is necessary for its safe and reliable operation, for determining the status of the plant in accident conditions and for making decisions for the purposes of accident management, instrumentation should be provided for the purposes of:• Monitoring of the stability of the containment structure;~~• Detection of deviations from normal operation;~~• Periodic testing;• Monitoring of the availability of the containment systems;• Initiation of automatic operation of systems;• Detection of deviations from normal operation;• Accident and Post-accident monitoring (monitoring of essential parameters of the containment for normal operation and accident conditions) | Requirement 59 of [3] *“Instrumentation shall be provided for determining the values of all the main variables that can affect … the containment at the nuclear power plant,* ***for obtaining essential information on the plant that is necessary for its safe and reliable operation, for determining the status of the plant in accident conditions and for making decisions for the purposes of accident management.”***is more pronounced as it is currently described in 4.191 and following paras. It should be mentioned that instrumentation for monitoring of essential parameters of the containment for normal operation and accident conditions is required. Information available under “Post-accident monitoring” should be extended to include “Accident situations” |  |  |  |  |
| 3 | 64 | 4.197 | Appropriate instrumentation for measurements relating to earthquakes should be installed at suitable places (e.g. on and/or the basemat of the containment at suitable floors). | Sentence is incomplete or “and/or” should be deleted. |  |  |  |  |
| 2 | 65 | 4.198 | Appropriate instrumentation should be incorporated inside the containment for an early detection ofdeviations from normal operation:• Abnormal pressure, temperature and gas concentration including combustible gases• Leaks of radioactive material (as airborne activity, activity in the sumps);• Abnormal radiation levels;• High energy leaks;• Leaks;• Fire;• Failure of components. | Why is there no need to implement instrumentation to measure pressure, temperature and gas concentrations incl. combustible gases? This is common praxis in operating NPPs. |  |  |  |  |
| 2 | 66 | 4.199 | Instrumentation sensitivity and ranges necessary to detect a developing deviation from normal operation and to detect the plant status in accidents should be estimated by appropriate analytical methods. | Not only the sensitivity is important, as well the measurement range.  |  |  |  |  |
| 2 | 67 | 4.200 | For an adequate detection of the different abnormal conditions, information provided by the instrumentation can be used alone or in combination with others. ~~Parameters typically monitored are dealt with in the following:~~ | Most of the parameters mentioned thereafter are obligatory to be measured; many of them are needed for plant status detection in case of accidents. Therefore the last sentence should be deleted. |  |  |  |  |
| 1 | 68 | 4.xxx | *Containment atmosphere gas composition*Monitoring of containment atmosphere gas composition is necessary to check whether challenging conditions exist where combustion processes are to be expected and where active safety features are to be initiated. | This system is already installed in many plants. Accident condition monitoring and plant state determination requires such instrumentation. I is surprising that nothing is added in the SSG. Compare 4.220 where such a measurement is requested for accident conditions. |  |  |  |  |
| 2 | 69 | 4.220 | **Accident and Post-accident monitoring** For the determination of the plant status in case of accidents and for management of accidents, appropriate instrumentation displays and records should be available in the MCR and the Emergency Control Center to allow personnel to make a diagnosis and to decide and to take the manual protection actions specified in the Emergency Operating Procedures or in the Severe Accident Management Guideline. Such instrumentationshould provide information about:* Conditions inside the containment (containment pressure and temperatures, radiation levels, airborne activity, gas composition (e.g. steam, oxygen or hydrogen concentration if relevant);
 | As recommended for extension of 4.191, Accident monitoring should be included in the headline, as the paras within the chapter already include such requirements.  |  |  |  |  |
| 2 | 70 | Page 59 | ~~Sampling~~ | Delete the headline sampling, as the instrumentation described belongs to the previous chapter  |  |  |  |  |
| 2 | 71 | 5.4 | A pressure test should be conducted to demonstrate the structural integrity of the containment ~~envelope~~ (including extensions and penetrations) and of the pressure retaining boundary of systems. | It was mentioned already in the comments received that envelope will be deleted, but it was not done. |  |  |  |  |
| 2 | 72 | 5.6 | **Integrated leak tests (of the containment ~~envelope~~)**A leak test should be conducted to demonstrate that the leak rate of the containment ~~envelope~~ does not exceed the specified maximum leak rate. The test should be conducted with the components of the containment in a state representative of the conditions that would prevail following an accident, to demonstrate that the specified leak rate would not be exceeded under such conditions. | It was mentioned already in the comments received that envelope will be deleted, but it was not done. |  |  |  |  |
| 2 | 73 | 5.12 | For double wall containments, one way to determine the direct leak rate from the primary containment to the environment (i.e. if the leaked water or gas does not collect in the secondary containment or annular space between both ~~the inner and the outer containment walls~~) is by calculation. This calculation should determine the difference between (a) the total leak rate from the primary ~~inner~~ containment as determined by the leak test for the primary ~~inner~~ containment (this consists of both flow from the primary ~~inner~~ containment into the secondary confinement / annulus and flow from the primary ~~inner~~ containment to the atmosphere) and (b) the leak rate from the primary ~~inner~~ containment wall to the annulus, obtained after ventilation of the annulus has been stopped (this is typically calculated by subtracting the normal flow out of the annulus vent from the flow out of the annulus vent during the leak test). | The wording primary and secondary containment was used  |  |  |  |  |
| 2 | 74 | A.5 | The assessment should consider a set of design extension conditions whose consequences should be analyzed with the purpose of further improving the safety of the nuclear power plant by: | Sentence incomplete |  |  |  |  |
| 2 | 75 | A.14 | Energy management:•Conditions leading to a direct containment heating should be prevented by different means;•Possibilities for steam explosion arising should be identified and their effects evaluated; •~~Different and d~~Diverse means should be implemented to control the pressure build up inside the containment in the different plant states;•Different and diverse means should be implemented to remove heat from the containment in the different plant states;•If a containment venting system is needed for certain beyond original design basis events, it should be reliable, robust to withstand loads from hazards (e.g. earthquake), accident conditions, and to withstand the dynamic and static pressure loads existing when the containment venting line is operated;•Specific safety features and systems should be implemented to ensure the cooling and stabilization of the molten core. ~~Direct contact of core debris and containment structural concrete should be reliably prevented.~~ | “Diverse” should include “different”The last requirement which is to be implemented for existing NPPs seems to be unrealistic. It should be deleted. |  |  |  |  |
| 2 | 76 | A.15, last bullet | Integrate the requirement 4.122 into A.15:4.122. Where containment venting systems are installed, the system should be designed to minimize the release of radionuclides to the environment [4]. The system design could include a filtering system such as sand, multi-venturi scrubber systems, HEPA or charcoal filters, or a combination of these. HEPA, sand or charcoal filters may not be necessary if the air is scrubbed in a water pool.  | The accident at Fukushima has caused large contaminated areas with severe consequences for the inhabitants. These consequences could have been largely avoided, if the releases had been filtered. By adequate filtering no significant Cesium- and Strontium-contamination had occurred.In several countries filtered vents were backfitted already in the 80ies or 90ies. This demonstrates that backfitting of filtered vents is possible for existing plants.Hence the requirements for filtered vents should be the same for existing plants (appendix) as for newly designed NPP. IAEA should demand this also in the interest of neighbouring countries, which should be protected from unfiltered releases from NPPs in the adjacent countries. |  |  |  |  |
| 2 | 77 | A.16 | Management of combustible gases:•Risks for hydrogen deflagration and detonation should be evaluated and adequate provisions should be implemented, if necessary, to prevent hydrogen combustions challenging the containment integrity ~~detonation~~ and to control the concentration of combustible gases inside the containment. | Compare 4.136 for use of text: “to prevent hydrogen combustions challenging the containment integrity” instead of “prevent detonations” |  |  |  |  |
| 2 | 78 | A.16New para | The venting system should not fail due to combustible gas effects. | Clarification. |  |  |  |  |
| 2 | 79 | A.17 | Instrumentation:•Operability, reliability and adequacy of instrumentation should be evaluated (e.g. measurement ranges, environmental qualification, power supply) to ensure operators obtain essential and reliable information about the containment status in the different plant states;•The containment shall be equipped with measuring and monitoring instrumentation that provides sufficient information on the progress of core melt accidents and threats to containment integrity and by which the operator can do the necessary SAMG actions. That instrumentation should be to the extent possible independent from the instrumentation used for the mitigation of DBAs;•The new instrumentation should be qualified for ~~severe~~ accident~~s~~ conditions with core melt. | Use wording as in main document with regard to “severe accidents” |  |  |  |  |
| 1 | 80 | New para | “The design of the inner structures of the containment should ensure that in case of a LOCA or a water loss event from the spent fuel pool (in case the pool is inside the containment) the water collects within the containment in such a way that it can be used for fuel cooling by recirculation.” | The proposal should be added at an appropriate location within this Guide. |  |  |  |  |