

## Argentine comments on DPP DS 490

| COMMENTS BY REVIEWER   |                                   |  |   | RESOLUTION                    |                                   |          |   |
|--|-----------------------------------|--|---|-------------------------------|-----------------------------------|----------|---|
| Reviewer: NUSSC  |                                   | Page 1 of 1  |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |   |
| Country/Organization: ARGENTINE/NUCLEAR REGULATORY AUTHORITY |                                   |  |   |                               |                                   |          |   |
| Date: 1 <sup>st</sup> November 2014                          |                                   |  |   |                               |                                   |          |   |
| Comment No.  | Para/Line No.                     | Proposed new text  | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection                                     |
| 1  | Page 4, chapter 3: Seismic Design | It is proposed to replace the item “Seismic Good Practices for Mass and Stiffness Distribution” for “Selection of An Appropriate Plant Layout”, as stated in NS-G-1.6.   | “Selection of An Appropriate Plant Layout” includes more rules than adequate distribution of masses and structural stiffness, that should be defined in early design stage. For example, plant layout provisions to avoid structural interferences and connections. | X                             |                                   |          |   |
| 2  | Page 4, chapter 7                 | General: In Page 5, when describing the chapter 7 content it is mentioned “quality assurance” as a topic to be addressed. There is a difference with the proposed title of the chapter 7 where it is stated Management System. Please confirm that the intended content is management system |   | X                             |                                   |          | Yes, the intended content is Management System, as appears in page 4. |

**TITLE: DPP for DS 490 – Seismic Design and Qualification for Nuclear Power Plants**

| COMMENTS BY REVIEWER                           |               |  |        | RESOLUTION                    |                                   |          |  |
|--|---------------|--|--------|-------------------------------|-----------------------------------|----------|--|
| Reviewer: ENISS<br>Country/Organization: ENISS |               | Page 1 of 1<br>Date: 30/10/2014  |        | Francisco BELTRAN – ISSC/NSNI |                                   |          |  |
| Comment No.                                    | Para/Line No. | Proposed new text  | Reason | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection  |
| 1  | General       | <p>Seismic classification should be updated and made consistent with the SSG-30 SAFETY CLASSIFICATION OF STRUCTURES, SYSTEMS AND COMPONENTS IN NUCLEAR POWER PLANTS just issued by IAEA.</p> <p>Design rules should be clarified in relation to the seismic class and with reference to the standards for industrial facilities with standard hazard. Use of ductility (both local and global) should be regulated, also in comparison with uniform building codes</p> <p>Classification by similarity should be addressed in terms of requirements for the reference databases, their validation, and their applicability to equipment other than those included in their statistics.</p> <p>The seismic re-evaluation of existing facilities should be generically addressed in this guide, at least as a principle, with reference made to the definition of the required margin beyond design value and to material properties to be used.</p> |        | X                             |                                   |          |  |
|  |               |  |        | X                             |                                   |          |  |
|  |               |  |        | X                             |                                   |          | It is understood that the reviewer means “qualification by similarity”, not “classification by similarity”.  |
|  |               |  |        |                               | X                                 |          | Seismic re-evaluation of existing facilities is out of the scope of this Safety Standard. The standard for existing facilities is IAEA NS-G-2.13. However, a whole chapter, Chapter 6, has been introduced here, which includes the points raised by the reviewer. |

**Comments on Document Preparation Profile, “Seismic Design and Qualification for Nuclear Power Plants”  
(Revision of Safety Guide NS-G-1.6) (DPP DS490)**

| COMMENTS BY REVIEWER   |                   |  |   | RESOLUTION                    |                                   |          |  |
|--|-------------------|--|---|-------------------------------|-----------------------------------|----------|--|
| Reviewer:<br>Country/Organization: Finland / Radiation and nuclear safety authority<br>Date: 31 <sup>th</sup> October 2014 |                   |  |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |  |
| Comment No. / Reviewer   | Para/Line No.     | Proposed new text  | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection  |
| 1  | Page 4, Chapter 3 | Subchapter for specific design rules for larger equipment combined with items listed in corresponding chapter 3 is needed. | Components like pumps, motors and piping are delivered by different vendors and therefore qualified separately. Guidance is needed for ensuring the seismic design for equipment consisting of separately qualified components.   |                               |                                   | X        | Please, clarify your comment.<br>Do you mean guidance for defining qualification requirements for equipment consisting of parts supplied by different vendors ?<br>Does this guidance require a separate section within the Safety Guide ? |
| 2  | Page 4, Chapter 4 | Subchapter “qualification by combined tests and analysis” should be added.   | Standards, ex. IEC 980, chapter 5 state that seismic qualification analysis covers tests, analysis or combination or both.<br><br>Components of larger equipment are often tested separately with different approval criteria. Guidance for understanding boundary conditions between components and final approval of the equipment is needed. | X                             |                                   |          |  |

**TITLE Japan NUSSC Comments for DPP DS490, “Seismic Design and Qualification for Nuclear Power Plants”**

| COMMENTS BY REVIEWER            |               |  |        | RESOLUTION                      |                                   |          |                             |
|---------------------------------|---------------|--|--------|---------------------------------|-----------------------------------|----------|-----------------------------|
| Reviewer:                       |               | Page 1 of 2  |        | Francisco BELTRAN – ISSC / NSNI |                                   |          |                             |
| Country/Organization: Japan/NRA |               | Date: 30 Oct. 2014   |        |                                 |                                   |          |                             |
| Comment No.                     | Para/Line No. | Proposed new text  | Reason | Accepted                        | Accepted, but modified as follows | Rejected | Reason for modif./rejection |
| 1                               | General       | <p>Generally, well considered structure.</p> <ul style="list-style-type: none"> <li>• However, we found a little missing item originally in NS-G-1.6 and not picked up in DS-490.</li> <li>See comment 2</li> <li>• Next step, discussion on direction of each chapters is very important.</li> </ul> <p>We will actively contribute to the discussion based on recent seismic hazard experience on Japanese NPP</p> |        | X                               |                                   |          | Thank you.                  |

| COMMENTS BY REVIEWER                           |               |   |   | RESOLUTION                    |                                   |          |  |
|--|---------------|---|---|-------------------------------|-----------------------------------|----------|--|
| Reviewer:                                      |               | Page 2 of 2   |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |  |
| Country/Organization:                          |               | Date: 30 Oct. 2014  |   |                               |                                   |          |  |
| Comment No.                                    | Para/Line No. | Proposed new text   | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modif./rejection                                |
| 2 Comment on content (Refer attached table 1 ) | Page 5        | -1 Add<br>“ Basic concept of seismic design”<br>to Chapter 1  | Not clearly described in NS-G-1.6 Chapter 1 ,2 and missing item in Chapter 1 of DS490 |                               | X                                 |          | Basic concept of seismic design is introduced in Chapter 3 |
|  |               | “Selection of an appropriate plant layout” and<br>“Geotechnical parameters”<br>to Chapter 3   | Originally in NS-G-1.6 and not picked up in DS-490                                    |                               | X                                 |          | Geotechnical parameters are introduced in Chapter 2        |
|  |               | -2 “Specific design rules for building<br>and civil structure”<br>in Chapter 3  | Ditto   | X                             |                                   |          |  |
|  |               | -3 Change order of<br>“Specific Design Rules for Piping” and<br>“Specific Design Rules for<br>Electrical Equipment Items”<br>in Chapter 3 | Better arrangement  | X                             |                                   |          |  |

**Table 1 Comparison of content of NS-G-1.6 and DS490**

| <b>- NS-G-1.6 -</b>   | <b>-DPP DS490 -</b>  | <b>-Our proposal on content of DS490 -</b>  |
|---|--|---|
| <p><b>1. INTRODUCTION</b><br/>Background (Basically, history of IAEA seismic design guide)<br/>Objective (Basically, objective of the guide, <b>objective of seismic design is not so clear</b>)<br/>Scope (Basically, scope of the guide)<br/>Structure</p> <p><b>2. GENERAL SAFETY CONCEPTS</b><br/>Scope (<b>scope of seismic design is not so clear</b>)<br/>Design basis earthquake<br/>Seismic categorization for structures, systems and components<br/>Combination of earthquake loads with operating condition loads<br/>Seismic capacity<br/>Content of the safety analysis report</p> <p><b>3. SEISMIC DESIGN</b><br/><b>Selection of an appropriate plant layout</b><br/><b>Geotechnical parameters</b><br/><b>Civil engineering structures</b><br/>Earth structures<br/>Piping and equipment<br/>Selection of appropriate design standards<br/>Periodic safety review</p> <p><b>4. GENERALITIES ON SEISMIC QUALIFICATION (4.1–4.10)</b></p> <p><b>5. QUALIFICATION BY ANALYSIS</b><br/>Modelling techniques<br/>Analytical techniques</p> <p><b>6. SEISMIC QUALIFICATION BY MEANS OF TESTING, EARTHQUAKE EXPERIENCE AND INDIRECT METHODS</b><br/>Seismic qualification by means of testing<br/>Seismic qualification by means of earthquake experience<br/>Seismic qualification by means of indirect methods</p> <p><b>7. SEISMIC INSTRUMENTATION</b><br/>Introduction<br/>Seismic structural monitoring<br/>Seismic monitoring and automatic scram systems<br/>Data processing<br/>Post-earthquake actions</p> <p><b>APPENDIX: SAMPLES OF SEISMIC CATEGORIZATION</b><br/><b>REFERENCES</b><br/><b>CONTRIBUTORS TO DRAFTING AND REVIEW</b><br/><b>BODIES FOR THE ENDORSEMENT OF SAFETY STANDARDS . . 57</b></p> | <p><b>Chapter 1 Introduction</b><br/>Background<br/>Objective<br/>Scope<br/>Structure</p> <p><b>Chapter 2 Input to Seismic Design and Qualification</b><br/>General<br/>Design Basis Earthquake<br/>Input from Site Characterization<br/>Seismic Categorization for Structures, Systems and Components<br/>Selection of Appropriate Design and Qualification Standards</p> <p><b>Chapter 3 Seismic Design</b><br/>Seismic Good Practices for Mass and Stiffness Distribution<br/>Site Response Analysis<br/>Seismic Demand on Structures, Systems and Components<br/>Combination of Earthquake Loads with Other Loads<br/>Seismic Capacity<br/>Specific Design Rules for Building Structures<br/>Specific Design Rules for Earth Structures<br/>Specific Design Rules for Seismically Isolated Structures<br/>Specific Design Rules for Mechanical Equipment Items<br/>Specific Design Rules for Electrical Equipment Items<br/>Specific Design Rules for Piping<br/>Specific Design Rules for Cable Trays and Conduits<br/>Specific Design Rules for HVAC Ducts</p> <p><b>Chapter 4 Seismic Qualification</b><br/>General<br/>Qualification by Test<br/>Qualification by Analysis<br/>Qualification by Earthquake Experience and Indirect Methods</p> <p><b>Chapter 5 Seismic Instrumentation</b><br/>General<br/>Seismic Structural Monitoring<br/>Seismic Monitoring and Automatic Scram Systems<br/>Data Processing<br/>Post-earthquake Actions</p> <p><b>Chapter 6 Seismic Margin to be achieved by the Design</b><br/>Concept of Seismic Margin<br/>Procedures to Assess the Margin in the Design Process</p> <p><b>Chapter 7 Safety Analysis and Management System</b><br/>Safety Analysis Report<br/>Management System<br/>Periodic Safety Review</p> <p><b>Appendix Samples of Seismic Categorization</b><br/><b>References</b><br/><b>Contributors</b></p> | <p><b>Chapter 1 Introduction</b><br/>Background<br/>Objective<br/><b>Basic concept of seismic design</b><br/>Scope<br/>Structure</p> <p><b>Chapter 2 Input to Seismic Design and Qualification</b><br/>General<br/>Design Basis Earthquake<br/>Input from Site Characterization<br/>Seismic Categorization for Structures, Systems and Components<br/>Selection of Appropriate Design and Qualification Standards</p> <p><b>Chapter 3 Seismic Design</b><br/><b>Selection of an appropriate plant layout</b><br/><b>Geotechnical parameters</b><br/>Seismic Good Practices for Mass and Stiffness Distribution<br/>Site Response Analysis<br/>Seismic Demand on Structures, Systems and Components<br/>Combination of Earthquake Loads with Other Loads<br/>Seismic Capacity<br/>Specific Design Rules for Building <b>and civil</b> Structures<br/>Specific Design Rules for Earth Structures<br/>Specific Design Rules for Seismically Isolated Structures<br/>Specific Design Rules for Mechanical Equipment Items<br/><i>Specific Design Rules for Piping</i> (change order)<br/><i>Specific Design Rules for Electrical Equipment Items</i> (change order)<br/>Specific Design Rules for Cable Trays and Conduits<br/>Specific Design Rules for HVAC Ducts</p> <p><b>Chapter 4 Seismic Qualification</b><br/>General<br/>Qualification by Test<br/>Qualification by Analysis<br/>Qualification by Earthquake Experience and Indirect Methods</p> <p><b>Chapter 5 Seismic Instrumentation</b><br/>General<br/>Seismic Structural Monitoring<br/>Seismic Monitoring and Automatic Scram Systems<br/>Data Processing<br/>Post-earthquake Actions</p> <p><b>Chapter 6 Seismic Margin to be achieved by the Design</b><br/>Concept of Seismic Margin<br/>Procedures to Assess the Margin in the Design Process</p> <p><b>Chapter 7 Safety Analysis and Management System</b><br/>Safety Analysis Report<br/>Management System<br/>Periodic Safety Review</p> <p><b>Appendix Samples of Seismic Categorization</b><br/><b>References</b><br/><b>Contributors</b></p> |
| <p>Red: Missed item in DS490<br/>Blue: Not enough described in NS-G-1.6</p>   |  |   |

**Comments on IAEA document  
DS490 Seismic Design and Qualification for Nuclear Power Plants (Draft September 2014)**

| <b>COMMENTS BY REVIEWER</b>  |                          |   |   | <b>RESOLUTION</b>             |                                   |          |                                   |
|--|--------------------------|---|---|-------------------------------|-----------------------------------|----------|-----------------------------------|
| Reviewer:<br>Country/Organization: Ukraine/ State Scientific and Technical Centre for Nuclear and Radiation Safety<br>Date: October 09, 2014 |                          |   |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |                                   |
| Comment No.  | Para/Line No.            | Proposed new text   | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection |
| 1  | Chapter 3 Seismic design | To add to chapter 3 “Specific Design Rules for Underground Pipes” | Definition of seismic resistance and calculation of underground pipes are very different from other pipes. It is reasonable to add general provisions of calculations for underground pipes and give corresponding references | X                             |                                   |          |                                   |

**Comments on Document Preparation Profile, “Seismic Design and Qualification for Nuclear Power Plants”  
(Revision of Safety Guide NS-G-1.6) (DPP DS490)**

| COMMENTS BY REVIEWER   |               |  |   | RESOLUTION                    |                                   |          |  |
|--|---------------|--|---|-------------------------------|-----------------------------------|----------|--|
| Reviewer: US Nuclear Regulatory Commission<br>Country/Organization: USA Date: October 2014 |               |  |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |  |
| Comment No. / Reviewer   | Para/Line No. | Proposed new text  | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection  |
| 1  | General       | DS490 is mute or vague regarding seismic design for combined natural external events such as severe earthquake and tsunami or flooding and earthquake. | We suggest that DS490 address safety issues and combined natural external events. |                               |                                   | X        | The scope of the safety guide is seismic design. The other potentially coincident natural design external events are taken into account through the corresponding load combinations.<br><br>It is noted that the current IAEA provisions for design against flood or tsunami are based on either the dry site concept or on introducing permanent barriers to keep the site dry (IAEA SSG-18, paragraph 7.5). Beyond design floods coincident with the design earthquake are out of the scope of the present safety guide and probably deserve a dedicated safety guide. |
| 2  | General       | DS490 is vague and unclear regarding beyond design basis accidents in consideration of seismic effects and severe earthquakes.                         | We suggest the document address in detail seismic effects beyond design basis.    |                               |                                   | X        | Please clarify the comment. A whole chapter, Chapter 6, has been introduced to address the safety margin beyond seismic design basis to be achieved by the design.   |



| COMMENTS BY REVIEWER                       |               |  |  | RESOLUTION                    |                                   |          |                                   |
|--|---------------|--|--|-------------------------------|-----------------------------------|----------|-----------------------------------|
| Reviewer: US Nuclear Regulatory Commission |               | Date: October 2014   |  | Francisco BELTRAN – ISSC/NSNI |                                   |          |                                   |
| Country/Organization: USA                  |               |  |  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection |
| Comment No. / Reviewer                     | Para/Line No. | Proposed new text  | Reason   | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection |
| 3  | General       | <p>DS490 should take into consideration the ongoing revisions of SSR1/2 in order to further consider safety margins and added requirements for most of IAEA main requirements on external hazards, including seismic design. In this context, DS490 should consider the following aspects:</p> <ul style="list-style-type: none"> <li>• <b>Revision through addenda of GSR Part 1, NS-R-3, SSR-2/1, SSR-2/2, and GSR Part 4</b></li> <li>• Para 5.21: <i>“The seismic design of the plant shall provide for a sufficient safety margin to protect against seismic events and to avoid cliff edge effects.”</i></li> <li>• Added paragraph 5.9 Nuclear sites shall have an adequate on-site seismically robust, suitably shielded, ventilated ...”</li> <li>• <b>management of beyond design basis accidents</b><br/>Para 5.9: Arrangements for accident management shall provide the operating staff with appropriate systems and technical support in relation to beyond design basis accidents. These arrangements and guidance shall be available before the commencement of</li> </ul> | <p>Completeness to address DS462 and modification of safety requirements and associated paragraphs to address external events including seismic hazards.</p> | X                             |                                   |          |                                   |

| COMMENTS BY REVIEWER   |                 |   |  | RESOLUTION                    |                                   |          |                                   |
|--|-----------------|---|--|-------------------------------|-----------------------------------|----------|-----------------------------------|
| Reviewer: US Nuclear Regulatory Commission<br>Country/Organization: USA Date: October 2014 |                 |   |  | Francisco BELTRAN – ISSC/NSNI |                                   |          |                                   |
| Comment No. / Reviewer   | Para/Line No.   | Proposed new text   | Reason   | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection |
|  |                 | <p>fuel loading and they shall address the actions necessary following beyond design basis accidents, including severe accidents. In addition, arrangements shall be made, as part of the emergency plan, to expand the emergency response arrangements, where necessary, to include the responsibility for long term actions and buildings equipped to house the Emergency Response Centre.</p> <ul style="list-style-type: none"> <li>• In addition, to enhance defense in depth, the design shall include provisions to avoid short term cliff-edge effect in case of an extreme external hazard of an intensity or a duration exceeding the one considered as the general design basis;</li> <li>• Consider a complex combination of events.</li> </ul> |  |                               |                                   |          |                                   |
| 4  | General comment | Consider providing an option to determine the seismic demand using a probabilistic dynamic analysis approach based on the random vibration theory (RVT). Based on RVT, input power spectral density (PSD) can be derived from the design basis earthquake   | The RVT methodology avoids using time histories and provides an alternative to multiple time history analyses to simulate the randomness of the earthquake ground motions. | X                             |                                   |          |                                   |

| COMMENTS BY REVIEWER   |                                    |  |   | RESOLUTION                    |                                   |          |   |
|--|------------------------------------|--|---|-------------------------------|-----------------------------------|----------|---|
| Reviewer: US Nuclear Regulatory Commission<br>Country/Organization: USA Date: October 2014 |                                    |  |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |   |
| Comment No. / Reviewer   | Para/Line No.                      | Proposed new text  | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection   |
|  |                                    | response spectra. Seismic demand can then be determined from the soil-structure interaction analysis using PSD as input.   |   |                               |                                   |          |   |
| 5  | Page 1/<br>Line 13                 | Background part of the preparation profile discusses two earthquakes that occurred since the publication of the current version of the guidance document as one of the major reasons to update the guidance. | Can that be more specific, for example, what are the lessons learned from those two earthquakes which prompted to update this guidance?   | X                             |                                   |          | A brief explanation is added. Basically, no safety significant seismic damage (i.e., due to shaking) occurred in the plants. Lessons include how site effects can produce very different building responses, even in closely located buildings; the importance of displacement controlled effects (seismic anchor motion); sloshing in pools, and the absence of damage in well anchored equipment, even for motions well above the design motions. |
| 6  | Page 1, bullet 2, and Reference 16 | Recommend describing both ASCE 43 and ASCE 4 for performance based seismic design approach.  | Performance based approach provides a quantifiable goal and a systematic method to achieve that goal for the seismic design of nuclear facilities. The recently updated ASCE 4 together with ASCE43 provides a mature performance based seismic design practice, which will be beneficial to member states. | X                             |                                   |          | Fully agree.<br><br>The bullet is expanded with this idea.  |

| COMMENTS BY REVIEWER   |                                 |  |   | RESOLUTION                    |                                   |          |  |
|--|---------------------------------|--|---|-------------------------------|-----------------------------------|----------|--|
| Reviewer: US Nuclear Regulatory Commission<br>Country/Organization: USA Date: October 2014 |                                 |  |   | Francisco BELTRAN – ISSC/NSNI |                                   |          |  |
| Comment No. / Reviewer   | Para/Line No.                   | Proposed new text  | Reason  | Accepted                      | Accepted, but modified as follows | Rejected | Reason for modification/rejection  |
| 7  | Page 2, Line12                  | Recent design tendencies favor seismic isolation of structures in high seismicity sites. See for example the JNES standard (Ref. 11).  | The draft NUREG discusses SI application using some non-nuclear facilities as examples and was not published due to various reasons. We suggest that IAEA rely on studies from nuclear facilities which already applied SI technologies and summarize the experience into a lesson learned document for the member states as a reference. | X                             |                                   |          | Agree.<br><br>Text is changed as proposed and the draft NUREG is eliminated from the list of references.   |
| 8  | Page 2, Line 12                 | Delete “the draft NUREG” and replace with “the report”   | The draft NUREG has not been published by the NRC. Recommend to replace the reference No. 15 with the identical report that is available in the public domain.  |                               | X                                 |          | The draft NUREG is eliminated from the list of references.   |
| 9  | Reference 15.                   | Bozidar Stojadinovic, “Technical Considerations for Seismic Isolation of Nuclear Facility Structures,” a draft report, University of California, Berkeley, 2012.   | The draft NUREG has not been published by the NRC. Recommend to replace the reference No. 15 with the identical report that is available in the public domain   |                               | X                                 |          | The draft NUREG is eliminated from the list of references and not replaced.  |
| 10   | Page 2, Section 3, First Bullet | One of the reasons to update NSG-G-1.6 is to allow use of the seismic experience during Chuetsu offshore and the Tohoku earthquakes. Recommend providing pertinent reference documents where these experiences are documented. | Provides documentation of the basis of the proposed updates to the safety guide   |                               |                                   | X        | The Japanese utilities have already compiled the performance of equipment during these earthquakes. The information will be released in the near future, but it is not publicly available yet. |

