GEN energija d.o.o., Vrbina 17, 8270 Krško

Technical sector

Project activity:

PA-2021-003 – Probabilistic Seismic Hazard Analysis for JEK2

TECHNICAL SPECIFICATIONS

TS-SP-2021-003

Revision 0

Probabilistic Seismic Hazard Analysis for JEK2

Prepared by: Date: Signature:	1. 09. 2021 X Mojca Planinc GEN energija, d.o.o. Project Engineer Podpisal: Mojca Planinc	**Reviewed by:** Date: Signature:	1. 09. 2021 X Bruno Glaser GEN energija, d.o.o. Head of Technical sector Podpisal: BRUNO GLASER
		Approved by: Date: Signature	1. 09. 2021 X Gordana Radanović GEN energija, d.o.o. Chief Financial Officer Podpisal: Gordana Radanović
Approved by: Date: Signature:	1. 09. 2021 X Danijel Levičar GEN energija, d.o.o. Chief Operating Officer Podpisal: Danijel Levičar	**Approved by:** Date: Signature:	1. 09. 2021 X Martin Novšak GEN energija, d.o.o. Chief Executive officer Podpisal: Martin Novšak

CONTENTS

CONTENT

ABBREVIATIONS

AF	Amplification Factor
EUR	European utility requirements
ESV STM	Extended Site Vicinity Seismotectonic Model
GMC	Ground Motion Characterization (model)
GMMs	Ground Motion Models
GMPE	Ground Motion Prediction Equations
IAEA	International Atomic Energy Agency
IR	Independent Review
HID	Hazard Input Document
JEK2	Jedrska elektrarna 2
MAFE	Mean annual frequency of exceedance
NI	Nuclear Island
NPP	Nuclear Power Plant
PGA	Peak ground acceleration
PSHA	Probabilistic Seismic Hazard Analysis
SAF	Site amplification factor
SHA	Seismic Hazard Analysis
SL-1	Seismic level 1 earthquake (IAEA)
SL-2	Seismic level 2 earthquake (IAEA)
SRA	Site Response Analysis
SSC	Seismic Source Characterization
SSCM	Seismic Source Characterization Model
SSE	Safe Shutdown earthquake
SSG	Specific Safety Guide (IAEA)
SSI	Soil-structure interaction
SSZ	Seismic source zone
UHRS	Uniform Hazard Response Spectrum
SNSA	Slovenian Nuclear Safety Administration
SHA JEK2	Preliminary PSHA analysis for JEK2 performed in 2018 by RIZZO and GeoZS
JEK2 PSHA Report	Updated PSHA analysis for JEK2 (see SHA JEK2)

1 INTRODUCTION

GEN energija d.o.o. (GEN) is committed to the continued future use of nuclear technology as a safe, reliable and viable option to meet long-term energy needs within Republic of Slovenia. GEN is analyzing and evaluating the options for construction of the second unit of Nuclear Power Plant Krško (hereinafter JEK2). The proposed sites for building JEK2 are adjacent to existing NPP Krško site and located in the Sava River valley as it crosses the west part of the Krško Plain.

GEN already carried out a comprehensive program addressing seismic hazard analysis of the site [[1]]. As a part of GEN activities related to the construction of JEK2, GEN launched the project Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2. The project was led by the Faculty of Civil and Geodetic Engineering, Institute of Structural Engineering, Earthquake Engineering and Construction IT (FGG-IKPIR) and was carried out in cooperation with Slovenian Environment Agency (ARSO), Norman A. Abrahamson Inc. (NAA) and Research and development department of Ėlectricitė de France (EDF R&D) (hereinafter reviewers).

The goal of the project was independent review, evaluation and development of comments and proposals for improvements of selected parts of seismic hazard analysis [[1]] and also to develop a Non-ergodic Ground Motion model. Project was decomposed into five subtasks: 1A – Evaluation of the GMC model [[2]], 1B- Evaluation of the methodology for determination of rock UHRS [[3]], 1C – Evaluation of site AFs [[4]], 1D – Independent evaluation of available Empirical ground-motion data in the region and development of Non-ergodic GMPE [[5]], and 1E – Independent recalculation of PSHA at JEK2 site [[6]]. Reports 1A, 1B and 1 C in Chapter 6 include suggestions, recommendations and requirements that need to be implemented and appropriately addressed in updated PSHA for JEK2 Report (hereafter JEK2 PSHA Report).

Methods of assessing seismic hazards have evolved over time as scientific understanding of earthquake hazards has improved. The purpose of this Technical Specifications is to define the scope of activities that need to be performed in compliance with up-to-date safety codes and standards defined in section 6.2 to ensure nuclear safety and to perform site specific PSHA analysis for the potential JEK2 site with the knowledge of all site specific data.

2 SCOPE OF WORK

The main purpose is to perform revision to Probabilistic Seismic Hazard Analysis (PSHA) study with Non-ergodic Ground-Motion Model, and with appropriate inclusion of findings presented by reviewers and developers in reports 1A, 1B, 1C, 1D and 1E.

The framework of this project is to define the best estimate of the site-specific seismic hazard at the NPP JEK2 site and to derive hazard curves for building new NPP at JEK2 site. Description of micro location shall be provided.

The proposals for changes and corrections are summarized in Chapter 6 of each Report 1A, 1B and 1C. Report 1D includes developed Non-ergodic Ground Motion Model. Report 1E includes sensitivity studies as well as recalculation of PSHA based on previous known input data.

Proposals for changes in Report 1A, 1B and 1C are presented in three levels: suggestions, recommendations and requirements. JEK2 PSHA shall be based on the existing data and shall address review comments as determined in Subchapter 2.1 of this document.

The overall scope of work is divided into Task 1, Task 2 and Task 3.

Task 1 includes implementation of findings of the following reports [[2], [3], [4] and [6]] and revision/development of PSHA report for JEK2:

1. Report 1A – Evaluation of the GMC model [[2]],
2. Report 1B- Evaluation of the methodology for determination of rock UHRS [[3]]
3. Report 1C – Evaluation of site AFs [[4]] and
4. Report 1 E – Independent recalculation of rock PSHA [[6]].

Report 1E – Independent recalculation of PSHA at JEK2 site also includes sensitivity studies, which are important to properly evaluate and trim the logic tree branches.

Task 2 includes preparation of Hazard Input Document and supporting document for computer code validation (test and checks) based on Non-ergodic GMM presented in 1D Report [[5]]. The verification tests are required to test the primary functions of the PSHA codes.

Task 3 includes calculation of PSHA which will be performed for two different Ground Motion Models. First, the reviewed study SHA JEK2 Report [[1]] shall be revised and updated to include update in Ground Motion Characterisation, Seismic Source Characterization and Site Response Analysis based on review comments. Second, PSHA shall be conducted using developed Non-ergodic Ground Motion Characterisation model as described in report 1D - Independent evaluation of available Empirical ground-motion data in the region and development of Non-ergodic GMPE [[5]] as indicated in Subchapter 2.1.

2.1 Detailed scope overview

2.1.1 Description of Task 1

The goal of this task is to address comments provided in the following reports (suggestions, recommendation and requirements):

- 1A - Evaluation of GMC model [[2]],
- 1B - Evaluation of methodology for determination of rock UHRS [[3]],
- 1C - Evaluation of site AFs [[4]],
- 1 E - Independent recalculation of PSHA at JEK2 site for rock [[6]].

2.1.1.1 Comments provided in Report 1A (Evaluation of GMC model)

Based on detail review and potential impact on the results and importance of the comments, a list of required actions is given below. The list is composed based on Report number (example 1A), and number of comment (example 6.3.3) and type of comment (suggestion - SUG, recommendation - REC or requirement - REQ) (example REQ). Some actions shall be addressed and documented in Task 3.

Revised PSHA report should include the following items from 1A Report [[2]]:

1. **1A-6.3.3 - REQ**

6.3.3 Scale factors for additional uncertainty (Section 5.2.1.3):

Remove the logic tree node with the additional host-to-target uncertainty (Figure 6-89 in SHA JEK2 Report [[1]]).

***Resolution of item*:** Perform an updated assessment of the available information related to the understanding of seismic source parameters for Slovenian earthquakes or other nearby earthquakes of interest. This updated assessment will be used to determine whether the scale factors for additional uncertainty are currently warranted or should be modified (or removed) from that used in the PSHA.

2. 1A-6.3.4 - REQ

6.3.4. Kappa correction (Section 5.2.1.3)

Replace the kappa correction with an amplitude correction based on the local ground-motion data.

***Resolution of item*:** Update partially non-ergodic ground motion model from SHA JEK2 Report [1] to replace kappa correction based approach with an amplitude correction based approach using the local ground motion data. Data were previously compiled for development of the Non-ergodic GMM. The results of this effort shall be a revised partially Non-ergodic GMM that can be used for an updated PSHA. Alternative model shall be described in JEK2 PSHA Report.

3. 1A-6.3.6 - REQ

6.3.6. Definition of the horizontal component (Section 5.2.1.3)

Clearly document that the GMM used in the JEK2-SHA_Rev.0 PSHA is based on the RotD50 definition for the horizontal component.

***Resolution of item*:** Revise SHA JEK2 Report [1] to document that the GMM is based on the RotD50 definition for the horizontal component.

2.1.1.2 Comments provided in Report 1B (Evaluation of methodology for determination of rock UHRS)

Based on detail review and potential impact on the results and importance of the comments, a list of required actions is given below. The list is composed based on Report number, and number of comment (suggestion, recommendation or requirement). Some actions shall be addressed and documented in Task 3.

JEK2 PSHA Report should include the following items from 1B Report [[3]]:

1. 1B-6.1.1-SUG

6.1.1. Usage of all available data (Section 5.5.4.3 and Section 6)

It should be explained why the use of fault plane solutions was restricted to the smaller area (40 km instead of 200 km) and to the period until year 2011. Similarly, a disregard of available strong motion data from accelerometers should be explained. However, the authors of Task 1D of the current revision project already used all available data.

***Resolution of item*:** Compile additional fault plane solution data from sources identified in the 1B Review Report. Compare additional data with the data used in development of the SSC model and assess if any update is needed. Update Figure 5-21 and Figure 5-22 to show any additional focal mechanism data. Update in JEK2 PSHA Report to reflect completion of these actions. With respect to use of available strong motion data, include in the JEK2 PSHA Report reference to 1D Report.

2. 1B-6.1.2-SUG

6.1.2. Earthquakes with 10 km focal depths (Section 5.7.4.2)

Earthquakes with exact 10 km focal depth should not have been removed from the depth analysis. Update the seismogenic thickness for source zones A9, A10, A11 and background, and update the Figures 5-28 and 5-23.

Resolution of item: The seismogenic thickness analysis for source zones shall be revised using a database including earthquakes with a reported depth of 10 km. The same technical approach as used in SHA JEK2 [[1]] shall be retained (D85, D90, D95). The probability distribution for the aleatory variability in focal depth shall also be reassessed using the revised focal depth database.

Figures and tables shall be developed supporting the updated assessment for all source zones and included in an update to the PSHA report. The PSHA JEK 2 Report shall be updated to describe the updated technical bases for assessment of seismogenic depth for all source zones. Correct JEK2 PSHA Report to include reference to 1E Report [6], noting the reviewer team found that inclusion or exclusion of 10 km focal depths has a negligable affect (estimated 0,001%) to the hazard.

3. **1B-6.1.3-SUG**

6.1.3. Reference rock PSHA output results (Section 7.3)
The most important output products (hazard results) for each alternative configuration of the SSC model should be provided in the report (or in Appendix). Tabular values of the spectral shape of the controlling earthquakes should be provided in the report, as well as the comparison to the mean UHRS.

Resolution of item: Generation of additional results and inclusion in an updated seismic hazard report shall be included as part of the updated hazard calculations and development of JEK2 PSHA Report. Hazard results shall include tables showing the contribution to total hazard by configuration (i.e., A, Af, B, Bf, and D). Controlling earthquake response spectra shall also be provided in tables for a range of mean annual exceedance frequencies. This item shall be addressed in Task 3.

4. **1B-6.2.4-REC**

6.2.4. Aseismic slip (Section 5.6.3)
Considering 100 % seismic coupling is conservative. It should be justified or the probable range of aseismic factor of slip rate should be estimated, and taken into account in PSHA calculation.

Resolution of item: Evaluate the conservative position that 100 % seismic coupling should be applied and assess a range of uncertainty for the partitioning, as appropriate; consider justifications for partitioning seismic vs. aseismic strain rates based on a consideration of published geodetic, geologic, and seismic information. Any updated assessment shall be included in the updated HID and updated PSHAs. Source zone recurrence parameters shall be updated to reflect the updated assessment of seismicity from fault sources. The technical basis for the refined assessments shall be described in the JEK2 PSHA Report.

5. **1B-6.2.5-REC**

6.2.5. Maximum magnitude estimation (Section 5.7.4.6)
Mmax estimation should avoid subjective opinion or at least the criteria and argumentation should be clearly specified. Different number of Mmax alternatives and different weights from source to source, which lead to huge number of logic tree branches, should be avoided, unless absolutely necessary.

Resolution of item: Expand, as appropriate, the discussion of Mmax assessments in JEK2 PSHA Report to explain more completely the justification and technical bases for the assessments made for each source. Also, the technical basis for why the SSC TI team assessed different Mmax distributions for different zones to appropriately represent differences in the uncertainty distribution needs to be provided.

Expand the discussion of logic tree development to address tradeoffs between less complexity and the need to represent the uncertainty in inputs. Also address the use of logic tree trimmingto achieve a simplified logic tree that can be calculated with minimal impact on the hazard curve distribution.
In addition, include in the JEK2 PSHA Report the observations and conclusions from Report 1E on how logic trees can be simplified based on sensitivity analyses. Specifically, it should be noted that hazard is relatively insensitive to Mmax distributions.

6. 1B-6.2.6-REC

6.2.6. ArcGIS and source zone coordinates (Section 5.10) Provided ArcGIS shape files and source zone coordinates in HID should be corrected as discussed in Section 5.3 of this review report.

Resolution of item: Compare the GIS database and the HID coordinates to assess the described discrepancies and other issues and make adjustments, if necessary. The PSHA report shall be updated to note that representation of fault sources for the hazard calculation can involve a simplification of the fault surface trace geometry from geologic mapping.

7. 1B-6.2.7-REC

6.2.7. ESV STM (Section 5.9):
The author entrusted of the planned revision of SHA report should provide additional elaboration of the impact of the updated ESV STM to the SSC model and hazard results. In case of a significant impact, the SSC model should be updated.

Resolution of item: Perform a review of the Extended Site Vicinity (ESV) Seismotectonic Model (STM) report to reassess if there are any significant aspects that were not adequately addressed in the SSCM (Seismic Source Characterization Model). If it is determined that the components of the 2018 ESV STM require changes to the SSCM, the model will be updated and the HID will be modified to reflect the assessment.

For each fault source, the reassessment shall examine if probabilities of existence and probabilities of activity in the 2018 SSCM should be updated based on the ESV STM. This shall involve consideration of the paleoseismic and age-dating results used to develop the ESV STM. Earthquake fault plane solutions that were unavailable for the development of the 2018 SSCM will be examined for their impact on the geometric and kinematic characterization of fault sources. The focus shall be on the Orlica fault source, the Article fault source and the Gorjanci fault source, which are the fault sources closest to the Krško site area.

The consideration of ESV STM impacts on the Orlica fault source shall also address Comment 12. 1B-6.3.12-REQ to eliminate inconsistencies in the characterization. The assessment of configuration and potential segmentation shall be updated, as appropriate.

For area source zones in the ESV, the updated seismotectonic model shall be evaluated for impacts on the technical basis for source zone boundaries and rupture characteristics.

For the updated PSHA Final Report, the ESV STM shall be used to provide expanded technical bases for the characterization of seismic sources, including any updated assessments of fault or area sources.

8. 1B-6.2.8-REC

6.2.8. Delineation of A12, A13 and B12 (Section 7.2):
Delineation of area seismic source zones A12, A13 and B12 is crucial, and should be reconsidered with great care, including determination of weights. The author entrusted of the planned revision of SHA report should provide

a more precise elaboration why seismic source zones have been delineated in such a way as it is documented. (In)homogeneity of seismicity, and unusual shape of seismic source zones (SSZs) (narrow eastern corners) should be examined.

***Resolution of item*:** Consideration shall be given to the inhomogeneity of the seismicity with respect to the SSZ configurations and their narrow eastern corners. If it is determined that modification of the SSZ configurations is appropriate, update the configurations. Technical justification for the original or updated configuration shall be enhanced or provided, as appropriate, in JEK2 PSHA Report.

9. 1B-6.2.9-REC

6.2.9. D configuration (Section 7.2):
D configuration should be omitted or replaced with configuration Df (smoothed seismicity should be combined with fault-specific source zones).

***Resolution of item*:** Reconsider the inclusion of the D configuration (future seismicity based only on the record of past seismicity) in the SSC model. As appropriate, expand justification for inclusion of the D configuration as part of the range of uncertainty for approaches to seismic source characterization. Elaboration shall include whether an alternative with fault sources is supported. Incorporate any changes in implementation of the approach in the updated PSHAs and in the JEK2 PSHA Report.

10. 1B-6.2.10-REC

6.2.10. Sensitivity studies (Section 7.2):
Sensitivity studies should be performed to analyze the impact of uncertainty of the most important parameters on hazard results (e.g. Mmax, seismogenic depth, b-value, slip rate, dip, source geometry). Based on the results, modeling of the epistemic uncertainty (logic tree for SSC model) should be simplified, especially different Mmax weights from source to source.

***Resolution of item*:** As the SHA JEK2 Report [[1]] shall be superseded by JEK2 PSHA Report using new ground motion models, there is no additional need for sensitivity analyses based on the 2018 PSHA models. Contractor shall expand hazard sensitivity analyses in the PSHA JE2 Report to include the contribution of key uncertain parameters to overall hazard variance as a function of mean annual frequency of exceedance (MAFE) for an updated PSHA. The level of effort for the expanded sensitivity analyses shall be included in the tasks to update the PSHA using the amplitude-based partially Non-ergodic ground motion model and the fully Non-ergodic ground motion model.

The sensitivity analyses shall be discussed with respect to how they can be used to simplify or trim logic tree branches for PSHA software that are limited in the logic tree complexity they can reasonably handle. This item shall be addressed in Task 3.

11. 1B-6.3.11-REQ

6.3.11. Completeness Analysis for the JEK2015 earthquake catalogue (Section 4.10):
Based on discussion in Chapter 5.2 of this review report, completeness results are questionable. For the smallest Mw (3.5), consider the alternative completeness year at the end of 19th century, and evaluate its impact, regarding the given completeness year (1975). Compare a-values and hazard curves for the most influential source zone A12.

***Resolution of item*:** Include the recent assessments of catalog completeness performed by ARSO in PSHA update. Efforts should complement the work that was performed in 1E (Report 1E - Ch.4, [6]).

12. 1B-6.3.12-REQ

6.3.12. Scenarios for Orlica fault source (Section 5.10):
Scenarios for Orlica fault source and their PE-normalized values should be reconsidered in order to be consistent with the given PEs.

> ***Resolution of item***: Effort to evaluate the impacts of the ESV STM on fault and area sources, including the Orlica fault source, shall be included in the scope to address Recommendation 7. 1B-6.2.7-REC.

2.1.1.3 Comments provided in Report 1C (Evaluation of Site Amplification Factors)

Based on detail review and potential impact on the results and importance of the comments, a list of required actions is given below. The list is composed based on Report number, and number of comment (suggestion, recommendation or requirement). Some actions shall be addressed and documented in Task 3.

Revised PSHA report should include the following items from 1C Report [[4]]:

1. **1C-6.2.1-REC**

6.2.1. (R) Section 8.2.2, "nonconsideration of WD-1 and ED-1 downhole seismic test is not fully justified": The SRA TI Team decided that LILW Vs measurements are more reliable than those associated with boreholes WD-1/09 and ED-1/09. Such a conclusion is highly uncertain because it is based on the expectations from the reflection related to greater over-consolidation at the West site. There is no argument given in the [JEK2-SHA_Rev.0] that the downhole seismic test at WD- 1/09 and ED-1/09 boreholes are incorrect. Additional investigations of the site shear-wave velocities may be carried out in the later stages of the JEK2 project to confirm or reject the decision of the SRA TI Team. At this stage of the project, it is recommended to consider shear wave velocities from WD-1/09 and ED-1/09 measurements as an integral part of the data used to define shear-wave velocity profiles for the site response analysis. Another option is to further justify why shear wave velocities from WD-1/09 and ED-1/09 measurements were disregarded. Namely, the weight of the measurements from WD-1/09 or ED-1/09 for the definition of the base-case shear wave velocity profile may be higher than that captured by a single shear-wave velocity profile from the randomisation process. Thus the decision not to use downhole seismic tests at the East and the West site because these sites are somehow addressed by the randomisation process, as discussed in [JEK2-SHA_Rev.0], is not justified.

> ***Resolution of item***: The discussion related to the development of the base case Vs profiles for the Site Response Analysis (SRA) shall be enhanced to include discussion of the downhole Vs measurements from boreholes WD-1 and ED-1 and confidence in those results relative to the more recent data.

2. **1C-6.2.2-REC**

6.2.2. (R) Section 8.3, "shear-wave velocity profiles for SRA may provide a bias in SAFs": The generation of the shear-wave velocity profiles are based on some assumptions which may provide biased SAFs. It may be acceptable that the standard deviation of the Vs for the aleatory part of the uncertainty is assumed from the literature [Toro, 1996], but the depth silty sand to sandy silt varies at Krško site. Thus, it may not be appropriate to constrain the Vs to 760 m/s at a depth of 100 m, which was adopted for the reference rock condition. From the geological structure, it is clear that the thickness of the silty sand and sandy silt systematically decreases looking from the Sava river to the North. One option is to consider the depth associated with Vs=760 m/s as a random parameter. Also, in the randomisation process, the shear wave velocity for a layer just above the bottom layer varies from about 500 to 760 m/s. For most profiles, this causes a sudden jump of shear-wave velocities at about 90 m, which may not be the case at Krško site. Because of constraining the shear-wave velocity to 760 m/s at the bottom layer and neglecting the variation of the depth as the random variable, the resulting SAFs can be biased. The variation of the depth would make it possible that the profiles used in the SRA may adequately account for the difference between the profile adopted in hazard analysis for reference rock condition and the SRA. In addition, site profile related uncertainty contributions that are already inherent in the ground motion attenuation relationships used in the seismic hazard analysis should be identified and disregarded so as not to be included more than once.

Resolution of item: Efforts shall be performed to understand if the randomized shear-wave velocity profiles result in any bias in SAFs. This work will test the inclusion of depth and thickness variation in the randomization process and the resulting impact on site amplification factors (SAFs). Additionally, other approaches [11] to the development of randomized Vs profiles shall be tested**.** This item shall be addressed in Task 3.

3. 1C-6.2.3-REC

6.2.3. (R) Section 8.4, "the use of low strain damping of 1.5% should be further explained and justified": On page 686 of [JEK2-SHA_Rev.0] it is stated: For the Krško SRA low-strain damping of 1.5% was selected by the SRA TI team primarily based on the ML soil Review of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1C - Evaluation of site AFs, Final Review Report, Rev.0 and Engineering solutions for building new NPP JEK2:classification for the site soils and comparing to the suite of dynamic property curves from EPRI (1993) for fine-grained soils (albeit these are mostly clays). Epistemic uncertainty is not considered for low-strain damping because it is anticipated that soils will be dominated by hysteretic damping. Based on the above explanation it is not clear how the value of low strain damping was estimated and which sources of damping are actually taken into account by the damping that is additional to strain-dependent damping curves presented in Figure 8-29 of [1]. It is recommended to further explain and justify the use of 1.5% low-strain damping.

Resolution of item: Additional explanation shall be provided in the JEK2 PSHA Report to justify the use of 1.5% low-strain damping for SRA. If approprite, the value shall be updated for updates of the site response analyses.

4. 1C-6.2.4-REC

6.2.4. (R) Section 8.6, "the log standard deviation of the SAFs due to ground motion randomness may be overestimated": The highest value of natural log standard deviations of SAFs is observed in the interval from 0.20 to 0.25 (i.e. see Tables 8- 8 to 8-10 in [JEK2-SHA_Rev.0]. The log standard deviations of SAFs were calculated according to the method of moments (see formula on page 949 of [JEK2- SHA_Rev.0]) by accounting the credible amplification factors from the site response analysis. Such an approach may overestimate the uncertainty in site amplification factor due to ground motion randomness, which is already accounted for by the ground motion model for reference rock site. It may be more appropriate to calculate natural log standard deviations of SAFs only by estimating the standard deviations of SAFs due to nonlinear site effects only.

Resolution of item: For the updated site response analysis, Contractor shall consider recent geotechnical literature and assess new approaches to avoid including variability in AFs that is already included in the ground motion model (i.e., double-counting). If warranted, sensitivity analyses shall be performed to examine the impact of over-estimating the log standard deviation of the SAFs on control point hazard. Insights from the sensitivity analyses shall be used to update the approach used for updated site response analyses. This item shall be addressed in Task 3.

5. 1C-6.2.5-REC

6.2.5. (R) Section 9.1.2, "calculation of hazard curves at control point elevation 148 m is not precisely elaborated, the effect of epistemic uncertainty in the AFs may be improved": Simplified SSC model was developed, verified and used for generation of hazard curves for the reference rock, which were then coupled by the site amplification factors to calculate the hazard curve at the control point elevation. However, from the report is not clear how many hazard curves were developed for the reference rock using simplified SSC model? It can be understood that many hazard curves for the reference rock site were generated. On the other hand, the effect of epistemic uncertainty of the AFs was considered only with AFs corresponding to BE, UR and LR site profiles. It seems that the consideration of uncertainty in reference rock hazard curves and the uncertainty of AFs is not balanced. It may be more convenient to calculate many fractiles of the hazard curves directly from the hazard curves of the reference rock and then combine those fractile curves with the fractile curves of the AFs rather than using only AFs for the BE, UR an LR site profiles. Such an approach would make it possible to address the uncertainties in the site response analysis more precisely (i.e. by using a coupled effect of epistemic and aleatory uncertainty).

Resolution of item: Based on current state of practice, Contractor shall re-examine the approach taken for combining the results of the reference rock PSHA with the updated site response analyses. Consideration shall be given to appropriately incorporating epistemic uncertainties and aleatory variability without double-counting. Updated sensitivity studies shall help guide simplification of PSHA and SRA logic trees to increase computational efficiency while still representing the significant impacts of uncertainty on the total hazard results (mean and fractile). This item shall be addressed in Task 3.

6. 1C-6.2.6-REC

6.2.6. (R) Section 9.2.1, "SL-1 may be inconsistent with IAEA guidelines [IAEA-NS-G-1.6]": IAEA guidelines do not specify precisely ground motions for design. However, it is noted (Note 4 in SL-1 [IAEA-NS-G-1.6]) that SL-1 corresponds to a level with a probability of being exceeded of 1e-2 per reactor per year. Thus, the SL-1 for JEK2 can be associated with the stricter value of MAFE than discussed in IAEA. More stringent levels of SL-1 ground motion may be problematic. According to [IAEANS-G-1.16] (Article 7.7), the lower trigger level of the seismic monitoring and scram system should be close to SL-1 ground motion, which is usually associated with the operational limit state. Thus, considering SL-1 at MAFE of 1e-3, which is the case of JEK2 [JEK2-SHA_Re.0], may provide quite a stringent criterion for the operational limit state of JEK2. It is thus recommended to evaluate design spectra which will be used for triggering purposes of the monitoring system (i.e. for MAFE of 1e-2 per year).

Resolution of item: Develop design response spectra based on UHRS with MAFE for SL-1 and SL-2 specified by safety codes and standards to ensure nuclear safety in discussion with GEN. This item shall be addressed in Task 3.

7. 1C-6.3.8-REQ

6.3.8. (RQ) Section 8.4, "the parameters of the randomization process of G/Gmax and damping curves is not defined": Although the model is adequately explained the parameters of the models (cG, cξ) which are used to adjust σln(ξ), σln(G/Gmax) are not clearly defined in the report [1]. Thus it is not possible to recreate the randomised G/Gmax and damping curves.

Resolution of item: Improve the description of the procedure and the parameters used to derive the randomized G/Gmax and damping curves. Provide sufficient information to allow for the randomized curves to be recreated. This shall be included in JEK2 PSHA Report.

8. **1C-6.3.9-REQ**

6.3.9. (RQ) Section 9.2.2, "recommended V/H ratio may be too low in the high-frequency range": It seems that the nonlinear effect in the horizontal acceleration was neglected in the application of the models of V/H ratio. Consequently, the V/H ratio in the high-frequency range can be too low. It is required to explain further and verify the recommended V/H ratio because the horizontal spectral acceleration for controlling point 148 m seems to be too low in the high-frequency range (see Figure 10-1 in SHA JEK2 Report [1] and reveiw in Section 5.3).

> ***Resolution of item***: The recommended V/H ratio shall be reviewed to verify that V/H ratios are appropriate (and not too low for higher response frequencies). This review will include consideration of how each empirical model treats potential nonlinear behavior for horizontal motions. Include results of the review in enhanced discussion in the JEK2 PSHA Report. This item shall be addressed in Task 3.

2.1.1.4 Comments provided in Report 1E (Independent recalculation of PSHA at JEK2 site for rock)

Based on detail review and potential impact on the results and importance of the comments, a list of required actions is given below. The list is composed based on Report number, and number of comment (suggestion, recommendation or requirement).

JEK2 PSHA Report should include the following item from 1E Report [[6]]:

1. **1E-1 - SUG**

Comment: Section 1 of Task 1E Final Report: "Recalculated hazard values are compared with the corresponding Rizzo & GeoZS results for the rock condition, which were presented in [JEK2-SHA_Rev.0]. With a generally good fit, the largest difference between the mean hazard curves of individual seismic sources is when comparing the Artiče fault seismic source, especially at 1 Hz SA. Therefore, the hazard for Artiče fault source was additionally recalculated by Norman A. Abrahamson Inc. (NAA) using their HAZ45 software. The results obtained by ARSO and NAA are almost identical. The possible cause for deviation from Rizzo & GeoZS hazard results of Artiče (and of other fault seismic sources) might be that they had probably ignored influence of epistemic uncertainty in dip on [Youngs and Coppersmith 1985] conversion from a slip rate to avalue."

> ***Resolution of item***: Investigate implementation of the conversion of slip rate to a-value for the Artiče fault source. As appropriate, clarify the implementation of the SSC logic tree or update the hazard calculation for the Artiče fault source in an JEK2 PSHA Report.

2.1.2 Description of Task 2 – Hazard Input Document (HID) for PSHA calculations

Recent ground-motion characterization studies have led to more complex source and ground-motion models, which necessitate implementation in PSHA codes. We describe the steps necessary to perform a site-specific PSHA with the developed Non-ergodic GMPE defined in Report 1D [[5]].

Preparation of hazard Input Document (HID) for Non-ergodic Model shall include:

- The HID shall document the logic tree for the model, including the branch alternatives and relative weights. It should also provide the functional form for the model and coefficient values and/or tables of ground motion values or adjustments as a function of model predictor variables. The HID should also include any instructions for the hazard analyst on how the model should be implemented to obtain the ground motion measure of interest. HID shall provide the complete model without the technical bases and justifications underlying the model elements and logic tree.
- Supporting document for computer code validation (test and checks). The verification tests are designed to test the primary functions of the PSHA code. Verification efforts need to be performed by running an expanded set of verification tests on codes for PSHA calculations.

2.1.3 Description of Task 3 – PSHA Report for JEK2

This Chapter describes the methodology used to perform the Probabilistic Seismic Hazard Calculations for ground motion at the JEK2 site. Contractor shall perform all required PSHA calculations for JEK2 PSHA Report. Organizational structure differences and processes shall be adequately documented in the JEK2 PSHA Report.

2.1.3.1 PSHA/SRA Update #1:

The update shall be performed with inputs for the calculations that are using existing RIZZO-GeoZS GMC model [[10]] revised with empirical amplitude adjustment approach instead of Vs-kappa adjustment approach with developed RIZZO-GeoZS SSC model [[9]]. It has to include revisions from Review Comments defined in Reports [[2],[3],[4] and [6]] and Site Response Analysis. The following approach is proposed:

- Update PSHA input files to reflect changes in GMC and SSC models;
- Perform reference rock PSHA calculations, including expanded sensitivity analyses; prepare reference rock PSHA Calculation document; verify and finalize Calculation;
- Update SRA input files to reflect changes in geotechnical model and reference rock ground motions; perform updated SRA calculations; prepare SRA Calculation to document updated SAFs; verify and finalize SRA Calculations;
- Develop updated control point ground motions by combining updated reference rock PSHA results with updated SRA results; prepare control point ground motion Calculation; verify and finalize control point ground motion Calculation;
- Update V/H spectral ratio functions for vertical ground motion; determine vertical ground motions; prepare Calculation for V/H spectral functions and vertical ground motion; verify and finalize V/H Calculation.

2.1.3.2 PSHA/SRA Update #2:

Contractor shall perform PSHA with inclusion of developed Non-ergodic Ground Motion Model for JEK2 described in [5]. All calculations shall be performed with inputs from Non-ergodic GMC model [[5]] adopted to run on RIZZO-GeoZS SSC model [[9]], including revisions to address Review Comments defined in Reports [2,3,4 and 6] and Site Response Analysis. The hazard calculations shall be conducted using qualified PSHA software. The following actions are proposed:

- Implement Non-ergodic GMC model in hazard calculation software, including Verification and Validation of modifications;
- Implement updated hazard calculation approach for Non-ergodic GMM as described in Subchapter 2.1.2 of this Technical Specifications, including V&V of modifications;
- Prepare PSHA input files for fully Non-ergodic GMC model from Hazard Input Document;
- Perform reference rock PSHA calculations, including expanded sensitivity analyses; prepare reference rock PSHA Calculation document; verify and finalize Calculation;
- Update SRA input files to reflect changes; perform updated SRA calculations; prepare SRA Calculation to document updated SAFs; verify and finalize SRA Calculations;

- Develop updated control point ground motions by combining updated reference rock PSHA results with updated SRA results; prepare control point ground motion Calculation; verify and finalize control point ground motion Calculation;
- Update V/H spectral ratio functions for vertical ground motion; determine vertical ground motions; prepare Calculation for V/H spectral functions and vertical ground motion; verify and finalize V/H Calculation.

2.1.3.3 Preparation of Final JEK2 PSHA Report

Following actions are required:

- Response actions taken to address external independent review comments described under Task 1 (Reports 1A [[2]], 1B [[3]], 1C [[4]], 1D [[5]], 1E [[6]]), and
- Discussion of hazard results for two alternative GMMs (partially Non-ergodic, amplitude-based adjustment approach defined in 2.1.3.1 of this Technical Specifications and fully Non-ergodic approach defined in 2.1.3.2 of this Technical Specifications).

Final JEK2 PSHA Report shall include discussion of hazard results for two alternative Ground Motion Models (partially non-ergodic, amplitude-based adjustment approach and fully Non-Ergodic approach). While the Non-ergodic approach is a new methodology, it is a clear improvement over the traditional ergodic approach that combines data from different regions into a single model that overestimates the variability [[5]]. The Non-ergodic approach provides a more accurate estimate of the ground motion (median and aleatory variability) than the partially Non-ergodic approach used in the SHA JEK2 Report [[5]]. Because of the significant improvement in uncertainties of the results discussed in [[7]], it is essential that proper interpretation and conclusion of PSHA is performed and described.

3 PROJECT DELIVERABLES

Contractor shall provide Reports listed in table below. Contractor shall provide JEK2 PSHA Report based on subtasks 2.1 as described in previous sections of this document. Report shall be prepared as preliminary report and will be subject to GEN review and Independent Review. After resolution and inclusion of all comments, Final Report shall be prepared and submitted. The Contractor is responsible to present results to GEN.

Following list of deliverables are obligated:

1st Deliverable	Preliminary Task 1 Report
	Task 1A - revision of Ch. 6 of the SHA Report [[1]]
	Task 1B – revision of Ch. 4, 5 and 7 of the SHA Report [[1]]
	Task 1C – revision of Ch. 8 and 9 of the SHA Report [[1]]
	Task 1E – inclusion of sensitivity analyses
2nd Deliverable	Final Task 1 Report
3rd Deliverable	Hazard Input Document (HID) and supporting document for computer code verification and validation
4th Deliverable	Preliminary JEK2 PSHA Report
5th Deliverable	Final JEK2 PSHA Report

6th Deliverable	6.a) Technical presentation of JEK2 PSHA Report
	6.b) General presentation of JEK2 PSHA Report

4 INFORMATION TO BE PROVIDED BY GEN

GEN shall provide all the referenced documents and Reports provided in Chapter 18 References.

GEN shall additionally provide the following documents:

1. Digital input data for PSHA;
2. ARSO, »Earthquake catalogue 2014«, Revision 1, Ljubljana, Slovenia
3. RIZZO, Geo ZS, SHA Project, Final Report »Seismic Hazard Analysis Report« Rev.0, 21 Sept 2018, with Appendices and supporting documentation.
4. RIZZO, Geo ZS, SHA project, Fault Capability Assessment Report for the proposed Krško 2 Nuclear Power Plant, Slovenia, September 2018.
5. RIZZO, Geo ZS - Technical presentation of the SHA project, September 2018.
6. RIZZO, Geo ZS - Seismotectonic model for the Nuclear Power Plant Krško 2 near-region and site vicinity, Slovenia, September 2018.
7. RIZZO, Geo ZS - Summary Report Seismic Source Characterization Model, Hazard Input document, Krško, Slovenia, December 2017.
8. RIZZO, Geo ZS – Ground Motion Characterization Model, Hazard Input Document, Rev. 0, Dec. 2017
9. RIZZO, Geo ZS - High Resolution Seismic Survey, Summary Report to evaluate the Artiče and Orlica faults near Krško, Slovenia, Rev. 1, March 2016.
10. RIZZO, Geo ZS - Strategy for developing Ground Motion Characterization Model, revision 0, November 2016.
11. RIZZO, Geo ZS - Krško Probabilistic Seismic Hazard Analysis - Site geotechnical model for Site Response Analysis, draft, December 2016.
12. NE Krško Nuclear Power Plant, “Section 2, Site Characteristics,” Revision 16 Safety Analysis Report.
13. Geomatrix Consultants, Inc., 2004, Revised seismotectonic model of the Krško basin: Report PSR-NEK-2.7.1 (Revision 1); prepared for Nuclear Power Plant Krško, Vrbina 12, Krško, Slovenia; by Geomatrix Consultants, Inc, Oakland, California, USA; in cooperation with University of Ljubljana, Faculty of Civil and Geodetic Engineering Institute of Structural Engineering, Earthquake Engineering and Construction IT; Environmental Agency of the Republic of Slovenia, Office of Seismology; and Geological Survey of Slovenia.
14. RIZZO (Paul C. Rizzo Associates), 2013d, “Sensitivity Analysis, Probabilistic Fault Displacement Hazard Analysis, Krško East and West Sites, Proposed Krško 2 Nuclear Power Plant, Krško, Slovenia,” Final Technical Report, Revision 1, 31 May 2013.
15. University of Ljubljana, Environmental Agency of Republic of Slovenia, and Geological Survey of Slovenia, in cooperation with Geomatrix Consultants and University of Zagreb, 2004, *Revised PSHA for NPP Krsko site, PSR-NEK-2.7.2*, Revision 1.

16. ARSO, 2017. The earthquake on 1 November 2015 at Gorjanci Mountains and its aftershocks. Final Report, The Slovenian Environmental Agency, Ljubljana.
17. FGG, 2021. Task 2A – Frequency-dependent site amplification factors, Preliminary Report, Rev. 0.

GEN shall provide documentation and Reports cited in specific sections of SHA Final report [1] and in review reports [2],[3], [4], [5] and [6] available at GEN disposal upon request, whereas publicly accessible documentation shall only be referenced. It is the Contractor's obligation to gain access to that sort of documentation.

Upon request, GEN shall contact developer and reviewers (RIZZO Internationa Inc., Geological Survey of Slovenia, Faculty of Civil and Geodetic Engineering, Institute of Structural Engineering) to clarify details about the PSHA methodology, input data, its interpretation and comments and findings based on review.

5 CONTRACTOR'S TECHNICAL APPROACH

In the Bid proposal, the Contractor shall provide the proposed scope of work, methods for work and requirements to perform required engineering services.

The Contractor shall submit a project plan which outlines when and how the work shall be performed and indicate what the Contractor understands under the Contractor's scope of service.

The Contractor is obliged to prepare and transmit the minutes of each meeting, either in-person or videoconference meeting, within five (5) working days after the meeting.

The Contractor is obliged to keep records of open issues (notes, questions and answers) during the project. A record of open / closed issues must be attached to Status Report.

6 PROJECT MANAGEMENT

6.1 Quality Assurance Requirements

Quality assurance in this project has two major goals: to minimize the possibility of errors occurring (or remaining undetected) and to guarantee reproducibility and traceability of all project results.

The work shall be carried out in accordance with sound and standard professional practices and in compliance with all applicable codes and regulations. All services shall be performed in accordance with a specific quality assurance program for Contractors.

It is desirable that it is in conformity with EN ISO 9001:2015, otherwise the Contractor shall provide GEN that his program meets the minimum requirements for the smooth execution of the tasks requested by the contracting authority.

6.2 Applicable standards

The Contractor shall, while performing the task, use and consider the latest national Slovenian nuclear rules, IAEA, EUR, US NRC, and ASCE guidelines and standards.

Applicable national rules on nuclear safety:

- SNSA, Rules on radiation and nuclear safety factors, June 2018.

Applicable IAEA Safety codes and standards:

- “Site Evaluation for Nuclear Installations”, Safety Standard Series No. NS-R-3, IAEA, Vienna, 2003;
- “Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants, NS-G-3.6, IAEA, Vienna, 2004;
- “Seismic Hazards in Site Evaluation for Nuclear Installations”, Specific Safety Guide No. SSG-9, IAEA, Vienna, 2010;
- “Seismic Design and Qualification for Nuclear Power Plants”, Safety Standards Series No. NS-G-1.6, IAEA, Vienna, 2003;
- »Ground Motion Simulation Based on Fault Rupture Modelling for Seismic Hazard Assessment in Site Evaluation for Nuclear Installations« Safety Report Series, IAEA, 2015;
- “Site Survey and Site Selection for Nuclear Installations”, SSG-35, Vienna, IAEA, 2015.

Applicable European Utility Requirements document chapters:

- EUR Revision E, Chapter 2.4.6 Design Basis, Seismic Design;
- EUR Revision E, Chapter 2.4.A, Method of Seismic Analysis.

US NRC guides as additional technical guidance:

- NRC’s Regulatory Guide 1.208 A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion (2007);
- NRC’s Regulatory Guide 1.132, Site investigations for foundations of Nuclear Power Plants (2003);
- US NRC, Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies Office of Nuclear Regulatory Research, NUREG-2117, Rev. 1 (2012);
- NRC (U.S. Nuclear Regulatory Commission), 2010, “Interim Staff Guidance on Ensuring Hazard-Consistent Seismic Input for Site Response and Soil Structure Interaction Analyses,” DC/COL-ISG-017, U.S. Nuclear Regulatory Commission, Washington, D.C.;
- NRC’s Regulations - 10 CFR 100.32 - Geologic and seismic siting criteria;
- US NRC Regulatory Guide 1.92 Combining Modal Responses And Spatial Components In Seismic Response Analysis, Revision 3;
- US NRC NUREG-0800, Standard Review Plan, Chapter 3.7;
- US NRC NUREG/CR-6896, Assessment of Seismic Analysis Methodologies for Deeply Embedded Nuclear Power Plant Structures;
- US NRC Regulatory Guide 1.60, Design response spectra for seismic design of Nuclear Power Plants.

American Society of Civil Engineering standards:

- ASCE 4-98, Seismic Analysis of Safety-Related Nuclear Structures and Commentary;
- ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures, Chapter 17 Seismic Isolated Structures.

7 SCHEDULE

The detailed project schedule shall be prepared within the contractor's approach plan. Work should be organized to plan in parallel in all Tasks and Subtasks as much as possible to ensure work is performed in the allocated timeframe.

The total estimated project duration is 55 weeks. The schedule starts at T_0 with contract signature.

The Contractor shall present the best-case schedule plan and its duration without jeopardizing any aspect of these Technical Specifications.

	Activity	**Activity Duration**	**End Time after Contract signature**
1	Contract signature	**To**	**To**
2	Information provided by GEN or subcontractors	**1 week**	**To + 1 week**
3	Preliminary Task 1 Report (Task 1A, 1B and 1C) delivery	**17 weeks**	**To + 18 weeks**
4	*Review of Report by GEN and IR*	***4 weeks***	**To + 22 weeks**
5	Revised Preliminary Task 1 Report delivery	**2 weeks**	**To + 24 weeks**
6	*Final review by GEN and IR*	***2 weeks***	**To + 26 weeks**
7	Final Task 1 Report delivery	**1 week**	**To + 27 weeks**
8*	HID based on 1D Report and supporting document for computer code validation	**7 weeks**	**To + 7 weeks**
9	Preliminary JEK2 PSHA Report delivery	**14 weeks**	**To + 41 weeks**
10	*Review of Preliminary JEK2 PSHA report by GEN and IR*	***4 weeks***	**To + 45 weeks**
11	Revised Preliminary JEK2 PSHA Report delivery	**2 weeks**	**To+ 47 weeks**
12	*Final Review by GEN and IR*	***4 weeks***	**To + 51 weeks**
13	Final JEK2 PSHA Report delivery	**2 weeks**	**To + 53 weeks**

14	Technical and Management Presentation delivery	**1 week**	**To + 54 weeks**
15	**Presentation of Final Results**	**1 week**	**To + 55 weeks**

NOTE:

T_0 = contract signature, Activity 8 can be performed simultaneously as Task 1, Activities 4,6,10 and 12 are out of scope for Contractor.

8 STATUS REPORTS

The Contractor is required to submit Intermediate Reports for each task on a monthly basis.

Intermediate Report(s) shall include project overview and progress, issues, risk and change management (open issues - identification of any key issues requiring resolution, open risks, open change requests) and action plan. The Contractor shall submit Intermediate reports to GEN Project Team members. The Intermediate Reports shall be numerated from 1 to N and send by email every last Friday each month.

9 CONTRACTOR REQUIREMENTS

The Contractor and GEN could propose and organize working meetings and/or conference calls after the Intermediate Report is submitted or at any other need during the project. Meetings shall be held at regular intervals or if justified by special agenda issue and shall be occurring online.

The Contractor is obliged to prepare and transmit the minutes of each meeting within three (3) working days after the meeting.

The Contractor is obliged to keep records of open issues (notes, questions and answers) during the project. A record of open / closed issues must be attached to the Intermediate Report.

10 CHANGES IN THE SCOPE OF WORK

The Contractor shall identify any scope changes that could cause an impact on the Contractor's cost or schedule of the project by the issuance of a Contractor Request for Change of Work Scope. The Contractor shall not proceed with the change of Work Scope until written approval has been authorized by GEN. It is the Contractor's obligation to notify the GEN Responsible Project Manager, Project Engineer and Deputy Project Engineer in writing of the noted scope changes and it is the responsibility of the GEN Responsible Project Manager/Project Engineer to respond within ten (10) working days from the receipt of the Contractor's request for work scope change.

Changes in the scope of work are possible on the basis of a written annex to the basic contract, which must be agreed between both parties.

11 DOCUMENTATION TO BE PROVIDED BY GEN - REFERENCES

GEN shall provide to the Contractor all the available input data at his disposal and necessary for the smooth conduct of analyses or analysis. Information that is freely publicly available is not required to be provided by GEN.

If the Contractor considers that he has not obtained all necessary information from GEN he is obliged to request this in writing, otherwise, GEN cannot be held liable for possible delays.

12 ORGANIZATIONAL CONTACT

Project organisation is as follows:

Responsible Project Manager	**dr. Bruno Glaser**
	Head of Technical division
✉	Bruno.glaser@gen-energija.si
☎	07 49 10 200

Project Engineer	**Mojca Planinc**
	Project Engineer
✉	Mojca.planinc@gen-energija.si
☎	07 49 10 244

Project Engineer	**Aleš Kelhar**
	Project Engineer
✉	Ales.kelhar@gen-energija.si
☎	07 49 10 231

13 DELIVERABLE DOCUMENTATION TECHNICAL REQUIREMENTS

The Contractor is obliged to deliver all documents in Preliminary form and after GEN approval, as final documents.

Documentation	Quantity	Media/Transfer	File type
Preliminary Reports	1	electronic: ftp	doc(x) & pdf
Final Reports	2	electronic: USB + ftp	doc(x) & pdf
	2	paper	/
Presentations	1	electronic: ftp	ppt(x)

Figure, photo, scan		electronic: ftp, USB	png, tiff, jpg, jpeg, pdf
Table		electronic: ftp, USB	xsl(x)
Spatial data		electronic: ftp, USB	shp
Calculation		electronic: ftp, USB	source file

The text should be written and delivered in MS Office Word format. Figures and tables included in the reports shall be inserted as objects. Figures shall be delivered also as original source files or in other formats in high-resolution size. Tables shall be delivered as original source MS Office Excel format files. Scanned text, figures and tables of reference documentation should be in MS Office compatible format or other formats which are widely used.

The documentation has to be written in programs: MS Word, MS Excel, MS Office PowerPoint, with the following features:

Paper size:	A4
Margins:	top, bottom, left, right – 2,54cm
Font style:	MS Office Word, use Calibri
Font size:	text 10 pt, titles 14 pt bold, subtitles 12pt bold
Language:	English

Delivery of the documentation:

The Contractor is obliged to deliver all additional documentation, which was used as a reference for the Final Report: Regulations and industry guidelines, Analyses and calculations results, Figures, graphs and tables, and other reference documents important for the implementation of the study.

14 ACCESS TO INFORMATION

The Contractor shall provide access to all the information used for purposes of consulting services

15 CONTRACT AND SUBCONTRACT WORK

When the Bid is accepted, the Contractor shall not subcontract any portion of the work without the written approval of GEN. Only Subcontractors already specified in the bid are considered to be approved directly. Appropriate contractors QA program shall be applied for selection of subcontrators.

16 PROPRIETARY INFORMATION

When the Contractor receives documents or data including propriety information from GEN, he shall bind himself to the protection of the documents or data of propriety information by signing a non-disclosure agreement to the list of provided documents including propriety information shall be attached.

The Contractor shall, by signing the project work performance contract, bind himself to safeguard all the data provided to him by GEN during the performance of the work defined by the contract as propriety information and intellectual property.

17 TRANSFER OF COPYRIGHT

Receiving all payments defined in the project work performance contract, the Contractor shall exclusively transfer for an indefinite period and all cases documentation copyright to GEN.

18 REFERENCES

[1] RIZZO, Geo ZS, SHA Project, Final Report »Seismic Hazard Analysis Report« Rev.0, 21 Sept 2018, with Appendices and supporting documentation.

[2] [JEK2-1A] Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1A - Evaluation of Ground-Motion Models, Preliminary Expert Evaluation Report, Norman A. Abrahamson Inc., Contractor: Faculty of Civil and Geodetic Engineering, IKPIR (project leader: M. Dolšek), September 10th 2020.

[3] [JEK2-1B] Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1B - Evaluation of Ground-Motion Models, Preliminary Expert Evaluation Report, Slovenian Environment Agency (B. Šket Motnikar, M. Živčić, P. Zupančič, M. Čarman, A. Gosar), Contractor: Faculty of Civil and Geodetic Engineering, IKPIR (project leader: M. Dolšek), October 2020.

[4] [JEK2-1C] Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1C - Evaluation of site AFs, Preliminary Expert Evaluation Report, M. Dolšek, Contractor: Faculty of Civil and Geodetic Engineering, IKPIR (project leader: M. Dolšek), September 10th 2020

[5] [JEK2-1D] Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1D, Non-Ergodic Ground-Motion model for JEK2, Final Report, Revision 1, December 2020, FGG.

[6] [JEK2-1E] Evaluation of Probabilistic Seismic Hazard Analysis and Engineering solutions for building new NPP JEK2: Task 1E, Independent recalculation of PSHA at JEK2 site for rock, Preliminary report, November 2020.

[7] Peer Review Team Panel - Peer Review of Non-Ergodic Ground-Motion model for JEK2 (Task 1D): Final Report to GEN energija, d.o.o., May 5, 2021

[8] IAEA, SSG-9 - Seismic hazards in site evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSG-9, Vienna, 2010.

[9] Rizzo, GeoZS, SHA Project, Summary Report Seismic Source Characterization model Hazard Input document Krško, Slovenia, Project NO. 14-5198B, Revision 0, 28 december 2017

[10] Rizzo, GeoZS, SHA Project, Ground Motion Characterisation Model Hazard Input Document Krško, Slovenia, 20 December, 2017, Revision 0

[11] Passeri, 2019. Development of an advanced geostatistical model for shear wave velocity profiles to manage uncertainties and variabilities in Ground Response Analyses. Doctoral dissertation.