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Dr. Richard Quittmeyer
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Dear Dr. Quittmeyer,

This letter conveys an assessment of the Peer Review Panel (PRP) on the development of a probabilistic fault displacement hazard analysis (PFDHA) to determine if potential ground surface displacements need to be considered for design of the proposed KRSKO2 nuclear power plant in Slovenia. The PRP was formed in 2012 and consists of three individuals (Drs. Serva, Costantino, and Gürpınar) all of whom participated in a meeting held in Pittsburgh, USA, on 16/17 January 2013.

The PRP reviewed the PFDHA Technical Report (Rev. 0), the Sensitivity Studies Report (Rev. 0), as well as the Geotechnical, Geologic and Seismological Report, Phase 1 (Rev. 1) and attended the presentation at the offices of Rizzo Associates where procedures used during the study and results developed were discussed. This letter report presents a summary of the PRP comments on the study and recommendations for future activities in the following paragraphs.

1. For the new KRSKO NPP Unit, there is no clear, undisputed evidence that would indicate that a fault displacement hazard is present using the criteria of the IAEA Safety Guide SSG-9. It is important to note that all faults in the KRSKO plain are postulated and their presence is questionable. Because the seismic reflection data do not yield unquestionable results, offsets on these faults are not considered significant.
2. Although, the IAEA Safety Guide recommends the use of a probabilistic fault displacement hazard analysis for existing NPPs, the present study is valuable for the following reasons:
 - It constitutes a risk informed approach for the estimation of potential displacements and their engineering significance,
 - It assists in understanding the importance of the various supposed faults in the site vicinity in order to prioritize additional field investigations

- It provides a qualitative basis for preferring one site over the other (East versus West)
3. The present study constitutes a “first of a kind” application of a PFDHA as recommended in SSG-9. For this reason, RIZZO was very cautious and conservative in selection of parameters used in the calculations. In this regard, the following examples can be cited:
 - the chosen tectonic model with the assumption that each of the considered faults are individually seismogenic (i.e. primary fault) with a specific slip rate;
 - assigning the possibility of a magnitude $M_w = 6.1$ to the Libna fault;
 - use of rather high slip rates (0.25 mm/yr) for the individual faults;
 - selecting a large value for the area of the NPP footprint.

Therefore the base-case analysis results are expected to be overly conservative. In a PFDHA, it would be expected that the base-case would be “best estimate”. It is suggested that some checks be made to ensure that these conservative assumptions have not led to unrealistically conservative results.

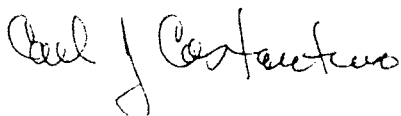
4. The faults considered in the PFDHA do not include some faults coming from literature and other type of data. The report should mention these and the reasons for not considering them further in the study should be provided. Fault description reported by Gosar, 1998 and Verbic, 1993 [references shown below] fall into this category.
5. Since the considered faults for the PFDHA indicate a significant normal component, it would be useful to compare this type of faulting with the database used in the Petersen paper.
6. In the Mmax assessment, the slip-rate versus Magnitude relationship reported in the papers of Slemmons and dePolo (1986) or dePolo and Slemmons (1990) should be taken into consideration and weighted appropriately in the PFDHA.
7. With regard to the fault location sensitivity analysis, it is recommended that the hypothesis that the Artice fault crosses the two chosen study areas be removed from the study. This is due to the fact that the excavation already completed for the existing NPP reportedly does not indicate any evidence of faulting in this area. The results from this postulated case are therefore unrealistic and should not be treated in the same light as the other studies.
8. In order to estimate an appropriate range of slip rate for the PFDHA, it could be useful to calculate the sedimentation and or deformation rate(s) using the thickness and the deformation of the different miocenic period horizons visible in the seismic reflection profile lines. These data can also provide a basis for selection of weights applied to the slip rate values used in the PFDHA.

9. The potential seismic surface displacement of engineering significance needs to be defined for application to the KRSKO NPP site. The magnitude of fault offset that may impact seismic demands on the facility for generic sites is clearly a function of stiffness and strength of the foundation materials immediately adjacent to the facilities. For the KRSKO2 site, soil sediments at some locations extend to depths of meters, while at some locations are relatively shallow. The impact of fault offsets on design seismic demands is expected to be different at these locations. Considering the conservatism that has been included in the displacement predictions, the degree to which the displacements are important will depend on these local site conditions.
10. A PSHA study was recently completed for the KRSKO site and a new study is currently being conducted. There are many common input parameters between the PSHA and PFDHA related to fault characteristics, recurrence values, etc. The consistency of these studies need to be checked and differences (if any) need to be appropriately justified.
11. The cutoff value for the annual probability of exceedance need not be lower than several orders of magnitude below those corresponding to severe accidents involving LERF (Large Early Release Frequency). Therefore, the output tables from the PFDHA should not go to levels below, e.g. 10^{-10} . Screening values of 10^{-7} for exceedance probabilities and 5 – 10 cm for displacements of engineering significance would be appropriate.

The Peer Review Panel agrees that the PFDHA study has shown that the resulting magnitude of offset displacements for the base-case parameters are small and insignificant and need not be considered for further study for the new facility.



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