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

T: + 386 7 491 01 12
F: + 386 7 490 11 18

info@gen-energija.si
www.gen-energija.si

IRSN
Institute de Radioprotection et de Surete Nucleaire
Mr. Jacques Repussard
Director General
BP 17
92262 Fontenay-aux-Roses
Cedex France

Your ref.: IRSN/DIR/2013-00010 Our ref.: GEN/2013/249 Vrbina, 26.02.2013

Response letter to your letter IRSN/DIR/2013-00010

Dear Mr. Repussard,

Introductory Remarks

This response letter acknowledges your letter dated January 9, 2013 and address statements within. The letter discusses Institute de Radioprotection et de Surete Nucleaire's (IRSN's) interpretation of the Libna Fault and its possible effect on the Krško site with existing Krško 1 nuclear power plant (NPP) and potential new unit Krško 2.

IRSN, using incomprehensive information from draft report "Paleoseismological trenches on the Libna Hill, Revision 1, Ver. 7" (Libna Hill Report), and drawn only from incomplete geological observation, states that the Libna fault lies within a "few hundred meters" of the Krško 2 NPP sites and has drawn an unacceptable conclusion that Libna Fault is a capable fault based on the Libna Hill trench studies. IRSN further opines that the potential Krško 2 NPP site, therefore, cannot be determined suitable and a search for alternative sites should be considered. IRSN also considers that implications of the available information for the safety of the Krško 1 NPP should be addressed in a timely manner.

Accountability and responsibility of Slovenia institutions to address safety questions in a timely manner

Slovenian institutions Nuclear Power Plant Krško (NEK) and Slovenia Nuclear Safety Authority (SNSA) consistently demonstrate proactive approach to relevant safety questions which might impact Krško plant safety. The latest example of this was the EU stress tests.

GEN energija (GEN) also acted proactively. When we received the first information that Libna fault might be interpreted as capable fault we immediately asked for Probabilistic Fault Displacement Hazard Analysis (PFDHA) to assess the potential impact of the presumed fault to existing and new sites. The PFDHA is being carried out as an additional tool to establish site suitability by complementing the findings of geologic and geophysical studies. The study provides additional information that is

relevant to risk-informed decision making in a regulatory environment, both for existing or new sites.

The available preliminary results from the PFDHA indicate that fault displacement of engineering significance would have a very low exceedance probability for a nuclear island footprint. The exceedance probabilities are well below regulatory levels of concern and are lower than the typical probabilities of a core melt or a large radioactive release. Preliminary results were presented also to the Consortium. The comments received will be incorporated into the final PFDHA sensitivity study. An international peer review was performed for the preliminary PFDHA analysis to confirm its adequacy and robustness. Recommendations of the peer review will be incorporated in final PFDHA and its sensitivity study.

Addresses of Specific IRSN's Statements and GEN Responses

In response to the views expressed by IRSN, GEN would like first to call attention to the Consortium field work and interpretations and to additional ongoing field and analytical work that has been carried out to implement many of the recommendations made by the Consortium. Results of this work, while preliminary at this time, suggest that IRSN's conclusions regarding the Libna fault and site suitability may be premature. In fact, GEN is currently conducting a comprehensive field investigation to develop a greater understanding of features on Libna Hill.

Using the most recent information available, we have addressed your statements in a Statement-Response mode as follows. Please note that, because our field and analytical work is not complete as of this date, our responses are preliminary. They are based, however, on the best currently available information.

IRSN Statement No 1:
The findings of these investigations led the Consortium to agree on the capability of this fault.

Response No. 1:
Given the Libna Hill Report, this statement is not correct and is only conditional and should be placed into its appropriate context, as stated in the Libna Hill Report. Thus, based on these ambiguities the Consortium concluded regarding the capability of the Libna fault in the Libna Hill Report (Revision 1, V7), page 55, Chapter 4, paragraph 2, as follows (quote):

> *"The Libna fault may also be described as a capable fault and additional data and/or analysis are required because some important issues for the assessment of the potential impacts of the fault are still open."*

Moreover, to address the many ambiguities left unanswered in the Libna Hill Report, Consortium proposed that GEN addresses these ambiguities with a series of new investigations. After this proposal GEN undertook the initiative and is currently conducting further investigations.

Thus, it is our opinion that the current state of knowledge on the issue of the Libna fault:

- does not meet the criteria to univocally define it as a capable fault (given the IAEA SSG-9) and
- does not meet the recommendation of NS-R-3 (quote):

  "3.7. Where reliable evidence shows the existence of a capable fault that has the potential to affect the safety of the nuclear installation, an alternative site shall be considered."

IRSN Statement No. 2:
The Libna fault outcrops "a short distance from the Krško 2 sites" and is "located at only a few hundred meters from these sites."

Response No. 2:
There is no evidence of the Libna fault outcropping near the Krško 2 sites. The feature is mapped along the base of a large northeast facing escarpment.

IRSN Statement No 3:
The finding that the Libna fault is capable "does not allow concluding in a favorable manner as regards the suitability of the Krško 2 sites."

Response No. 3:
New findings indicate the Plio-Quaternary displacement along the Libna fault should be understood in the context of the complex geological processes that dominate the landscape. These include mass wasting, as well as tectonics. Based on the interpretation of a digital elevation model (DEM) derived from Light Detection and Ranging (LiDAR) provided by GEN, our consultants have interpreted the mapped fault escarpment on Libna Hill to be dominated by mass wasting and karstic collapse.

The DEM shows five major sinkholes along the mapped trace of the Libna fault, and a deep-seated landslide complex on the southern flank of Libna Hill. Combined, these two geomorphic features accentuate the relief on the crest of Libna Hill which has been interpreted as a fault escarpment. These new data provide evidence that some of the tectonic interpretations in Trench 2 on Libna Hill may be in fact related to mass wasting. Although the current evidence could be postulated as being indicative of tectonic deformation, (possibly a non-seismogenic secondary tear fault) apparent displacement is highly questionable because the Libna escarpment is accentuated by karstic collapse and mass wasting. Both of these geomorphic features are common to the Krško region.

IRSN Statement No. 4:
The use of probabilistic fault displacement hazard analysis (PFDHA) in establishing site suitability represents a challenge given the limited international experience and *"lack of recognized methods and tools"*.

Response No. 4:
PFDHA has been used in the USA on a number of nuclear projects and is recognized by the International Atomic Energy Agency (IAEA) in Specific Safety Guide SSG-9 for assessing fault displacement hazard at existing nuclear power plant sites. Results of a PFDHA were included in a license application to the US NRC for a high-level nuclear waste repository at Yucca Mountain, Nevada, USA. The fault displacement hazard

results formed part of the safety case establishing that the repository met the performance goals of the regulatory requirements.

A PFDHA for the Krško 2 sites is underway. The PFDHA is being carried as an additional tool to establish site suitability to complement the findings of geologic and geophysical studies. The study provides additional information that is relevant to risk-informed decision making in a regulatory environment, both for existing or new sites.

The available results from the PFDHA indicate that fault displacement of engineering significance would have a very low exceedance probability for a nuclear island footprint within the Krško 2 sites. The exceedance probabilities are well below regulatory levels of concern and are lower than the typical probabilities of a core melt or a large radioactive release.

The PFDHA for the Krško 2 sites underwent a peer review on January 16 and 17, 2013. The Peer Review Panel (PRP) was made up international experts who have worked for the IAEA or the USNRC or both. The PRP indicates that the input parameters for the PFDHA are too conservative and should be re-considered to develop a "best estimate" type of analysis.

Most importantly, we quote as follows from the Peer Review Panel Report (Page 3, paragraph 4) on the issue of designing the NPP for fault displacement (quote):

> *"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."*

IRSN Statement No. 5:
Thus, IRSN considers that the use of PFDHA is more appropriate in the process of upgrading safety demonstration of existing nuclear facilities than for supporting the licensing of new plants.

Response No. 5:
We addressed this specific issue at the PRP meeting on January 16, 2013. The PRP addressed this matter in their letter and we quote below from that document:

> *"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."*

Concluding Response

Although results and conclusions in the Libna Hill Trench Report were inconclusive, GEN found all interpretations important and immediately initiated several parallel activities to reduce uncertainties presented in the report.

GEN continues to carry out robust, multidisciplinary investigations to assess if any capable faults with the potential to affect the safety of nuclear installations exist at the Krško sites. The most recent phase of investigation carried out over the last six months incorporates tectonic geomorphology, geochronology, and high-resolution seismic (HRS) geophysics, following the advice of the Consortium on this matter. Multiple geochronology techniques are being used to constrain the age of the youngest fault offset. HRS is being used to determine the buried southern extent (and total length) of the Libna feature and evaluate the existence of the postulated Stara Vas fault.

We expect IRSN will review and take into account positions of other institutions, which participated in Libna investigations, new data that are being collected, new analyses that are being carried out, and results of PFDHA analysis together with international expert review panel report. We also expect that you will reconsider your letter of January 9, 2013, and take appropriate steps.

GEN, with contractors and consultants, is working on the investigation and expects to complete the work within the next eight months. Also, we are in communication with the Slovenian Regulator and the operator of Krško 1 NPP on a regular basis.

We suggest continuing further communications on an expert level. The additional investigations and new methods and tools used for Krško geological hazard investigations and its results may provide valuable information that prevent ambiguities and future unnecessary differing interpretations of the same subject.

Very truly yours

ENERGIJA

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

Martin Novšak,
Director GEN energija, d.o.o.

Copies:

- Slovenian Nuclear Safety Authority w/a IRSN letter
- Nuklearna elektrarna Krško w/a IRSN letter
- BRGM
- Geološki zavod Slovenije

References:

1. GeoZS, "Paleoseismological trenches on the Libna Hill", Revision 1, Version 7, Geotechnical, Geological, and Seismological (GG&S) Evaluations for the New Nuclear Power Plant at the Krško Site (NPP Krško II), Ljubljana, Slovenia, 2011
2. GEN, "GEN Comments on the "Paleoseismological trenches on the Libna Hill", TP-012, Krško, Slovenia, 2011.
3. Paul C. Rizzo Associates, Inc., "Review and Comments, BRGM Consortium Report, Paleoseismological Trenches on the Libna Hill Krško II, Revision 2".
4. Paul C. Rizzo Associates, Inc., "Probabilistic fault displacement hazard analysis Krško East and West sites proposed Krško 2 Nuclear Power Plant Krško, Slovenia", Technical Report, Revision 0, Pittsburgh, PA, USA, 2012.
5. Paul C. Rizzo Associates, Inc., "Sensitivity Analysis Probabilistic fault displacement hazard analysis Krško East and West sites proposed Krško 2 Nuclear Power Plant Krško, Slovenia", Final Interim Technical Report, Revision 0, Pittsburgh, PA, USA, 2012.
6. Paul C. Rizzo Associates, Inc., Attachment A Information package "Krško Probabilistic Fault Displacement Hazard Analysis (PFDHA) Peer Review Meeting" to Letter L2 Progress Report No. 5, Pittsburgh, PA, USA, 4 February 2013.
7. Paul C. Rizzo Associates, Inc., Technical position paper Libna fault response to IRSN/DIR/2013-00010, Project No. 12-4835, Pittsburgh, PA, USA, 15 February 2013
8. GeoZS letter, Ref: 128-1130/2013, Ljubljana, Slovenia, 13 February2013
9. BRGM letter, Ref: DRP/DIR/13-063, Orléans, France, 19 February 2013.