

SEISMIC RISKS

in the Belene Nuclear Power Project

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Introduction

In this fact sheet, you will find three original documents concerning the seismic risks of the Belene nuclear power plant (Belene NPP) project. Two of them date from the original planning phase of the nuclear power station and conclude that the Belene site is unsuitable, the last one from the Environmental Impact Assessment (EIA) of the current attempt to construction of the Belene NPP concludes the contrary.

The Belene NPP project is controversial. In the early 1990s, this originally communist project was dropped for economic and environmental reasons. One of the key-arguments in the environmental debate was the fact that Belene is situated in a seismic active area. In 2003, plans for finishing the Belene project resurfaced and led to the present construction project for a Russian made AES-92 NPP with two power blocks of 1000 MW each delivered by VVER 1000/466B reactors.

Recently recovered documents from the original planning phase show that the Russian developers of the original Belene project dismissed the Belene site as unsuitable for a nuclear power station. In this document you find a letter from the Bulgarian Academy of Science – Central Laboratory on High Geodesy to the project leader, the state utility “Energia”.

Shortly after the political changes in 1989, the Bulgarian Academy of Science issued a comprehensive study concerning the Belene NPP project – the so-called “White Book”. Seismic activity was one of issues covered, and the authors come to the conclusion that in Belene there will not be any safety margins left in case of a large earthquake.

The third document quoted here is the technical summary of the official Environmental Impact Assessment (EIA) report from 2004, which states that Belene does not know any seismic risk.

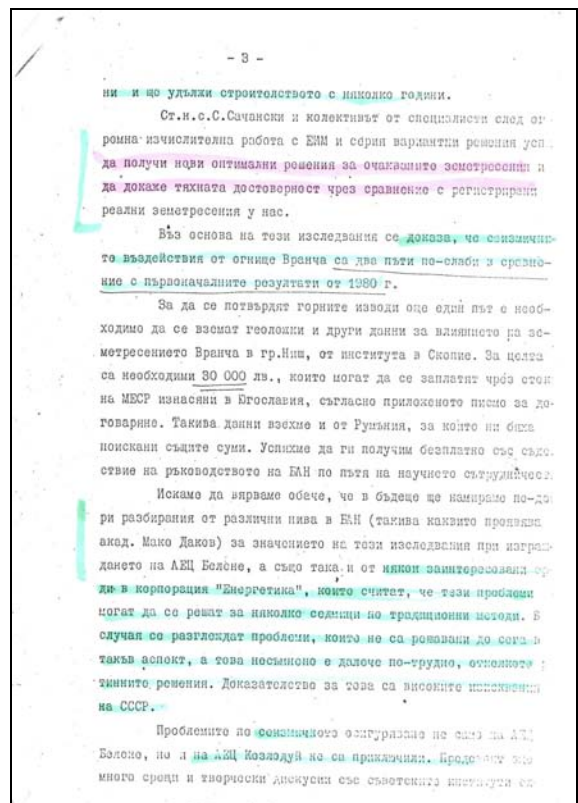
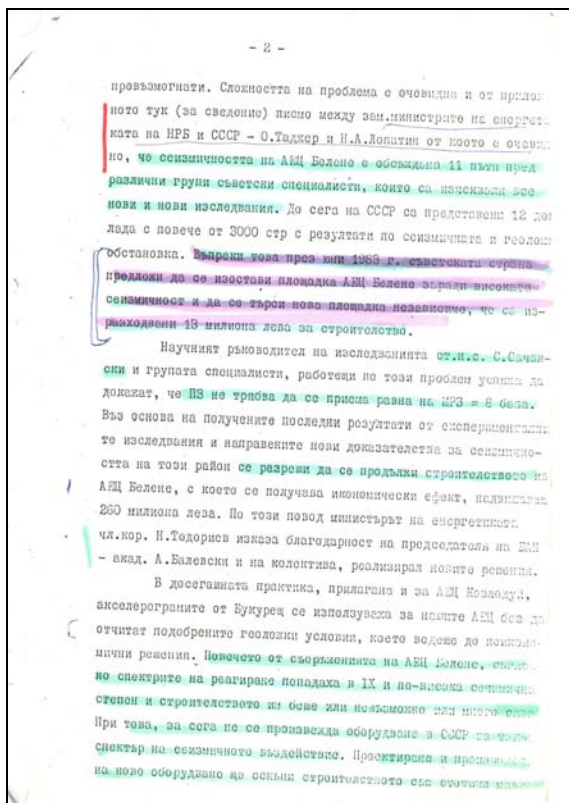
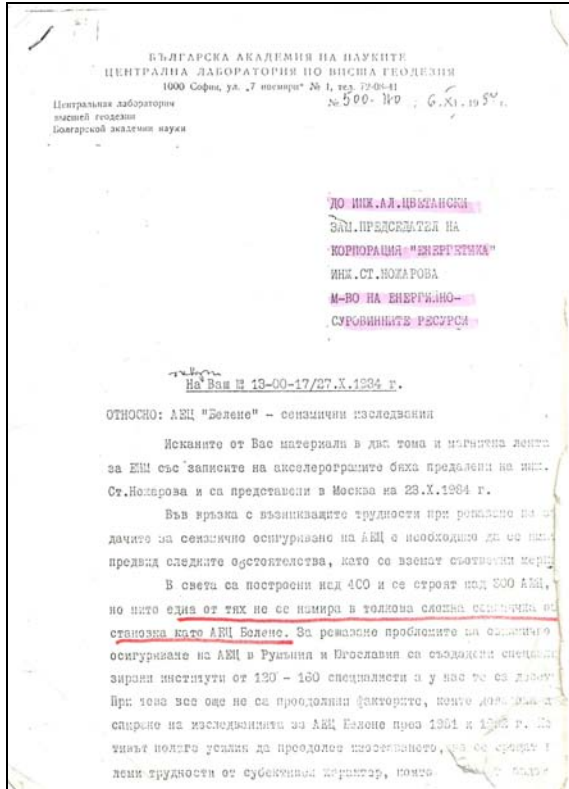
This latter statement flagrantly collides with the 1977 earthquake in the area, which cost around 120 people their lives in Svishtov, the nearest major town from the Belene site, on 14 km East. This earthquake also destroyed buildings in the town of Belene, 3 km West. We therefore also asked the Svishtov Municipal Council for its opinion on the EIA report. According to the Chairman of the Svishtov Municipal Council, Mr. Andrey Zahariev, no requests have been submitted by the EIA team in the surrounding municipalities of Belene and Svishtov (Bulgaria) and Zimnicea (Romania) – and therefore no permissions have ever been issued – for on-site seismic and other investigations during the preparation of EIA report.

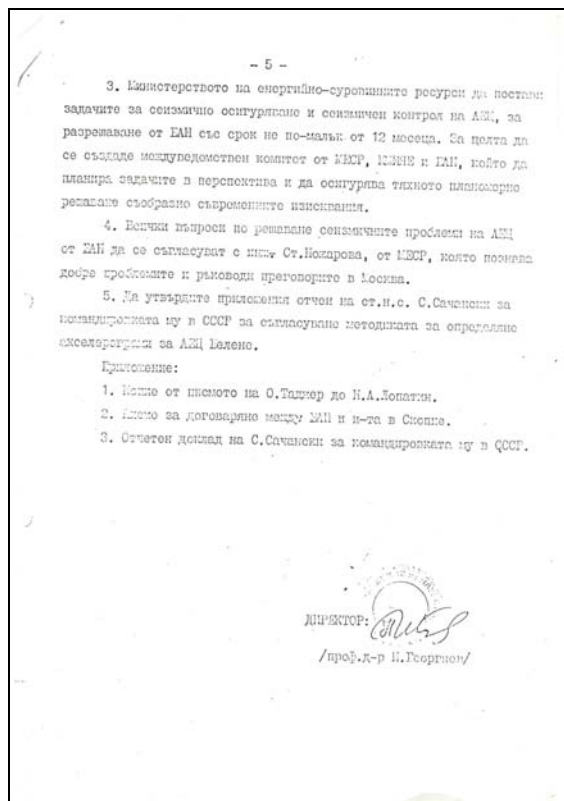
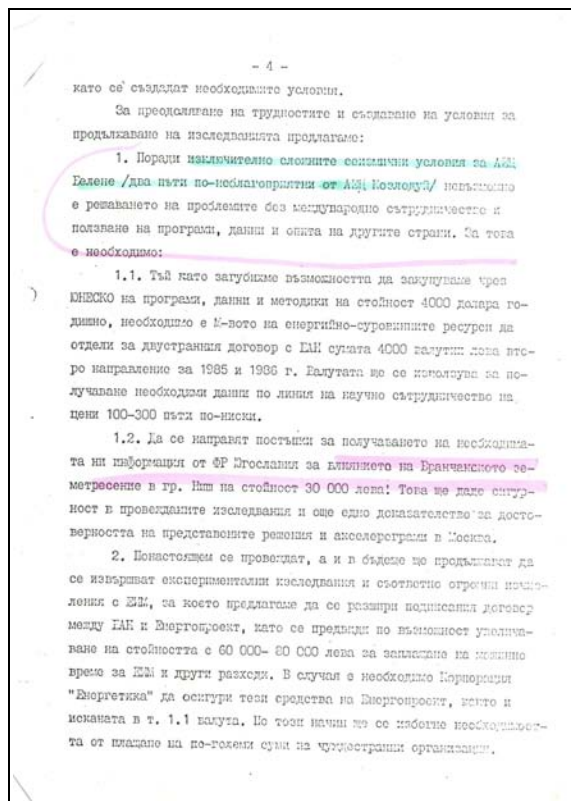
The conclusion of the editors of this fact-sheet is that the EIA for Belene has been carried out on the basis of selected paper sources and without proper on-site investigations. This in spite of the fact that seismic risk was flagged in the past on several occasions on the basis of the same data as a serious ground to dismiss the site as unsuitable. This is but one of the proofs that the planning process of the Belene NPP project has been manipulated to yield the result of go-ahead.

I. Letter 500-HO/06.11.1984 from N. Georgiev, Director of the Central Laboratory on High Geodesy, Bulgarian Academy of Science, to St. Nozharova, Deputy Head of the utility "Energia"

"There are more than 400 NPPs constructed worldwide and another 300 are under construction, but none of these is situated in such a complicated area from a seismic point of view as the Belene NPP is. [...] The complexity of the problem is obvious according to the added letter between deputy energy ministers of Bulgaria and the USSR, O. Tadjer and N. A. Lopatin, which makes clear that the issue of seismic properties has been discussed 11 times with various groups of Soviet specialists, which required more and more new investigations to be done. Up to now 12 reports with more than 3000 pages of results about seismic and geological situation have been presented to the USSR. In spite of this, the Soviet counterparts suggested in June 1983 that the site of Belene NPP should be withdrawn due to the high seismic risks and a new site to be found, in spite that 13 million leva has already been spent for construction works."

Later in the letter, the scientists call for more funding to be able to prove that the seismic conditions are not so problematic as the Soviet specialists think.





II. Belene NPP – Investigations and position of Bulgarian Academy of Science 1990, p. 324 – 325 (so called “White book”)¹

“What is presented in the points 1-5 gives us the reasons to conclude as follows:

1. If the VVER 1000 reactors are guaranteed to withstand a maximum projected earthquake (MPE) of the level 8 for the next 10000 years, the selected site does not offer a reserve in seismic security.
2. A substantial support comes from the excellent construction of the ballast pillow under the foundation. [...] this improvement however, cannot increase the seismic security to a sufficient level.
3. In spite of the fact that the investigation and research of the Belene project site have been done in line with the at that time good practices, the given fact that earthquakes are accompanied with yet unforeseen consequences applies also to today’s life and this particular case. Taking also into account the objectively existing gaps in the initial information, there is a definitive uncertainty regarding future seismic impacts on the plant.

It is our duty to remember that the assessment above applies for the construction site and not for the constructions and equipment, where additional options for increasing the seismic security reserve have been found to a level of reasonable sufficiency.”

1 Plamen Tsvetanov (ed), АЕЦ "БЕЛЕНЕ" - Изследвания и становище на Българската Академия на Науките (NPP "BELENE" – Analysis and conclusions from the Bulgarian Academy of Science), (Sofia, 1990) Bulgarian Academy of Science, 421 pp.

в т о р а , з а о т т р е т а к а т о р и я (п о С Н И П , Ч . 11 , г л . 7) , п р и к о и т о и н т е н з и в н о с т т а с е у в е л и ч а в а с е д н а с т е п е н в с р а в н е н и е с т а з и з а с р е д н и г р у н т о в и у с л о в и я ;

в) Установените сеизмични интензивности от седма-осма степен (на българска територия) и от осма и над осма степен (на румънска територия) в участъци, разположени на максимално разстояние 8-10 km от площадката;

г) обстоятелството, че съгласно т. 2.3.2.6. от съветските "Указания по размещению атомных станций"-1987 г. и "Нормы проектирования сейсмостойких атомных станций - НП-АЭ Г-006-87" площадки с инженерногеоложки условия като тези на АЕЦ "Белене" са неблагоприятни за строителство на атомни централи и че съгласно т. 2.3.1.3. на същите указания в зона с интензивност за МРЗ, по-висока от осма степен, не се допуска разполагане на АЕЦ;

д) обстоятелството, че става дума за строителство, свързано с опасности, изисквания и отговорности от най-висок ранг, за конкретните инженерногеоложки условия на площадката на АЕЦ "Белене" проектното земетресение (ПЗ) би следвало да е от о с м а степен, а максимално разчетното (МРЗ) - от девета степен, т.е. с една степен над приетите в проекта седма, респ. осма степен.

Изложеното в т.1 до т.5 дава основание за следните изводи:

1. Ако атомните реактори от конфигурацията ВВЕР-1000 са осигурени за МРЗ от осма степен за 10 000 годишен период на повтаряемост, избраната строителна площадка не предлага резерв (запас) за сеизмична осигуреност.

2. Съществено облекчение внася отлично изпълнената баластрова възглавница под фундаментите, която намалява опасността от вторични деформации в земната основа при динамични въздействия. Това

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подобряване обаче не би могло да увеличи в достатъчна степен сеизмичната сигурност.

3. Независимо от това, че проучванията и изследванията за сеизмичността на площадката на АЕЦ "Белене" в много отношения са извършени на добро равнище за времето си, обстоятелството, че земетресенията се съпровождат с все още непредвидими последиствия важи и за днес и за дадения случай. Като се вземе предвид и обективно съществуващата непълнота на изходната информация възниква определена несигурност относно отражението на бъдещи сеизмични въздействия върху централата.

Длъжни сме да напомним, че направената по-горе оценка се отнася за строителна площадка, а не за конструкциите и съоръженията, където трябва да се търсят допълнителни възможности за увеличаване на запаса (резерва) от сеизмична сигурност до степен на разумна достатъчност.

3.8. ЛИТЕРАТУРА

1. АЕЦ-2 "Белене-Изток" микросеизмично райониране на строителната площадка.- Доклад в НИТИ "Енергопроект", 1980.
2. Атанасов, А., П. Боков, (ред.) Геология и нефтогазоносна перспективност на Мизийската платформа в Централна Северна България, С., Техника, 1983, 287 с.
3. Боков, П. Характерни черти и генезис на преднеогенския релеф в Северозападна България. Сп БГД, год. 29, кн. 2, 1968.
4. Боков, П. Основни етапи в мезо-неозойското развитие на Ломската депресия. Изв. ГИ на БАН, кн. 19, 1970.
5. Бранков, Г. (отг.ред.), Земетресението Вранча-1977 год.- Последствия в НР България, изд. БАН, София, 1983.

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III. The 2004 Environmental Impact Assessment report²

With regard to their potential impact on NPPs, earthquakes are considered the most dangerous natural disasters. Seismic activity in the local area surrounding the Belene NPP has been studied in details. In the 30 km zone, there is no data about earthquakes with intensity greater than 2.5. These events have been analyzed and evaluated with regard to the hydrology conditions of the Danube River. They do not pose a potential danger to the plant. (p. 31, non-tech summary)

The final conclusion regarding the neotectonics of the regional and local zones is, that within the studied territory there are no big fault structures of high energy potential. This is defined by the general calm tectonic situation in the area of the Moessian platform, also well-expressed in its geomorphologic structure. These conclusions put forward the necessity of greater attention for the seismic assurance of the NPP only against eventual strong earthquakes, the epicenters of which are in the foci Vranча, Gorna Oryahovitsa, Shabla, Dulovo, Chirpan-Plovdiv, Sofia and Kresna.(p. 54)

It can be noted that the absence of historic earthquakes of magnitude above 4.0, as well as of instrumentally manifested seismicity with magnitude above 3.6 in the stable part of the Moessian platform show that the NPP Belene site is located in the calmest (in seismic aspect) part of the considered 320-km region. (p. 55)

From the viewpoint of seismo-tectonic and seismic hazard, there are no excluding conditions for the use of Belene site as site of a nuclear power plant; (p. 115)

² Ivan Ivanov e.a., *Environmental Impact Assessment Report of Investment Proposal for Construction of Belene Nuclear Power Plant; Non-Technical Summary*, 2004 (Sofia) NEK; <http://www.nek.bg/tender/BNPP-EIA-GCR-PEC-9.0-E3.pdf>

All potential road and railway transport accidents will have only local impact and would not pose emergency situation in the plant area.
 Due to its remoteness from the NPP site and the island barriers, river accidents, including explosions, would not initiate emergency situations.
 There are no civil flight corridors over the NPP site. These are located outside the 30 km area (Figure 1.5-1). Agricultural aviation is forbidden to approach the site in less than 5 km. Nevertheless, in accident cases the protection cover of the reactors, where the main components of the reactor installation are located, is designed to endure a plane crash.

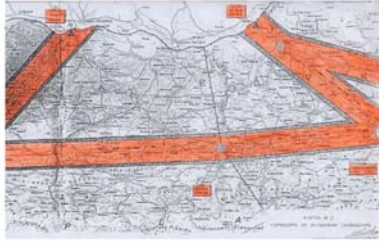


Figure 1.5-1

All explosions at the quarry are local and cannot induce emergency events at the NPP site.

The summary risk that accidents arising from human activity pose to the Belene NPP and its personnel, given that the events are not related, is negligible minimal.

1.5.3 Impact of natural disasters on the Belene NPP

With regard to their potential impact on NPPs, earthquakes are considered the most dangerous natural disasters. Seismic activity in the local area surrounding the Belene NPP has been studied in details. In the 30 km zone, there is no data about earthquakes with intensity greater than 2.5.

These events have been analyzed and evaluated with regard to the hydrology conditions of the Danube River. They do not pose a potential danger to the plant.

In Bulgaria, conditions for the formation of tornadoes rarely exist. Tornado formation probability for the Belene NPP area is lower than the country average. The known tornadoes in Bulgaria during the 20th century are shown on a map on Figure 1.5-2.

- It was proved that the greater part of them cease their activity by the end of the Upper Triassic (the Belene, Oresh and other faults).
- The specialized surveys of the Danube and Dragomirovo faults, previously noted by some authors as active, did not confirm their activeness in the Quaternary.

All the established foci of Quaternary activeness of the old fault structures are found outside of the 25-km zone of NPP Belene, and the extent of their activeness does not exceed 30-40 m for the whole Quaternary. According to direct geomorphologic indications, some of them, and especially the North-Bulgarian and the Novachene faults, totally die down and fossilize in the Pliocene. The results of the studies on the active faults in the area have been discussed and approved jointly with experts of IAEA in 1995.

The final conclusion regarding the neotectonics of the regional and local zones is, that within the studied territory there are no big fault structures of high-obey potential. This is defined by the general calm tectonic situation in the area of the Moesian platform, also well-expressed in its geomorphologic structure. These conclusions put forward the necessity of greater attention for the seismic assurance of the NPP only against eventual strong earthquakes, the epicenters of which are in the foci Vrancha, Goma Oryahovitsa, Shabla, Dulovo, Chirpan-Plovdiv, Sofia and Kresna.

The above and the additional geological surveys of the area have shown that the structure of the area of the site is clear, and near to it there are no traces of active faults in the Quaternary. From this viewpoint the NPP Belene site is considered suitable for the construction of a nuclear power plant.

SEISMICITY

The survey on seismicity and the seismic characteristics in the phase "selection of site" was accomplished in 3 stages, including the independent expert reports before the final stage, as follows: Stage I - 1970-1980; Stage II - 1981-1986; Expert reports of Westinghouse Energy Systems and Siemens KWU - 1990; Stage III - 1990-1995.

The accepted seismic characteristics have been confirmed - MDE (Maximum Design Earthquake) level of seventh degree on the MSK-64 scale, and acceleration $a = 0.20g$ for the area of the town of Belene.

For the assessment of the seismic characteristics of NPP Belene site, the seismicity of an extended 320 km region of the site is considered (usually 150 km according to the recommendations of the International Agency for Atomic Energy). This extension had to be made because of the strong influence of the inter-foci earthquakes in the area of Vrancha (Romania) (deeper earthquakes with depth between 60 and 300km).

For the purposes of the assessment, a catalog of earthquakes in a 320km region was composed. This catalog is based on Bulgarian, Rumanian, Russian catalogs, as well as on other catalogs composed in the framework of international projects, and also the publications of the International Seismologic Center. The catalog includes 746 independent events (345 shallow and 401 deep - inter-foci earthquakes) from the beginning of the new era (A.D.) till 1992.

The considered area includes a part of the Balkan Peninsula, belonging to the Altpian-Himalayan seismic belt, which is characterized by high seismic activity (15-20% of the earthquakes on the Earth). The spatial distribution of the earthquakes with M_s≥1.0 in the 320km region of the NPP site is shown in Figure 3.6-1. A clearly seismic zone is outlined, which coincides with the stable part of the Moesian platform. The considered site is located in the east part of this zone.

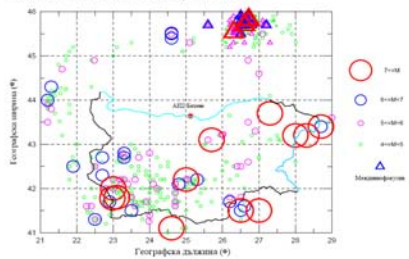


Figure 3.6-1

The seismicity in the local zone (30-km) around NPP Belene was studied in detail in the period 1980-1995. The activeness of the seismic manifestations in it is lower than the average for the stable part of the Moesian platform.

It can be noted that the absence of historic earthquakes of magnitude above 4.0, as well as of instrumentally manifested seismicity with magnitude above 3.6 in the stable part of the Moesian platform show that the NPP Belene site is located in the calmest (in seismic aspect) part of the considered 320-km region.

The seismic hazard of the site has been evaluated on the basis of the seismologic and seismotectonic studies. The natural hazard is the probability for manifestation of a given natural phenomenon in a certain time period. The adequate assessment of the seismic hazard provides the possibility for reducing the seismic risk, i.e. - the possible losses (damaged buildings and facilities, human casualties and wounded people, after-effects as fires, floods, etc.). The seismic hazard shows what seismic impacts we should expect, respectively - for what seismic impact the buildings and facilities should be provided against.

The seismic hazard of the NPP Belene site was evaluated taking into account all the influencing factors, with a reasonably conservative approach because of the character of the site - a nuclear plant. The obtained results provided the basis for determining the maximum horizontal accelerations for the NPP Belene site.

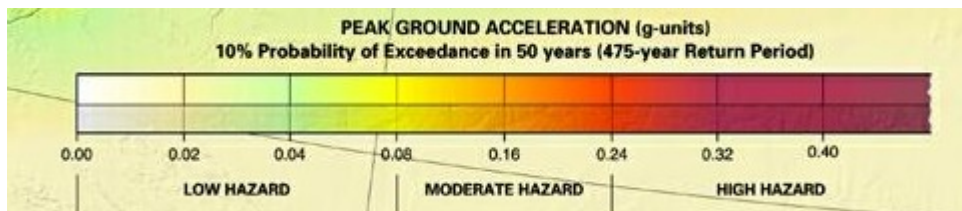
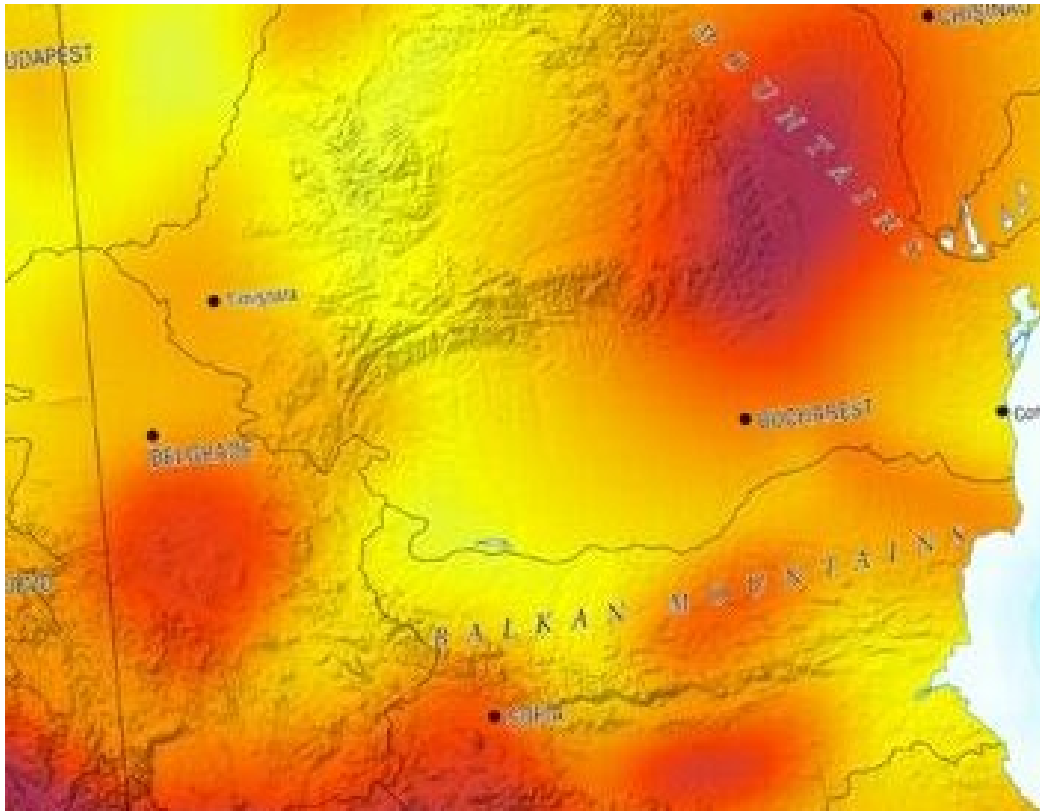
- there are no design solutions for the options with different reactor types, except for the WWER-1000/B-320 option; however, there is no objective necessity to require the companies to develop designs before the type of reactor for the implementation of the investment proposal is selected. For the WWER-1000/B-320 option, there is a design from 1987; however, it should also be updated for compliance with current safety requirements, environmental protection norms, etc.

Based on the above, on one hand, there are grounds to make differentiated evaluations of impact on environmental components and, on the other hand, to make conclusions and recommendations to supplement companies' proposals with important parameters for a more comprehensive of the impact of two power units with a specific type of reactor, as well as measures for the prevention and reduction of the impact on the environment. The evaluations made can be summarized as follows below.

1. The natural and geographic conditions of site Belene are suitable for the construction of a nuclear power plant, namely:

- In morpho-tectonic aspect, the NPP Belene site and the surrounding area are part of the Lower Danube epiplatform plain, situated between the Lom depression and the Ludogorie vault-block elevation. It is located on territory dominated by the Pleven heights, with a hard bedding of Sarmatian-Pontian denudation surface, covered with loess;
- In regional tectonic aspect, the area of NPP Belene site is in the Moesian platform. The greater part of this area is covered by Quaternary sediments of different continental genesis. In the north-west parts of the area, in the river valleys and big gullies, there are revealed Lower-Cretaceous and Upper-Cretaceous sediment rocks. There are surface appearances also of Neogene basalt bodies. Drilling works have discovered in-depth rocks of Triassic, Jurassic and Lower Cretaceous age;
- The investigation of the seismic activity and seismic characteristics of the site, performed in three stages (from 1970 to 1995) by various Bulgarian and international expert teams, including expert reports by Westinghouse energy systems, Inc., Siemens-KWU in a team with the Skopje institute IZIS, and others, determined the seismic characteristics - Maximum Design Earthquake (MDE) of 7 degree on the Medvedev-Sponheuer-Karnik scale (MSK-64), and acceleration $a = 0.20g$, for the area of town Belene. The concluding missions of IAEA in 1997 approved all works of the extended program, including the results of the additional studies of the design seismic characteristics of NPP Belene. The absence of historic earthquakes of magnitude above 4.0, as well as of instrumental seismicity with magnitude above 3.6 in the stable part of the Moesian platform shows that the NPP Belene site is located in the calmest (in seismic aspect) part of the considered 320-km region. From the viewpoint of seismo-tectonic and seismic hazard, there are no excluding conditions for the use of Belene site as site of a nuclear power plant;

SEISMIC HAZARD MAP SURROUNDINGS BELENE³



3 European Seismological Commission, February 2003; <http://wija.ija.csic.es/gt/earthquakes/>

Pictures from the aftermath of the earthquake of 4 March 1977 in Svishtov

(pictures provided by the municipality of Svishtov)





This fact sheet was developed by **GREENPEACE** in cooperation with WISE Brno and the BeleNE! coalition

