Documents necessary for preparation of the expert report pursuant to § 9(6) of Act No. 100/2001 Coll., as amended, in relation to the statement of the Regional Health Station of the Vysočina Region

1. ***The documentation does not assess the health risk impact of the low-frequency noise component which can be expected due to the characteristics of the intent.***

The justification of the comment states that "low-frequency noise can be expected to spread to the surroundings. This noise component does not have a separate sanitary limit but is generally perceived by people worse than the broad-spectrum noise of the same level and, therefore, we request to assess the effect of low-frequency noise on human health."

The low-frequency noise (LFN) will, of course, spread, it is part of the noise spectrum of stationary sources. The question is with what intensity and in which area.

In response to the comment it is necessary to clarify what is actually concerned. In the literature, low-frequency noise is regarded as the lower end of the audio spectrum from 16 Hz to 160 Hz (or sometimes 200 Hz). Since the 1980s it became the object of interest to noise specialists, in particular in relation to complaints of some individuals (about 2.5% of the population) particularly sensitive to this portion of the noise spectrum. The complaints come mainly from apartments and offices rather than, for example, from industrial workplaces. Sufferers complain of audible weak hum that distracts them, causes annoyance and sometimes sleep disturbance. Other present individuals of the same age and gender do not hear this hum. It is often sound that cannot be measured. This is not a different auditory acuity, that is at the same level for affected individuals as for other persons.

The LFN is airborne, spreads into the houses through windows, peripheral façade, roof, etc. Its source can be sometimes discovered: fans, pumps or other noisy processes in the house and surrounding area. However, it remains unidentified very often. Affected are mainly middle-aged people; the reasons for their increased sensitivity are not clear. These are not just subjective psychological impressions. The WHO (World Health Organization) recognizes LFN as a real risk to the environment. Given these circumstances (rare occurrence of sensitive persons, unclear sources, etc.) there are still no criteria for the evaluation of the measurement results in the communal environment.

Conventional noise measurement by filter "A" here distorts the reality because for that portion of the sound spectrum, ear is least sensitive and the filter "A", therefore, strongly attenuates its intensity. The filter "C" would have to be used and the intensity of the portion of the spectrum would have to be evaluated in isolation. The significance of the low-frequency components can thus be evaluated with the use, for example, of the difference between the measured values of the filter A (weighted values) and the filter C (regarded to some extent as "unweighted values"). However, there are no generally acceptable limits in the communal environment under which it would be possible to assess the measurement result. The mechanisms of its action on the human organism are far from clear. It is essential to continue to deal with this specific problem and its influence. The issue of low-frequency noise in terms of public health protection against noise in the communal environment is currently one of the main research priorities of the European Union. The current system of measurement and evaluation of noise in the communal environment in the Czech Republic (based on the correction of broadband noise indicators) does not currently allow to objectively assess its nuisance.

Low-frequency sound with frequency components in terms of its physical characteristics when airborne has very low attenuation and is very little affected by obstacles. It spreads thus to great distances. Problems with low-frequency noise are often recorded inside the rooms and not outdoors. This relates to the material composition and thickness of the partitions, dimensions of rooms and length of the sound wave.

Particular attention should therefore be given to the tonal components of noise at these low frequencies, particularly because the low-frequency noise penetrates through building structures with only a very low attenuation and is subjectively felt strongly negative compared to the medium and high frequencies, which are substantially filtered out by building envelopes.

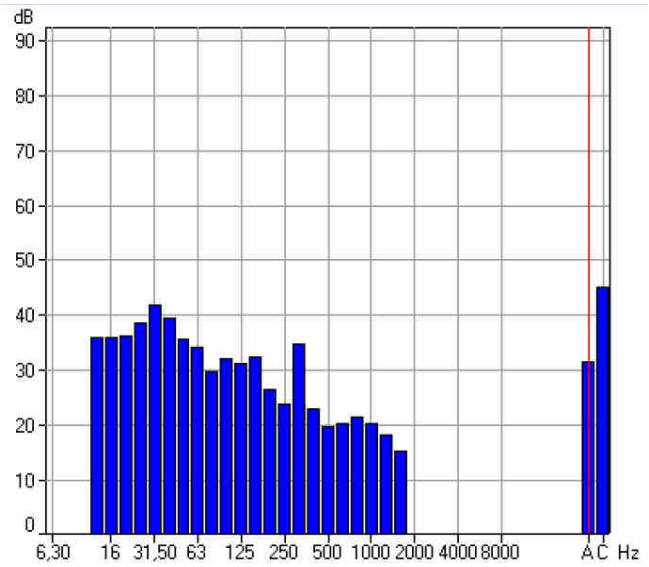
Pursuant to § 2 of Government Regulation No. 272/2011 Coll., noise with tonal components is regarded as noise in the frequency spectrum of which the sound pressure level is in the one-third

octave band, possibly in two immediately adjacent one-third octave bands, more than 5 dB higher than the sound pressure levels in both adjacent one-third octave bands and in the frequency band from 10 Hz to 160 Hz, the equivalent sound pressure level in the one-third octave band is higher than the level of hearing threshold set for this frequency band in Annex 1 thereto.

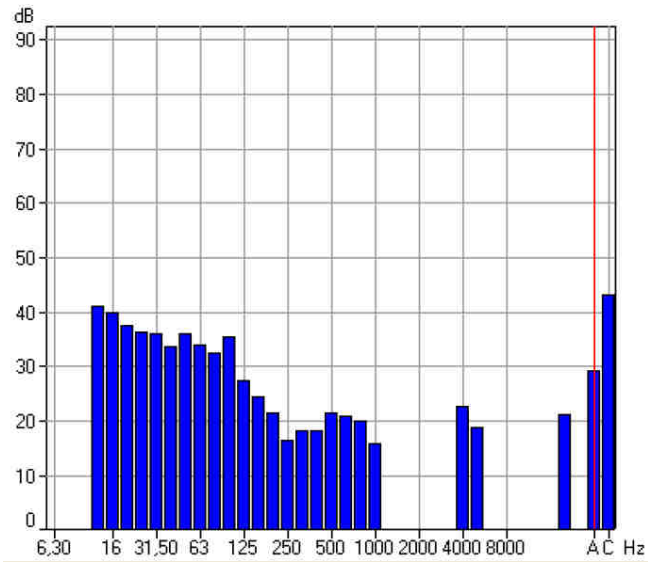
By simply exceeding the measured values in the band from 10 Hz to 160 Hz above the defined L_{PS} (hearing threshold levels) still gives no reason for recognizing the tonal character (and therefore does not justify the establishment of a stricter sanitary limit), there must also occur exceeding of the sound pressure levels more than 5 dB in the two adjacent one-third octave bands.

To assess the character of noise in the most affected areas, there are the results of authorized measurements including spectral analysis:

1) Most affected building at the Slavětice substation – <u>Slavětice No. 51</u>
   - L_{Aeq} (night) = 31.3 dB
   - Tonal component at 320 Hz
   - The sound pressure levels at all low frequencies are below the hearing thresholds



2) Nearest building north of the existing transformers - Mohelno no. 327
   - L_{Aeq} (night) = 29.1 dB
   - Without tonal components
   - The sound pressure levels at all low frequencies are below the hearing thresholds



Assuming that the measurement in the outdoor protected area of buildings shows that the sound pressure level at low frequencies reaches the values far below the hearing threshold (see measurement results), it can be expected, even in case of very low attenuation of low frequencies while passing through the building structure, that the sound pressure level at low frequencies will be still below the hearing threshold. Thus, even in case of potential 5dB difference of adjacent 1/3 octave bands at these low frequencies and dominance of low frequencies inside the building, we do not expect demonstrating the presence of tonal components according to Government Regulation No. 272/2011 Coll., and hence setting stricter limits for indoor protected area of buildings.

Moreover, the evaluation of tonal component has any significance for LFN in risk assessment of disturbance to sensitive persons, because there are no criteria for assessing the result. There is no point in applying Annex 1 to Government Regulation No. 272/2011 Coll., it deals with the general population. Disturbance to people extremely sensitive to LFN has no direct relationship to the level of the hearing threshold in the general population.

Given the above, the LFN yet remains a matter of research, the assessment of low-frequency noise in normal evaluation of noise load is not a standard part of the study on the effects on public health.

The above comment requires us not to conduct conventional assessment, but research study, which would have to involve separate measurement of the LFN and its spread, even into nearby houses, because the perimeter structures are different for each building. This would have to be followed by search for sensitive individuals (if any in small population groups of nearby houses) and assessment of their complaints in relation to the measured intensities. It could be hardly expected to have sets large enough for statistical evaluation so the entire work would remain only in hints and unsubstantiated connections. Not to mention greatly increased associated costs.

The measurements performed in the past (2007-2009) in the municipality of Lhánice in connection with potential effect of noise from transformers of the EDU1-4 (whose noise spectrum is inherently low-frequency noise) showed always deeply below-limit results for both protected outdoor and indoor areas of the buildings monitored.

Interim conclusion: The objective of the EIA documentation for the “New Nuclear Source at the Dukovany Site” is the conventional assessment of the effects of the intent on the environment and on health, not the research study. The low-frequency noise component from the NNS could be, if necessary, verified by specifically targeted measurement after putting the NNS into operation, e.g. in the trial operation. The requirement for this measurement can be included in the draft terms of the decision the final statement under preparation of the expert report to the EIA documentation.

2. ***In point D. IV. of the documentation, we recommend to include the requirement for additional monitoring of traffic noise in the most affected areas for the different stages of operation and construction, and on the basis of its evaluation, propose effective noise measures. Please note that the Regional Hygiene Station of the Vysočina Region, based in Jihlava, does not grant time-limited permit within the meaning of § 31 of Act No. 258/2000 Coll., as amended, for noise of the new source of noise or for traffic noise associated with new sources of noise.***

The requirement complements two already related points in Chapter D.IV.2.3.3 of the EIA Documentation:

- Having selected the contractor, a detailed acoustic study will be conducted, assessing noise impact of the selected design in the most affected protected outdoor building-site or protected outdoor area of buildings of surrounding municipalities.
- Noise measurement will be carried out in the areas potentially most affected by construction traffic before the commencement of construction and an acoustic study will be conducted to assess the impact of construction traffic on the acoustic situation. On the basis of these data, any measures will be taken to reduce noise load (e.g. transport-organizational measures, vehicle deceleration, replacement of windows in the affected buildings, etc.).

According to the authors of the EIA documentation, the requirement for monitoring of traffic noise in the most affected areas for the different stages of construction and operation could be the result of the second of the already proposed related points, because the actual local situation before the commencement of construction could be different under real conditions than conservatively assumed "worst" possible case in the noise study and the EIA documentation, in particular in relation to cumulation of both construction activities on two units of the NNS and parallel operation of the EDU1-4.

We agree with the comment and the possible way of its application is to include it in the draft terms of the decision the final statement under preparation of the expert report to the EIA documentation.

3. ***The documentation does not assess health impact assessment of emitted radionuclides with respect to their chemical properties. Emissions of radionuclides in the operation of nuclear sources to air and water are assessed against health detriment to the population only with respect to their radiation properties.***

Chemical toxicity of radionuclides is not evaluated in assessment of the effect of nuclear sources due to the fact that

a) mass quanta of radionuclides penetrating into the environment from effluents are already very low in the absolute values of the annual quantity (see the tables drawn up on the basis of the maximum envelope effluents of the NNS) and, when dispersed in the air and water, insignificant and negligible in terms of toxicology,

b) for toxic effects, radionuclides would have to penetrate into the body by ingestion or inhalation, so the portions of radionuclides acting externally or rapidly metabolised are eliminated,

c) radiation effects of radionuclides are of considerably greater importance to health, so any slight toxicology contribution is irrelevant.

Note: The above also applies to tritium which normally prevails among radionuclides in the wastewater from nuclear sources and which has no chemical toxicity; it poses a risk only due to emitted radiation.

Interim conclusion: For the above reasons, the chemical toxicity of radionuclides was assessed by the author of the study on the effects on public health on the basis of the data of the NNS and expert experience in impact assessment of nuclear facilities on health as quite negligible and, therefore, has not been explicitly assessed in the health impact assessment and there is no point in this respect in incorporating the requirements in the draft terms of the decision the final statement under preparation of the expert report to the EIA documentation.

4. Dispersion study and study "Effects on public health" use different wind roses. The reason is not explained in the documentation.

A reference model SYMOS'97 was used for the actual calculation of the dispersion of pollutants in the **dispersion study**. Meteorological data entering this model are in the form of stability-structured wind rose divided into three classes of wind velocity and five classes of air stability according to the Bubník and Koldovský classification.

According to the methodological guideline of the Department of Air Protection for the elaboration of dispersion studies pursuant to § 32(1) e) of Act No. 201/2012 Coll., on Air Protection, it is recommended using the rose created from data averaged over 5 years to exclude large fluctuations in weather changes. For the purpose of dispersion studies the wind roses for a **10-year period of time** are currently supplied by the Czech Hydrometeorological Institute, which were also used in the present dispersion study for the NNS project at Dukovany site. The wind rose used in the **dispersion study** was developed by the Czech Hydrometeorological Institute in the context of the technical report "Analysis of the Current State of Air Pollution at the Dukovany Site" including the evaluation of related meteorological data and information to the extent necessary for the preparation of dispersion studies (2015).

For the purposes of assessment of the **radiation effects** of effluents from the NNS and the EDU1-4, the wind rose developed on the basis of real measurements of the meteorological station Dukovany operated by the Czech Hydrometeorological Institute was used. Due to the conservatism of results when evaluating the **annual doses** for representative (most exposed) person, specific roses were developed for each year from 2012 to 2014 and the rose of 2014 was selected for the calculation of radiological consequences, which according to the sensitivity calculations resulted in the highest doses with the same source term. The procedure is described in detail in Chapter 3.4.2 of Annex 5.1 to the EIA documentation - Summary Report on Radiation Effects of NNS EDU. The wind rose from the meteorological station Dukovany for 2014 is also given in Chapter 3.4.2 of Annex 2.1 to the EIA documentation - Effects on Public Health.

Using the wind rose for a 10-year period of time in the dispersion study for the site in question and for the worst year and from the nearest meteorological station in the study of radiation effects is therefore in both cases methodically correct and in line with the current approaches in various technical disciplines.

Interim conclusion: An explanation was given that confirms the correctness of use of "different" wind roses for different types of calculations in the EIA documentation and its annexes in accordance with the currently applied methodological principles.

5. ***Please note that if any tonal components of noise occur in the parallel operation of the new nuclear source and the existing EDU1-4, it can be expected to exceed the sanitary limit of noise for stationary sources during the night in the protected outdoor building-site of the nearest residential area of Slavětice and Dukovany. (The calculated values of noise level are above 35 dB)***

For assessment of the prospective situation it is not possible to deduce the nature of the frequency spectrum from the results of the model calculation of noise load, however, the following professional assessment can be conducted:

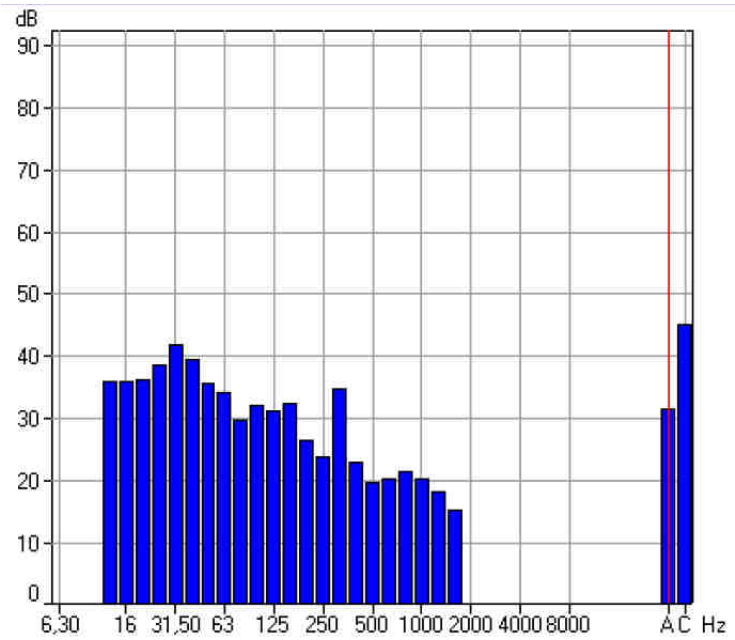
On the basis of the noise measurements of significant noise sources, the tonal component has been identified for existing transformers. The tonal component was also confirmed on the path of the spread of noise from the premises of the EDU1-4, only in a northerly direction, i.e. north of the area of transformer location. In this direction, there is the municipality of Mohelno where noise levels are below the sanitary limit of 35 dB (L_{Aeq} at night = 29.1 dB). The tonal components in this area have not been demonstrated, i.e. the limit of 40 dB should be set for night-time.

A significant source of noise associated with the operation of the power plant is also the Slavětice transformer station (operated by ČEPS, a. s.) for which the tonal component was also confirmed, both in its vicinity and at the nearest protected area of buildings (Slavětice no. 51). In the current state in these areas, the resulting noise level in cumulation with all stationary sources of noise in the area is also reliably below the limit (L_{Aeq} at night = 31.3 dB, the tonal component demonstrated at 320 Hz).

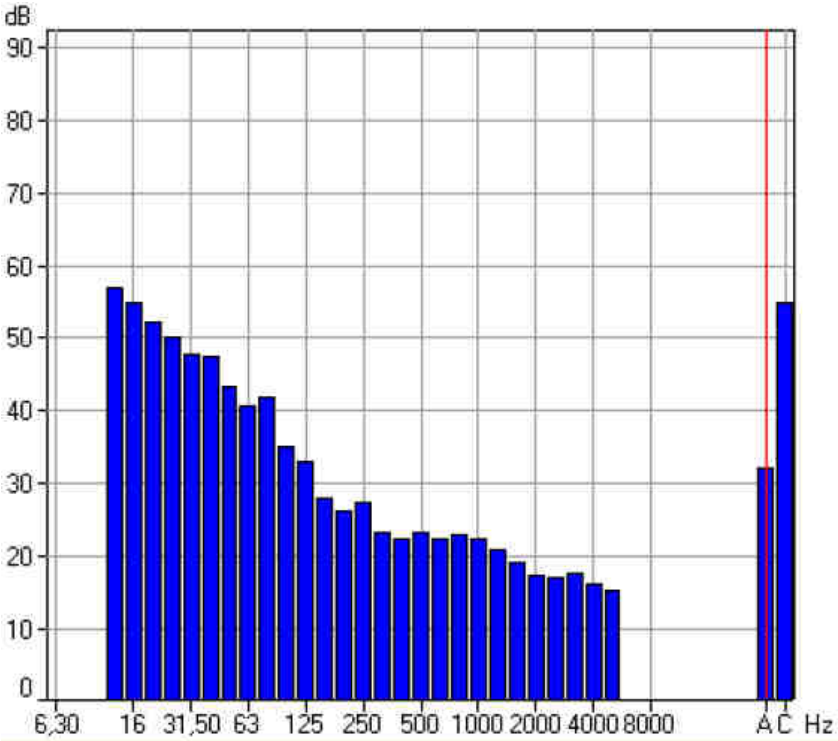
The measurement results of the current state show that in the most affected areas where the tonal component of noise could be expected, the sanitary limit applicable in the presence of tonal component (35 dB) is reliably fulfilled, with a sufficient margin.

In the prospective state, the contribution of the Slavětice substation after its extension was modelled at 32.5 dB for the nearest noise protected building, while the other sources of noise of the NNS contribute at the total level of 38.8 dB with 37.7 dB (predominantly cooling towers, for which the tonal component of noise cannot be assumed). Therefore, there is a realistic assumption that under modelled conditions (conservatively considered maximum noise sources and their most unfavourable spatial arrangement), the tonal components of noise from the operation of the Slavětice substation will be suppressed by higher noise levels from the operation of other sources (hence the limit of 50/40 dB was used).

This assumption was based on the results of the measurements by means of which we tried to estimate the prospective situation even in terms of the possible establishment of a stricter limit for the case of the presence of the tonal component of noise. For this purpose, the measured spectra near the Slavětice no. 51 were used, which is the only potential building, where the presence of tonal component could be assumed (in particular due to the presence of the Slavětice substation) as well as the resulting sound pressure level above 35 dB at night (see the following spectral analysis).



The contribution of the NNS in the frequency spectrum was simulated on the basis of the measurement of noise spreading from the existing EDU1-4, which was carried out at the additional distance (approximately 850 m), thus with a significant proportion of low frequencies spreading without significant attenuation (for frequency range see below).



The measured level L_{Aeq} in this area was about 32 dB. The model-assumed maximum contribution of the NNS near Slavětice no. 51 is at the level below 37.7 dB. In case of increasing the values of the entire spectrum by about 5.7 dB (simulation of the contribution of the prospective NNS) and subsequent summing up with the frequency spectrum at the Slavětice substation, it suggests

elimination of the tonal component at a frequency of 320 Hz, wherein the tonal component was demonstrated in the current state. Of course, this is only a simple approximation, the presence or absence of the tonal component for this single problematic building cannot be 100% eliminated in this modelled way.

Given the sufficient margin to reach 35 dB in the current state, conservatively considered "envelope method" of the noisiest equipment of potential contractors for reference projects, most unfavourable arrangement of noise sources (including the height location of the foundations for cooling towers) and the worst absorption properties of the field, the simultaneous occurrence of the tonal component and the resulting sound pressure level above 35 dB is very unlikely.

Nevertheless, we recommend to include in the draft terms of the decision the final statement under preparation of the expert report to the EIA documentation as part of the monitoring of noise after the commencement of operation of the NNS and in the event of a conflict with sanitary noise limits to implement additional noise measures to comply with the limits. This is the only way to reliably prove these facts. At the same time, it is the only building in the affected area where such exceeding can occur in case of coincidence between theoretical unfavourable circumstances, i.e. measures to ensure compliance with the sanitary limits are therefore solvable.

The tonal component of noise in those sites could be assumed if the noise from the NNS contributed to the total noise levels to a lesser extent and the noise from the Slavětice substation should therefore have a significant proportion in the total noise levels. In this case, however, significantly lower total levels could be expected in the affected buildings.

Furthermore, it should be noted that the calculation conservatively took into account the worst properties of the terrain from the standpoint of noise propagation (reflective terrain that can represent, for example, a situation in the winter season with wet and melted snow cover with a minimum absorbability). Under standard conditions in which authorized noise measurement is carried out pursuant to Act No. 258/2000 Coll., the resulting noise levels can be expected significantly lower (the terrain at the site has entirely absorbing character in the form of grassing, grain or low agricultural cultures).

For the above reasons, compliance with the sanitary limits of noise from stationary noise sources can therefore be expected in all of the most affected protected areas of buildings even in the parallel operation of the existing power plant and the NNS.

Interim conclusion: Although for the above reasons we do not expect exceeding the sanitary limit of noise for stationary sources at night in the protected outdoor area of buildings of the nearest residential area of Slavětice and Dukovany in the parallel operation of the NNS and the existing units of the EDU1-4 even in the event of occurrence of the tonal component of noise, it is recommended to include verification in the draft terms of the decision the final statement under preparation of the expert report to the EIA documentation as part of the monitoring of noise after the commencement of operation of the NNS pursuant to paragraph 2. The condition could be formulated, for example, as follows: "In the trial operation, perform authorized measurements of noise from the operation of the NNS; in the event of a conflict with the sanitary limits of noise, implement additional noise measures to comply with the limits."