



# **NEW SMR POWER PLANT AT THE TEMELÍN SITE**

## **ASSESSMENT OF IMPACTS ON PUBLIC HEALTH**

**June 2026**

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## 1. INTRODUCTION

This study assesses the effects of the implementation of the “New SMR Power Plant at the Temelín site” project on the health of residents living in the vicinity of the project.

The objective of the project is the construction and operation of a small modular reactor (SMR) at the Temelín site. The project will involve the construction of a single nuclear unit with a net electrical output of up to 500 MWe. The proposed technological solution comprises a Generation III+ pressurised water reactor in a three-loop configuration with forced coolant circulation, using a combination of active and passive safety features. A significant portion of the construction will be carried out using a modular approach. The reactor uses standard fuel (UO<sub>2</sub>, enrichment <5%). Power evacuation will be provided via a 400 kV overhead line to the Kočín substation; backup power will also be supplied from the Kočín substation, either via a 110 kV overhead line or partly via a 110 kV underground cable. The project is expected to be implemented between 2029 and 2034, with intensive work, i.e. the actual construction of the power plant unit, taking place from 01/2033 to 09/2034.

When assessing potential effects on the health of the affected population, all factors that may affect human health must generally be taken into account. In the case of the project under assessment, the following potential effects are relevant:

- effects of ionising radiation (radiation exposure) associated with discharges of trace amounts of radionuclides into the atmosphere and watercourses
- effects of electromagnetic fields associated with overhead and underground power lines
- effects of air pollution associated with the construction and operation of the project (during the operational phase, these are primarily associated with traffic)
- effects of noise associated with the operation of the project (the effects of noise on human health are generally associated with long-term exposure; given the duration of acoustically significant construction work, no effects are anticipated during the construction phase)
- psychological effects (assessed for Temelín NPP as a whole)
- social and economic effects

In relevant cases (radiation exposure, noise and air pollution, and socioeconomic effects), both the effects of the SMR ETE project and cumulative effects are assessed, taking into account the combined effects of the operation of the existing Temelín Nuclear Power Plant and other projects at the site (the New Nuclear Power Plant, expansion of the spent nuclear fuel storage facility).

The assessment is based on expert studies and supporting documentation prepared for the individual areas of the project’s potential effects on human health. Specifically, these include:

- assessment of the radiological effects of SMR ETE operation [1]
- test report from an accredited laboratory – verification of the applicable public health limits for electric and magnetic fields [2]
- assessment of the effects of air pollution and noise exposure on public health [3]
- study of the mental health of residents in the Temelín area [4]
- study of the social and economic effects of the project [5]

These studies examine in greater detail the individual areas of potential effects on the population and human health. This assessment must be viewed in the context of those studies.

This assessment considers effects arising during normal operation; its findings cannot be applied to emergency situations, including radiation emergencies.

## 2. ASSESSMENT METHODOLOGY

The assessment methodology used is based on the fundamental methodological procedures for assessing effects on public health and health risks developed by the World Health Organization (WHO) and the U.S. Environmental Protection Agency (US EPA), and uses the authorisation guidelines of the National Institute of Public Health (hereinafter “NIPH”) for health risk assessment and relevant scientific literature [6, 7, 8, 9, 10].

Overall, the assessment considers the following effects that may potentially be associated with the implementation of the project:

- radiological effects (effects of ionising radiation)
- electromagnetic field effects
- effects of air pollution
- effects of noise
- psychological effects
- social and economic effects

In the case of radiological effects, electromagnetic field effects, air pollution, and noise, a quantitative and qualitative assessment is conducted using a health risk assessment procedure consisting of four sequential steps:

- **Hazard identification** – this involves identifying the factors to be assessed and describing their properties, with a focus on their hazards to humans and the conditions under which these hazards may manifest.
- **Dose–response assessment** – in this step, the quantitative relationships between the level of exposure and the magnitude of the risk are determined. A single factor may be associated with multiple effects, each with a different dose–response relationship. The basic concept divides the relevant factors into two groups. For factors with a threshold effect, it is assumed that exposure up to a certain level (the threshold) has no adverse effect. Above the threshold level, the severity of the effect increases with increasing exposure. Most toxic substances, as well as the deterministic effects of ionising radiation, fall into this group. For factors with a non-threshold effect, a certain adverse effect is assumed to occur even at the lowest doses. The dose–response relationship then expresses not the severity of the effect, but the probability of a health effect occurring (a stochastic effect), with this probability increasing with exposure from zero exposure. The relevant relationships are usually derived from studies involving much higher doses than those that can be expected in the normally exposed population. Linear extrapolation is then usually used to assess the dose dependence of the response (i.e. the probability of an effect occurring) in the low-dose range.
- **Exposure assessment** – this includes a qualitative description of contact between the factor under assessment and the outer boundary of the body and a quantitative description of the intensity of that contact. The objective is to determine the pathways through which,

the extent to which, and the quantities in which a specific population is exposed to the chemical substance etc.

- **Risk characterisation** – this stage expresses the level of health risk to the exposed population based on knowledge of the hazards posed by the relevant factor and an estimate of the specific level of exposure. It provides a qualitative and quantitative description of the estimated health risk to the population under assessment, i.e. a list of all potential adverse health effects in that population and the probability of their occurrence. All baseline conditions and facts included in the risk assessment procedure must be described, as must all simplifications and uncertainties reflected in the assessment. Risks assessed in this manner must always be regarded as potential, but sufficiently probable for the population in the area of interest.

Given the nature and location of the project, in addition to the potential effects of the project itself on human health, the combined (cumulative) effects of other existing or planned nuclear facilities at the ETE site are also assessed.

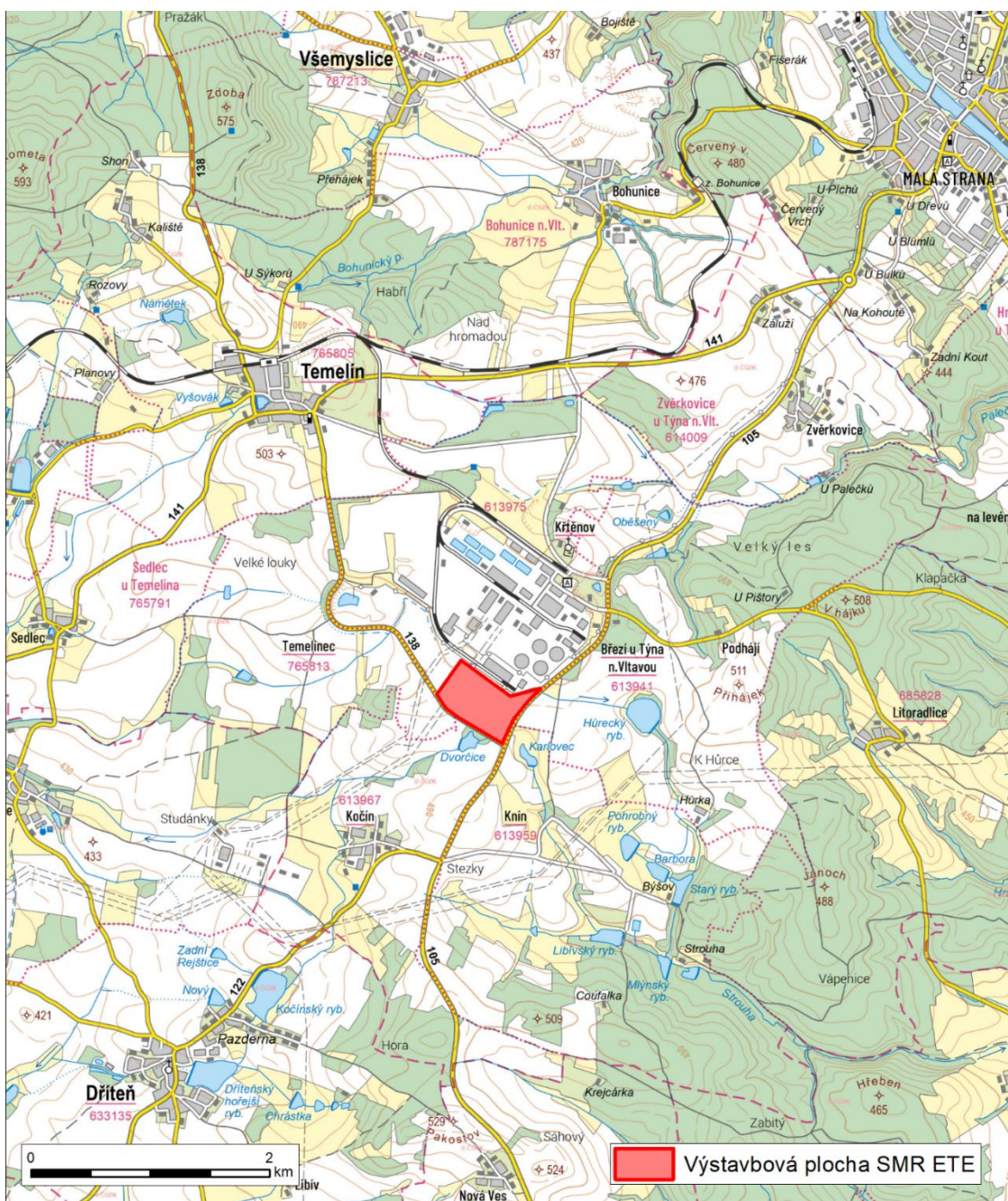
In the case of electromagnetic field effects, given the threshold effect and in accordance with the relevant methodology [11] and legislation [12], a screening assessment is performed, specifically by verifying compliance with the applicable limits.

In the case of psychological and socioeconomic factors, given the nature of their effects, a qualitative assessment is performed on the basis of expert studies [4, 5].

### 3. CHARACTERISTICS OF RESIDENTIAL AREAS IN THE VICINITY OF THE PROJECT

The project under assessment is located in the South Bohemian Region, in the municipality of Temelín, on the left bank of the Vltava River. Residential areas in the vicinity of the project are located primarily within the individual constituent parts of the municipality of Temelín. The location of the project is shown in Figure 1.

**Fig. 1. Location of the project in relation to the surrounding development**



Výstavbová plocha SMR ETE

SMR ETE construction area

According to the 2021 Population and Housing Census (SLBD), the municipality of Temelín had a total population of 757 residents. The municipality comprises the following basic settlement units (hereinafter “BSUs”): Lhota pod Horami, Kaliště, Sedlec, Temelín, Temelínec, Křtěnov, Kočín, Záluží, Zvěrkovice, Březí u Týna nad Vltavou, Podhájí, Knín, and Litoradlice.

The residential areas closest to the project under assessment are located in Temelín, Kočín, Litoradlice, and Knín. The following table provides information on the populations of the nearest BSUs according to the 2021 Population and Housing Census and their locations relative to the project:

**Table 1. BSUs closest to the project under assessment and their populations according to the 2021 Population and Housing Census**

| BSU         | Municipality | Distance      | Population of the BSU |
|-------------|--------------|---------------|-----------------------|
| Kočín       | Temelín      | 1.3 km SW     | 76                    |
| Knín *)     | Temelín      | 2.3–2.7 km SE | 4                     |
| Temelín     | Temelín      | 2.6 km NW     | 312                   |
| Litoradlice | Temelín      | 3 km E        | 49                    |
| Pazderna    | Dříteň       | 3.2 km SW     | 170                   |
| Sedlec      | Temelín      | 3.4 km W      | 51                    |
| Zvěrkovice  | Temelín      | 3.5 km NE     | 58                    |
| Malešice    | Dříteň       | 3.5 km SW     | 124                   |
| Dříteň      | Dříteň       | 3.8 km SW     | 706                   |

\*) The Knín BSU comprises several isolated buildings in areas with the local names Býšov and Strouha.

Given that the individual effects of the construction and operation of the SMR ETE project on public health and the population differ significantly in their spatial extent, the exposed/affected population was assessed individually in relation to the specific issue under consideration.

With regard to radiation risks, the areas most affected by atmospheric and liquid discharges are assessed (representative persons – see Section 4.3). The assessment depends, among other things, on the meteorological conditions in the model year (dry, wet, average):

- in terms of atmospheric discharges, in a model year with below-average total precipitation, these are the municipality of Dříteň and the Kočín location (part of Temelín), situated to the south-west, and the municipality of Temelín, situated to the west. In model years with average and above-average total precipitation, these are locations north-east of Temelín, particularly the area between Temelín and Týn nad Vltavou, including Zvěrkovice and the settlement of Zadní Kohout (part of the town of Týn nad Vltavou), which is located approximately 4.5 km north-east of the project. The differences are primarily due to the different distribution of airflow directions in the modelled years.

- in terms of liquid discharges, Neznašov (part of the municipality of Všemyslice), Újezd (part of the municipality of Albrechtice nad Vltavou), and the Pašovice cottage area (part of the municipality of Chrást'any) were identified as the most affected locations. These locations lie near the southern part of the Orlík Reservoir, approximately 200 m downstream on the Vltava River from the Kořensko Reservoir weir-and-lock complex, and are approximately 8 km north of the project site.
- For the combined effects of atmospheric and liquid discharges, the greatest effect was identified in the municipality of Chrást'any and the Neznašov area (part of the municipality of Všemyslice).

As can be seen, potential radiological effects are considered within the territories of the municipalities and towns of Albrechtice nad Vltavou, Dříteň, Chrást'any, Temelín, Týn nad Vltavou, and Všemyslice. According to [5], the total population of these municipalities and towns as at 1 January 2024 was 13,363, of whom 7,850 were residents of the town of Týn nad Vltavou; the populations of the other municipalities ranged from 734 to 1,699 residents.

The effects of electromagnetic fields may potentially occur only in the immediate vicinity of the relevant overhead and underground power lines; specifically, this concerns the peripheral residential areas of Kočín.

With regard to the effects of air pollution, the assessed area is defined by the extent of the receptor points used in the underlying air dispersion study [3]. This is an area measuring approximately 12×12 km. The greater extent of the area is primarily due to the fact that road traffic on the surrounding roads is a significant source of potential effects, with the distribution of ambient air pollution levels modelled throughout the defined area. The assessed area extends northwards as far as the municipality of Všemyslice and also includes the town of Týn nad Vltavou and the municipalities of Bohunice and Záluží. The eastern boundary of the area is approximately defined by the course of the Vltava River. The municipalities of Předčice, Třitím, and Hněvkovice, for example, are located on the eastern edge of the area, on the right bank of the Vltava River. The southern part of the assessed area includes, among others, the municipalities of Dříteň and Jeznice. The settlements of Chvalešovice and Lhota pod Horami are located on the western boundary of the area. The representative area also includes other settlements in the immediate vicinity of the project that are listed in Table 1.

Based on study [4], psychological effects are assessed for residents of the following municipalities and their constituent parts in the vicinity of the ETE site:

- Dříteň
- Nákří – Chvalešovice, Libív, Malešice, Nákří, Radomilice, Strachovice, Velice, Záblatí, Záblatíčko
- Temelín – Kočín, Lhota pod Horami, Litoradlice, Sedlec, Temelín, Zvěrkovice

- Týn nad Vltavou – Hněvkovice on the left bank of the Vltava River, Jarošovice, Koloděje nad Lužnicí, Malá Strana, Netěchovice, Nuzice, Předčice, Týn nad Vltavou, Vesce
- Všemyslice – Bohunice, Neznašov, Slavětice, Všemyslice, Všetec

A group of 550 representative individuals from these settlements was assessed.

The study of the social and economic effects of the construction and operation of SMR ETE in combination with New NPP ETE [5] primarily assesses effects within a 10 km radius of the existing power plant; to capture differences within the area, a separate group of a small number of municipalities within 7.5 km of the power plant was distinguished in the assessment. Larger towns within 25 km are therefore also included in the assessment of relevant topics. In summary, the following towns and municipalities are included:

- municipalities within 7.5 km – Dříteň, Temelín, Týn nad Vltavou, Všemyslice
- municipalities at a distance of 7.5–10 km – Albrechtice n. V., Bečice, Číčenice, Dívčice, Dobšice, Hluboká n. V., Horní Kněžeklady, Hosty, Chrást'any, Modrá Hůrka, Mydlovary, Nákří, Olešník, Protivín, Zahájí, Žďár, Žimutice
- towns within 25 km – Bechyně, České Budějovice, Písek, Veselí nad Lužnicí, Vodňany

## 4. EFFECTS OF IONISING RADIATION (RADIOLOGICAL EFFECTS)

### 4.1. Hazard identification

The physical basis for the generation of ionising radiation is radioactivity, i.e. the natural or artificially induced ability of certain unstable atomic nuclei to undergo spontaneous radioactive decay, emitting energy in the form of radiation (electromagnetic or corpuscular) in the process and thereby transitioning to a lower-energy and more stable state. The primary event in the interaction of radiation with matter is the absorption of a quantity of emitted energy by an atom or molecule and its use to ionise the same or another atom or molecule (hence the term ionising radiation). This results in the formation of free electrons and charged ions. Charged ions are characterised by instability and greater reactivity and, when interacting with other substances, may induce chemical or electrostatic changes in them. This may have serious consequences in the cells of living tissues, where the production of ions and free radicals disrupts chemical bonds, damaging the cells.

The fundamental quantity used to describe radiation exposure is *absorbed dose*. It is defined as the quotient of the radiation energy absorbed and the mass of the matter in which this energy is absorbed. The unit of absorbed dose is the gray (Gy), dimensionally J/kg. The response of living tissues exposed to different types of radiation is not directly proportional to the physical dose – the effect depends on the type of radiation ( $\alpha$ ,  $\beta$ ,  $\gamma$ , neutron)<sup>1</sup>, i.e. on the energy, mass, and charge of the particles or photons. At the same absorbed dose, densely ionising corpuscular radiation has substantially greater effects than sparsely ionising radiation.

Differences in relative biological effectiveness between the individual types of radiation are expressed by the *quality factor*. This is then used to determine the *dose equivalent* (for a point in tissue), which places the biological effectiveness of radiation from different radionuclides on a common basis and thus enables comparison, or the *equivalent dose* (for an entire organ or tissue). The unit of dose equivalent and equivalent dose is the sievert (Sv), again dimensionally J/kg. As stated above, different organs and tissues of the human body vary in their susceptibility to health effects caused by radiation exposure. The equivalent dose therefore provides no information about the overall risk that may result from radiation exposure. For this reason, the assessment incorporates the *tissue weighting factor*, which expresses the sensitivity of individual organs to radiation exposure, with the sum of the weighting factors for all organs in the entire body being equal to one. *Effective dose* is then used to calculate the risk. It is defined as the weighted sum of the equivalent doses to all irradiated tissues and organs.

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<sup>1</sup> Alpha ( $\alpha$ ) radiation consists of a stream of alpha particles composed of two protons and two neutrons (a helium nucleus,  $\text{He}^{2+}$ ). Beta ( $\beta$ ) radiation consists of a stream of electrons ( $\beta^-$ ) or positrons ( $\beta^+$ ). Gamma ( $\gamma$ ) radiation consists of electromagnetic waves (photons). Neutron radiation consists of a stream of neutrons ( $n$  or  $n^0$ ).

The unit of effective dose is again the sievert (Sv). In the case of uniform whole-body exposure to a particular type of radiation, the effective dose is equal to the equivalent dose.

The total effective dose received is the time integral of its rate over a specified period (e.g. an annual effective dose in Sv/year etc.); for lifetime exposure, a period of 50 years is usually considered for adults and a period extending to the age of 70 years for children [15].

The adverse effects of ionising radiation on humans are divided into two groups:

**1) Deterministic effects** are characterised by direct tissue damage and occur following high radiation doses. According to the State Office for Nuclear Safety (hereinafter “SONS”) [14], these effects result from the death of part of the irradiated cell population; their severity increases with dose above a certain dose threshold (below which the effect does not occur), and they have a characteristic clinical presentation. This group includes, in particular, acute radiation syndrome, acute skin damage (radiation dermatitis), impaired fertility following irradiation of the gonads, and, among late effects, chronic skin inflammation and cataracts.

**2) Stochastic effects** are characterised by the development of malignant tumours and heritable damage. According to SONS [14], the clinical presentation of these effects is not characteristic and does not differ from that of “spontaneously” occurring cases. They may occur not only at high radiation doses but also at low doses. These effects are caused by changes in the genetic information of a cell (mutations), and a linear, non-threshold dose–response relationship is assumed for them. In this case, it is not the severity of the damage that increases with dose, but the probability of malignant neoplasms and heritable damage occurring. However, once an effect occurs, it has the same clinical severity regardless of the magnitude of the dose that caused it.

According to SONS [14], the process of cancer development is multicomponent in nature. One component is the existence of cells carrying modified (mutated) information and transmitting this atypicality to their progeny (genomic instability and the development of a genetically unstable phenotype); the second component is a set of conditions that counteract the tendency to eliminate atypical cells or suppress their growth. A number of factors are involved in both components, including ionising radiation, which, according to current knowledge, may act at different stages of the cancer development process. The assumption that malignant tumours may also be induced by low doses of ionising radiation is derived from a number of observations, of which the study of survivors of the atomic bombings of Hiroshima and Nagasaki, observations of patients treated with X-rays, and an analysis of the causes of death among US radiologists exposed between 1900 and 1950 are of particular importance. The various organs and tissues of the human body differ in their radiosensitivity in terms of the probability of occurrence of health effects. The most radiosensitive organs include the bone marrow, stomach, colon, lungs, and the female

breast [13, 14].

Given the nature of the project and the very low potential radiation doses that may be associated with its implementation, including cumulative effects, the quantitative analysis in this assessment is performed for the stochastic effects of ionising radiation. Deterministic effects will not occur.

Stochastic effects are delayed and do not manifest until after a certain period, often many years. According to SONS [14], the latency period is 5–20 years for leukaemia and 10–40 years for lung cancer.

Genetic changes in the offspring of exposed persons constitute an important group of late effects. Such genetic changes are caused by a gametic mutation in the nucleus of the germ cells (ova or sperm) of the gonads. A mutated gene is capable of reproducing during cell division, and the mutation is thus transmitted to subsequent generations. An adverse genetic constitution may result in early foetal death or premature delivery (miscarriage), or in death shortly after birth of a newborn with a severe congenital defect.

According to the International Commission on Radiological Protection (hereinafter “ICRP”) [15], evidence of radiation-related cancer risk is provided by epidemiological and experimental studies, although uncertainty exists at doses of around 100 mSv or lower. In the case of hereditary diseases, there is no direct evidence of this radiation risk in humans; nevertheless, experimental studies provide convincing evidence supporting the inclusion of such risks to future generations in the protection system.

The limits used, as set out in SONS Decree No. 422/2016 Coll., on Radiation Protection and Security of Radionuclide Source [18], are also derived from current knowledge of the stochastic effects of ionising radiation on humans; the Decree reflects the recommendations of the ICRP [15] and other international legislation, in particular Directive 2013/59/Euratom. Pursuant to Section 3 of the Decree, the general annual limit for members of the public from all authorised or registered activities is 1 mSv for the sum of effective doses from external and internal exposure. For the equivalent dose to the lens of the eye, this limit is 15 mSv, and for the average equivalent dose to 1 cm<sup>2</sup> of skin it is 50 mSv, irrespective of the size of the exposed area.

Given the nature of any limit, it may be stated that these limits represent values which, if complied with, ensure that the exposed population is protected in a socially acceptable manner. However, as stated above, assuming non-threshold effects, it is not possible to establish levels that would ensure that radiation is completely harmless (zero risk). Therefore, even at values below the limits, an assessment is performed with the aim of reducing doses to the lowest reasonably achievable level. The result should be a probability of effects that is as low as reasonably achievable in practice and, at the same

time, acceptable from health and societal perspectives. For factors with non-threshold effects, the most stringent criterion conventionally used for acceptable risk is a level of  $1 \times 10^{-6}$  for the individual effect of the project under assessment (i.e. one case of health detriment per one million exposed residents), or an order of magnitude of  $10^{-6}$  for the combined effects of multiple sources. In many cases, however, less stringent criteria are used (up to  $1 \times 10^{-4}$ ).

## 4.2. Dose–response assessment

The radiation protection system is based on the generally accepted assumption that, at low radiation doses, an increase in dose results in a directly proportional increase in the probability of radiation-induced cancer or heritable effects. This approach, generally known as the “*linear no-threshold dose–response model*”, is conservative (i.e. it tends to overestimate the risk).

For the purposes of assessing the health effects of low radiation doses, the ICRP<sup>2</sup> developed and published in Publication 103 [15] coefficients for estimating the health detriment. Health detriment is defined as “the total harm to health experienced by an exposed group and its descendants as a result of the group’s exposure to a radiation source”. It is a multidimensional concept whose principal components are the following stochastic quantities: the probability of an induced fatal neoplasm, the weighted probability of an induced curable neoplasm, the weighted probability of severe heritable effects, and the shortening of life resulting from the damage. The ICRP also includes heritable damage transmitted to offspring, which has not been demonstrated in humans, although convincing evidence exists in experimental animals.

Accordingly, this assessment uses the most highly developed, scientifically justified, and conservative risk estimation methods developed by the ICRP to assess the stochastic effects of ionising radiation. The coefficients used to estimate health detriment are presented in the following table.

**Table 2. Nominal risk coefficients for estimating health detriment from the stochastic effects of low radiation doses [15]**

| Exposed population | Risk coefficient [ $10^{-2} \text{ Sv}^{-1}$ ] |                   |       |
|--------------------|------------------------------------------------|-------------------|-------|
|                    | Neoplasms                                      | Heritable effects | Total |
| Total population   | 5.5                                            | 0.2               | 5.7   |
| Adults             | 4.1                                            | 0.1               | 4.2   |

Note: The risk coefficient is probabilistic in nature, with a risk coefficient expressed in units of  $10^{-2} \text{ Sv}^{-1}$  indicating the probable number of cases of health detriment per 100 persons individually exposed to an effective dose of 1 Sv.

<sup>2</sup> The ICRP (International Commission on Radiological Protection) is an independent non-governmental organisation established in 1928. It continuously reviews new scientific knowledge in the field of radiological protection and uses it to update preventive recommendations for protection against risks associated with ionising radiation, whether artificially produced or naturally occurring. It brings together the world’s leading experts in this field and enjoys considerable international authority. All international standards and national regulatory activities in the field of radiation protection are based on ICRP recommendations.

The total nominal risk coefficient relating to total detriment from stochastic effects for exposure at a low dose rate is therefore  $5.7 \times 10^{-2} \text{ Sv}^{-1}$ . Because small risks are difficult to detect in epidemiological studies, the dose-specific risk estimates in ICRP Publication referred to above are based primarily on acute doses of 200 mSv and above. However, many of the more challenging issues in radiation protection involve continuous or fractionated exposures with individual fractions of a few mSv or less. Experimental research tends to support the finding that fractionated or protracted doses are associated with a lower risk, suggesting that dose-specific estimates derived from high doses received during acute exposure should be divided, when applied to low continuous or fractionated doses, by the dose and dose-rate effectiveness factor (DDREF). This factor reflects the lower biological effectiveness of exposure at low doses and low dose rates compared with exposure at high doses and high dose rates. The ICRP considers that the adoption of the linear no-threshold model combined with a well-judged DDREF value provides a prudent basis for practical radiation protection purposes, i.e. for controlling the risk of radiation exposure in the low-dose range.

For the induction of gene and chromosomal mutations, DDREF values generally fall within the range of 2–4. Having considered all the supporting data, the ICRP recommends using a DDREF value of 2 for cancer risk at low dose rates for general radiation protection purposes; this applies to all cancers combined. However, the underlying study [1] uses a DDREF value of 1 in order to maintain continuity with previous assessments of impacts on public health for projects at the Temelín Nuclear Power Plant site [20, 21] and to ensure the comparability of the assessment results. Given the need for compatibility with the underlying study [1], this assessment also uses a DDREF value of 1. This is therefore a highly conservative approach, as it assumes radiation effects twice as high as under the current ICRP recommendation.

In summary, a risk coefficient of  $5.7 \times 10^{-2} \text{ Sv}^{-1}$  is used to estimate the health effects of low radiation doses. As can be seen, when this risk coefficient is used, a dose of 1 mSv, i.e. the general annual limit for members of the public from all authorised or registered activities for the sum of effective doses from external and internal exposure, corresponds to a risk of  $5.7 \times 10^{-5}$ , i.e. one case per approximately 17,500 residents.

### 4.3. Exposure assessment

The assessment of the effects of radiation on the population and public health resulting from the implementation of SMR ETE is based on the document “Assessment of Radiological Effects of Operation of the SMR ETE Nuclear Power Plant” [1], prepared by Doc. Ing. František Podzimek, CSc. (Czech Technical University in Prague, Faculty of Biomedical Engineering, Department of Health Sciences and Civil Protection). Both the effects of the SMR ETE project alone and the cumulative exposure resulting from the operation of the existing power plant (ETE1,2) and other projects in the area are assessed

(see below). The exposure assessment for SMR ETE is based on a study by ABmerit [19]; for cumulative sources, it is based on the 2010 study for the New Nuclear Power Plant at the Temelín site [20] and the 2024 study for the expansion of the spent nuclear fuel storage facility (hereinafter “SNFS”) [21].

The calculation of the radiological consequences of SMR ETE operation determines individual effective doses and 50-year committed individual effective doses for adults and 70-year committed individual effective doses for children. A large number of radionuclides in potential discharges and all potential exposure pathways are assessed. For atmospheric discharges, these pathways comprise inhalation, ingestion (e.g. of crops on which radionuclides have been deposited), external exposure from ground deposition, and external exposure from the cloud. For discharges into the hydrosphere, the pathways comprise ingestion of drinking water, irrigation, watering of animals and consumption of fish, as well as external exposure during swimming, boating, and time spent on the riverbank. Total effective doses and committed effective doses are subsequently determined for atmospheric discharges, hydrospheric discharges, and the sum of all pathways for the relevant age category.

In accordance with Act No. 263/2016 Coll., the Atomic Energy Act, as amended [17], the assessment is performed for a representative person, defined as “a member of the public representing a model group of natural persons who receive the highest exposure from the given source and via the given pathway”. The characteristics of the representative persons identified are provided below in the exposure description.

The calculations were performed for three scenarios with different meteorological conditions. Based on meteorological and hydrological data, the following years were selected as representative:

- 2018 as a dry year with a lower flow rate in the Vltava River at the Kořensko profile
- 2023 as an average year with values corresponding to the long-term annual average at the Kořensko profile
- 2024 as a wet year

#### **4.3.1. Radiation exposure from SMR ETE operation**

In the underlying study by ABmerit [19], residential areas in the vicinity of SMR ETE with the highest effective doses to a representative person were identified on the basis of the calculations performed:

- in the case of atmospheric discharges, these are the locations of Kočín, Litoradlice, and Zvěrkovice
- in the case of liquid discharges, these are the locations of Neznašov, Újezd, and the Pašovice cottage area

The population age groups in which the maximum annual effective dose values

occurred were also identified. For atmospheric discharges, these are the age groups 6–15 years and, in some cases, 16+ years; for hydrospheric discharges, fetuses and children aged 0–5 years are the most affected.

The calculations show that, in the case of radioactive discharges into the atmosphere, the highest total annual effective dose, including the committed effective dose to a representative person, occurs in Zvěrkovice for the 6–15 age group under the average meteorological conditions of 2023, at **0.18  $\mu\text{Sv/year}$** .

The radiological effect of discharges into the hydrosphere is greatest in Újezd and the Pašovice cottage area for the fetus under the dry-year conditions of 2018, at **0.28  $\mu\text{Sv/year}$** . For discharges into the hydrosphere, the meteorological situation plays a significant role, as effective dose values in an average or wet year, when the water level in the Vltava River is higher, are only approximately half those calculated for the dry year 2018.

When jointly assessing the effects of discharges into the atmosphere and the watercourses, the highest effective dose values are observed for a representative person with the following characteristics: a fetus or child aged 0–5 years living in the cadastral area of the municipality of Chrást'any or Všemyslice or in Neznašov, assuming the dry year 2018. In this case, an effective dose of **0.3  $\mu\text{Sv/year}$**  was calculated.

The following table summarises data on radiation exposure from the individual SMR ETE discharges.

**Table 3 Identification of the representative person and total dose to the representative person due to SMR ETE operation [1]**

| Year                                                                                                                  | 2018                                                                                                                  | 2023                                                                                                        | 2024                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|                                                                                                                       | Dry year                                                                                                              | Average year                                                                                                | Wet year                                                                                                    |
| <b>Effect of atmospheric discharges</b>                                                                               |                                                                                                                       |                                                                                                             |                                                                                                             |
| <b>Populated location with the highest effective dose [Sv] to the representative person</b>                           |                                                                                                                       |                                                                                                             |                                                                                                             |
| Description of location                                                                                               | Cadastral areas of the municipalities of Dříteň and Temelín, Kočín location                                           | Cadastral areas of the municipalities of Temelín and Týn nad Vltavou, Zvěrkovice and Zadní Kohout locations | Cadastral areas of the municipalities of Temelín and Týn nad Vltavou, Zvěrkovice and Zadní Kohout locations |
| Effective dose                                                                                                        | $1.4 \times 10^{-7}$                                                                                                  | $1.8 \times 10^{-7}$                                                                                        | $1.6 \times 10^{-7}$                                                                                        |
| Age group                                                                                                             | 16 years and older                                                                                                    | 16 years and older                                                                                          | 6–15 years, 16 years and older                                                                              |
| <b>Effect of discharges to the Vltava River</b>                                                                       |                                                                                                                       |                                                                                                             |                                                                                                             |
| <b>Populated location with the highest effective dose [Sv] to the representative person</b>                           |                                                                                                                       |                                                                                                             |                                                                                                             |
| Description of location                                                                                               | Cadastral areas of the municipalities of Albrechtice and Chrášťany, the Újezd location, and the Pašovice cottage area | Cadastral areas of the municipalities of Albrechtice and Chrášťany, Újezd location                          | Cadastral areas of the municipalities of Albrechtice and Chrášťany, Újezd location                          |
| Effective dose                                                                                                        | $2.8 \times 10^{-7}$                                                                                                  | $1.5 \times 10^{-7}$                                                                                        | $1.3 \times 10^{-7}$                                                                                        |
| Age group                                                                                                             | Children aged 0–5 years<br>6–15 years                                                                                 | Children aged 0–5 years<br>6–15 years                                                                       | Children aged 0–5 years                                                                                     |
| <b>Combined effect of atmospheric discharges and discharges to the Vltava River (resulting representative person)</b> |                                                                                                                       |                                                                                                             |                                                                                                             |
| <b>Populated location with the highest effective dose [Sv] to the representative person</b>                           |                                                                                                                       |                                                                                                             |                                                                                                             |
| Description of location                                                                                               | Cadastral areas of the municipalities of Chrášťany and Všemyslice, Neznašov location                                  | Cadastral areas of the municipalities of Temelín and Týn nad Vltavou, Zvěrkovice and Zadní Kohout locations | Cadastral areas of the municipalities of Temelín and Týn nad Vltavou, Zvěrkovice and Zadní Kohout locations |
| Effective dose                                                                                                        | $3.0 \times 10^{-7}$                                                                                                  | $1.8 \times 10^{-7}$                                                                                        | $1.6 \times 10^{-7}$                                                                                        |
| Age group                                                                                                             | Foetus, child aged 0–5 years                                                                                          | 16 years and older                                                                                          | 6–15 years, 16 years and older                                                                              |

Based on the calculated maximum annual effective dose values, a conservative model can be used to calculate total radiation exposure for different durations of residence in the area of interest and subsequently determine the total health detriment. Radiation exposure was calculated using a conservative approach (on the safe side), as the product of the maximum dose across all age categories and the duration of lifetime exposure, i.e. without taking into account the age distribution of exposed persons. For lifetime exposure of a representative person to discharges from SMR ETE, defined as 50 years for adults and 70 years for children, radiation exposure over the entire period of residence will be as follows:

- in the case of atmospheric discharges, it will amount to 9  $\mu\text{Sv}$  for adults and 12.6  $\mu\text{Sv}$  for children
- in the case of discharges into the hydrosphere, it will amount to a maximum of 14  $\mu\text{Sv}$  for adults and 19.6  $\mu\text{Sv}$  for children

- for the combined effect of discharges into the atmosphere and the hydrosphere, it will amount to a maximum of 15  $\mu\text{Sv}$  for adults and 21  $\mu\text{Sv}$  for children

#### **4.3.2. Radiation exposure from all existing and planned operations at the ETE site**

For the purposes of determining the cumulative effects of Temelín Nuclear Power Plant operation, the following sources were also considered in addition to SMR ETE:

- existing operation of the Temelín Nuclear Power Plant (ETE1,2)
- New Nuclear Power Plant at the Temelín site (New NPP ETE) – two additional new units with an electrical output of up to  $2 \times 1,700 \text{ MW}_e$
- expansion of the capacity of the spent nuclear fuel storage facility (SNFS) at the ETE site from 96 to 152 packages

For the analysis of the combined effects of the operation of ETE1,2, SNFS, SMR ETE, and New NPP ETE, the area of interest for atmospheric discharges was defined in the same way as for SMR ETE, i.e. as the locations of Kočín, Zvěrkovice, and Litoradlice. In the analysis of ETE1,2 and New NPP ETE, effective dose values for atmospheric discharges were calculated for distances of 2,333 and 3,333 m (according to the locations of nearby municipalities). For SNFS, effective dose values from atmospheric discharges were determined for a distance of 1,600 m, corresponding to the distance of the municipality of Kočín. Similarly, the locations of Neznašov, Újezd, and the Pašovice cottage area were selected for assessing the effects of discharges into the hydrosphere.

The effects of atmospheric discharges from the individual facilities or projects were assessed using different age-based population categories, due to differences between the legislation previously in force and the legislation currently in force. Therefore, when comparing the values, the overlap between the age groups concerned was taken into account and, in the case of ETE1,2 and New NPP ETE, the highest annual effective dose value was selected conservatively to avoid any potential underestimation in the calculation. When calculating effective doses from hydrospheric discharges, three meteorological scenarios were considered for SMR ETE, whereas only an average year was considered in the calculations for ETE1,2 and New NPP ETE. For this reason, the cumulative annual effective dose was only determined for the average year 2023.

To determine the cumulative maximum annual effective doses to a representative person, the public exposure values from the individual facilities were subsequently added together. In reality, however, the maximum values will be lower due to the different directional distributions of the radiological effects of the individual facilities; the calculations are therefore on the safe side.

The calculations show that:

- in the case of atmospheric discharges, the maximum cumulative annual effective dose, including the committed effective dose to a representative person, will reach **2.05  $\mu\text{Sv}/\text{year}$**  in Kočín for children aged 0–5 years, assuming the dry year 2018
- in the case of hydrospheric discharges, the maximum cumulative annual effective dose is recorded for a representative person from the group comprising foetuses or children aged 0–5 years living in Újezd and the Pašovice cottage area, assuming the average year 2023. It may reach up to **3.89  $\mu\text{Sv}/\text{year}$** . Given the location of these areas, SNFS will make no contribution to the exposure of the representative persons.
- when jointly assessing the radiological effects of atmospheric and hydrospheric discharges from ETE1,2, New NPP ETE, and SMR ETE, the maximum annual effective dose, including the committed effective dose to a representative person in the Pašovice cottage area, is **4.33  $\mu\text{Sv}/\text{year}$**

Based on the calculated maximum annual effective dose values, a conservative model can be used to calculate total radiation exposure for different durations of residence in the area of interest and subsequently determine the total health detriment. For lifetime exposure of a representative person to discharges from SMR ETE, ETE1,2, SNFS, and New NPP ETE, defined as 50 years for adults and 70 years for children, radiation exposure over the entire period of residence will be as follows:

- in the case of atmospheric discharges, it will amount to 103  $\mu\text{Sv}$  for adults and 144  $\mu\text{Sv}$  for children in Kočín
- in the case of discharges into the hydrosphere, it will amount to a maximum of 195  $\mu\text{Sv}$  for adults and 272  $\mu\text{Sv}$  for children in Újezd and the Pašovice cottage area
- for the combined effect of discharges into the atmosphere and the hydrosphere, it will amount to a maximum of 217  $\mu\text{Sv}$  for adults and 303  $\mu\text{Sv}$  for children in the Pašovice cottage area

#### 4.3.3. Radiation exposure from natural sources

For comparison, radiation exposure from natural sources, which is also documented in the underlying study [1], may be presented. Data on external exposure from natural sources and internal contamination, associated primarily with the inhalation of radon and its decay products, are presented separately.

The primary source of external exposure data is the Monitoring of the Radiation Situation in the Czech Republic (MonRaS), performed mainly through the nationwide Radiation Monitoring Network – the Early Warning Network and the integral measurement network. The average ambient dose equivalent rate at the Temelín site in 2025 was 132 nSv/hour, corresponding to an average annual effective dose from natural background radiation of 1.16 mSv per resident.

Data on exposure from internal contamination are derived from the radon index. The Temelín site is located in an area with a medium radon index, for which the average

exposure from radon and its decay products is approximately 4.47 mSv per year. The average annual effective dose per resident from the inhalation and ingestion of terrestrial radionuclides other than Rn can be estimated at 0.3 mSv. The total estimated annual radiation exposure from natural sources at the Temelín site is therefore approximately 5.93 mSv per year. As can be seen, the level of exposure to natural sources is more than one thousand times higher than the total exposure calculated for the existing and planned sources at the Temelín site.

#### 4.4. Risk characterisation

In accordance with the ICRP [15], the level of health risk is expressed in terms of health detriment, which represents the probability of developing cancer at a given exposure level. It is calculated as the product of total radiation exposure, the nominal risk coefficients, and the dose and dose-rate effectiveness factor (DDREF).

In this assessment, the risk coefficients specified in Table 2 and a dose and dose-rate effectiveness factor (DDREF) of 1 are used to estimate health detriment from the stochastic effects of low radiation doses (this is a highly conservative approach; see the comment in Section 4.2). Given that the higher radiation exposure was calculated for children in all cases (and thus for an exposure period of 70 years), a risk coefficient of  $5.7 \times 10^{-2} \text{ Sv}^{-1}$  is used.

Both calculations were performed using a highly conservative approach (on the safe side). In particular, a DDREF value of 1 was used instead of the DDREF value of 2 recommended by the ICRP, and thus a risk coefficient twice as high as that under the current ICRP recommendation. Other procedures were also on the safe side – these involved considering the least favourable combination of meteorological conditions, the highest number of potentially affected persons, a combination of all potential exposure pathways, and the combined effects of all sources over a period of 70 years.

The resulting health detriment values for the effect of SMR ETE are presented in the following table.

**Table 4 Calculation of total health detriment – effect of the SMR ETE project**

| Source                           | Locations                                                                                                            | Annual effective dose [Sv] | Lifetime radiation exposure [Sv] | Total health detriment |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------|------------------------|
| Atmospheric discharges           | Cadastral areas of the municipalities of Temelín and Týn nad Vltavou, Zvěkovice and Zadní Kohout locations           | $1.8 \times 10^{-7}$       | $12.6 \times 10^{-6}$            | $7.18 \times 10^{-7}$  |
| Discharges into the Vltava River | Cadastral areas of the municipalities of Albrechtice and Chrástany, the Újezd location and the Pašovice cottage area | $2.8 \times 10^{-7}$       | $19.6 \times 10^{-6}$            | $1.12 \times 10^{-6}$  |

|                                                                       |                                                                                      |                      |                       |                       |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------|-----------------------|-----------------------|
| Combined effect of discharges into the atmosphere and the hydrosphere | Cadastral areas of the municipalities of Chrástany and Všemyslice, Neznašov location | $3.0 \times 10^{-7}$ | $21.0 \times 10^{-6}$ | $1.20 \times 10^{-6}$ |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------|-----------------------|-----------------------|

As can be seen, the risk from SMR ETE operation reaches a maximum value of  $1.2 \times 10^{-6}$ ; the calculated value corresponds to one case per approximately 835,000 residents. The number of residents living in the area potentially affected by radiological effects is in the order of several thousand or (if the entire population of Týn nad Vltavou is included) slightly more than 10,000. It is therefore clear that the increase in the level of health risk in the affected residential areas will be entirely insignificant in terms of any threat to health.

The calculation results for the cumulative effect of all existing and planned operations at the Temelín site are as follows.

**Table 5 Calculation of total health detriment – cumulative effect of all existing and planned operations at the ETE site**

| Source                                                                | Locations                                | Annual effective dose [Sv] | Lifetime radiation exposure [Sv] | Total health detriment |
|-----------------------------------------------------------------------|------------------------------------------|----------------------------|----------------------------------|------------------------|
| Atmospheric discharges                                                | Kočín                                    | $2.05 \times 10^{-6}$      | $144 \times 10^{-6}$             | $8.18 \times 10^{-6}$  |
| Discharges into the Vltava River                                      | Újezd location and Pašovice cottage area | $3.89 \times 10^{-6}$      | $272 \times 10^{-6}$             | $1.55 \times 10^{-5}$  |
| Combined effect of discharges into the atmosphere and the hydrosphere | Pašovice cottage area                    | $4.33 \times 10^{-6}$      | $303 \times 10^{-6}$             | $1.73 \times 10^{-5}$  |

For cumulative effects, where total exposure from the operation of SMR ETE, the existing Temelín Nuclear Power Plant (ETE1,2), the planned New Nuclear Power Plant at the Temelín site (New NPP ETE), and the expanded spent nuclear fuel storage facility (SNFS) is considered, total health detriment amounts to no more than  $1.73 \times 10^{-5}$ . This value can also be expressed as an increase of one case per 58,000 residents. The total population in the area under assessment is approximately 10,000. However, the calculation was performed using the highest annual effective dose values, which occur in areas with populations in the hundreds; exposure will be lower in other parts of the area (moreover, even in the locations referred to above, this represents an upper-bound estimate of the potential risk, as stated in Section 11).

As can be seen, for all sources at the Temelín site, total health detriment to a representative person is at the lower end of the order of  $10^{-5}$ . However, this is because, in order to maintain continuity with the underlying study and previous assessments, a risk coefficient twice that recommended by the ICRP was used. If the ICRP approach were followed (i.e. DDREF = 2), total health detriment would clearly be of the order of

$10^{-6}$ . Given the size of the exposed population, the cumulative effect of all sources at the Temelín site may also be considered insignificant in terms of the health risk to the affected population.

For information, a comparison with the effects of natural background radiation in the affected area may also be provided. The associated risk can be quantified as follows:

$$5.93 \times 10^{-3} \text{ Sv/year} \times 70 \text{ years} \times 5.7 \times 10^{-2} \text{ Sv}^{-1} = 2.37 \times 10^{-2}.$$

As can be seen, the risk from exposure to natural sources is approximately 20,000 times higher than the effect of SMR ETE and approximately 1,300 times higher than the total exposure to all existing and planned sources at the Temelín site.

## 5. EFFECTS OF ELECTRIC AND MAGNETIC FIELDS

### 5.1. Hazard identification and dose–response assessment

Electromagnetic radiation is a natural phenomenon representing one of the fundamental means of energy transfer. It is emitted by various sources, whether natural or man-made. The space into which this radiation extends is referred to as an electromagnetic field. Electromagnetic radiation occurs, among other places, in the vicinity of all power lines, cables, and electrical equipment. In the case of the SMR ETE project under assessment, assessment of its effects is therefore relevant in relation to the overhead and underground power lines that will connect the SMR ETE facility to the Kočín substation.

The energy of electromagnetic radiation increases in direct proportion to its frequency. The frequency of power lines is determined by the frequency of the 50 Hz alternating current; this is therefore very-low-frequency radiation and fields with a long wavelength. The following overview therefore discusses the expected health effects of human exposure to low-frequency electromagnetic (or electric and magnetic) fields.

The health effects of long-term exposure to electromagnetic radiation were unknown for a long time, and greater attention was only devoted to research into them in the second half of the 20th century. Since then, however, a large number of research studies have been conducted and published in which possible associations between exposure to electromagnetic fields and a wide range of health effects were identified and subsequently investigated. Since 1996, the WHO has been running an ongoing project (The International EMF Project) [22] in response to growing concerns associated with the fact that almost the entire global population is currently exposed to some form of anthropogenic electromagnetic radiation and with indications of certain serious health effects (specifically childhood leukaemia). It has been concluded that several decades of research into electromagnetic fields have not identified any serious risks to public health, although uncertainties remain. A comprehensive report on this issue was published by the European Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) in 2015 [23]. With regard to the effects of low-frequency electromagnetic fields on human health, the Committee states that studies conducted to date provide no convincing evidence of a causal relationship between exposure to low-frequency electromagnetic fields and subjectively reported symptoms.

Epidemiological studies indicate an increased risk of childhood leukaemia in persons with an estimated average daily exposure above 0.3–0.4  $\mu\text{T}$ , but no mechanisms have been identified and there is no evidence from experimental studies that could explain these findings. Given the generally recognised limitations of epidemiological studies, no conclusion supporting a causal interpretation can therefore be drawn.

Studies investigating the possible effects of exposure to electromagnetic fields on

neurological functions (the power spectrum of waking EEG, behavioural outcomes, cortical excitability) are too heterogeneous to allow a reliable conclusion to be drawn. Epidemiological studies provide no convincing evidence of an increased risk of neurodegenerative diseases.

No adverse effects on foetal development have been demonstrated. Studies of childhood health outcomes in relation to maternal exposure to electromagnetic fields during pregnancy are subject to uncertainties that will need to be investigated. No effect on reproductive function has been demonstrated either.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) also published an important comprehensive work on this issue in 2010. These are the Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz–100 kHz) [24]. The guidelines synthesise the available scientific data on both the direct and indirect effects of low-frequency electric and magnetic fields. Acute effects are considered established – direct stimulation of nerve and muscle tissue and the induction of retinal phosphenes (the perception of flashes or light on the retina associated with effects on the nervous system). There is also indirect evidence of transient effects on brain functions (visual processing and motor coordination) induced by electric fields. All these effects have threshold values below which they do not occur. The magnitude of the effect is determined by the strength of the internal electric field induced in tissues by external time-varying electric or magnetic fields.

The report extensively discusses other potential effects of human exposure to low-frequency electric and magnetic fields that have been investigated – effects on the neuroendocrine system, neurodegenerative disorders, cardiovascular diseases, reproductive and developmental disorders, and cancer – and in all cases finds no basis for establishing a causal relationship between exposure and a health effect.

Based on the assessment performed, the ICNIRP establishes guideline values related to the field frequency. It can be concluded that, provided the guideline values for the general population are complied with, the occurrence of the health effects described can be ruled out; in the case of occupational exposure, their limited occurrence (for a defined period and under controlled conditions) is considered acceptable. European legislation and, subsequently, Czech legislation, specifically Government Regulation No. 291/2015 Coll., on the protection of health against non-ionising radiation, are based on the ICNIRP recommendations [12]. The fundamental quantity for the protection of the public is the modified electric field strength induced in human tissue,  $E_{\text{mod}}$ , which is the determining factor in the assessment of exposure to low-frequency electromagnetic fields. Its value must not exceed 0.2 V/m at any time in the general public environment.

However, determining the modified electric field strength is a relatively complex task. To facilitate exposure assessment, reference values are therefore also specified for

the external electric field strength  $E$  and magnetic flux density  $B$ . Compliance with these values ensures that the maximum permissible value of  $E_{\text{mod}}$  will also be met [11]. The reference values for a frequency of 50 Hz are  $E_{\text{ef}}^{\text{ext}}_{\text{lim}} = 2 \text{ kV/m}$  and  $B_{\text{ef}}^{\text{ext}}_{\text{lim}} = 200 \text{ }\mu\text{T}$ .

Where the values measured near the source exceed the reference values, it must be demonstrated by calculation or measurement that the maximum permissible values are not exceeded. In the case of overhead lines, all calculated values and limits relate to a height of 1.8 m above ground level, i.e. the head region, and in the case of underground lines, to a height of 0.1 m, representing a person lying down.

Compliance with the maximum permissible value ensures adequate protection of individuals against all currently known direct and indirect effects of electromagnetic fields [12].

## 5.2. Exposure assessment and risk characterisation

The SMR ETE project also includes, among other things, the construction of new power lines. Power evacuation will be provided via a 400 kV overhead line to the Kočín substation; backup power will also be supplied from the Kočín substation, either via a 110 kV overhead line or partly via a 110 kV underground cable. The corridor for these lines is designed largely to avoid residential areas; the exception is its eastern section, where the corridor boundary adjoins the edge of the residential area of Kočín. However, the corridor is defined as including the power-line protection zone, the width of which is specified by Energy Act No. 458/2000 Coll. For a 400 kV overhead line, the protection zone will be 20 m wide. Since no structures may be located within this zone, the outermost conductors will be at least 20 m from the edges of the roofs of the nearest houses.

Exposure to electric and magnetic fields in connection with the location of these power lines, including the related calculations, was assessed by EGU HV Laboratory in 2026 [2]. The calculations were performed for locations where the newly proposed lines run parallel to or cross the existing transmission and distribution systems, where the potential effects of electric and magnetic fields will be greatest. The assessment method consists of calculating the parameters of the 50 Hz electromagnetic field (electric field strength  $E$  (kV/m) and magnetic flux density  $B$  ( $\mu\text{T}$ )). Based on these quantities, the modified electric field strength  $E_{\text{mod}}$  induced in human tissue is calculated at a height of 1.8 m above ground level for overhead lines and at a height of 0.1 m above ground level for underground cable lines (persons lying on the ground are considered). The following three options for the possible proximity of the planned lines were assessed:

- Option 1: Parallel routing of 110 kV underground cable lines (power supply for the auxiliary consumption of SMR ETE) and a 400 kV single-circuit overhead line (power evacuation from SMR ETE)

- Option 2: Parallel routing of a 400 kV single-circuit overhead line (power evacuation from SMR ETE) and two 400 kV single-circuit overhead lines (ETE1,2)
- Option 3: Crossing of 110 kV underground cable lines (power supply for the auxiliary consumption of SMR ETE) with the 400 kV and 110 kV overhead lines of the existing units

The calculations therefore already take into account the effect of the SMR ETE project in combination (i.e. cumulatively) with the lines from the existing power plant (ETE1,2).

The calculations assumed the minimum height of the lower phase conductors above or below ground level, which is 12.5 m above ground level for overhead lines and 1.3 m below ground level for underground lines. An exception is the 110 kV overhead line in Option 3, for which a minimum height of 7.1 m is assumed.

The assessment considered the least favourable exposure scenario from a public health perspective, in which the human body is conductively connected to the ground and exposed to a homogeneous magnetic field perpendicular to the chest and a homogeneous electric field directed from head to foot. The effects of electric and magnetic fields in space are relatively complex; the situation can therefore be simplified by considering the least favourable case from a public health perspective, in which exposure to the electric and magnetic fields is added together where simultaneous exposure occurs.

The results of the assessment performed by EGU HV Laboratory are presented in the following table.

**Table 6. Exposure of persons to electric and magnetic fields at locations where power lines run parallel or cross [2]**

| Option   | Height above ground level | Minimum height of lower phase conductors above ground level $h_{min}$ | Maximum electric field strength $E_{max}$ [kV/m] | Maximum magnetic flux density $B_{max}$ [μT] | Maximum modified electric field strength $E_{mod}$ [V/m] |
|----------|---------------------------|-----------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------|----------------------------------------------------------|
| Option 1 | 1.8 m                     | 12.5 m (400 kV)<br>-1.3 m (110 kV cable)                              | 5.31                                             | 26.9                                         | 0.047                                                    |
|          | 0.1 m                     | 12.5 m (400 kV)<br>-1.3 m (110 kV cable)                              | 5.13                                             | 51.6                                         | 0.045                                                    |
| Option 2 | 1.8 m                     | 12.5 m (400 kV)                                                       | 5.36                                             | 25.4                                         | 0.048                                                    |
| Option 3 | 1.8 m                     | 12.5 m (400 kV)<br>7.1 m (110 kV)<br>-1.3 m (110 kV cable)            | 5.36                                             | 35.1                                         | 0.049                                                    |
|          | 0.1 m                     | 12.5 m (400 kV)<br>7.1 m (110 kV)<br>-1.3 m (110 kV cable)            | 5.18                                             | 63.3                                         | 0.052                                                    |

As can be seen, the specified reference value for magnetic flux density  $B_{max}$  (200  $\mu\text{T}$ ) is met for all the options assessed, but the reference value of 2 kV/m for electric field strength  $E_{max}$  is exceeded. For this reason, the modified electric field strength  $E_{mod}$  was calculated, as required by Government Regulation No. 291/2015 Coll. The calculated  $E_{mod}$  values show that the maximum permissible value of the modified electric field strength (limit 0.2 V/m) will not be exceeded. The maximum modified electric field strength  $E_{mod}$  in the individual options ranges from 22.5–26.0% of the maximum permissible value.

As stated in the previous section, low-frequency electric and magnetic fields have a threshold below which adverse health effects no longer occur. The values recommended by the ICNIRP and, consequently, the maximum permissible values under Czech legislation are set well below the identified threshold for the observed effects. Since the maximum permissible value specified in Government Regulation No. 291/2015 Coll. is met, the occurrence of a health risk associated with the exposure of persons to electric and magnetic fields in the vicinity of the power line under assessment can therefore be ruled out.

In the case of overhead power lines, the assessment was performed for the exposure of persons standing at ground level with the conductor at a height of 12 m (or 7.1 m) above ground level. Given that the corridor runs parallel to residential areas, the potential exposure of a person standing on the roof of a house, i.e. closer to the conductor in the vertical direction, must also be considered. In this case, the corridor also includes the protection zone, meaning that the conductors will be no less than 20 metres from the edges of the roofs. Therefore, the maximum permissible value will also be met with a sufficient margin in this situation, and the occurrence of a health risk can be ruled out.

## 6. EFFECTS OF AIR POLLUTION

The implementation and operation of the SMR ETE project will be associated with a certain increase in air pollution, particularly during the construction phase. The project is expected to be implemented partly concurrently with the construction of New NPP ETE; it is therefore also necessary to assess the cumulative effects of the construction of both projects. During the operational phase, effects on air quality will be associated primarily with induced traffic.

The effects of air pollution associated with the SMR ETE project on human health are assessed together with noise exposure in a separate study [3]. The assessment is based on the underlying air dispersion study [25] and, in accordance with that study, examines the following scenarios for the implementation and operation of the project:

- Scenario 1: 2034 – effects of SMR ETE construction, with the maximum potential cumulative effects arising from the possible concurrent construction of New NPP ETE and SMR ETE (expected duration of up to 1 year)
  - No-project scenario 1 = 2034 + initial phase of New NPP ETE preparation
  - Project scenario 1 = 2034 + initial phase of New NPP ETE preparation + SMR ETE construction phase
- Scenario 2: 2040 – effects of SMR ETE operation, a temporary scenario involving the possible concurrent operation of SMR ETE and the most traffic-intensive stage of New NPP ETE construction (expected duration of up to 1 year)
  - No-project scenario 2 = 2040 + main phase of New NPP ETE construction
  - Project scenario 2 = 2040 + main phase of New NPP ETE construction + SMR ETE operation
- Scenario 3: 2042 – effects of SMR ETE operation, combined operation of New NPP ETE and SMR ETE (permanent scenario)
  - No-project scenario 3 = 2042 + New NPP ETE operation
  - Project scenario 3 = 2042 + New NPP ETE operation + SMR ETE operation

The calculations thus already take into account the effect of the SMR ETE project cumulatively with other existing or planned projects at the ETE site. The following sections provide an overview of the hazards associated with the pollutants assessed, followed by a summary of the risk quantification results.

### 6.1. Hazard identification and dose–response assessment

#### 6.1.1. Particulate matter

Particulate matter in ambient air is a complex mixture of organic and inorganic substances whose components have diverse chemical and physical properties. It is

produced in both outdoor and indoor environments. It is therefore an important factor contributing to adverse health effects.

Different characteristics of particulate matter may be associated with different health effects, depending on particle size, physical characteristics, and chemical composition. Epidemiological indicators of mortality and morbidity are therefore used for general indicative assessment.

In 2021, the World Health Organization (WHO) issued new air quality guidelines [27], which largely supersede the previous guidelines issued in 2005 [26]. According to the WHO [27], exposure to particulate matter increases the risk of mortality from the following conditions:

- long-term PM<sub>2.5</sub> concentrations – with high certainty for diseases of the circulatory system (particularly ischaemic heart disease) and lung cancer, and with moderate certainty for non-malignant respiratory diseases;
- long-term PM<sub>10</sub> concentrations – with high certainty for non-malignant respiratory diseases and lung cancer, and with moderate certainty for ischaemic heart disease;
- short-term PM<sub>10</sub> and PM<sub>2.5</sub> concentrations – with high certainty for cardiovascular diseases and with moderate certainty for cerebrovascular diseases and non-malignant respiratory diseases.

To quantify the risk from exposure to particulate matter (and similarly from exposure to nitrogen dioxide, see below), this assessment uses concentration–response functions published by the World Health Organization as part of the *Health Risks of Air Pollution in Europe: HRAPIE-2* project (HRAPIE-2) [28] in 2025. This document updates the previous guidance issued in 2013 [29].

### 6.1.2. Nitrogen dioxide

Nitrogen dioxide (NO<sub>2</sub>) is one of the pollutants most commonly monitored when assessing the effects of combustion sources (i.e. particularly motor vehicle traffic and the heating of buildings) on air quality and public health. The sources predominantly emit nitric oxide (NO), which is gradually oxidised to NO<sub>2</sub> in the air; only a small proportion of NO<sub>2</sub> is emitted directly.

When nitrogen dioxide enters the respiratory tract, the most sensitive areas are the trachea and bronchi, followed by the pulmonary alveoli, where type I alveolar epithelial cells are replaced by cells more resistant to oxidation, which also gradually undergo hypertrophy as the NO<sub>2</sub> concentration increases. This reduces the resistance of lung tissue to infection.

According to the WHO [27], exposure to nitrogen dioxide increases the risk of mortality from the following conditions:

- long-term NO<sub>2</sub> concentrations – with high certainty for chronic obstructive pulmonary disease, and with moderate certainty for non-malignant respiratory diseases and acute lower respiratory tract infections, including mortality in children;
- short-term (24-hour) NO<sub>2</sub> concentrations – with high certainty for all-cause mortality (excluding injuries) and also for hospital admissions due to asthma.

The HRAPIE-2 project [28] also provides relative risk values for the individual effects of long-term exposure to NO<sub>2</sub>.

### 6.1.3. Combined effects of PM<sub>2.5</sub> and NO<sub>2</sub>

To assess the effects of project construction and operation on public health, it is necessary to consider the combined effects of PM<sub>2.5</sub> and NO<sub>2</sub>. In real-world environments, particularly in areas affected by motor vehicle traffic and emissions from combustion processes, residents are not exposed to individual pollutants in isolation.

Quantifying this combined effect is a crucial step in the health risk assessment process. Since PM<sub>2.5</sub> and NO<sub>2</sub> largely share the same emission sources (e.g. exhaust emissions), their ambient air concentrations are very strongly correlated.

The HRAPIE-2 project [28] provides adjusted RR values for calculating the combined effect of PM<sub>2.5</sub> and NO<sub>2</sub>. For example, with an increase in the PM<sub>2.5</sub> concentration of 5 µg.m<sup>-3</sup> and in the NO<sub>2</sub> concentration of 20 µg.m<sup>-3</sup>, the estimated health effects of combined exposure are reduced by approximately 30.3% compared with the use of single-pollutant models.

### 6.1.4. Benzene

Benzene is released into the atmosphere in emissions from motor vehicle traffic both as a combustion product and as a component of unburned fuel (it is present in motor petrol at approximately 0.5–2%, while its proportion in diesel fuel is negligible). Ambient air is the main source of human exposure to benzene. However, significant individual differences resulting from smoking must be taken into account, as smoking may increase exposure severalfold.

At high concentrations (which do not occur in ambient air), benzene has acute irritant and neurotoxic effects. At low doses (which may occur in ambient air), long-term exposure suppresses blood cell production and is also believed to contribute to the initiation of leukaemia. For this reason, both the US EPA and IARC classify benzene as carcinogenic to humans. The World Health Organization specifies a unit cancer risk value for benzene of  $UCR = 6 \times 10^{-6} (\mu\text{g}\cdot\text{m}^{-3})^{-1}$ .

### 6.1.5. Benzo[a]pyrene

The group of polycyclic aromatic hydrocarbons (PAHs) comprises several hundred compounds formed primarily during the incomplete combustion of organic material. Their principal effects on human health are mutagenicity and carcinogenicity, whereas their systemic toxic effects are probably minor (based on animal testing). Mutagenicity and carcinogenicity are considered established for many PAHs with higher boiling points, and benzo[a]pyrene is one of the compounds with the highest carcinogenic potency.

According to IARC, benzo[a]pyrene is classified in Group 1 as carcinogenic to humans. Owing to its carcinogenicity, no safe threshold can be established. WHO [26] specifies a guideline value for unit cancer risk for B[a]P of  $8.7 \times 10^{-2} (\mu\text{g} \cdot \text{m}^{-3})^{-1}$ .

## 6.2. Exposure assessment and risk characterisation

### 6.2.1. Particulate matter

As noted above, elevated concentrations of particulate matter in ambient air are generally associated with respiratory diseases, lung cancer, cardiovascular diseases and, in the case of the PM<sub>2.5</sub> fraction, stroke. Study [3] quantifies the incidence of health effects defined by the HRAPIE-2 project [28]. The following tables summarise the incremental changes in health effects, i.e. the changes caused by implementation of the SMR ETE project in the individual scenarios.

**Table 7. Assessment of changes in the level of health risk in residential areas due to changes in PM<sub>2.5</sub> pollution, incremental values (Project scenario) – (Baseline scenario)**

| Health effect                                                  | Population segment | Scenario 1 2034 | Scenario 2 2040 | Scenario 3 2042 |
|----------------------------------------------------------------|--------------------|-----------------|-----------------|-----------------|
| adult natural-cause mortality                                  | ≥ 25 years         | 0.0457          | 0.00008         | 0.00059         |
| adult mortality – diseases of the circulatory system           | ≥ 25 years         | 0.0210          | 0.00004         | 0.00027         |
| adult mortality – cerebrovascular diseases                     | ≥ 25 years         | 0.0031          | 0.00001         | 0.00004         |
| adult mortality – ischaemic heart disease                      | ≥ 25 years         | 0.0080          | 0.00001         | 0.00010         |
| adult mortality – respiratory diseases, excluding neoplasms    | ≥ 25 years         | 0.0055          | 0.00001         | 0.00007         |
| adult mortality – chronic obstructive pulmonary disease (COPD) | ≥ 25 years         | 0.0020          | 0.00000         | 0.00003         |
| adult mortality – lower respiratory tract infections           | ≥ 25 years         | 0.0037          | 0.00001         | 0.00005         |
| adult mortality – malignant neoplasm of the bronchus and lung  | ≥ 25 years         | 0.0020          | 0.00000         | 0.00003         |
| morbidity – childhood asthma                                   | 0–18 years         | 0.0141          | 0.00002         | 0.00018         |
| morbidity – chronic obstructive pulmonary disease (COPD)       | ≥ 30 years         | 0.0175          | 0.00003         | 0.00023         |
| morbidity – ischaemic heart disease (myocardial infarction)    | ≥ 30 years         | 0.0082          | 0.00001         | 0.00011         |
| morbidity – stroke                                             | ≥ 30 years         | 0.0132          | 0.00002         | 0.00017         |
| morbidity – high blood pressure                                | ≥ 30 years         | 0.0953          | 0.00017         | 0.00124         |
| morbidity – malignant neoplasm of the bronchus and lung        | ≥ 30 years         | 0.0041          | 0.00001         | 0.00005         |
| morbidity – type 2 diabetes                                    | 0–18 years         | 0.0001          | 0.00000         | 0.00000         |
| morbidity – dementia                                           | ≥ 19 years         | 0.0244          | 0.00004         | 0.00032         |

**Table 8. Assessment of changes in the level of health risk in residential areas due to changes in PM<sub>10</sub> pollution, incremental values (Project scenario) – (Baseline scenario)**

| Health effect                                                  | Population segment | Scenario 1 2034 | Scenario 2 2040 | Scenario 3 2042 |
|----------------------------------------------------------------|--------------------|-----------------|-----------------|-----------------|
| adult natural-cause mortality                                  | ≥ 25 years         | 0.2368          | 0.00014         | 0.0045          |
| adult mortality – diseases of the circulatory system           | ≥ 25 years         | 0.0878          | 0.00005         | 0.0017          |
| adult mortality – respiratory diseases, excluding neoplasms    | ≥ 25 years         | 0.0301          | 0.00002         | 0.0006          |
| adult mortality – cancers of the trachea, bronchi, and lungs   | ≥ 25 years         | 0.0136          | 0.00001         | 0.0003          |
| adult mortality – ischaemic heart disease                      | ≥ 25 years         | 0.0247          | 0.00001         | 0.0005          |
| adult mortality – chronic obstructive pulmonary disease (COPD) | ≥ 25 years         | 0.0167          | 0.00001         | 0.0003          |

As shown in the tables above, the assessed project is expected to result in a slight increase in health risk from exposure to both PM<sub>2.5</sub> and PM<sub>10</sub>:

- in Scenario 1 (2034, expected duration of up to 1 year), exposure to PM<sub>2.5</sub> pollution was calculated to result in an increase in adult natural-cause mortality of the order of hundredths of a new case and an increase in the individual morbidity categories of less than one tenth

of a case across the entire affected population. Exposure to  $PM_{10}$  pollution was calculated to result in an increase in natural-cause mortality of the order of tenths of a new case across the entire affected population. The highest increase in  $PM_{2.5}$  pollution in residential areas was calculated at up to  $0.7 \mu g \cdot m^{-3}$  (affecting a few residents), while the highest increase in  $PM_{10}$  pollution was calculated at up to  $2 \mu g \cdot m^{-3}$  (affecting no more than a few dozen residents); a value of approximately  $4 \mu g \cdot m^{-3}$  was only recorded in a very localised area (affecting one residential building). Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.

- in Scenario 2 (2040, expected duration of up to 1 year), exposure to  $PM_{2.5}$  pollution was calculated to result in an increase in adult natural-cause mortality of the order of hundred-thousandths of a new case and an increase in the individual morbidity categories also of the order of hundred-thousandths, and definitely no more than approximately one ten-thousandth of a case across the entire affected population. Exposure to  $PM_{10}$  pollution was calculated to result in an increase in natural-cause mortality of the order of ten-thousandths of a new case across the entire affected population. The highest increase in  $PM_{2.5}$  pollution in residential areas was calculated at approximately  $0.003 \mu g \cdot m^{-3}$  (affecting a few to a few dozen residents), while the highest increase in  $PM_{10}$  pollution was calculated at up to  $0.005 \mu g \cdot m^{-3}$ . Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.
- in Scenario 3 (2042, permanent scenario), exposure to  $PM_{2.5}$  pollution was calculated to result in an increase in adult natural-cause mortality of the order of ten-thousandths of a new case and an increase in the individual morbidity categories also of the order of ten-thousandths of a case across the entire affected population. Exposure to  $PM_{10}$  pollution was calculated to result in an increase in natural-cause mortality of the order of thousandths of a new case across the entire affected population. The highest increase in  $PM_{2.5}$  pollution in residential areas was calculated at up to  $0.005 \mu g \cdot m^{-3}$  (affecting a few dozen residents), while the highest increase in  $PM_{10}$  pollution was calculated at up to  $0.020 \mu g \cdot m^{-3}$  (affecting a few dozen residents). Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.

## 6.2.2. Nitrogen dioxide

The following tables summarise the incremental values for the health effects of NO<sub>2</sub> exposure in the individual scenarios.

**Table 9. Assessment of changes in the level of health risk in residential areas due to changes in NO<sub>2</sub>, pollution, incremental values (Project scenario) – (Baseline scenario)**

| Health effect                                                  | Population segment | Scenario 1 2034 | Scenario 2 2040 | Scenario 3 2042 |
|----------------------------------------------------------------|--------------------|-----------------|-----------------|-----------------|
| adult natural-cause mortality                                  | ≥ 25 years         | 0.0134          | 0.0006          | 0.0005          |
| adult mortality – respiratory diseases, excluding neoplasms    | ≥ 25 years         | 0.0012          | 0.0001          | 0.0000          |
| adult mortality – chronic obstructive pulmonary disease (COPD) | ≥ 25 years         | 0.0004          | 0.0000          | 0.0000          |
| adult mortality – lower respiratory tract infections           | ≥ 25 years         | 0.0010          | 0.0000          | 0.0000          |
| adult mortality – diseases of the circulatory system           | ≥ 25 years         | 0.0050          | 0.0002          | 0.0002          |
| adult mortality – ischaemic heart disease                      | ≥ 25 years         | 0.0018          | 0.0001          | 0.0001          |
| adult mortality – malignant neoplasm of the bronchus and lung  | ≥ 25 years         | 0.0009          | 0.0000          | 0.0000          |
| morbidity – childhood asthma                                   | 0–18 years         | 0.0031          | 0.0001          | 0.0001          |
| morbidity – asthma in adults                                   | ≥ 19 years         | 0.0089          | 0.0004          | 0.0003          |
| morbidity – lower respiratory tract infections in children     | 0–12 years         | 0.0096          | 0.0004          | 0.0004          |

As shown in the tables above, only a slight increase in health risk due to the project under assessment can also be expected in the case of exposure to nitrogen dioxide.

- in Scenario 1 (2034, expected duration of up to 1 year), exposure to nitrogen dioxide pollution was calculated to result in an increase in adult natural-cause mortality of the order of hundredths of a new case and an increase in the individual morbidity categories of the order of thousandths of a case across the entire affected population. The highest increase in nitrogen dioxide pollution in residential areas was calculated to be below 0.1 µg·m<sup>-3</sup> (affecting a few residents). Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.
- in Scenario 2 (2040, expected duration of up to 1 year), exposure to nitrogen dioxide pollution was calculated to result in an increase in adult natural-cause mortality of the order of ten-thousandths of a new case and an increase in the individual morbidity categories also of the order of ten-thousandths of a case across the entire affected population. The highest increase in nitrogen dioxide pollution in residential areas was calculated at approximately 0.005 µg·m<sup>-3</sup> (affecting dozens of residents). Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.

- in Scenario 3 (2042, permanent scenario), exposure to nitrogen dioxide pollution was calculated to result in an increase in adult natural-cause mortality of the order of ten-thousandths of a new case and an increase in the individual morbidity categories also of the order of ten-thousandths of a case across the entire affected population. The highest increase in nitrogen dioxide pollution in residential areas was calculated at approximately  $0.005 \mu\text{g}\cdot\text{m}^{-3}$  (affecting dozens of residents). Even in the residential area most affected by the project, the increases in natural-cause mortality and the individual morbidity categories were several orders of magnitude below one case in the affected population.

Nor is the occurrence of health effects from acute exposure to nitrogen dioxide expected in any part of the area of interest.

### 6.2.3. Combined effects of PM<sub>2.5</sub> and nitrogen dioxide

PM<sub>2.5</sub> and NO<sub>2</sub> largely share the same emission sources. To ensure the methodological correctness of the calculation, a procedure is used that reduces the risk of double-counting their effects. The assessment is performed for the health effect of natural-cause mortality among adults. The assessment results show that, when the combined effect is taken into account, the increase in natural-cause mortality due to the SMR ETE project is approximately one hundredth of a case in the entire affected population in Scenario 1 (year 2034), while in Scenarios 2 and 3 (years 2040 and 2042, expected duration of 1 year and permanent scenario) it is in the order of hundred-thousandths of a case in the entire affected population.

### 6.2.4. Benzene and benzo[a]pyrene

Benzene and benzo[a]pyrene are proven human carcinogens. In the case of benzene, the increase in the number of leukaemia cases due to implementation of the project is in the order of ten-millionths of a new case in the entire affected population. In Scenario 1 (2034, expected duration of up to 1 year), the highest increase in residential areas was calculated at up to  $0.004 \mu\text{g}\cdot\text{m}^{-3}$  and affects several dozen residents. This value corresponds to an increase in the risk of health effects from chronic benzene exposure of no more than  $2.40 \times 10^{-8}$  (1 case in more than 41.6 million residents).

In the case of benzo[a]pyrene, the increase in the number of cancer cases ranges from the order of ten-millionths to hundred-thousandths of a new case in the entire affected population. The highest increase in residential areas was calculated at up to  $0.0005 \text{ ng}\cdot\text{m}^{-3}$  (affecting dozens of residents). This value corresponds to an increase in the risk of health effects from chronic exposure to benzo[a]pyrene of no more than  $4.35 \times 10^{-7}$  (1 case per almost 2.3 million residents).

In view of the number of residents affected by the highest increase, it can be concluded for both pollutants that the calculated changes in health risk are entirely insignificant in terms of adverse health effects.

### 6.2.5. Effects of short-term exposure during construction work

An assessment was also performed of the effects on human health associated with changes in short-term concentrations (daily means) of PM<sub>2.5</sub> and PM<sub>10</sub> and nitrogen dioxide during construction work. Sources of air pollution will include both the construction site itself and induced road traffic. The assessment is performed for the most affected part of the residential areas, both for the effects of SMR ETE construction and for the combined effects of construction activities associated with the SMR ETE and New NPP ETE projects. For SMR ETE construction, the maximum short-term increase in daily concentrations is expected to be up to 50.6 µg.m<sup>-3</sup> for PM<sub>2.5</sub>, 168.5 µg.m<sup>-3</sup> for PM<sub>10</sub>, and 3.4 µg.m<sup>-3</sup> for NO<sub>2</sub>. Cumulatively with construction of the New NPP ETE project, the increase in daily concentrations is up to 180 µg.m<sup>-3</sup> for PM<sub>2.5</sub>, 600 µg.m<sup>-3</sup> for PM<sub>10</sub>, and 3.5 µg.m<sup>-3</sup> for NO<sub>2</sub>. These are maximum values that could potentially occur under the least favourable combination of meteorological and emission conditions. Changes in ambient concentrations were calculated without taking into account measures to reduce the effects of construction on air quality.

The effects were quantified for daily exposure. The results of the assessment are summarised in the following table.

**Table 10. Assessment of changes in the level of health risk in residential areas due to changes in PM<sub>2.5</sub> and NO<sub>2</sub> pollution levels**

| Air quality characteristic   | Health effect                                           | Population segment | Baseline scenario | New NPP ETE construction |            | SMR ETE construction |            |
|------------------------------|---------------------------------------------------------|--------------------|-------------------|--------------------------|------------|----------------------|------------|
|                              |                                                         |                    |                   | Project scenario         | Difference | Project scenario     | Difference |
| PM <sub>2.5</sub> daily mean | adult natural-cause mortality*                          | entire population  | 0.000015          | 0.000349                 | 0.000334   | 0.000109             | 0.000094   |
| PM <sub>2.5</sub> daily mean | morbidity – diseases of the circulatory system          | entire population  | 0.000041          | 0.000983                 | 0.000942   | 0.000306             | 0.000265   |
| PM <sub>10</sub> daily mean  | restricted activity days (RADs) – days of school missed | 5–14 years         | 0.014660          | 0.729814                 | 0.715153   | 0.215499             | 0.200839   |
| NO <sub>2</sub> daily mean   | adult natural-cause mortality*                          | entire population  | 0.000015          | 0.000024                 | 0.000009   | 0.000019             | 0.000004   |
| NO <sub>2</sub> daily mean   | morbidity – respiratory diseases                        | entire population  | 0.000023          | 0.000030                 | 0.000007   | 0.000030             | 0.000007   |

The table shows that, for each day on which the highest calculated daily values occur, natural-cause mortality will increase by no more than the order of ten-thousandths of a new case and the incidence of diseases of the circulatory system will increase by approximately one thousandth of a new case. For restricted activity days expressed as days of school missed, an increase of just under one case was calculated for the concurrent construction of New NPP ETE and SMR ETE. The result may be interpreted as meaning that, at the maximum exposure values, no significant effect on mortality or morbidity in terms of the defined diagnoses is expected; however, health effects in the form of mild respiratory symptoms (manifested as restricted activity) may occur.

In this case, however, the calculations are based on a theoretical concurrence of adverse circumstances both in terms of construction (the highest emissions) and meteorological conditions, and since this concerns exposure to PM<sub>10</sub> (i.e. dust), this concurrence of adverse circumstances can essentially be eliminated by technical measures. These measures comprise measures to minimise particulate emissions, as specified in the air dispersion study. Provided that these measures are complied with, the maximum increases in exposure described, and therefore the associated health effects, will not occur (or these effects will be reduced to the level of the mean values described in Sections 6.2.1–6.2.3).

## 7. EFFECTS OF NOISE

The effects of noise exposure associated with the SMR ETE project on human health are assessed together with the effects of air pollution in a separate study [3]. The identified effects of noise on human health that are relevant to this assessment are associated exclusively with long-term (multi-year) exposure. For this reason, only the operational phase of the project is assessed. No effects of noise during the construction phase on the health of residents living in the vicinity of the project are anticipated. In accordance with the underlying noise studies [30, 31], the assessment is performed for the following scenarios.

- Future scenario (2034) – traffic volumes in 2034
  - Operation of ETE1,2 without SMR ETE operation
  - Operation of ETE1,2 with SMR ETE operation
- Future scenario (2034) – stationary noise sources
  - Operation of ETE1,2 with SMR ETE operation
- Target scenario (2042) – traffic volumes in 2042
  - Operation of ETE1,2 and New NPP ETE without SMR ETE operation
  - Operation of ETE1,2 and New NPP ETE with SMR ETE operation
- Target scenario (2042) – stationary noise sources
  - Operation of ETE1,2 and New NPP ETE with SMR ETE operation

The following sections provide an overview of the effects of noise on human health, followed by a summary of the results of the health risk quantification and the related indicators (annoyance, sleep disturbance).

### 7.1. Hazard identification and dose–response assessment

Adverse effects of noise on human health are generally defined as morphological or functional changes in the body that lead to impairment of its functions, a reduction in its compensatory capacity in response to stress, or increased susceptibility to other adverse environmental effects. With a certain degree of simplification, the effects of noise on human health may be divided into specific effects, manifested as impaired functioning of the auditory system, and non-specific (non-auditory) effects, involving effects on the functions of various systems of the body.

Normal exposure to traffic noise results primarily in systemic (non-specific) effects involving the functions of various systems of the body, often mediated by a stress response, sleep disturbance, and effects on higher nervous functions. Chronic stress caused by noise may contribute to triggering or accelerating the progression of diseases with multifactorial causes.

According to the current WHO guidelines [33], serious effects of noise considered to be supported by sufficient evidence include annoyance, sleep disturbance, cardiovascular disease, cognitive impairment, and hearing impairment. The following overview provides brief characteristics of these effects according to NIPH [34]:

- **Noise annoyance** is the most general human response to noise exposure. Annoyance refers to a psychological state arising from the involuntary perception of effects towards which an individual has a negative attitude and to which they respond with feelings of aversion, irritation, and, in some cases, even psychosomatic disorders; for simplicity, the term annoyance also covers other negative emotions associated with noise (anger, dissatisfaction, anxiety, and agitation). Annoyance is significantly influenced by the individual characteristics of the recipient; from the perspective of the individual, it is therefore considered a non-threshold effect, meaning that even the quietest sounds may annoy a sensitive person.
- **Adverse effects of noise on sleep** are demonstrably manifested by changes in physiological responses (changes in heart rate, signs of awakening on an EEG, changes in the duration of sleep stages, increased movement during sleep, difficulty falling asleep, awakening, and reduced sleep duration); sufficient evidence also exists for subjectively perceived sleep disturbance, environmental insomnia, and increased use of sleeping medication. The health consequences of sleep disturbance caused by night-time noise include changes in stress hormone levels, cardiovascular disease, mental disorders, obesity, reduced life expectancy, an increased incidence of occupational accidents, and psychological and social consequences (drowsiness and fatigue, irritability, reduced performance, impaired cognitive abilities, and disruption of social contacts).
- The **effects of noise on the cardiovascular system** have been demonstrated in numerous epidemiological studies. The recognised mechanism is the body's stress response, in which a sound signal is subconsciously assessed as alarming, triggering a stress response associated with activation of the autonomic nervous system and the release of stress hormones, which leads to a temporary increase in blood pressure and heart rate and to vasoconstriction. Following long-term exposure, permanent effects such as hypertension and ischaemic heart disease may develop in susceptible individuals. Other possible mechanisms by which noise affects the cardiovascular system include magnesium depletion (with magnesium being released from the body as a result of repeated nerve impulses) or long-term sleep deprivation and its consequences. According to current WHO data, the increased risk of ischaemic heart disease due to road traffic noise is considered established; by contrast, the quality of evidence for the previously reported risk of hypertension is now considered low, while the findings for stroke are inconsistent.
- Noise-related **impairment of cognitive abilities** includes impaired speech comprehension, impaired attention, and reduced working memory capacity. This results in reduced performance, poorer task performance, errors at work, and potentially accidents and injuries. Noise may also seriously interfere with speech communication or mask other signals containing important information. Impaired speech communication has a number of demonstrated adverse consequences for behaviour and relationships, leading to irritability, uncertainty, reduced work performance, and feelings of dissatisfaction. An

association between aircraft noise and impaired reading ability, speech comprehension, and test performance among schoolchildren has been confirmed in field studies; for road and rail traffic noise, the results are inconsistent and the quality of the evidence is insufficient.

- **Damage to the auditory system** essentially involves two mechanisms. Extremely high sound pressure levels may cause acoustic trauma involving injury to the eardrum, auditory ossicles, or membranous labyrinth, resulting in permanent hearing impairment. Long-term to lifelong exposure of the auditory system to noise results in hearing impairment, initially involving temporary and subsequently permanent functional and morphological changes to the sensory and nerve cells of the organ of Corti in the inner ear. These disorders initially manifest as a temporary increase in the hearing threshold; with continued noise exposure, permanent hearing impairment develops after a certain latency period. Hearing impairment has been sufficiently demonstrated for occupational noise exposure, depending on the equivalent sound pressure level and the number of years of exposure; however, it also occurs with noise in non-occupational environments, for example in connection with noise from leisure activities. Hearing loss is generally the result of combined exposure to noise from various sources, i.e. occupational, environmental, and leisure noise.

The effects of noise are considered non-threshold (i.e. no safe limit can be established below which the effect no longer occurs); in practice, however, certain threshold values are used above which the relationship between the effect and noise exposure is considered significant. WHO [33] specifies the following recommended exposure values for road traffic noise:

- average value, expressed by the day-evening-night noise indicator ( $L_{\text{dvn}}$ ) – 53 dB
- night-time noise ( $L_n$ ) – 45 dB

For the quantitative assessment of the effects of road traffic noise in the study area, the procedures specified in NIPH Authorisation Guideline [32], based on Annex III under Commission Directive (EU) 2020/367, were used. The assessment covers the following effects of noise:

- high annoyance
- high sleep disturbance
- ischaemic heart disease (IHD)

## 7.2. Exposure assessment and risk characterisation

Based on the results of the noise study, the proportion of residents in noise exposure bands above the recommended exposure values, the numbers of residents experiencing high noise annoyance and high sleep disturbance, and the incidence of IHD attributable to road traffic noise were quantified. As shown by the assessment, even under the no-project scenario, the proportion of residents in the surrounding residential areas falling within bands above the WHO guideline values for average day-evening-night

noise and night-time noise will be 100%. The project will not result in any change. The results of the quantification of noise effects are summarised in the following table.

**Table 11. Total values for high annoyance, high sleep disturbance, and the incidence of IHD due to road traffic noise (for a total of 350 affected residents)**

|                        | Without the project | With the project | Change |
|------------------------|---------------------|------------------|--------|
| <b>2034</b>            |                     |                  |        |
| High annoyance         | 64                  | 65               | 1      |
| High sleep disturbance | 19                  | 19               | 0      |
| Incidence of IHD       | 0.2358              | 0.2381           | 0.0023 |
| <b>2042</b>            |                     |                  |        |
| High annoyance         | 65                  | 66               | 1      |
| High sleep disturbance | 19                  | 19               | 0      |
| Incidence of IHD       | 0.2421              | 0.2443           | 0.0022 |

The results of the assessment show that:

- the number of residents in the surrounding existing residential areas who are highly annoyed by road traffic noise is 64 and 65, respectively, in the baseline scenarios; an increase of one case was calculated as a result of the project
- the number of residents experiencing high sleep disturbance is 19 in both scenarios; no change was identified as a result of the project
- the increase in cardiovascular risk (number of cases of IHD) was calculated at approximately 0.0022–0.0023 cases; this is therefore an entirely negligible change.

Overall, it can therefore be concluded that the project will result in a very slight increase in annoyance (by one case among 350 affected residents). In the case of IHD incidence, the change is several orders of magnitude below the threshold of detectability.

The indicative assessment of the effects of stationary noise sources shows that their operation may only cause annoyance or sleep disturbance in the Kočín area, involving 2–3% of the residents concerned; given the number of affected residents, this therefore represents isolated cases at most.

## 8. PSYCHOLOGICAL EFFECTS

An assessment of the project's psychological effects on the population of the surrounding municipalities is an important aspect of assessing its effects on public health. The mental health of the population has been monitored over the long term under the Programme for Monitoring and Assessment of the Environmental Effects of the Temelín Nuclear Power Plant, which defines a set of environmental components and indicators to be monitored and assessed beyond the statutory obligations of the power plant operator. This is based on the assumption that residents in the immediate vicinity could potentially be adversely affected by concerns about the proximity of the nuclear power plant and the associated potential risks of radiation exposure and possible accidents. The programme documented the health of residents during the pre-operational period of the power plant; subsequently, current data for the preceding period are collected and assessed at regular annual intervals, both for residents living near the Temelín Nuclear Power Plant (the exposed area) and for residents living in other, more distant regions with similar natural and socioeconomic conditions (the control areas). The most recent survey was conducted in 2025 and followed up on previous surveys conducted in 2000, 2002, 2004, 2011, and 2018. The survey results were subsequently compared with a control sample of the East Bohemian population unaffected by the presence of a nuclear power plant in its vicinity. The research results are presented in the document DP14 Study of the Mental Health of Residents in the Temelín Area [4]. A summary of the most important research findings is provided below.

The aim of the research was to determine more precisely whether psychological difficulties such as emotional instability, feelings of anxiety, stress, or concerns occur to a greater extent among residents living near the Temelín Nuclear Power Plant than among population groups unaffected by the presence of the nuclear power plant. The research was conducted using a methodology specifically developed for the purposes of this survey. The procedure was designed to identify any negative changes associated with the presence of the nuclear power plant (neuroticism, lie score, depressive symptomatology, locus of control, life satisfaction, experienced fear and concerns, and self-efficacy). Data were collected through structured interviews between an interviewer and a respondent using the aforementioned interviewer-administered questionnaire; participation in the survey was voluntary and anonymous. The research questions and statements were incorporated into a comprehensive interviewer-administered questionnaire in which respondents expressed their views on the individual statements using a seven-point scale. To eliminate any consciously negative attitude towards ETE (or SMR ETE) and avoid distortion of the data, the interviewer-administered questionnaire was designed so that it was not apparent that the research was related to the Temelín Nuclear Power Plant. The data obtained were processed using statistical analyses and specialised software.

The respondent sample comprised 550 persons living in the vicinity of the Temelín Nuclear Power Plant and 551 persons living in Eastern Bohemia. The structure of the respondent sample was specified on the basis of social and demographic indicators derived from the structure of the underlying population, such as sex, age (15 years and older), and highest level of educational attainment (four selected levels).

The assessed area in the vicinity of ETE included the following municipalities and their constituent parts: Dříteň; Nákří (Chvalešovice, Libív, Malešice, Radomilice, Strachovice, Velice, Záblatí, and Záblatíčko); Temelín (Kočín, Lhota pod Horami, Litoradice, Sedlec, and Zvěrkovice); Týn nad Vltavou (Hněvkovice on the left bank of the Vltava River, Koloděje nad Lužnicí, Malá Strana, Netěchovice, Nuzice, Předčice, Vesce, and Jarošovice), and Všemyslice (Bohunice, Neznašov, Slavětice, and Všeteč). The control sample of respondents in Eastern Bohemia was selected from residents of the districts of Hradec Králové, Chrudim, Náchod, Rychnov nad Kněžnou, Pardubice, Svitavy, and Ústí nad Orlicí.

Based on the results of the psychological survey, statistically significant differences were identified between the Temelín sample and the control sample in neuroticism, the lie score, depressive symptomatology, and locus of control. In all these cases, the more favourable result was consistently identified in the sample of respondents from the vicinity of the Temelín Nuclear Power Plant. Based on the research results, it may therefore be concluded that proximity to the Temelín Nuclear Power Plant does not adversely affect the mental health of residents living in its vicinity. Moreover, none of the respondents mentioned or directly identified the power plant itself as a cause of life dissatisfaction.

These results are consistent with the findings of previous surveys and confirm the long-term trend towards a higher quality of mental life among residents living in the vicinity of ETE. It may be assumed that most local residents have accepted the existence of the nuclear power plant and do not perceive it as a threatening factor. However, the stable and favourable development of the psychological characteristics of the population living in the vicinity of the Temelín Nuclear Power Plant depends on its trouble-free operation and on the safety of nuclear power in general. Local residents undoubtedly perceive the potential safety risks associated with operation of the power plant; however, most evidently consider it safe, or rather consider it to be operated in accordance with high safety standards. The existence and proximity of ETE do not adversely affect important personality traits or the psychological balance and well-being of residents in its immediate vicinity.

Based on the results of study [4], it may therefore be concluded that operation of ETE as a whole is not associated with adverse effects on the mental health and psychological well-being of residents living in its vicinity. At the same time, the assumption that the effects of ETE on residents' mental health will not change as a result

of the siting of the SMR ETE project (which represents modern technology incorporating a high proportion of active and passive safety features) may be regarded as fully substantiated. The same conclusion applies to the combined effects of SMR ETE and other existing and planned operations at the site.

## 9. SOCIAL AND ECONOMIC EFFECTS

The anticipated social and economic effects of the construction and operation of the New SMR Power Plant at the Temelín site were assessed in document DP28 – Socioeconomic Study of Regional Development [5]. The study primarily assesses the effects of the SMR ETE project, but also takes into account the effects of the construction of the New Nuclear Power Plant at the Temelín site (hereinafter “New NPP ETE”), as the effects of the two construction projects will interact. The assessment primarily focuses on effects on the population, labour market, economy, living conditions, transport infrastructure, amenities, housing, and public administration in the area.

For the assessment of the project’s effects, the area of interest was defined as follows:

- municipalities and territorial self-governing units located within 5 km of the project site are considered affected areas
- socioeconomic effects were assessed in a wider area extending up to 10 km from the project site
- for relevant topics, larger towns located within 25 km of the project site that may also be affected by implementation of the project were included in the assessment.

This Section summarises the most important findings of the study.

### Human resources

Implementation of the project will result in an influx of new residents associated with an increase in the number of jobs. According to estimates, approximately 400 workers will be required to operate SMR ETE after completion of construction, while operation of New NPP ETE will require approximately 600 workers. In total, approximately 1,000 persons will therefore be employed in the newly established operations, which could as much as double the population in the area when the family members of the new employees are also taken into account. Part of this workforce may come from the wider vicinity of the power plant; however, given the specialised nature of the jobs and the stringent qualification requirements for workers, most may be expected to come from other, more distant regions. The arrival of new residents will benefit the region in many respects. Highly qualified workers will contribute to increasing educational attainment in the region, while the increase in the proportion of people of working age will mitigate the trend of demographic ageing in the region; this effect will be further strengthened by the arrival of their family members or the subsequent establishment of families.

From the perspective of human resources, the construction phase of SMR ETE and New NPP ETE will also be significant, requiring a combined workforce numbering in the thousands. The number of construction workers will not remain constant but will

vary depending on the specific stages of construction and the complexity of the work. SMR ETE construction will take place between 2028 and 2036, and the average daily workforce is estimated at 750; during the peak construction phase around 2032, however, it may exceed 2,000 persons. New NPP ETE construction is expected to take place between 2032 and 2042 and will therefore partly overlap with SMR ETE construction. Given the difference in timing, some workers may be transferred from SMR ETE construction; nevertheless, additional workers will need to be recruited, as the construction workforce may reach up to 3,000 around 2037. Between 2030 and 2040, 2,000–3,000 workers will therefore be involved in the construction of the projects each year.

A large proportion of the workers involved in the construction of SMR ETE and New NPP ETE may be assumed to come from other, more distant parts of the Czech Republic or from abroad. Given that the work will continue for several years, a large proportion of these workers will be accommodated in the immediate and wider vicinity of ETE; however, this will generally represent a temporary form of migration. These workers cannot be expected to purchase local properties with a view to remaining in the region in the long term, or to be accompanied by their family members. On the contrary, increased mobility among these persons (whether regular or irregular) is expected precisely because they will be separated from their families. Once construction is completed, the vast majority of these persons are expected to leave the area.

Given the overlap between the commissioning of SMR ETE (around 2034) and the construction of New NPP ETE (expected between 2032 and 2041), the greatest pressure from incoming residents may be expected during these years. Based on geographical considerations and experience from the construction of the first two units of the Temelín Nuclear Power Plant, the greatest population pressure and increased demand for both short-term accommodation and long-term housing may be expected in the town of Týn nad Vltavou. The increased population will also result in higher traffic volumes, greater demand for public transport services, and higher costs of maintaining transport infrastructure.

## **Labour market**

The existence of the Temelín Nuclear Power Plant has a significant effect on the labour market, as it already employs approximately 1,500 persons and is therefore a key employer throughout the area of interest. One consequence is the relatively low unemployment rate, which as at 31 December 2024 stood at 3.1% in Týn nad Vltavou and 2.8% in the 20 municipalities located within 10 km of the Temelín Nuclear Power Plant, compared with a national average of 4.1%.

Implementation of SMR ETE and New NPP ETE will create 1,000 additional jobs. Given the nature of power plant operation and the stringent qualification

requirements for employees, these jobs are stable and long-term. However, the specific entry requirements limit employment opportunities for people with lower levels of education or disabilities. Construction of SMR ETE and New NPP ETE will help maintain unemployment at a low level; however, employment opportunities for people with lower levels of education will also be limited in this case. Given the limited availability of suitable applicants, the vast majority of the new jobs may be expected to be filled by applicants from other regions. Additional employment opportunities will be provided, for example, by contractors linked to power plant operation. The construction of SMR ETE and New NPP ETE itself will offer a specific type of employment that will provide some opportunities for people with lower levels of education, but only temporarily for the duration of construction.

Operation of the Temelín Nuclear Power Plant also influences commuting patterns in the region. Without ETE, the majority of the economically active population in the region would probably commute to České Budějovice or other larger towns and cities. At present, however, Temelín is one of the main commuting destinations for residents of municipalities in both the immediate and wider vicinity. The largest commuter flows to Temelín originate in Týn nad Vltavou (564 persons according to the 2021 Census) and České Budějovice (553 persons according to the 2021 Census). Commuting to Temelín will increase further following implementation of SMR ETE and New NPP ETE.

Cooperation between the Temelín Nuclear Power Plant and schools in the region represents a significant benefit. This relationship is mutually beneficial, as support for schools and specialised technical education may facilitate the recruitment of new qualified employees in the future, while schools can provide their students with education closely linked to practical experience and potentially also future employment. Cooperation between ETE and schools may also lead to the establishment of new specialised fields of study required for power plant operation.

## **Economy**

The Temelín Nuclear Power Plant is a major economic entity that may be regarded as an important stabilising element in the regional economy, and its operation influences the economic structure of the entire region. Given the large number of ETE employees, the proportion of employment in industry is higher, and this effect will be further strengthened by implementation of SMR ETE and New NPP ETE.

As already stated, implementation of the SMR ETE and New NPP ETE projects will create approximately 1,000 jobs, which may result in the arrival of up to twice that number of persons. The arrival of family members of new power plant employees will increase the economically active population, which may have a positive effect on the structure of business activities in the region. The incoming population will also support

the development of the business environment through demand for services in the area of interest. However, given the proximity of the municipalities in the area of interest to major cities (particularly České Budějovice), the effect of the expansion of ETE in this respect will not be particularly significant.

Power plant operation is supported, among other things, by a network of approximately 200 qualified suppliers of services and materials. A significant proportion of the suppliers are located near the Dukovany Nuclear Power Plant, while only one is based in the South Bohemian Region. Construction of SMR ETE and New NPP ETE may create opportunities for greater involvement of local suppliers. Establishing supply chains with local companies should not only increase efficiency but also contribute to the development of the regional economy.

Neither the Temelín Nuclear Power Plant nor implementation of the SMR ETE and New NPP ETE projects will have any significant effect on the development of tourism. Tourists visiting South Bohemia for its sights, culture, or natural attractions would do so even without the existence of the power plant. The power plant itself may, however, be regarded as one of the region's tourist attractions. The Temelín Nuclear Power Plant Information Centre received almost 42,000 visitors in 2023. Following completion of SMR ETE construction, an increase in the number of visitors to the Information Centre may be expected, as this will be the first reactor of its type in the Czech Republic. Nevertheless, the anticipated effect of the project on the development of tourism will be very limited. Consequently, no significant effect of the project on accommodation facilities in the region is anticipated.

### **Living conditions**

During construction, the number of public transport services and certain related services is likely to increase due to the greater movement of people. Construction of the project will not require the development of new public transport infrastructure and will make full use of the existing infrastructure. Some class II roads located near ETE are in an unsatisfactory condition and will be repaired before SMR ETE construction begins to prevent their complete deterioration as a result of the construction work. It is also anticipated that some roads currently in good condition may be damaged by construction after 2030 and will require repair or reconstruction. Construction traffic for SMR ETE will be organised so as to avoid overlap between the most logistically demanding activities and New NPP ETE construction. Road II/105, which will provide access to the project, will be most heavily affected by construction traffic, together with a section of road II/138 near the SMR ETE project. Given the currently low traffic volume on road II/138, traffic volumes may increase by up to 70% during construction, while the increase on road II/105 will be in the lower tens of percent.

Following the commissioning of SMR ETE and New NPP ETE, traffic

generated by their operation will increase total traffic volumes by up to 54% on the relevant section of road II/138 and by up to 11% on the main access road II/105. The traffic generated by the projects is therefore not negligible; however, the existing road network has sufficient capacity to accommodate this increase, and no special or additional measures will therefore be required. The increase in traffic volumes is therefore acceptable.

The presence of the Temelín Nuclear Power Plant significantly influences the availability of services in the area of interest (commercial establishments, schools, healthcare facilities, social services, etc.). The concentration and availability of services are above average compared with other similar rural regions, where services tend to decline gradually. Implementation of the SMR ETE and New NPP ETE projects will temporarily bring thousands of construction workers into the area of interest, followed by a permanent workforce of approximately 1,000, most of whom will be highly qualified. This population increase will support demand for services, positively affecting the operation and retention of existing services and the development of new ones.

Operation of the Temelín Nuclear Power Plant also has a positive effect on the development of infrastructure in municipalities within the area of interest, which ČEZ, as the power plant operator, has supported over the long term through various sponsorship programmes. This support for the surrounding municipalities makes a significant contribution to improving the quality of local residents' living conditions. If the SMR ETE and New NPP ETE projects are implemented, continued support in this area may be expected.

### **Housing construction and property prices**

The SMR ETE and New NPP ETE projects are located in the immediate vicinity of the existing industrial site of the Temelín Nuclear Power Plant, at a sufficient distance from the nearest populated areas or areas designated for housing in the spatial plan. The residential areas nearest to the SMR ETE project site are Kočín, part of the municipality of Temelín, located approximately 1.1 km to the south, and the municipality of Temelín, located approximately 2.5 km to the north-west. In the case of New NPP ETE, the nearest locations are the municipality of Temelín, approximately 0.9 km to the north-west, and parts of the municipality of Temelín: Kočín, approximately 2 km to the south, and Sedlec, approximately 2.3 km to the west. Implementation of the projects will not result in any changes to the settlement structure of the area; it will only expand the existing power plant site. Adverse social effects of construction associated, for example, with the resettlement of residents can therefore be ruled out.

No large-scale housing construction is envisaged in connection with implementation of the projects. Construction workers are expected to be accommodated primarily in collective accommodation facilities, rental housing, and ETE facilities built

to house construction workers. Incoming operational staff are more likely to seek their own housing or rental accommodation and may be expected to concentrate primarily in nearby Týn nad Vltavou or České Budějovice.

Proximity to the Temelín Nuclear Power Plant is a factor affecting property prices in the area of interest. This factor may be perceived negatively by some people and may therefore result in lower prices. However, the continuously increasing number of power plant employees, with a further increase expected as a result of implementation of SMR ETE and New NPP ETE, is generating greater demand for property in the area of interest, thereby increasing prices. Implementation of the projects may be expected to result in a moderate increase in property prices and a significant increase in the prices of land potentially suitable for development as building plots. Implementation of the projects will only have a minimal effect on agricultural land prices. It should be noted that rising prices are also influenced to some extent by the proximity of larger towns and cities and by suburbanisation. During the construction phase, the prices of some properties near major transport routes may be adversely affected in the short term, for example due to increased traffic volumes, noise, or dust generated by construction. Overall, the adverse effects of project implementation are not expected to be particularly significant, primarily because of the attractiveness of the Temelín Nuclear Power Plant as a stable employer, the proximity of larger towns and cities within commuting distance, the natural qualities of the landscape, and the above-average amenities available in the area.

### **Local administration**

The presence and operation of the Temelín Nuclear Power Plant also affect the administration of municipalities in the area of interest. This effect is most apparent in the municipality of Temelín, within whose territory the power plant is located. As a result, the municipality has relatively high budget revenues, derived primarily from property tax and the tax revenue-sharing system, which takes into account the large number of power plant employees. The budget of the municipality of Temelín is substantially higher than that of other municipalities of a similar size, enabling it to invest more in municipal development and improving the quality of life of local residents.

ČEZ, which operates the Temelín Nuclear Power Plant, actively supports the development of the regions in which it operates, primarily by providing donations or promotional sponsorship to municipalities and legal entities. In 2023, the ČEZ Foundation provided financial support amounting to CZK 2,135,490 to legal entities operating within 10 km of the Temelín Nuclear Power Plant and donations amounting to CZK 2,456,389 to municipalities within the same area.

If the SMR ETE and New NPP ETE projects are implemented, the financial

support provided by the power plant operator to the affected municipalities and legal entities may be expected to continue. The expansion of operations and the increase in the number of employees will also have a positive effect on the tax revenues of the municipality of Temelín. The development of the ETE site will therefore enable the region to continue to stabilise and develop and to maintain high-quality living conditions that are above average compared with other regions.

In summary, the SMR ETE project will provide an economic benefit to residents of the surrounding area, and this effect will be further strengthened by its cumulative interaction with the New NPP ETE project. Economic development will also be accompanied by an improvement in social living standards in the area under assessment. The adverse aspects of development may be associated primarily with the potential environmental effects of increased traffic volumes; these effects are assessed separately in [3] and are discussed in Sections 6 and 7 of this document.

## 10. INFORMATION ON HEALTH EFFECTS EXTENDING BEYOND NATIONAL BORDERS

The underlying study [1] also assesses the radiation exposure risk from operation for the combined effect of ETE1,2, New NPP ETE, and SMR ETE (the effect of SNFS is zero) in the border areas of Austria and Germany, quantifying the contribution of SMR ETE to the values identified:

- for the cumulative effect in the border area of Austria, the representative person was determined at the Rottal location in the 6–15 years age category. The maximum annual effective dose from discharges from SMR ETE, ETE1,2, and New NPP ETE to this representative person will not exceed 50 nSv. For an exposure period of 70 years, this corresponds to total health detriment of  $2 \times 10^{-7}$ . The contribution of SMR ETE to this value is less than 10%.
- for the cumulative effect in the border area of Germany, the representative person was determined at the Schnellenzipf location, also in the 6–15 years age category. The maximum annual effective dose from discharges from SMR ETE, ETE1,2, and New NPP ETE to this representative person will not exceed 65 nSv. For an exposure period of 70 years, this corresponds to total health detriment of  $2.6 \times 10^{-7}$ . The contribution of SMR ETE to this value is less than 5%.

In both cases, the health risk is considered entirely negligible, lying in the lower quarter of the order of  $10^{-7}$ ; this may also be expressed as an increase of one case per several million residents.

## 11. CHARACTERISATION OF KNOWLEDGE GAPS AND UNCERTAINTIES

The supporting data and information for assessing effects on public health and health risks are sufficient. The assessment is based on a comprehensive set of expert studies covering the project's radiological effects, electromagnetic field effects, air pollution and noise effects, psychological effects, and social and economic effects. In general, however, the assessment of impacts on public health is associated with uncertainties relating primarily to exposure assessment and the dose–response relationship. In exposure assessment, these relate primarily to the determination, using calculation models, of radionuclide and pollutant emissions and noise, their propagation through the environment, and exposure scenarios for residents living in the surrounding area. Validated modelling tools were used for the calculations and, despite the uncertainties described, their outputs may be regarded as sufficiently reliable for drawing conclusions concerning the effect on the overall level of health risk. The exposure scenarios were always selected on the safe side, and the uncertainties therefore operate to the disadvantage of the project (increasing the risk compared with the actual situation).

With regard to the dose–response relationship, uncertainties relate primarily to the influence of other factors on individual risk (lifestyle, health status, occupational exposure, etc.) and differences in the sensitivity of exposed persons. In all cases, the dose–response relationship data are based on up-to-date comprehensive documentation from renowned scientific institutions (ICRP, ICNIRP, WHO), and the relationships used consistently apply an approach that is on the safe side of the assessment. In the case of radiation risks, a risk coefficient twice that recommended by the ICRP was applied (the reduction factor was not used) to ensure continuity with previous assessments.

The potential uncertainties therefore do not adversely affect the reliability of the conclusions. Taking together all uncertainties operating to the disadvantage of the project, the quantified risks may be regarded as conservative upper-bound estimates of the level of health risks.

## 12. CONCLUSION

This study assesses the effects of the implementation of the “New SMR Power Plant at the Temelín site” project on the health of residents living in the vicinity of the project. The objective of the project is the construction and operation of a small modular reactor (SMR) with a net electrical output of up to 500 MW<sub>e</sub> at the Temelín site. The assessment considers both the effects of the SMR ETE project itself and cumulative effects, taking into account operation of the existing power plant and other projects at the site (the New Nuclear Power Plant at the Temelín site and expansion of the spent nuclear fuel storage facility). The following potential effects were assessed:

- effects of ionising radiation (radiation exposure) associated with discharges of trace amounts of radionuclides into the atmosphere and watercourses
- effects of electromagnetic fields associated with overhead and underground power lines
- effects of air pollution associated with the construction and operation of the project (during the operational phase, these are primarily associated with traffic)
- effects of noise associated with the operation of the project (the effects of noise on human health are generally associated with long-term exposure; given the duration of acoustically significant construction work, no effects are anticipated during the construction phase)
- psychological effects (assessed for Temelín NPP as a whole)
- social and economic effects

The assessment is based on expert studies and supporting documentation prepared for the individual areas of the project’s potential effects on human health. These studies examine the potential effects of the project on the population and human health in greater detail, and this assessment must therefore be viewed in their context.

In the case of radiological effects, electromagnetic field effects, air pollution, and noise, a quantitative and qualitative assessment is performed using health risk assessment procedures. Given their nature, psychological and socioeconomic factors are assessed qualitatively.

The assessment results are summarised below.

The effects of **ionising radiation (radiation exposure)** are assessed for a representative person within the meaning of the Atomic Energy Act, i.e. the most affected part of the population. The effects of radionuclide discharges into the atmosphere and watercourses, including their combined effects, are assessed. The level of health risk is expressed in terms of total health detriment, which represents the probability of cancer occurring. The assessment results show that total health detriment associated with SMR ETE operation reaches a maximum value of  $1.2 \times 10^{-6}$ ; the calculated value therefore corresponds to one case per approximately 835,000 residents. For the combined effect of all existing and planned operations at the ETE site, total

health detriment to a representative person amounts to no more than  $1.73 \times 10^{-5}$ . As can be seen, the health risk is at most of the order of  $10^{-6}$  for the SMR ETE project and at most at the lower end of the order of  $10^{-5}$  for all sources at the power plant, and may therefore be considered acceptable in terms of public health protection. All assessments were performed using conservative approaches (i.e. on the safe side), and the actual risk associated with implementation of the project (and also with the other nuclear facilities at the site) will therefore probably be substantially lower. Among other things, to maintain continuity with the underlying study and previous assessments, the reduction factor recommended by the ICRP was not applied, so the calculated values are twice those obtained using the currently recommended procedure. If it were applied, total health detriment would clearly be of the order of  $10^{-6}$ , even when the cumulative effects of all sources are considered.

The underlying study also assesses the radiation exposure risk from ETE operation in the border areas of Austria and Germany. The assessment considers the combined effect of all potential sources of radiation exposure. The assessment results show that total health detriment at the locations under assessment will be no higher than the order of  $10^{-7}$  (which may also be expressed as an increase of one case per several million residents), and the health risk may therefore be considered entirely negligible. The contribution of SMR ETE to the calculated values is 5–10%.

Assessment of **electromagnetic field** effects is relevant to the corridor through which the power lines to and from the Kočín substation will pass, and potentially to the immediate vicinity of this corridor. The acute effects of low-frequency electric and magnetic fields are assessed. This is a factor with a threshold effect, meaning that a safe level can be identified below which the effects no longer occur. It was concluded that the maximum permissible value established by the applicable legislation for the general public environment is substantially below the safety threshold and therefore ensures adequate protection of individuals against all currently known direct and indirect effects of electromagnetic fields. The calculations presented in the underlying study show that, at the assumed height of the overhead lines and depth of the underground lines, the modified electric field strength will range from 22.5% to 26.0% of the maximum permissible value. Given the width of the power-line protection zone, the same applies to the peripheral residential areas near the corridor concerned.

In accordance with the underlying air dispersion study, three time horizons (2034, 2040, and 2042) combining the construction and subsequent operation of SMR ETE with the construction and operation of the New NPP ETE were assessed for the effects of **air pollution**. These represent the least favourable scenarios in terms of the potential cumulative effects of emission sources at the site. The effects of exposure to PM<sub>10</sub> and PM<sub>2.5</sub>, nitrogen dioxide, benzene, and benzo[a]pyrene are assessed. For PM<sub>10</sub>, PM<sub>2.5</sub>, and NO<sub>2</sub>, potential changes in health indicators (mortality, morbidity or hospital admissions for specific

diagnoses, restricted activity, etc.) are quantified using WHO methodology; for benzene and benzo[a]pyrene (as carcinogens), the probability of disease occurrence is quantified.

For chronic exposure to particulate matter, an increase in adult mortality of no more than 0.2 cases was calculated, and only for the 2034 time horizon, for which the exposure lasts no more than 1 year. For the 2040 and 2042 time horizons, the changes are of the order of thousandths of a new case in the entire affected population. For exposure to nitrogen dioxide, the increase in the health effect of natural-cause mortality among adults was calculated to be of the order of hundredths of a new case at most in the entire affected population for 2034 and of the order of ten-thousandths for the other two scenarios. For exposure to benzene and benzo[a]pyrene, changes in the level of health risk are of the order of  $10^{-8}$  and  $10^{-7}$ , respectively, and may be considered entirely insignificant in terms of any threat to health.

The changes in health indicators resulting from short-term exposure show that, if the least favourable meteorological and emission conditions coincide and measures to reduce dust are not taken into account, mild health effects represented by restricted activity (or days of school missed) could potentially occur. For this reason, dust emissions from the construction site and from the access and departure routes used by construction traffic must be consistently minimised. Provided that these measures are complied with, the maximum increases in exposure described, and therefore the associated health effects, will not occur (or these effects will be reduced to the level of the mean values described above).

Given their nature (acute effects are ruled out and only long-term exposure is assessed), **noise** effects are assessed for the operational phase at two time horizons, 2040 and 2042. The effects are virtually identical in both cases. The levels of high annoyance and high sleep disturbance, expressed as the numbers of highly annoyed persons and persons experiencing high sleep disturbance, are assessed, together with cardiovascular risk, expressed as the number of IHD cases. The assessment results show that the number of highly annoyed persons may potentially increase by one case.

The assessment results indicate that the number of residents in the surrounding existing residential areas who are highly annoyed by road traffic noise is 64 and 65, respectively, in the baseline scenarios; an increase of one case was calculated as a result of the project. The number of residents experiencing high sleep disturbance is 19 in both scenarios; no change was identified as a result of the project. The increase in cardiovascular risk (cases of IHD) was calculated at approximately 0.0022–0.0023 cases; this is therefore an entirely negligible change from the perspective of health protection.

In accordance with the underlying study, **psychological effects** were assessed for the power plant as a whole. The assessment is based on the assumption that residents in the immediate vicinity could potentially be adversely affected by concerns about the proximity of the nuclear power plant and the associated potential risks of radiation

exposure and possible accidents. The mental health of the population has therefore been monitored over the long term under the Programme for Monitoring and Assessment of the Environmental Effects of the Temelín Nuclear Power Plant; the latest results are from 2025. The Programme results show that the psychological characteristics of the population living in the vicinity of the Temelín Nuclear Power Plant exhibit a relatively stable and favourable trend; maintaining this trend, however, undoubtedly depends on the plant's trouble-free operation and on the safety of nuclear power in general. Public opinion is likewise relatively favourable, and although residents are aware of the potential safety risks, most regard the Temelín Nuclear Power Plant as safe and operated in accordance with high safety standards. The existence and proximity of the nuclear power plant therefore do not adversely affect important personality traits or psychological balance and well-being. This favourable situation may also be expected to continue if the SMR ETE project is implemented.

The analysis of the **social and economic effects** of the construction and operation of the new SMR ETE assessed effects on the population, labour market, economy, living conditions, transport infrastructure, amenities, housing, and local administration. The analysis results show that the SMR ETE project will provide an economic benefit to residents of the surrounding area, and this effect will be further strengthened by its cumulative interaction with the New NPP ETE project. Economic development will also be accompanied by an improvement in social living standards in the area under assessment. The adverse aspects of development may be associated primarily with the potential environmental effects of increased traffic volumes; however, these effects were assessed separately and are discussed above.

**In summary**, all quantifiable effects with a non-threshold effect (ionising radiation, air pollution, and noise) were assessed as insignificant in terms of any threat to the health of the affected population and therefore as acceptable. All assessments were performed using conservative approaches (i.e. on the safe side), and the actual level of risk associated with the individual factors will in all probability be substantially lower. The quantification results may be regarded as upper-bound estimates of the level of health risk. To reduce the effects of short-term increases in air pollution during construction work, the underlying air dispersion study recommends implementing measures to minimise dust emissions and prioritising the use of electrically powered machinery. Given the threshold effect and compliance with the maximum permissible value, electromagnetic field effects can be ruled out. No psychological effects beyond the current situation, which is assessed as predominantly favourable, are expected as a result of implementation of the project. The project will provide an economic benefit to residents of the surrounding area, and economic development is expected to be accompanied by an improvement in social living standards.

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## 14. LIST OF ABBREVIATIONS

|                   |                                                                      |
|-------------------|----------------------------------------------------------------------|
| ČEZ               | ČEZ, a. s.                                                           |
| CR                | Czech Republic                                                       |
| DDREF             | Dose and dose-rate effectiveness factor                              |
| EEG               | Electroencephalography                                               |
| ETE               | Temelín Nuclear Power Plant                                          |
| IARC              | International Agency for Research on Cancer                          |
| ICNIRP            | International Commission on Non-Ionizing Radiation Protection        |
| ICRP              | International Commission on Radiological Protection                  |
| IHD               | Ischaemic heart disease                                              |
| New NPP ETE       | New Nuclear Power Plant at the Temelín site                          |
| NO <sub>2</sub>   | Nitrogen dioxide                                                     |
| PAH               | Polycyclic aromatic hydrocarbons                                     |
| PM <sub>10</sub>  | Particulate matter with an aerodynamic diameter of 10 µm or less     |
| PM <sub>2.5</sub> | Particulate matter with an aerodynamic diameter of 2.5 µm or less    |
| SCENIHR           | Scientific Committee on Emerging and Newly Identified Health Risks   |
| SLDB              | Census of Population, Houses, and Apartments                         |
| SMR               | Small modular reactor                                                |
| SMR ETE           | New SMR Power Plant at the Temelín site                              |
| SONS              | State Office for Nuclear Safety                                      |
| SNFS              | Spent nuclear fuel storage facility                                  |
| NIPH              | National Institute of Public Health                                  |
| UO <sub>2</sub>   | Uranium dioxide                                                      |
| US EPA            | U.S. Environmental Protection Agency                                 |
| IHIS CR           | Institute of Health Information and Statistics of the Czech Republic |
| WHO               | World Health Organization                                            |
| BSU               | Basic settlement unit                                                |