

SCIENTIFIC ANALYSIS
ON ENVIRONMENTAL IMPACT ASSESSMENT
FOR UGLJEVIK 3 POWER PLANT
(COMPLIANCE WITH EIA DIRECTIVE)

Torun (PL), 29th July 2014

This scientific analysis describes the compliance of the Environmental Impact Assessment for the planned lignite-fired 600 MWe power plant Ugljevik 3, issued in May 2013 (*Studija uticaja na životnu sredinu za nove blokove termoelektrane Ugljevik 3*), hereafter called *Ugljevik 3 PP EIA* – with the *Environmental Impact Assessment Directive*.

The Environmental Impact Assessment Directive (Directive 2011/92/EU of the European Parliament and of the Council, of 13 December 2011, on the assessment of the effects of certain public and private projects on the environment), hereafter called the EIAD, says in Article 3: “*The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 12, the direct and indirect effects of a project on the following factors: (a) human beings, fauna and flora; (b) soil, water, air, climate and the landscape; (c) material assets and the cultural heritage; (d) the interaction between the factors referred to in points (a), (b) and (c).*”

Analysis of *Ugljevik 3 PP EIA* reveals, however, that the majority of environmental effects of the planned installation have not been identified at all, or have been described only qualitatively, or, in cases when they have been described quantitatively, the respective calculations are wrong. In consequence, it is impossible to assess the environment impact of *Ugljevik 3 PP* on the basis of this *EIA*.

1) In Table 33 *Procijenjene emisije u vazduh TE Ugljevik 3* (p. 115-116) describing emissions of the main gaseous-dusty pollutants to the atmosphere, the annual/hourly emissions (*Maseni protok emisija, godišnje/po satu*) of SO₂, NO_x or solid particles/dust (*Čvrste čestice*) are not proportional to the emission concentrations (*Koncentracija zagađujuće materije*), which at the first glance indicates that some calculations must be wrong.

It is obvious that the mass of any pollutant (emitted in a given unit of time) is the product of its emission concentration and the volume of waste gases (evolved in the same time)

$$m_x = c_x * V$$

while the proportionality coefficient, *i.e.* waste gases volume, can be expressed as:

$$V = m_x / c_x$$

Then, if we take into account, for example, the masses emitted hourly:

SO₂: 304 kg/h, NO_x: 432 kg/h, dust: 52 kg/h

and the respective emission concentrations

SO₂: 200 mg/m³, NO_x: 150 mg/m³, dust: 10 mg/m³

we can get three different waste gases hourly volumes, for each pollutant:

$$\text{in case of } X = \text{SO}_2: V = m_{\text{SO}_2} / c_{\text{SO}_2} = 304 \text{ kg/h} / 200 \text{ mg/m}^3 = 304000000 \text{ mg/h} / 200 \text{ mg/m}^3 = 1520000 \text{ m}^3/\text{h}$$

$$\text{in case of } X = \text{NO}_x: V = m_{\text{NO}_x} / c_{\text{NO}_x} = 432 \text{ kg/h} / 150 \text{ mg/m}^3 = 432000000 \text{ mg/h} / 150 \text{ mg/m}^3 = 2880000 \text{ m}^3/\text{h}$$

$$\text{in case of } X = \text{dust}: V = m_{\text{dust}} / c_{\text{dust}} = 52 \text{ kg/h} / 10 \text{ mg/m}^3 = 52000000 \text{ mg/h} / 10 \text{ mg/m}^3 = 5200000 \text{ m}^3/\text{h}$$

The same paradox occurs if we take into account the annually emitted masses:

SO₂: 2219 t/year, NO_x: 3154 t/year, dust: 380 t/year

and the respective emission concentrations

SO₂: 200 mg/m³, NO_x: 150 mg/m³, dust: 10 mg/m³

as we can get three different waste gases annual volumes, for each pollutant:

$$\text{in case of } X = \text{SO}_2: V = m_{\text{SO}_2} / c_{\text{SO}_2} = 2219 \text{ t/year} / 200 \text{ mg/m}^3 = 2219000000000 \text{ mg/year} / 200 \text{ mg/m}^3 = 11095000000 \text{ m}^3/\text{year}$$

$$\text{in case of } X = \text{NO}_x: V = m_{\text{NO}_x} / c_{\text{NO}_x} = 3154 \text{ t/year} / 150 \text{ mg/m}^3 = 3154000000000 \text{ mg/year} / 150 \text{ mg/m}^3 = 21027000000 \text{ m}^3/\text{year}$$

$$\text{in case of } X = \text{dust}: V = m_{\text{dust}} / c_{\text{dust}} = 380 \text{ t/year} / 10 \text{ mg/m}^3 = 380000000000 \text{ mg/year} / 10 \text{ mg/m}^3 = 38000000000 \text{ m}^3/\text{year}$$

These are of course nonsense, because this must be the same hourly or annual volume of waste gases.

In consequence, while the ratios of hourly or annual amounts of distinct pollutants emitted to the atmosphere

$$\text{SO}_2 : \text{NO}_x : \text{dust} = 304 \text{ kg/h} : 432 \text{ kg/h} : 52 \text{ kg/h} = 5.846 : 8.308 : 1$$

or $\text{SO}_2 : \text{NO}_x : \text{dust} = 2219 \text{ t/year} : 3154 \text{ t/year} : 380 \text{ t/year} = 5.839 : 8.300 : 1$ are more or less the same, within the limits of a rounding error ($5.8 : 8.3 : 1$), they are entirely different from the ratio of emission concentrations:

$$\text{SO}_2 : \text{NO}_x : \text{dust} = 200 \text{ mg/m}^3 : 150 \text{ mg/m}^3 : 10 \text{ mg/m}^3 = 20 : 15 : 1.$$

This error is obvious even for non-chemists and it should have been noticed by the EIA authors (for example: if the emission concentration of SO_2 is larger than of NO_x : $200 \text{ mg/m}^3 > 150 \text{ mg/m}^3$, it is impossible that hourly or annual emissions of SO_2 are smaller than of NO_x : $304 \text{ kg/h} < 432 \text{ kg/h}$, or $2219 \text{ t/h} < 3154 \text{ t/h}$).

This is a very serious error because both the hourly and annual emissions (determined in the EIA by multiplying hourly emissions by 7300 operating hours per year; *Predviđeno je da blokovi rade 7300 sati godišnje* – p. 104)

$$\text{SO}_2: 304 \text{ kg/h} * 7300 \text{ h/year} = 2219200 \text{ kg/year} = \text{ca. } 2219 \text{ t/year}$$

$$\text{NO}_x: 432 \text{ kg/h} * 7300 \text{ h/year} = 3153600 \text{ kg/year} = \text{ca. } 3154 \text{ t/year}$$

$$\text{Dust: } 52 \text{ kg/h} * 7300 \text{ h/year} = 379600 \text{ kg/year} = \text{ca. } 380 \text{ t/year}$$

are false.

2) In the whole EIA there is no quantitative data on emission concentrations or annual/hourly emissions of any other pollutants, commonly appearing in waste gases from coal- or lignite-fired power plants, such as: carbon monoxide CO, ammonia NH_3 , hydrogen fluoride HF, hydrogen chloride HCl, heavy metals (arsenic As, cadmium Cd, nickel Ni, lead Pb, mercury Hg, chromium Cr, copper Cu, zinc Zn), benzo(a)pyrene, benzene C_6H_6 , greenhouse gases (carbon dioxide CO_2 , methane CH_4 , nitrous oxide N_2O) and radioactive isotopes (especially of uranium, thorium and radium: ^{238}U , ^{232}Th , ^{228}Ra , ^{226}Ra).

In particular, these data have not been listed in the sub-paragraph *Emisije u vazduh* (p. 112-116), although the appearance of some of the above substances was generally mentioned in the introduction to the whole chapter 2.3.4 *Prikaz vrste i količine ispuštenih gasova, vode i drugih tečnih i gasovitih otpadnih materija, posmatrano po tehnološkim cjelinama uključujući: emisije u vazduh, ispuštanje u vodu i zemljište, buku, vibracije, svjetlost, toplotu, zračenja (jonizujuća i nejonizujuća): „Termoelektrana svojim postojanjem i radom može prouzrokovati sljedeće uticaje na životnu sredinu: - uticaj na kvalitet vazduha putem emisije gasovitih polutanata: - sumpor-dioksid (SO_2), - azotni oksidi (NO , NO_2), pod opštim nazivom NO_x , - ugljen-monoksid (CO), - čvrste čestice i - teški metali i organske komponente.”* (p. 112).

The respective calculations could have been performed based on the official handbooks published by *European Environment Agency*, e.g. *EMEP/EEA Air Pollutant Emission Inventory Guidebook (2013)* or *UNECE/EMEP Task Force on Emission Inventories and Projections: Joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook (2006)*, where many emission factors related to fossil fuels burning are given. Another possible source is *BREF for Large Combustion Plants (2006)*, as well as some documents of the *US Environmental Protection Agency* (e.g. *AP 42, Compilation of Air Pollutant Emission Factors*).

3) In the whole EIA quantitative data on annual CO₂ emissions is absent, although the importance of carbon dioxide as a greenhouse gas having harmful impact on climate was noted in the introduction to the already mentioned chapter 2.3.4: „*Termoelektrana svojim postojanjem i radom može prouzrokovati sljedeće uticaje na životnu sredinu: (...) - emisija ugljen-dioksida (CO₂), doprinos efektu staklene bašte*” (p. 112), as well as in the chapter 2.4.3 *Promjene meteoroloških parametara i klimatskih karakteristika*, sub-paragraph *Promjene klimatskih karakteristika u toku eksploatacije*: „*Uticaji globalnog karaktera termoenergetskih postrojenja na fosilna goriva su vezani za promjenu klime usljed emisije gasova staklene bašte, prije svega CO₂.*” (p. 144).

4) In the whole EIA there is no description of waste water composition (both qualitative, *i.e.* the types of salts present, and quantitative, *i.e.* their molar concentrations), or data on their hourly or annual volumes. The respective sub-paragraph *Otpadne vode* (p. 116) yields nearly no information, besides one general sentence: „*Tokom rada TE Ugljevik 3, javiće se otpadne vode različitog porijekla, koje je potrebno na različite načine (mehanički i hemijski) tretirati, u cilju svođenja zagađenja na zakonom propisane granice.*”, which, in fact, means nothing.

5) In the whole EIA discussion of environmental impact of gaseous-dusty emissions on air quality is absent. In particular, there is no mathematical description of distribution of any pollutants in the atmosphere (which is usually calculated in EIAs by computer modelling, using advanced numeric models), their final concentrations in air, and, in the case of heavy metals, their precipitation on the ground surface.

The only mention of this problem concerns the monitoring of air quality (*Monitoring kvaliteta vazduha* – p. 195-196; see also Table 74 and Table 78 *Monitoring plan u toku eksploatacije termoelektrane Ugljevik 3* – p. 198-199 and p. 226-228). This is an important

tool of environment protection, however, applied *ex post*, whereas EIA should quantitatively describe the predicted pollution.

6) In the whole EIA discussion of the environmental impact of waste waters on surface waters is absent. In particular, there is no mathematical description of distribution of any salts and their final concentrations in the rivers Janja and Mezgraja.

The only mention on that problem concerns the monitoring of water quality (*Monitoring kvaliteta voda* – p. 196; see also Table 74 and Table 78), which is again a tool applied *ex post*.

7) In the whole EIA discussion of the environmental impact of heavy metal precipitation on the quality of soils and underground waters is absent. The only mention of this problem concerns the monitoring of soil quality (*Monitoring kvaliteta zemljišta* – p. 196; see also Table 74 and Table 78), which is again a tool applied *ex post*.

8) In the EIA there are some quantitative data on the present concentrations of SO₂, NO₂, PM 10 and CO in air (Table 12 *Rezultati mjerenja nultog stanja kvaliteta vazduha* – p. 68-69), of some substances in the rivers Janja and Mezgraja (Tables 17-18 *Rezultati ispitivanja fizičko hemijskih parametara rijeke Janje kod buduće termoelektrane Ugljevik 3* – p. 76-77; Table 19 *Rezultati ispitivanja fizičko hemijskih parametara rijeke Mezgraje* – p. 80; Table 20 *Analiza vode na osnovne parametre i sadržaj teških metala AAS metodom* – p. 81) and in underground waters (Tables 22-23 *Rezultati ispitivanja fizičko hemijskih parametara podzemne vode na lokaciji Termoelektrane Ugljevik 3* – p. 84-85), as well as in soil (Table 24 *Rezultati analize plodnosti zemljišta* – p. 88). However, there are no analogous tables with the same parameters predicted in the future, which would illustrate the impact of the planned installation.

In the EIA there are also some historical data on Ugljevik 1 Power Plant (sub-paragraphs *Emisije u vazduh rudnika i termoelektrane Ugljevik 1* – p. 156-166; *Emisije u vode rudnika i termoelektrane Ugljevik 1* – p. 167-168). The annual and daily gaseous-dusty emissions are listed in Table 45 *Godišnji izvještaj prosječnih emisija polutanata TE Ugljevik 1* (p. 156) and Table 46 *Pregled jednodnevne emisije polutanata TE Ugljevik 1* (p. 157), while the resulting concentrations in air of some pollutants are reviewed in Tables 47-70 *Dnevne vrijednosti kvaliteta vazduha za...* (p. 158-166). Similarly, the concentrations of some pollutants in river Janja are listed in Table 71 *Godišnji izvještaj analize vode za 2009, 2010 i*

2011 godinu (prosječne vrijednosti) (p. 167). Nevertheless, although such an approach gives some picture of the results of activity of an existing Ugljevik 1 PP, it is, in my opinion, insufficient to evaluate, by simple analogy, the impact of the planned Ugljevik 3 PP.

9) In the EIA there are detailed data on the present noise level (Tables 13-15 *Rezultati mjerenja na MM1, MM2, MM3* – p. 71), but no quantitative description concerning the future.

10) A quantitative description is absent also in the chapter 2.5.1 *Mjere koje su predviđene zakonom i drugim propisima, normativima i standardima i rokovima za njihovo sprovođenje* (p. 170-191). The content of the paragraphs 2.5.1.1 *Mjere za zaštitu vazduha* (p. 169-176), 2.5.1.2 *Mjere za zaštitu voda* (p. 176-177), 2.5.1.3 *Mjere za zaštitu zemljišta* (p. 177-179) and 2.5.1.4 *Mjere za zaštitu od buke i vibracija* (p. 180) is qualitative and describes only which kinds of measures will be undertaken to protect air, water, soil or the acoustic environment, without any quantitative description after the power plant starts to operate.

In my opinion such a means of EIA preparation, where, after a detailed quantitative description of the present state or the impact of the existing power plant, there is no quantitative determination of the same parameters in the future, is unacceptable.

This is why, in my opinion, on the basis of the *Ugljevik 3 PP EIA* it is impossible to assess the environmental impact of the planned installation, as required by the EIAD.

Thus, in my opinion *Ugljevik 3 PP EIA* has not been prepared in accordance with the EIAD.

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