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CONCEPTUAL FRAMEWORK FOR THE BREF DOCUMENTS SELECTION AND BAT DESIGN AS ADVISABLE RESPONSE TO EU INDUSTRIAL EMISSIONS DIRECTIVE DEMANDS

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Abstract. *In the average national environmental management system of a medium-developed economy, the total registered emissions of pollutants are dominated by those originating from large industrial activities, public utilities, ore and oil extraction and related processing operations, followed by transportation, large farms and waste-related activities (incineration primarily). According to novel European practice, within the part of emissions originating from large emitters, a special focus is given to large industrial and other operators (commonly known as IPPC operators) which, although represented in smaller numbers, emit the largest share of industrial emissions (recognized as Pareto rule). At the level of the European Union (EU), this approach to pollution control originating from large industrial operators is regulated in detail by the provisions of the IPPC/IED – Integrated Pollution Prevention and Control/Industrial Emissions Directive, with numerous technical and organizational guidelines expressed in relevant BREF (Best available technique REFerence) documents. Given that the importance, content and usability of BREF documents are still underappreciated among IED operators as well as among competent authorities issuing integrated permits on the territory of the Republic of Serbia, this paper aims to analyse and present in a synthetized way the most important requirements and guidelines given in the relevant BREF documents. Additionally, an appropriate model of the BAT (Best Available Technique) evaluation, selection, implementation and effectiveness/performance monitoring system is given. Also, special attention was paid to the procedure for issuing an integrated permit, as well as to the stages and steps in the process of selecting the appropriate best available techniques (BATs).*

Key words: *industrial emissions, IPPC/IED directive, BREF documents, BAT, model*

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1. INTRODUCTION

Within the framework of EU legislation in the field of environmental protection, one of the key directives is Council Directive 96/61/EC of September 24, 1996 (published in the official gazette OJL 257) on integrated pollution prevention and control (IPPC Directive), which is applied to industrial and other facilities and activities that are classified according to the level of pollution and the risk that these activities may have on human health and the environment [1, 2]. This Directive entered into force on October 30, 1996, and the aim of issuing this Directive was the integrated prevention and control of pollution arising from the activities listed in Annex I of the Directive. Over time, the ever-present need for changes in the field of environmental law led to the issuance of Council Directive 2008/1/EC of the European Parliament and the Council on January 15, 2008, which replaced Council Directive 96/61/EC of September 24, 1996, on the issue of integrated pollution prevention and control. Council Directive 2008/1/EC of the European Parliament was published in the Official Journal OJL 24 on January 29, 2008. This Directive entered into force on February 18, 2008. As in the previous case, the activity to which the Directive applies is listed in Annex I of this Directive. Its provisions remained applicable until January 6, 2014 [3, 4].

On January 6, 2011, the IED - Industrial Emissions Directive came into force (Directive 2010/75/EU of the European Parliament and the Council of November 24, 2010, on industrial emissions (a new term used instead of integrated prevention and control pollution)). The transposition of this directive into national legislation lasted until January 7, 2013. Directive 2010/75/EU was published in the Official Gazette OJL 334 of December 12, 2010. The goal of IED is to reduce or eliminate pollution emissions from industrial activities, increase the effectiveness of legislation on the BATs, strengthen the existing minimum requirements for environmental quality and reduce all unnecessary administrative burdens related to the implementation of the Directive. The new characteristics in accordance with the IED are mainly related to the new limits for emission limit values - ELVs (which will be defined in the integrated permit) or with the maximum ELVs ("Safety nets" according to the IED). The IED integrates in its text six different directives aimed at the prevention and control of pollution from large industrial operators [5].

The motive for the adoption of the IPPC/IED directive (among other trends in the field of environmental protection resulting from the Rio Conference on the Environment and Sustainable Development) is the application of the Pareto rule (Pareto principle) in the field of pollution control. Namely, Vilfredo Pareto was an Italian engineer who advanced mathematical economics and microeconomic theory, especially by introducing the concepts of efficiency (Pareto efficiency) and ordinal utility (utility is not measured, but compared). Applied to the field of environmental protection, the Pareto rule states that the reduction of 80% of emitted pollution can be achieved by additional prevention and control activities/measures in the field of environmental protection at the level of 20% of the largest identified industrial and other (namely farms, etc.) polluters [1, 4]. The early system of integrated control of environmental pollution already existed in raw version in some EU countries (Great Britain, Sweden, Ireland, etc.), but the IPPC/IED Directive established a general framework in the EU for the uniform prevention and control of pollution, which contains measures to achieve dedicated goals [3].

2. IPPC/IED Directive Implementation in the European Union

The current IED directive at the EU level aims to reduce or eliminate emissions of pollution from industrial, agricultural and other activities (like waste management), to increase the effectiveness of BAT legislation, strengthen existing minimum environmental quality requirements, and reduce all unnecessary administrative burdens regarding implementation of Directive. It is necessary to keep in mind that the current IED directive, throughout integration, definitively replaces/integrates the following Directives:

1. Directive 78/176/EEC of 20th February 1978 on waste from the titanium dioxide industry (Titanium Dioxide Directive),
2. Directive 82/883/EEC on the surveillance and monitoring of titanium dioxide waste,
3. Directive 92/112/EEC on the reduction of titanium dioxide industrial waste,
4. Directive 1999/13/EC on reducing emissions of volatile organic compounds (VOCs),
5. Directive 2000/76/EC on waste incineration (Waste Incineration Directive (WID)), and
6. Directive 2008/1/EC concerning integrated pollution prevention and control (IPPC Directive).

In addition to other sectoral directives, IED represents a significant part of the EU regulation aimed at the prevention and control of various emissions into the environment from industrial plants. Approximately 52,000 different installations (IED operators) that perform industrial activities defined in Annex I of the directive must work in accordance with a special permit (integrated permit that defines additional environmental protection conditions). The integrated permit should contain conditions harmonized in accordance with the principles and provisions of the IED. The IED directive is based on several key principles, among which the integrated approach is the most influential. An integrated approach implies that integrated permits must define protection conditions for the entire environmental performance of the plant. The mentioned performance includes emissions to air, water and soil, waste generation, use of raw materials, energy efficiency, noise, prevention of industrial accidents as well as remediation of the operator's location after closing the work unit. Integrated permit-associated conditions, including emission limit values, must be based on the performance of BAT. In order to select BAT and environmental performance related to BAT, competent bodies (like the European IPPC Bureau - EIPPC, etc.) organize an exchange of information with interested experts. This work is carried out under the supervision of the European IPPC Bureau located at the EU Joint Research Center in Seville. The result of this process is the BAT Reference Documents (BREF) in which the Commission adopts the final conclusions on BAT. The IED requires that the BATs defined in this way form the basis for setting the conditions in the integrated permit [6].

For certain industrial activities, such as large combustion plants, waste incineration plants, activities using various solvents and titanium dioxide production, the IED also defines EU-wide emission limit values for certain pollutants. However, the IED allows national competent authorities some flexibility to define revised, less stringent emission limit values, which is possible only in certain cases where the environmental impact assessment (EIA) shows that achieving the emission levels associated with BAT would lead to disproportionately higher costs compared to environmental benefits, either due to

the operator's geographic location or local environmental protection conditions, i.e. the technical characteristics of the installations. In those cases, the competent authority must always document its reasons for granting such deviations. For example, Chapter III of the IED which is dedicated to large combustion plants (LCP) defines certain flexibility instruments (Transitional National Plan, limited deviation from the life cycle, etc.). The IED also contains mandatory requirements for periodic environmental inspections. Member States must establish a system of environmental inspections and draw up inspection plans accordingly. The IED requires a visit to a work unit for which an integrated permit has been issued at least every 1 to 3 years, applying criteria based on environmental risk assessment. The IED ensures public participation in the decision-making process by guaranteeing public access to permit applications, issued permits, and issuance of monitoring results. In this regard, through the European Pollutant Release and Transfer Register (E-PRTR), data on environmental emissions reported by Member States are available online [6, 7].

In 2022, the European Commission adopted proposals for the revision of the IED and E-PRTR following the changes at the operator's level of work. These proposals aim to improve the performance of the directive in the context of energy, water and material flows, as well as to promote the use of safer, less toxic, or non-toxic chemicals in industrial processes. The revised IED should:

- Ensure the full implementation of IED provisions in all member states, with stricter control of emissions,
- Increased investment in new, cleaner technologies,
- Support the sustainable growth of sectors that are key to the low-carbon and circular economy,
- Include additional intensive agricultural and industrial activities,
- Establish the Innovation Center for Industrial Transformation and Emissions (INCITE),
- Integrates previously separate requirements for depollution and decarbonization,
- Increases data transparency and public access to environmental information.

The expected revision of the IED should provide a framework for the operation of industrial installations at the EU level that is in line with the European Green Deal [7, 8].

The implementation of the IED by EU member states is controlled by national bodies. Several implementation decisions and guides have been published so far. The directive is an example of the successful joint creation of new environmental protection standards through the cooperation of EU member states, industry, non-governmental organizations for environmental protection and the European Commission. However, there is potential for improvement (which is why the revision is actually expected), especially through expanding the scope of the application, adapting key provisions for issuing permits, and ensuring more transparent access to environmental information. In this sense, especially important are the results of the implemented emission monitoring system and their transparency [9, 10].

2. IPPC/IED Directive Implementation in the Republic of Serbia

The IPPC Directive is one of the first European directives that was fully transposed into the legal system of the Republic of Serbia, with the adoption of the Law on Integrated Prevention and Control of Environmental Pollution in 2004 ("Official Gazette of RS", No. 135/2004). This law was revised in 2015 and 2021, so the last valid version was published in the Official Gazette of the Republic of Serbia, No. 109/2021 [11]. Essentially, the only changes in both revisions of the law related to the correction/extension of the deadline given to operators for obtaining an integrated permit, bearing in mind a very small number of operators who obtained an integrated permit within the legal deadline. The Law on Integrated Prevention and Control of Environmental Pollution, as well as a series of decrees and regulations accompanying this law, regulates the conditions and procedure for issuing an integrated permit for facilities and activities that may have negative impacts on human health, the environment or material goods. Also, law and subsequent by-laws define the conditions for the application of the BAT standards adopted by the European Commission in the respective reference documents (BREF). The implementation of these regulations enables an integrated approach to pollution control and aims to prevent emissions into the air, water or soil wherever applicable, including waste disposal, and where not applicable, to reduce them to a minimum in order to achieve a high level of environmental protection [12 - 18]. Considering its complexity, implementation of this law and accompanying regulations is still ongoing, with the new date for full compliance with the requirements of the directive given in the last version of the law as December 2024 [11]. This is also supported by the fact that within the recently created online register of issued integrated permits, the public version of which has been awaited for more than 15 years, there are approximately (the term "approximately" is used in this research because the register of issued integrated permits is a periodically supplemented with newly issued, revised, reissued or withdrawn integrated permits, so that operator numbers and permits constantly change) 43 operators with issued integrated permits (approximately 26 issued by the Ministry of Environmental Protection and 16 issued by local self-government units as competent authorities). In comparison to the total number of registered operators who are required to issue an integrated permit (a number that also changes periodically), which is 220 according to the last revision of the list of operators from September 2022, only approximately 20% of operators have successfully completed the procedure of obtaining an integrated permit [20]. There are several reasons for such a relatively small number of operators who have obtained an integrated license (historical heritage, transformation and change of ownership structure, lack of financial resources, lack of relevant knowledge of competent authorities, delay in the publication of by-laws specifying the procedure for issuing an integrated permit, insufficient capacities for preparation and evaluation of documentation for issuing an integrated permit at the operator and the competent authority levels, etc.). Among others, significant financial resources that need to be allocated to create documentation for the purposes of obtaining an integrated permit, refer to the implementation of the BATs described in reference documents (BREFs) published by the European IPPC Bureau.

Subsequent figures 1, 2 and 3 depict the relevant functional shares within the field.

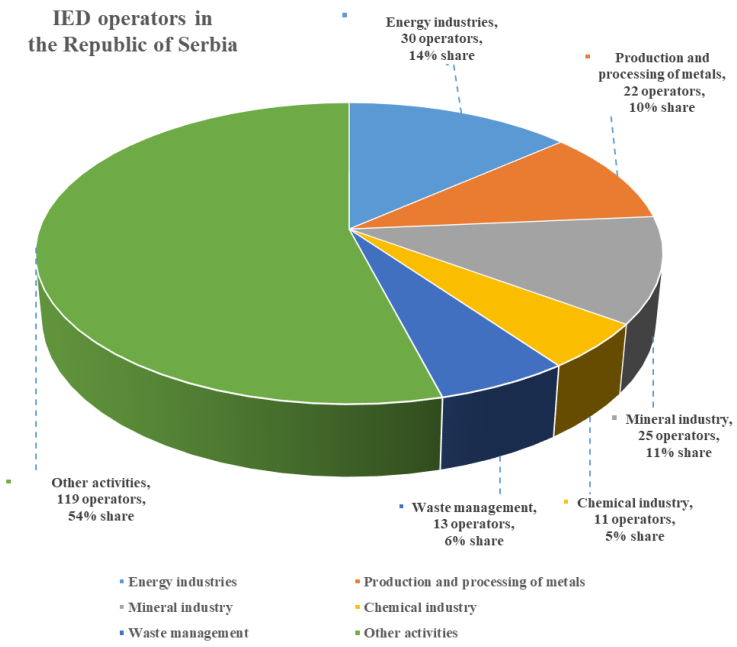

Fig. 1 Sectoral distribution of the IED operators (source: author, according to 19)

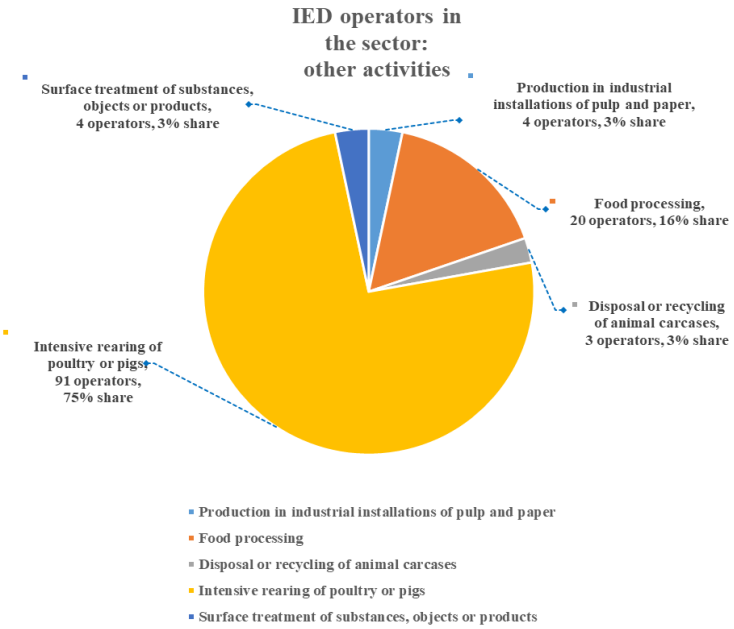

Fig. 2 IED operators in the sector: *other activities* (source: author, according to 19)

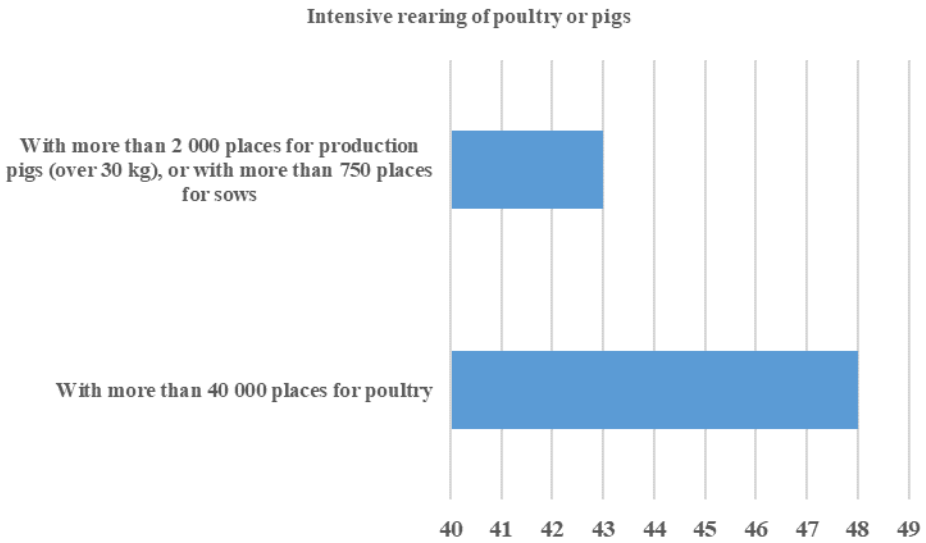

Fig. 3 IED operators within the sector: *intensive rearing of poultry and pigs* (source: author, according to 19)

Bearing in mind the derived distribution of operators in the sectors of IED application, it is noticeable that the total number of registered operators in the Republic of Serbia is dominated by operators classified in the sector other activities (as much as 54%), which in itself is an indicator of insufficiently developed primary sectors such as energy, mineral or chemical industry (Figure 1). On the other hand, it is noticeable that even within this sector, operators associated with agriculture or food production dominate, so that large IED farms (either poultry or pigs) make up 75% of all registered operators in the other activities sector (Figure 2), with almost by the uniform distribution of pig farms and poultry farms (Figure 3). This data indicates a pronounced significant share of operators in the primary production activity in the Republic of Serbia, but also insufficient representation of IED operators in some other sectors, for example, waste management - only 13 operators, or 6% of the total number of registered IED operators in the Republic of Serbia. While the share of operators in the energy, mineral or chemical industry sectors is certainly a reflection of the development of the national economy, the small number of operators in the field of waste management points to the fact that the Republic of Serbia still has an insufficiently developed waste management system, which would have to be significantly improved. On the other hand, the fact that the largest number of operators are farms (either poultry or pigs) is actually an indicator of an insufficient number of issued integrated permits in general, considering that this sector is recognized as the most vulnerable in the context of the capacity to implement IED requirements. For example, in relation to the total number of operators in this area of 91, at the time of writing this paper only 8 operators, i.e., less than 10% of operators in this sector were registered in the public register of operators with an integrated permit issued, along with the fact that all registered operators within this sector received integrated permits from the local self-government unit as the competent authority [19, 20].

This data undoubtedly confirms the previously highlighted fact that it is necessary to bring the procedure of issuing an integrated permit closer to the average team that prepares documentation for specific operators, especially in the part that regularly proves to be the most demanding, which is the interpretation of the BREF documents and selection of corresponding BATs.

3. BREF DOCUMENT SELECTION AND BAT DESIGN

A BREF is defined in Article 3 (11) of the IED as "a document that results from the exchange of information organized pursuant to Article 13 of the IED, drawn up for defined activities and describing, in particular, applied techniques, present emissions and consumption levels, techniques considered for the determination of best available techniques as well as BAT conclusions and any emerging techniques, giving special consideration to the criteria listed in Annex III" of the IED. Consequently, BAT conclusions are defined in Article 3 of the IED as "a document containing the parts of a BAT reference document laying down the conclusions on best available techniques, their description, information to assess their applicability, the emission levels associated with the best available techniques, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures" [5-7].

The issuance of an integrated permit is primarily based on the selection of BATs, leading to the thorough BREF documentation analysis, which can represent a significant task for an average trained applicant, bearing in mind the number of BREF documents but also the scope and amount of information provided in them. In this regard, a certain recommended conceptual framework for the interpretation of BREF documents and the selection and design of BATs is more than necessary. In this sense, different approaches can be found in the scientific and professional literature that deals with this issue, where in fact a combination of several of them is probably the most appropriate model, suitable for the already mentioned majority of operators in various sectors in the Republic of Serbia that have to submit a request for the issuance of an integrated permit [21 - 26].

In this sense, the assessment and selection of the BATs may rely on the proposed model of 5 phases, subdivided into 15 steps to be followed to justify the final selection of BAT for each industrial process or work unit.

Phase 1 contains four methodological steps and provides an analysis of the starting point of the existing situation in an industrial plant through the assessment of priority pollutants and "weak points" where these pollutants are created. Completion of phase 1 achieves the following results: List of priority pollutants, according to Annex II IED (Annex III IPPC Directive), which may endanger local Environmental Quality Standards - EQS by releasing additional quantities of pollutants (Annex I of the EU EQS Directive 2008/105/EC), 2. The priority list of work units for the introduction of the BAT that creates large burdens caused by pollution; A set of data on "weak points" in each work unit, e.g. high energy consumption/water use; A set of points for intervention (base for the BAT search). Phase 1 is considered the starting point for the BAT assessment and provides the necessary information for a targeted search of BREF documents.

Phase 2 contains three methodological steps and is focused on preparing a list of BAT candidates according to their environmental performance. The goal is to conduct an efficient search of complex BREF documents in such a way that the most adequate BAT

for each "weak point" can be found and properly described to be a candidate for final selection. Completion of phase 2 achieves the following results: List of BAT candidates for all problematic work units in order to reduce the corresponding priority pollutants, which contains BAT-AELs (BAT-associated emission levels or emission levels associated with the best available techniques); The level of reduction of priority and other pollutants and inputs (raw materials, chemicals, water, energy) for each BAT candidate followed by outputs (products, by-products, air emissions, wastewater, waste quantities) for each BAT candidate.

Phase 3 also contains three methodological steps and aims to define the expected reduced emissions and resource use resulting from the application of BAT candidates. A significant role in this analysis is played by the compliance of BAT candidate emissions with the set EQS. Completion of phase 3 achieves the following results: List of BAT candidate options previously selected according to their environmental importance (reduction of emissions, use of resources...); List of work units to which the candidate's BAT options may apply; Report on expected impacts of BAT emissions on the environment (water, air, soil).

Phase 4 contains two methodological steps and is an analysis of the technical characteristics of the BAT candidate options in order to find out whether the proposed technique is technically mature enough to be applied on a wide industrial scale. Upon completion of Phase 4, the following results will be achieved: a list of pre-selected BATs containing the main technical characteristics of each and a list of the benefits of those BATs that demonstrate the highest degree of compliance with the IED-defined criteria.

Phase 5 contains three methodological steps and consists of assessing the feasibility/ sustainability of the proposed BAT options by comparing the investment/operational costs required to implement the candidate BAT with the expected savings in raw materials and resources. Upon completion of Phase 5, the following results will be achieved: a list of pre-selected BATs containing calculations of expected investment and operating costs as well as maintenance costs and a list of preferred BATs that show a certain economic attractiveness, i.e. seem economically and technically viable. This last step represents the most important consideration in the entire economic analysis that has been conducted. It reflects the usefulness of introducing the BAT in full and can convince the investor of the necessity of introducing one or more good BAT options in the industrial production process. It must be pointed out that the ideal situation would be that the BAT investment can pay for itself over its lifetime from savings in operational/maintenance costs. However, this is not always feasible. In any case, the introduction of the BAT leads to a clear cost saving that generally contributes positively to the economic results of the company to a greater or lesser extent.

Nevertheless, the final choice of the most appropriate BAT includes the most important selection criteria from the IED Directive and must take into account not only the environmental benefits expected from the introduction of the BAT but also the technical and environmental sustainability of the respective techniques, with particular focus on energy efficiency [27].

The stages described in this paper should not be considered as an alternative to the application for an integrated permit. They represent a broader explanation of the application form, specifically with regard to BAT selection, whereas the application form itself, which applicants must fill out must always be based on the Decree on the content, appearance, and method of filling out the request for issuing integrated permits [16].

4. CONCLUSION

Bringing the level of industrial pollution management practices and related emissions to the EU level improves both the environment and the quality of life of Serbian citizens, primarily through prevention and protection against the harmful effects of industrial pollution. Significant financial, legislative and educational efforts have already been made during the process of implementing the IED in all related industrial sectors. However, further large-scale investments are needed to support the modernization of industrial facilities in the Republic of Serbia that are required to issue an integrated permit, as well as to combine environmental protection with efficient and competitive production, preparing them for competition in the EU market. This is primalrily important because it requires a significant commitment of material, financial, and human resources on the part of the operator to respond to the requirements of Industrial Emissions Directive. In this sense, certain steps are already being taken in order to reach the emission limit values fully defined by the Directive, and it is acknowledged that raising environmental quality standards entails indirect costs, with a special emphasis that the benefits are greater than the costs and that the implementation of this directive is a responsible move that will also benefit future generations. In order to maximize the protection effects and thereby reduce the costs associated with the requirements of the Directive, it is of great importance to understand not only the requirements of the Directive, but also to know the content of BREF documents, followed by reasonable, environmentally sustainably selection of BATs and their implementation according to the operator's needs.

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KONCEPTUALNI OKVIR ZA SELEKCIJU BREF DOKUMENATA I DIZAJN BAT-OVA KAO USKLAĐENI ODGOVOR NA SAVREMENE ZAHTEVE DIREKTIVE O INDUSTRIJSKIM EMISIJAMA EVROPSKE UNIJE

U prosečnom nacionalnom sistemu upravljanja životnom sredinom srednje razvijene privrede, u ukupnim registrovanim emisijama zagađujućih materija dominiraju one koje potiču iz velikih industrijskih delatnosti, javnih komunalnih preduzeća, operacija vađenja i prerade rude i nafte, transporta, farmi i aktivnosti povezanih sa tretmanom otpada (posebno spaljivanja). Prema postojećoj evropskoj praksi, u okviru dela emisija koje potiču od velikih emitera, poseban fokus je na velikim industrijskim i drugim operaterima (koji su poznatiji kao IPPC operateri) koji, iako su zastupljeni u manjem broju, emituju najveći deo industrijskih emisija (procentualni udeo poznat kao Paretovo pravilo). Na nivou Evropske unije, ovaj pristup kontroli zagađenja koje potiče od velikih industrijskih operatera detaljno je regulisan odredbama IPPC/IED – Integrisana prevencija i kontrola zagađenja/Direktiva o industrijskim emisijama, uz brojne tehničke i organizacione

smernice izražene u relevantnim BREF dokumentima (Referentni dokument najbolje dostupnih tehnika). S obzirom na to da su značaj, sadržaj i upotrebljivost BREF dokumenata još uvek nedovoljno prepoznati od strane operatera kao i nadležnih organa koji izdaju integrisanu dozvolu na teritoriji Republike Srbije, cilj ovog rada je da analizira i na sintetisan način prikaže najvažnije zahteve i smernice date u relevantnim BREF dokumentima. Dodatno, dat je odgovarajući model evaluacije, odabira, implementacije i praćenja efektivnosti/učinka BAT-ova (najbolje dostupnih tehnika). Takodje, posebna pažnja je posvećena i proceduri izdavanja integrisane dozvole, kao i fazama i koracima u procesu selekcije odgovarajućih najbolje dostupnih tehnika (BAT).

Ključne reči: *industrijske emisije, IPPC/IED direktiva, BREF dokumenti, BAT, model*