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## INTRODUCTION

The subject matter of this Report is the equipment provision and the construction of biomass-based 9.99 MW *Viridas Biomass* cogeneration plant in the municipality of Babina Greda in Vukovarsko-srijemska county. According to the excerpt from the technical specifications of cogeneration plants, the total capacity of the plant amounts to 9.7 MW in theory (**Appendix 4**).

UNI VIRIDAS Ltd. based in Zagreb is the project developer. The company is registered with the Commercial Court of Zagreb, the City of Zagreb (excerpt from the court register is in the Attachment).

The Report will be the basis for the certificate of compliance of the Activity concerned with national and EU environmental standards, which will be issued by Ministry of Environmental and Nature Protection.

The Activity concerned involves the construction of a 9.99 MW biomass cogeneration plant. According to the environmental legislation in force - Regulation on strategic environmental assessment of plans and programs (Official Gazette no. 64/08 and 67/09), the obligation for carrying out either the assessment of environmental impact or the assessment of the need for the evaluation of environmental impact is not prescribed for the activities of the aforementioned capacity (Annex II of Regulation; Article 2.1 Plants for the production of electricity, steam and hot water of capacity greater than 10 MWel using renewable energy sources (except water and wind))

Regulation on the procedure for establishing integrated environmental requirements (Official Gazette no. 114/08) stipulates the activities which may cause pollutant emissions to the soil, air, water and sea in terms of Regulation, and among others specifies: Combustion power plants with nominal thermal power exceeding 50 MW. In the case of the Activity concerned, the nominal thermal power of the cogeneration plant amounts to 28.8 MW whereby the procedure for determining integrated environmental protection is not required.

For display of the Activity on a topographic map see Map 1. and Graphic attachment 1.

The scheduled Activity is located in cadastral plot no. 3649 in cadastral municipality of Babina Greda, within the work zone “Tečine“, in the area of the village of Babina Greda.

For the Activity concerned the location permit was issued on June 14, 2012, Class: AP/ I 350-05/12-01/55, Reg.No: 2196/1-14-03-12-8, by Spatial Organization, Building and Environment Protection Administrative Department in Vukovarsko-Srijemska county (**Text attachment 1.**)

Pursuant to the Article 14 of the Ordinance on the Implementation of Measure 302 "Diversification and Development of Rural Economic Activities" under IPARD program (Official Gazette no. 72/12 and 93/12) (hereinafter: the Ordinance on the Implementation of Measure 302 (Official Gazette no. 72/12 and 93/12)) eligible investments in the renewable energy sector are as follows:

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- Investment in construction and/or reconstruction and/or equipment of power plants which use renewable energy sources for electrical energy production, i.e. cogeneration plants which are connected to the electrical grid and for which the project developer or the producer can obtain the status of privileged producer - Ordinance on the obtaining of the privileged producer status (Official Gazette no. 67/07) and the Ordinance on the use of renewable energy sources and cogeneration (Official Gazette no. 67/07).

Pursuant to Annex VIII – List of eligible expenditure from the Ordinance on the Implementation of Measure 302 (Official Gazette no. 72/12 and 93/12) for the Activity concerned, funding is requested for the following expenditures:

302.5 RENEWABLE ENERGY SOURCES

302.5.A. Construction and/or reconstruction of renewable energy based plants (solar power plants, hydroelectric power plants, wind power plants, biomass power plants, etc.), including the connection of the plant to the electrical grid and the connection of the plant to the facility.

302.5.B. Equipment provision for plants

The construction of biomass cogeneration plant within the work zone “Tečine” is defined by the Spatial development plan of the municipality of Babina Greda (Official Gazette of Vukovarsko-Srijemska county no. 7/04, 13/08, 16/11).

I. STATEMENT OF GROUNDS/EXPLANATION

3.3. Review of Economic and social activities

3.3.1. Economic activities

INDUSTRY AND CRAFTS

*Stronger industrial development is expected after the creation of economic zones (mainly of industrial purpose-small industry) in the southern area of the village of Babina Greda next to the highway route D-4. Detailed town-planning schemes will be designed for these areas, the area of Jos (70.23 ha) and “Tečine” (17.32 ha) in particular. The Activity location will not affect the quality of life in the village of Babina Greda, given the dominance of the northern winds and the position of the location south of the highway; the municipal center is to be developed on the north side. Two crucial factors for the location selection were the developed infrastructure and transport connections.*

II. REGULATIONS FOR IMPLEMENTATION

3. Conditions of economic activities location

Economic zones (business-work zone)

Article 75

*Economic zones (business-work zones) encompass business buildings, manufacturing facilities, service activities and crafts, warehouses and services and other activities that by no means affect other functions or the environment of the local residents.*

*The concept of construction within the economic zones (business-work zones):*

- *land development level must not exceed 60% of the total plot area*
- *green surfaces should cover at least 20% of the total plot area*

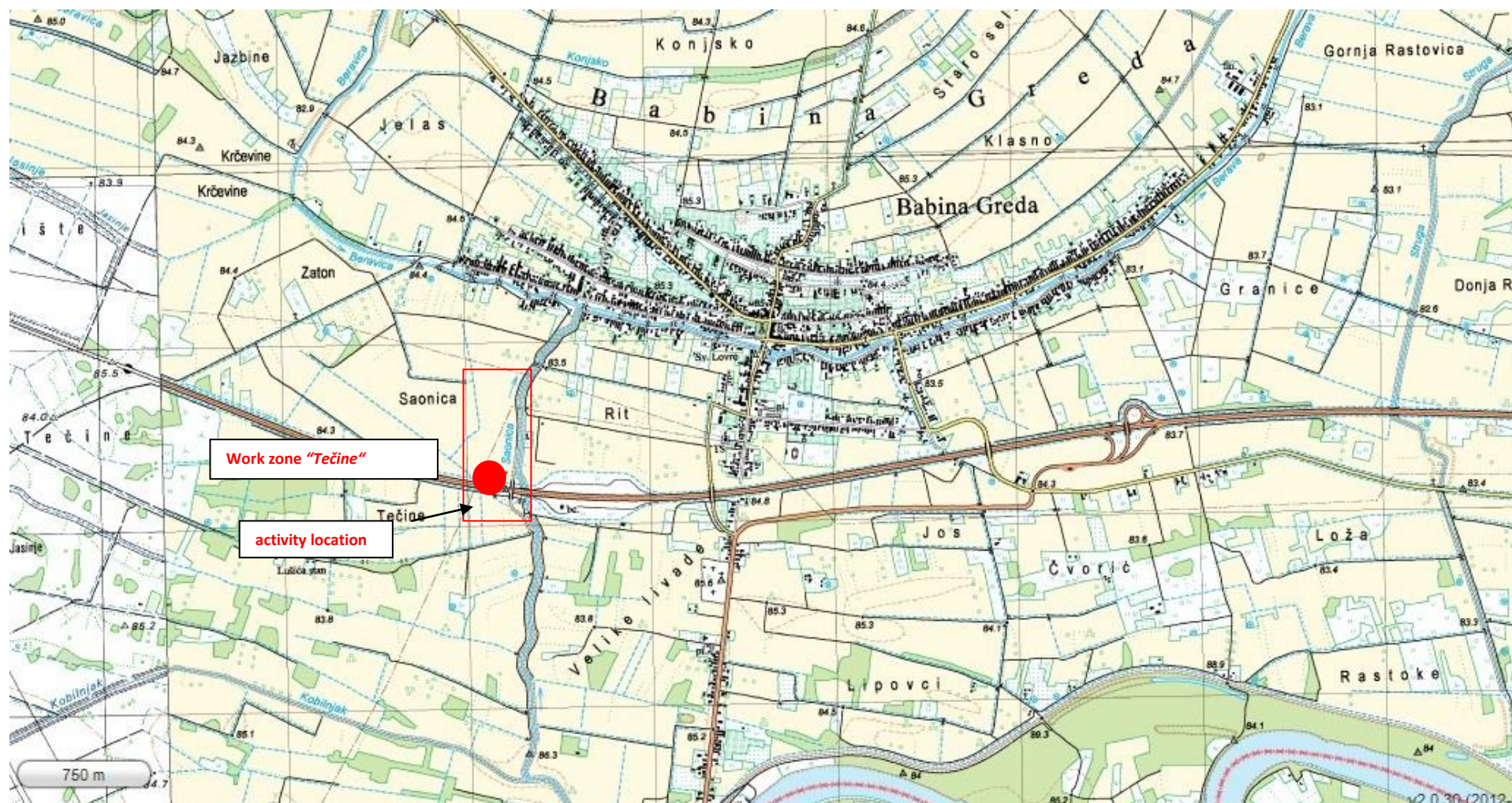
*Building plots in economic zones (business-work zones) must be separated by a green belt or public surface transportation from the building plots of residential and public buildings within the mixed-use development zones.*

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*The construction within the economic zones in the municipal center of Babina Greda is to be carried out in accordance with the detailed spatial development plan.*



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Map 1. Activity project area (within the work zone "Tečine") on the topographic map (Source: [www.arkod.hr](http://www.arkod.hr))

## A DESCRIPTION OF THE ACTIVITY

### A.1.1. GENERAL

The liberalization of the electricity market, the production and sales of electric and heat energy are prescribed by the following acts:

- Energy act (Official Gazette no. 68/2001, 177/2004, 76/2007 and 152/2008)
- Electricity market act (Official Gazette no. 177/2004, 76/2007 and 152/2008)
- Act on the production, distribution and supply of thermal energy (Official Gazette no. 42/2005)
- Act on the regulation of energy activities (Official Gazette no. 177/2004 and 76/2007)

Under the authority of these acts, the following regulations were passed defining the terms of use of renewable energy sources and cogeneration:

- Regulation on the minimum share of electricity produced from renewable energy sources and cogeneration whose production is incentivized (Official Gazette no. 33/2007)
- Ordinance on fees for incentivizing electricity production from renewable energy sources and cogeneration (Official Gazette no. 33/2007 and 155/2008)
- Tariff system for the production of electricity from renewable energy sources and cogeneration (Official Gazette no. 33/2007)
- Ordinance on use of renewable energy sources and cogeneration (Official Gazette no. 67/2007)
- Rules on acquiring the status of eligible electricity producer (Official Gazette no. 67/2007)

The biomass-fueled cogeneration plant scheduled for construction will produce the electric energy from forest biomass purchased from Croatian Forest Ltd. (Hrvatske šume d.o.o.) or the wood processing industry. Renewable power plants have a set feed-in tariff, and have a right to deliver the entire generated electrical energy into the grid.

According to the County Development Strategy of Vukovarsko-srijemska county (2011-2013), particularly its section titled *Vision, main objectives, priorities and development measures*, the third strategic objective - *Quality spatial planning, modern infrastructure and preserved environment* focuses on the integration and modernization of transport infrastructure, complete and efficient water management, improvement of communal equipment, investment in renewable energy sources, efficient energy use, environment preservation and nature protection.

Priority **3.4. Investment in renewable energy resources and efficient energy use**; its measure **3.4.1. Incentivizing electricity production from renewable energy sources** and **3.4.2. Promoting energy efficiency** aims at promoting the production of energy from renewable energy sources and cogeneration.

The measure refers to the following:

- Incentivizing renewable energy project preparation and implementation in counties, cities and municipalities
- Exploiting geothermal energy sources
- Developing County energy strategy whereby the county priorities will be defined, measures for the use of renewable energy (RE) sources will be proposed and the Activity plan will be created

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- Creating a quality energy database for systematic monitoring and the analysis of energy consumption in the county-owned facilities, as well as the Activity planning in the renewable energy field and the verification of results
- Identifying adequate projects in the field of renewable energy use and defining the criteria for their approval and activation
- Supporting preparation of projects eligible for funding through EU funds
- Adapting spatial plans to the projects concerning the production of energy from renewable sources

For the Activity concerned – the construction of a 9.99 MW biomass cogeneration plant – the location permit was issued based on the following project documentation:

- Concept design for 9.99 MW *Viridas Biomass* cogeneration plant; Office of the certified mechanical engineer Marijan Hohnjec, Zagreb, February 2012
- Analysis of construction justifiability for the plant and the connection to the electricity grid containing techno-economic data and data on spatial organization for the 9.99 MW *Viridis Biomass* cogeneration plant, Enerkon Ltd., June 2012
- Study of the optimal technical solution for the connection to the electricity grid – *Viridas Biomass* cogeneration plant (9500 kW), Končar – Institute of Electronics, Zagreb, December 2011



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Map 2. The Activity project area (within the work zone "Tečine") on the ortophoto map (Source: [www.arkod.hr](http://www.arkod.hr))



## **A.1.2. TECHNICAL REPORT**

### **A.1.2.1. General**

Main elements of 9.99 MW forest biomass-fueled cogeneration plant capable of operating 8000 hours per annum with a 25-year life span are as follows:

- raw material inlet – forest biomass (preparation, storage and supply) which serves as fuel,
- prepared biomass fuels are fired in the Bubbling Fluidized Bed (BFB) unit and by releasing heat energy high-pressure steam is produced (also flue gases are cleaned, supplementary feed water chemically treated and the total amount of boiler feed water is thermally treated),
- high-pressure steam in the steam turbine connected to the generator (steam-turbine generator system) is expanded delivering the pressure energy to the turbine which converts it to mechanical power which runs the electric generator,
- expanded steam from the turbine is cooled in the condensing unit and then converted to water with closed cooling circuit and a dry cooling tower
- other: substations for delivering electrical energy to the electricity grid and a self-sufficient transformer, electrical plant, thermal power station for delivering heat to the future consumers, ash handling system, warehouse and workhouse, control room, management and control system, personnel room.

Taking into consideration the wood chips available in Croatia, the equipment supplier will guarantee the following operating parameters of the plant:

| <b>Condensation mode<br/>(electric energy only)</b> |     |    | <b>Cogeneration mode<br/>(electric and thermal energy)</b> |      |     |
|-----------------------------------------------------|-----|----|------------------------------------------------------------|------|-----|
| Electrical power, gross                             | 9.9 | MW | Electrical power, gross                                    | 7.8  | MW  |
| Thermal power                                       | 0.0 |    | Steam exit flow                                            | 26.0 | t/h |
|                                                     |     |    | Thermal power                                              | 16.0 | MW  |
|                                                     |     |    | Hot water flow                                             | 90   | °C  |
|                                                     |     |    | Hot water return                                           | 50   | °C  |

**Table 1. Electric and thermal power for different operating modes**

### **A.1.2.2. Raw material Input**

The plant will be using forest woody biomass and clean wood water from the wood processing industry. The investor will make long-term agreements with the suppliers for delivering fuel wood, timber, wood chips and residues from the wood industry (e.g. sawdust). Polluted wood waste is not to be used, therefore any special wood preparation such as flue gas and waste treatment will not be required.

Woody biomass will be delivered to the location by trucks from the vicinity of the cogeneration plant within the 50-kilometer radius, the area of adequate wood resources managed by Croatian Forest Ltd., that can provide sufficient amount of wood energy.

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Should the total amount of fuel (biomass) in the form of wood chips (logistically the most demanding due to volume) weighing 80,000 tons be delivered to the location by dedicated trucks with 5-ton load-bearing capacity, 8,000 deliveries per annum by trailer trucks will be required. Considering that the chips will be delivered daily, 20 to 30 truckloads will have to be unloaded per day, during the first two shifts. The access road is wide enough for two trucks or vehicles to pass each other.

Main elements of biomass preparation, storage and supply:

- truck scale
- biomass sampling and analysis
- outdoor timber storage without roofing (with a mobile crane) for storing the amount of fuel sufficient for several weeks
- wood chips depot (outdoor storage without roofing) for seven-day amount of wood chips
- roofed automatic wood chips storage with a crane for spreading and manipulation sufficient for three-day storage and piling of wood chips.
- wood processing line for receiving and wood sizing (chipping) with metal detectors, metal removal and sieving machine
- conveying lines for the transfer of wood chips
- dedicated biomass loaders (excavators) with front loaders
- dedicated excavators for loading timber

The characteristics of the biomass (size and moisture) that will be delivered, as well as the current situation at the plant and storages will define the management of biomass including the final step - combustion in the BFB unit. The strategic use of storage space will optimize energy consumption for biomass manipulation, including the biomass moisture, i.e. the heating value of biomass while being fed into the combustion chamber of the boiler. Biomass that has been air-dried has lower moisture level (water content – total weight of wet wood ratio) and consequently higher heating value and lower total consumption during firing.

Upon entering the premises, the chips-loaded trucks will be weighed on the truck scale and the worker in charge of biomass control will take a sample for determining the characteristics in the laboratory, especially moisture (water content weight compared to the total wet wood weight). Afterwards, the truck with removable body will drive to the entrance to the roofed chips storage (three-day capacity) and unload automatically. If necessary, the biomass will be “pushed” with a dedicated loader into the storage and spread by the automatic crane within the storage. After the unloaded truck is weighed again on the truck scale, it may leave the premises of the plant.

Alternatively, after the weighing and sampling, the wood chips-loaded trucks will drive to the depot of seven-day capacity where the chips will be unloaded and arranged within the depot by a dedicated loader. The loader will regularly fill the three-day capacity storage by transferring chips from the depot.

Raw material for wood chips (fuel wood, timber, ore wood, lower-quality sawmill roundwood, parasite-contaminated wood etc.) of 70 to 800 mm diameter and 6 m length, will be transported by dedicated trucks to the plant and upon entering the premises, the loaded trucks will be weighed on the truck scale and the worker in charge of biomass control will measure the wood moisture level with a portable device and assess the wood condition (the presence of wood rot etc.). The truck will

then park under the mobile crane for unloading and spreading of biomass over the depot. Afterwards upon being weighed again, the truck will leave the plant premises.

Chipped woody biomass – raw material will be processed into G100 size chips according to the austrian standard ÖNORM M 7133.

After placing timber from the depot into the wood chipper and processing the material into G100 size chips, the chips will automatically be:

- conveyed into the 20 m<sup>3</sup> biomass feed hopper in front of the combustion chamber or
- transported to the three-day capacity storage or
- transported and loaded into the previously weighed truck (for transportation to the seven-day capacity storage or outside the plant) weighed if necessary on the truck scale and sampled.

Biomass will be conveyed from the automatic three-day capacity storage into the 20 m<sup>3</sup> feed hopper by belt conveyor, producing enough fuel to meet the needs of the boiler, up to 72 hours without the presence of the operator.

#### Description of the raw material storage and processing elements of the cogeneration plant

##### **Outdoor timber storage without roofing**

The purpose of this type of storage is storing the sufficient amount of raw material for wood chips production for several weeks of fuel for a biomass cogeneration plant. Besides the assumed stack height up to 5-6 m, also 2.5 m<sup>3</sup>/m<sup>2</sup> storage is possible with 45% of average moisture level and 1 t/m<sup>3</sup> of average raw material density. For operating, the boiler requires 12.3 t/h of chipped biomass. 3,400 m<sup>2</sup> of available storage surface is manipulated by a mobile crane with a telescoped boom length of 64 m. 8,500 m<sup>3</sup> of stored biomass can meet the need of the plant for 4 weeks (8,500 / 12.3 x 24 = 29 days). East of that surface, another one covering 1,000 m<sup>2</sup> (50 x 20 m) is available for storing supplementary biomass that can be managed by excavators. South of corridor regional water system there is an extra surface in case of storage expansion.

##### **Wood chips depot**

This storage will be used for storing the seven-day amount of wood chips of 250 kg/m<sup>3</sup> of bulk density and 35% of moisture level (for faster air-drying). 10 t/h or 40 m<sup>3</sup>/h of biomass is necessary for the boiler's operation. For seven days, 6,720 m<sup>3</sup> is required and the assumed average wood chip stack height of 3.5 m requires the surface area of 1,920 m<sup>2</sup>. A paved trapezoidal surface of 2050 m<sup>2</sup> with 4-meter retaining walls on three sides is also provided.

This storage is roofed optionally so that the wood chips can be air-dried whereby the heating value increases and the wood chips consumption decreases.

##### **Automatic wood chips storage**

Considering the assumed density of 250 kg/m<sup>3</sup> and the moisture level of 35%, 10 t/h or 40 m<sup>3</sup>/h of biomass will be required for the boiler's operation, three-day amount of biomass being 2,880 m<sup>3</sup>. The wood chips being stacked up to the assumed height of 6 m by a crane for wood chips spreading



and manipulation, a surface of 480 m<sup>2</sup> (24 x 20 m) is required. In the automatic storage there is also a biomass feeder with a live bottom which drops the chipped biomass onto the conveyor belt that carries it to the boiler.

Between the roofing and the 7-meter concrete walls of the storage there are partial infill walls allowing air circulation and air-drying of the upper layer of wood chips. For truck unloading there is a big rolling door on the east side of the storage/warehouse.

### **Wood chipping line**

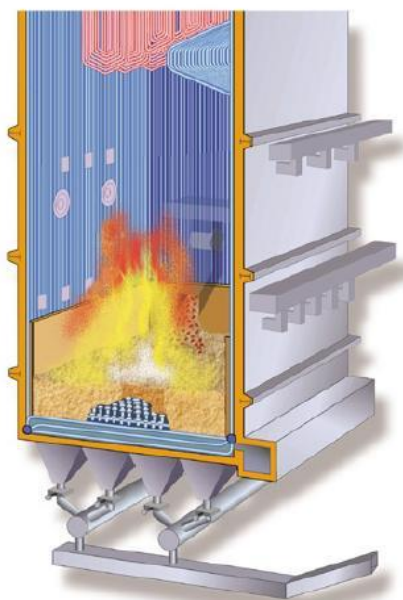
The mobile crane will be loading the raw material for the wood chips production from the timber storage and placing it into the receiving unit which transports the timbers to the wood chipper. The chipping and supply line will be designed to chip 30 t/h so that the preparation could be carried out during one shift (8 h x 30 = 240 t, daily amount of reserve required) or two shifts when the wood chip storage has to be filled for the weekend. The logs go through the metal detector which protects the chipping machinery. After the 250kW wood chipper, there is a sieving machine, a separator for metal removal and transport equipment which can transport wood chips into the fuel tank or to the automatic storage.

#### **A.1.2.3. Boiler unit**

The boiler consists of the main part: combustion chamber and boiler pressure system

#### **Combustion chamber and flue gas system**

The use of fire grate boilers or Bubbling Fluidized Bed (BFB) boiler system is to be used.



**Figure 1. BFB boiler illustration**

The basis for a BFB system is a bed of sand through which air is blown from below. The diameter of silicate sand particles is usually 1 mm whereas the speed of fluidization air varies between 1 and 2.5

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m/s. The heat exchanger through which water vapor flows keeps the layer temperature between 800 and 900 °C. The secondary air enters above the bottom of the combustion chamber through air distribution nozzles. The combustion air is admitted gradually which lowers the emissions of NO<sub>x</sub>.

The combustion technology in the circulating fluidized layer allows the homogeneous conditions for combustion as well as reduce carbon-dioxide and nitrogen-oxide concentration in flue gas. The combustion chamber is covered with concrete fireproof insulation and bricks and is resistant to the temperature during the combustion process. The external surface of the combustion chamber is insulated with mineral wool protected by Al sheet metal. The boiler will be manually ignited for start-up by torches which will ensure the initial biomass ignition and combustion chamber heating until the required operating temperature is attained, fluidized layer starts reacting. The other option is to use the extra light heating oil burner. For this type of burner a 20 m<sup>3</sup> tank, a pump and equipment will be provided.

Upon being exhausted out of the boiler room and preheated with 1.5 bar steam, the primary combustion air will enter the air heater in the flue gas system and then passes under the distribution board. After passing, the air mixes with recirculated flue gases removed from flue gas. Flue gas recirculation is carried out by using a special fan. The secondary air is partially supplied along with fuel and partially after being preheated with steam in heaters situated in the flue gas system into certain secondary and tertiary combustion chamber zones in order to achieve total combustion.

The remains of combustion (ash) fall onto the bottom of the combustion chamber cyclone and flue gas system and are transported into the special tank that should be emptied occasionally.

Hot flue gas delivers the heat to the boiler pressure system and air preheaters through the following passages:

- through the first passage (the combustion chamber) the heat is delivered to the vaporizers and the steam superheater III
- through the second passage the heat is delivered to the steam superheater II and I
- through the second passage the heat is delivered to the preheater of the feed water economizer and the preheaters of the combustion air

The cooled flue gases are exhausted through the flue gas channel to the electrostatic filter which serves for separating the remaining solid particles from the flue gas. In the first part of the filter there is a multicyclone which removes the oversize particles of ash centrifugally and transports them into the ash tank. Afterwards, in the electrostatic part of the filter, particles of fly ash are collected by the electrostatic precipitator. The plates slightly vibrate and the fly ash flows towards the collector at the bottom which transports fly ash into the ash tank. The flue gas cleaning ensures that the value of the emission of particles into the atmosphere be significantly lower than 150 mg/m<sup>3</sup> or 50 m<sub>N</sub><sup>3</sup> (according to the valid regulations).

The exhaust fan is situated after the electrostatic filter which ensures that the flue gas system remains under pressure in order to prevent the flue gas from being released into the facility area. The fan ensures that the flue gas reaches the freestanding steel double stack chimney of 40 m in height and external/internal diameters of 1.5/1.3 m respectively.

## **Boiler**

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Hot flue gases from the combustion chamber deliver the heat to the water-steam medium on the surface exchanger, so called boiler pressure system. After the water from the feed water chamber is pressured by feed pumps into the feed water preheater – economizer for preheating which facilitates the vaporizing, the water is supplied to the boiler drum. The water is heated in the combustion chamber panels and evaporated whereby the mixture of water and saturated steam of the adequate saturation for operating pressure is produced and transferred back to the boiler drum where the steam phase is then separated in the cyclone. The steam is led to the three-stages superheater with the possibility of temperature regulation by injecting feed water into the coolers, so the boiler with nominal operating parameters produces 38 t/h of superheated steam with 92-bar pressure and 505°C of temperature.

The boiler water is completely demineralized and the chemical water preparation unit serves for water supply and loss recovery. Water loss in the system includes secondary vapor loss in the feed water chamber, secondary vapor loss in the desalination expander, blow-downing and turbine draining expander. These losses are estimated at max. 3% of steam flow or 1 m<sup>3</sup>/h. The thermal water treatment serves for heating the supplementary cold water from the chemical water preparation unit and heating of the condensate so that the oxygen and other gasses dissolved in water can be degassed. The high operating parameters of feed water chamber, which also serves as high-pressure feed water heater, are 158°C and 5.8-bar of pressure.

Basic parameters of boiler unit:

|                                                                      |                      |
|----------------------------------------------------------------------|----------------------|
| - Fuel heat power / nominal boiler power                             | 32 / 28,8 MW         |
| - Sufficient amount of wood chips with 35 / 45 / 50 % moisture level | 10 / 12,3 / 16,1 t/h |
| - Sufficient amount of absolutely dry wood chips (ATRO)              | 6,1 t/h              |
| - Feed water pressure                                                | 99 bar               |
| - Feed water temperature                                             | 160 °C               |
| - Fresh steam pressure                                               | 92 bar               |
| - Fresh steam temperature                                            | 505 °C               |
| - Fresh steam flow                                                   | 38 t/h               |
| - Exhaust flue gas temperature                                       | 160 °C               |
| - Exhaust flue gas flow                                              | 18.8 kg/s            |
| - Minimum boiler load                                                | 40%                  |

**A.1.2.4. Turbo generator unit**

In the steam turbine the 90 bar 500°C fresh steam from the boiler expands until it reaches 0.08 bar condenser pressure delivering kinetic energy to the turbine rotor which runs the electric generator. The steam turbine is a condensing turbine with regulated subtraction for heat requirements when the pressure is at 1.5 bar. When the pressure reaches 9 bar an amount of steam is subtracted for own needs of the unit (preheating and degassing of feed water), whereas at 1.5 bar there is a regulated subtraction for the future heating demands of the economic zone.

The high speed turbine is connected to a 10 kV, 50 Hz generator rated 9.86 MW through a reductor reducing the the velocity to 1500 rpm.

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The unit equipment: rotational speed adjuster and pressure regulator, oil battery with air-cooler, oil system for running executive elements of regulation, equipment for measuring and regulating and control system.

Basic parameters of turbo generator unit:

Single-casing condensing reaction steam turbine with regulated subtraction

|                                                           |         |
|-----------------------------------------------------------|---------|
| - Fresh steam turbine inlet pressure                      | 90 bar  |
| - Fresh steam turbine inlet temperature                   | 500 °C  |
| - Fresh steam flow                                        | 38 t/h  |
| - Subtraction pressure for feed water chamber heating     | 9.5 bar |
| - Subtraction pressure for feed water heating             | 1.5 bar |
| - Steam subtraction for heating needs – cogeneration mode | 23 t/h  |
| - Maximum thermal power of heating – cogeneration model   | 16 MW   |
| - Heating water flow temperature                          | 90 °C   |
| - Heating water return temperature                        | 50 °C   |

Generator is attached to the turbine through epicycling gearing

|                                                         |                         |
|---------------------------------------------------------|-------------------------|
| - Maximum power on clamps condensation mode             | 9.86 MW                 |
| - Maximum power on clamps cogeneration mode – max. heat | 7.79 MW                 |
| - Rotation speed                                        | 1.500 min <sup>-1</sup> |
| - Frequency                                             | 50 Hz                   |
| - Voltage                                               | 10 kV                   |
| - Cooling                                               | water                   |

**A.1.2.5. Condensation unit**

The condensation unit on the turbine exhaust serves for the transformation of the expanded steam back into liquid in order to return it by feed pumps back into the boiler through low-pressure heaters and degassers. The condenser is water-cooled from the closed cooling system with dry cooling tower which releases the heat into the ambient air.

The unit consist of: dry cooling tower, cooling medium circulation pump (water-glycol mixture), condenser, vacuum unit for maintaining vacuum in the condenser, condensate pump and auxiliary equipment.

Air-cooled dry cooling tower is situated next to the engine room and occupies a large space where a number of cooling fans will be installed on an elevated structure for cooling the finned tubes through which a cooling medium will flow in a closed system.

Basic parameter of condensation unit:

|                                                     |         |
|-----------------------------------------------------|---------|
| - Condenser pressure                                | 0.8 bar |
| - Nominal thermal power of condenser                | 19 MW   |
| - Cooling water inlet temperature in closed circuit | 34 °C   |



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- Cooling water outlet temperature in closed circuit 40 °C
- Cooling water maximum pressure 7 bar

There is no adequate watercourse for use on the location, neither is there a possibility of water supplying for the wet cooling tower, which is why a dry air-cooled cooling tower of 73 x 18 m surface area was selected.

- Cooling power 20 MW
- Cooling water inlet temperature 40 °C
- Cooling water outlet temperature 34 °C
- Ambient air project temperature 28 °C

#### **A.1.2.6. Technology equipment specifications**

Listed hereafter is the preliminary list of equipment of the biomass-fueled cogeneration plant to be constructed.

| Ordinal number | Equipment description                                                                                                                                                                                                                                                                                                                                                                                                                                        | Quantity |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>1.</b>      | <b>Fuel system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
| <b>1.1</b>     | <b>Biomass fuel handling</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| 1.1.1          | Protective grating panel: <ul style="list-style-type: none"> <li>- Fuel capacity 100 m<sup>3</sup>/h</li> <li>- Length 3000 mm</li> <li>- Width 1200 mm</li> <li>- Engine 2x0,75 kW</li> <li>- Body material – carbon steel</li> <li>- Panel - carbon steel</li> <li>- Axle – carbon steel</li> <li>- Outlet chute - stainless steel</li> <li>- Rotation detector, inlet aperture size 30 x 70 mm</li> <li>- Grating panel aperture size 50x70 mm</li> </ul> | 1 Piece  |
| 1.1.2          | Magnetic conveyor belt for transporting <ul style="list-style-type: none"> <li>- Fuel capacity 100 m<sup>3</sup>/h</li> <li>- Length 3000 mm</li> <li>- Width 1200 mm</li> <li>- Engine approx. 4,0 kW</li> <li>- Belt material - high-resistance rubber – 1200 EP 500/4-3/1</li> <li>- Body – carbon steel</li> <li>- Drive pulley – stainless steel</li> <li>- Tail pulley – carbon steel</li> <li>- Drive – reversible</li> </ul>                         | 1 Piece  |
| 1.1.3          | Magnetic separator for metal removal from fuel                                                                                                                                                                                                                                                                                                                                                                                                               | 1 Piece  |
| <b>1.2</b>     | <b>Feedstock storage room and transport</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| 1.2.1          | Storage (±0.00 stroke) : <ul style="list-style-type: none"> <li>- Hydraulic pushers 4+4 pcs</li> <li>- Length (pushers) 17.0 m</li> </ul>                                                                                                                                                                                                                                                                                                                    | 1 Set    |

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|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|            | <ul style="list-style-type: none"> <li>- Width (pushers) 1.5 m</li> <li>- Hydraulical cylinder 12 pcs</li> <li>- Cylinder stroke 700 mm</li> <li>- Cylinder diameter 200/90 mm</li> <li>- Hydraulical unit 2 sets with oil tank capacity V= ~600 l, two pump, one per unit, hydraulic motor power ~30 kW</li> <li>- Hydraulic pipeline system</li> <li>- Hydraulics complementary equipment set</li> </ul>                                                                                                                                                                                                                                                                                                                                                                      |          |
| 1.2.2      | <p>Fuel alignment rollers</p> <ul style="list-style-type: none"> <li>- Capacity 200 m<sup>3</sup>/h/unit</li> <li>- Length 4000 mm</li> <li>- Diameter 650 mm</li> <li>- Electric motor power 3x7,5 kW</li> <li>- Material – carbon steel</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3 Pieces |
| 1.2.3      | <p>Chained drag conveyor for fuel transport from belt conveyor to silo for boiler fuel feeding</p> <ul style="list-style-type: none"> <li>- Capacity 100 m<sup>3</sup>/h</li> <li>- Length 28 m</li> <li>- Electric motor power 7,5 kW</li> <li>- Chain material carbon steel M315-A-200</li> <li>- Drag conveyor HD 100</li> <li>- Bottom carbon steel + stainless steel</li> <li>- Sides carbon steel</li> <li>- Throttle Aluminum</li> </ul>                                                                                                                                                                                                                                                                                                                                 | 1 Piece  |
| <b>1.3</b> | <b>Boiler fuel feeding</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| 1.3.1      | <p>Fuel storage silo (biomass)</p> <ul style="list-style-type: none"> <li>- Capacity V= 20 m<sup>3</sup></li> <li>- Length 3800 mm</li> <li>- Width 3000 mm</li> <li>- Height 4600 mm</li> <li>- Bottom material – stainless steel</li> <li>- Jacket material – carbon steel</li> <li>- Carbon steel externally and internally coated for corrosion protection; paint E180/3+Sa2,5</li> <li>Silo equipped with: <ul style="list-style-type: none"> <li>- Service door and safety exit</li> <li>- Service platform with service hatch</li> <li>- Ladder leading to service hatch and ladder leading to top of silo</li> <li>- Steam fire extinguisher</li> <li>- Level indicator</li> <li>- Drag conveyor on silo roof</li> <li>- Silo steel support base</li> </ul> </li> </ul> | 1 Set    |
| 1.3.2      | <p>Screw conveyor for feeding fuel from silo into boiler:</p> <ul style="list-style-type: none"> <li>- Capacity/2 screws 4-40 m<sup>3</sup>/h</li> <li>- Length 5000 mm</li> <li>- Diameter 500 mm</li> <li>- Electric motor power 4x7,5 kW</li> <li>- Frequency converter</li> <li>- Rev 1,4-14 o/min</li> <li>- Intake end material – stainless steel</li> <li>- Screw material – stainless steel</li> <li>- Axle material – stainless steel</li> <li>- Rest – carbon steel</li> </ul>                                                                                                                                                                                                                                                                                        | 4 Pieces |
| <b>1.4</b> | <b>Extra light fuel oil system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
|            | <b>Extra light fuel oil system for boiler ignition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |

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|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 1.4.1      | Double-wall underground fuel oil reservoir with tightness control :<br><br><ul style="list-style-type: none"> <li>- Capacity V= 50 m<sup>3</sup></li> <li>- Diameter 2500</li> <li>- Length 10 m</li> </ul>                                                                                                                                                                                                               |         |
| 1.4.2      | Pumping station and pipeline for reservoir fuel injection into burner and recirculation of extra fuel back into reservoir                                                                                                                                                                                                                                                                                                 |         |
| <b>1.5</b> | <b>Fuel combustion system</b>                                                                                                                                                                                                                                                                                                                                                                                             |         |
| 1.5.1      | Boiler grate bottom for fuel combustion in fluidized bed, equipped with water-cooled air membrane with many nozzles for releasing air into combustion chamber and fuel fluidization. Between air nozzles there is open space through which ash falls through funnel into boiler bottom dust collector.                                                                                                                    |         |
| 1.5.2      | Start-up burner (LFO)<br><br><ul style="list-style-type: none"> <li>- Forced draft burner</li> <li>- Fuel consumption 600 kg/h extra-light fuel oil</li> <li>- Equipment includes shut-off valve, irreversible and control valves</li> <li>- Pressure switch, thermometer</li> <li>- Local control panel</li> </ul>                                                                                                       | 1 Piece |
| 1.5.3      | Load burner<br><br><ul style="list-style-type: none"> <li>- Forced draft burner</li> <li>- Fuel consumption 600 kg/h extra-light fuel oil</li> <li>- Equipment includes shut-off valve, irreversible and control valves</li> <li>- Pressure switch, thermometer</li> <li>- Local control panel</li> </ul>                                                                                                                 | 1 Piece |
| <b>1.6</b> | <b>Combustion air system</b>                                                                                                                                                                                                                                                                                                                                                                                              |         |
| 1.6.1      | Primary combustion air fan:<br><br><ul style="list-style-type: none"> <li>- Type : Radial</li> <li>- Air flow : 6,4-7,0 Nm<sup>3</sup>/h</li> <li>- Air temperature 25-40°C</li> <li>- Static pressure : 16,6-14 kPa</li> <li>- Electric motor power : 200 kW</li> <li>- Rev : 3000 o/min</li> <li>- Fan equipped with rotation detector, frequency converter, vibration sensor, motor coil temperature sensor</li> </ul> | 1 Set   |
|            | Secondary combustion air fan:<br><br><ul style="list-style-type: none"> <li>- Type : Radial</li> <li>- Air flow : 8,2-9,4 Nm<sup>3</sup>/h</li> <li>- Air temperature 25-40°C</li> <li>- Static pressure : 5-6 kPa</li> <li>- Electric motor power: 110 kW</li> <li>- Rev : 3000 o/min</li> <li>- Fan equipped with rotation detector, frequency converter, vibration sensor, motor coil temperature sensor</li> </ul>    | 1 Set   |
| 1.6.2      | Pipeline for primary and secondary combustion air distribution, with piping support structure, flanges and other connecting material for execution and attachments of pipes to fans and boiler.                                                                                                                                                                                                                           |         |
| 1.6.3      | Primary and secondary combustion air steam heater.                                                                                                                                                                                                                                                                                                                                                                        |         |
| <b>1.7</b> | <b>Steam generator system</b>                                                                                                                                                                                                                                                                                                                                                                                             |         |

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|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.7.1      | <p>Steam generator of following dimensions :</p> <ul style="list-style-type: none"> <li>- Height 22 m</li> <li>- Depth (Boiler + convection part) 17 m</li> <li>- Width 6 m</li> <li>- Empty boiler weight 130 t</li> <li>- Economizer weight 50 t</li> </ul> <p>Boiler consists of following basic components :</p> <ul style="list-style-type: none"> <li>- Combustion chamber (water-cooled membrane wall, low refraction index, thermally insulated), combustion chamber dimensions: depth 4420 mm, width 4420 mm and height 13400 mm, radiation surface 228 m<sup>2</sup>, membrane wall pipe <math>\varnothing 60.3 \times 5.6</math> mm, pipe inclination 85 mm, pipe material P265GH-TC2</li> <li>- Steam drum with cyclone, dimensions: diameter <math>\varnothing 1500</math> mm, drum wall length 5500 mm, drum wall thickness 48 mm, drum material steel sheet 15NiCuMoNb5-6-4, with two service apertures <math>\varnothing 600</math></li> <li>- Steam superheater, primary, secondary and tertiary<br/>Primary from tube <math>\varnothing 31.8 \times 3.6</math> mm, spacing 114.3 mm, heating surface 296 m<sup>2</sup>, material 16Mo3 or 13CrMo4-5<br/><br/>Secondary from tube <math>\varnothing 31.8 \times 4.5</math> mm, spacing 114.3 mm, heating surface 118 m<sup>2</sup>, material 13CrMo4-5<br/><br/>Tertiary from tube <math>\varnothing 31.8 \times 3.6</math> mm, spacing 170 mm, heating surface 110 m<sup>2</sup>, material 10CrMo9-10<br/><br/>Steam pipeline <math>\varnothing 168.3 \times 14.2/20</math>, material 13crMo4-5</li> <li>- Feed water steam cooler</li> <li>- Vaporizer</li> <li>- Water gauge</li> <li>- Feed water economizer</li> </ul> | 1 Piece  |
| 1.7.2      | Flue gas superheater, installed behind economizer, made of tube $\varnothing 51 \times 3.2$ mm, spacing 80/70 mm, material S235JRG2, heating surface 2x618 m <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2 Pieces |
| 1.7.3      | Pipeline and fitting, made of steam piping connecting steam generator and turbine, steam generator and reduction station, shut-off and safety valves piping fitting, measuring instruments etc., and pipe mounting brackets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 Set    |
| 1.7.4      | <p>Soot blower which serve for soot blowing steam for following:</p> <ul style="list-style-type: none"> <li>- 2 pieces for steam superheater soot blowing</li> <li>- 3 pieces for second passage</li> <li>- 3 pieces for economizer</li> <li>- 4 pieces on flue gas superheater</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 Set    |
| 1.7.5      | <p>Main steam module equipped with following :</p> <ul style="list-style-type: none"> <li>- Start-up valve – 1 piece</li> <li>- Valve for shutting off start-up – 1 piece</li> <li>- Safety valve with adjustment</li> <li>- Steam flow meter</li> <li>- Main boiler steam shut-off valve</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 Set    |
| <b>1.8</b> | <b>Flue gas exhaust system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
| 1.8.1      | <p>Flue gas exhaust fan with following parameters :</p> <ul style="list-style-type: none"> <li>- Type : Radial</li> <li>- Air flow : 20.3 Nm<sup>3</sup>/h</li> <li>- Air temperature 150-170°C</li> <li>- Static pressure : 2.1-2.9 kPa</li> <li>- Electric motor power : 160 kW</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 Set    |

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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|             | <ul style="list-style-type: none"> <li>- Rev : 990 o/min</li> </ul> <p>Fan equipped with rotation detector, frequency converter, vibration sensor, motor coil temperature sensor</p>                                                                                                                                                                                                                                                             |       |
| 1.8.2       | <p>Flue gas recirculation fan with following parameters :</p> <ul style="list-style-type: none"> <li>- Type : Radial</li> <li>- Air flow : 3.8 Nm<sup>3</sup>/h</li> <li>- Air temperature: 150-170°C</li> <li>- Static pressure : 1.53-1.68 kPa</li> <li>- Electric motor power : 160 kW</li> <li>- Rev : 990 o/min</li> </ul> <p>Fan equipped with rotation detector, frequency converter, vibration sensor, motor coil temperature sensor</p> | 1 Set |
| 1.8.3       | Entire pipeline for conveying flue gases with pipe joints, valves, isolation and mounting brackets for installing                                                                                                                                                                                                                                                                                                                                |       |
| <b>1.9</b>  | <b>Flue gas cleaning system</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |       |
| 1.9.1       | Bag filter, set with supporting structure and platforms                                                                                                                                                                                                                                                                                                                                                                                          |       |
| <b>1.10</b> | <b>Ash and sand handling system</b>                                                                                                                                                                                                                                                                                                                                                                                                              |       |
| 1.10.1      | Fly ash handling comprises fly ash screw conveyor from bag filter into tank, 2 valves on second ash passage and fly ash alignment container with capacity V= approx. 10 m <sup>3</sup>                                                                                                                                                                                                                                                           |       |
| 1.10.2      | Sand and ash from the boiler bottom handling comprises bottom funnels for ash collecting (2 pieces), cooled water fly ash conveyor and bottom fly ash alignment container with capacity V= approx. 10 m <sup>3</sup>                                                                                                                                                                                                                             |       |
| 1.10.3      | Sand silo V= 30 m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                   |       |
| <b>1.11</b> | <b>Flue gas stack</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |       |
| 1.11.1      | Flue gas stack; height 30 m internal diameter ø1300 mm, (Corten B or coated)                                                                                                                                                                                                                                                                                                                                                                     |       |
| <b>1.12</b> | <b>Feed water system</b>                                                                                                                                                                                                                                                                                                                                                                                                                         |       |
| 1.12.1      | Feed water pumps module, one for use and one for backup with 100% reserve, equipped with control valve, safety valve and corresponding measurement and regulation equipment.                                                                                                                                                                                                                                                                     |       |
| 1.12.2      | Module with feed water tank with degasser with shut-off valves, actuators, safety equipment and corresponding measurement and regulation equipment and tank mounting structure                                                                                                                                                                                                                                                                   |       |
| 1.12.3      | Feed water pipeline with shut-off valves and corresponding, steam dispersion pipeline and piping mounting structure                                                                                                                                                                                                                                                                                                                              |       |
| 1.12.4      | Low-pressure steam condensate preheater                                                                                                                                                                                                                                                                                                                                                                                                          |       |
| <b>1.13</b> | <b>Drainage and ventilation system</b>                                                                                                                                                                                                                                                                                                                                                                                                           |       |
| 1.13.1      | <p>Blow-down module comprises:</p> <ul style="list-style-type: none"> <li>- Blow-down tank</li> <li>- Safety valves</li> <li>- Blow-down cooler</li> </ul>                                                                                                                                                                                                                                                                                       | 1 Set |



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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|             | <ul style="list-style-type: none"> <li>- Pipeline and corresponding equipment</li> <li>- Piping support</li> <li>- Pipeline insulation</li> </ul>                                                                                                                                                                                                                                                                                                                                                       |       |
| 1.13.2      | <p>Deaeration module comprises:</p> <ul style="list-style-type: none"> <li>- Drainage pipeline</li> <li>- Deaeration pipeline</li> <li>- Safety pipeline (safety valves outlet)</li> <li>- Other corresponding equipment for drainage and deaeration</li> <li>- Mounting structure for piping and equipment</li> <li>- Pipeline and equipment insulation</li> </ul>                                                                                                                                     | 1 Set |
| 1.13.3      | Continuous blow-down module                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1 Set |
| 1.13.4      | Drainage and deaeration pipeline for steam and water deaering with corresponding equipment and insulation                                                                                                                                                                                                                                                                                                                                                                                               | 1 Set |
| 1.13.5      | Continuous blow-down module cooler                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 Set |
| <b>1.14</b> | <b>Main steam system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |
| <b>1.15</b> | <b>Steam turbine and generator system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |
| 1.15.1      | <p>Steam turbine and generator comprises:</p> <ul style="list-style-type: none"> <li>- Condensing steam turbine with controlled extraction</li> <li>- Oil module for turbine lubrication</li> <li>- Oil module for turbine operation control</li> <li>- Water-cooled generator 11 kV 50 Hz, 1250 kVA</li> <li>- Reductor 1500 o/min</li> <li>- Equipment for turbine to generator connection</li> <li>- Corresponding flexible connectors</li> </ul>                                                    | 1 Set |
| 1.15.2      | Closed circuit water cooling module                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |
|             | <p>Comprises :</p> <ul style="list-style-type: none"> <li>- Generator cooling</li> <li>- Turbine lubrication oil cooling</li> <li>- Turbine operation control oil cooling</li> <li>- Sample cooling</li> <li>- Blow-down continuous cooling</li> <li>- Entire pipeline and corresponding fitting for cooling system, piping support structure included</li> </ul>                                                                                                                                       | 1 Set |
| 1.15.3      | Module with turbine drainage tank                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1 Set |
| <b>1.16</b> | <b>Condensation system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |
| 1.16.1      | <p>Condensate from air-cooled condensers :</p> <ul style="list-style-type: none"> <li>- Condensate filter</li> <li>- Condensate tank-part of unit with condensate pumps</li> <li>- 2 condensate pumps with 100% capacity, one for use, one for backup (mounted on condensate module)</li> <li>- Condensate pipeline</li> <li>- Corresponding equipment</li> <li>- Piping support structure</li> <li>- Steam pressure reduction pipeline</li> <li>- Steam pressure reduction piping equipment</li> </ul> | 1 Set |
| 1.16.2      | <p>Vacuum condenser, condensate pipeline and corresponding equipment:</p> <ul style="list-style-type: none"> <li>- Condensate piping set</li> <li>- Auxiliary equipment set</li> <li>- Piping support structure</li> </ul>                                                                                                                                                                                                                                                                              | 1 Set |

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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
|             | - Pipeline insulation                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| <b>1.17</b> | <b>Condensation system – back pressure</b>                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| 1.17.1      | Hot water heat exchanger for outside plant consumers                                                                                                                                                                                                                                                                                                                                                                                                 | 1 Piece |
| 1.17.2      | Condensate pumping system for heat exchanger 2 pumps with 100% capacity one for use, one for backup, installed on condensate pumps module W170, condensate filter                                                                                                                                                                                                                                                                                    | 1 Set   |
| <b>1.18</b> | <b>Hot water heating system for outside plant consumers (outside of cogeneration plant)</b>                                                                                                                                                                                                                                                                                                                                                          |         |
| 1.18.1      | Module with hot water pumps for end consumers (outside of cogeneration plant) with 2 pumps of 100% capacity, for use and one for backup, control valves sets, shut-off valves with flow and energy measurement.                                                                                                                                                                                                                                      | 1 Set   |
| 1.18.2      | System for maintaining constant pressure in hot water system for end consumers which comprises : <ul style="list-style-type: none"> <li>- Expansion vessel, capacity <math>V = 6\text{m}^3</math></li> <li>- Pressure pump for maintaining pressure in system</li> <li>- Chemical dosing</li> </ul>                                                                                                                                                  | 1 Set   |
| 1.18.3      | Hot water piping system for end consumers, including entire pipeline within plant, corresponding fitting for piping and pipe brackets, within delivery limits in cogeneration plant.                                                                                                                                                                                                                                                                 | 1 Set   |
| <b>1.19</b> | <b>Cooling system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| 1.19.1      | Air-cooled condensation system (ACC), ACC steam ejector, steam pipeline from turbine to ACC system                                                                                                                                                                                                                                                                                                                                                   |         |
| 1.19.2      | Closed water cooling system, with air coolers for water cooling and module with circulator pumps in closed water cooling system                                                                                                                                                                                                                                                                                                                      |         |
| <b>1.20</b> | <b>Electrical system</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |         |
| 1.20.1      | Medium-voltage system 11 kV, which comprises : <ul style="list-style-type: none"> <li>- Generator panel (generator switch)</li> <li>- Network panel (network switch)</li> <li>- Terminal cabinet</li> <li>- Stationary transformer</li> </ul>                                                                                                                                                                                                        | 1 Set   |
| 1.20.2      | Transformers : <ul style="list-style-type: none"> <li>- Stationary backup transformer 1600 kVA, wet</li> <li>- Step-up transformer 11kV/35 kV</li> <li>- Reactive power compensation</li> </ul>                                                                                                                                                                                                                                                      |         |
| 1.20.3      | Low-voltage system 400 V which comprises : <ul style="list-style-type: none"> <li>- Low-voltage panel</li> <li>- Frequency converter for :</li> <li>- Fuel screw conveyor</li> <li>- Feed water pump</li> <li>- Flue gas exhaust fan</li> <li>- Air fan for fuel combustion (primary)</li> <li>- Air fan for fuel combustion (secondary)</li> <li>- Flue gas recirculation fan</li> <li>- Hot water circulation pumps</li> <li>- ACC fans</li> </ul> | 1 Set   |
|             | DC system, 110 V which comprises : <ul style="list-style-type: none"> <li>- Charger</li> </ul>                                                                                                                                                                                                                                                                                                                                                       |         |

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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|             | <ul style="list-style-type: none"> <li>- Batteries</li> <li>- DC distribution panel</li> <li>- DC cables</li> <li>- Connection elements</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |
| 1.20.4      | Diesel generator switchgear 160 kVA, in case of emergency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1 Set |
| <b>1.21</b> | <b>Automatic control</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |
| 1.21.1      | <p>Automatic control system METSO DNA CR, cogeneration plant operation BP8 which comprises :</p> <ul style="list-style-type: none"> <li>- Operator workstation with 2 monitors</li> <li>- Trend and Event Archive, DNA history</li> <li>- Reports and trend solution DNA report</li> <li>- Trend with analysis kit DNA tracer</li> <li>- SRS system for BP8 (Himatrix)</li> <li>- Color printer</li> <li>- Distribution I/O panel with :</li> <li>- Turbine control panel</li> <li>- Generator control panel comprising :</li> <li>- Automatic voltage regulator</li> <li>- Synchronization and protection for generator relay panel</li> <li>- Bag filter control panel</li> <li>- Water treatment control panel</li> <li>- Heating, cooling and ventilation control panel</li> <li>- Fire alarm and protection control panel</li> <li>- Storage system and fuel handling control panel</li> </ul> | 1 Set |
| 1.21.2      | <p>Instruments:</p> <ul style="list-style-type: none"> <li>- Transmitters i switches</li> <li>- Local measurement</li> <li>- Measurement flanges</li> <li>- Other measurement equipment</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 Set |
| 1.21.3      | <p>Cables and corresponding mediums for automatics</p> <p>Impulse pipeline</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 Set |
| <b>1.22</b> | <b>Water treatment system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 1.22.1      | Module for boiler feed water treatment with water demineralization system, reverse osmosis and ion exchange water softener                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1 Set |
| 1.22.2      | Water treatment system piping, including raw water within plant and processed water pipeline within plant, as well as corresponding equipment and piping brackets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 Set |
| 1.22.3      | <p>Sampling system for ion exchange water softener including :</p> <ul style="list-style-type: none"> <li>- Sample cooler</li> <li>- Sample tank</li> <li>- Sample lines (pipes)</li> <li>- Sample lines (pipes) corresponding equipment</li> <li>- Sample piping brackets</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1 Set |
| 1.22.4      | <p>Chemical-into-feed-water dosing system which comprises :</p> <ul style="list-style-type: none"> <li>- pH value control unit</li> <li>- Oxygena dosing unit</li> <li>- Dosing pipeline</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 Set |
| <b>1.23</b> | <b>Processed water system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 1.23.1      | Processed demineralized water tank of capacity $V= 60 \text{ m}^3$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 Set |

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|             |                                                                                                 |       |
|-------------|-------------------------------------------------------------------------------------------------|-------|
| 1.23.2      | Module with 2 processed water circulation pumps with 100% capacity, one for use, one for backup | 1 Set |
| <b>1.24</b> | <b>Compressed air system</b>                                                                    |       |
| 1.24.1      | Instrument air compressor, screw compressor with dryer, cooler i compressed air tank            | 2 Set |
| 1.24.2      | Compressed air piping system with corresponding equipment                                       | 1 Set |

#### **A.1.2.7. Power**

Woody biomass cogeneration plant will continuously operate for more than 8000 hours per annum with regular annual repair and a 25-year life span. It is therefore expected that the work will be done in three shifts, with larger part of the activities taking place during the first shift. The plant will be entirely automated and will be capable of working 24 hours without surveillance. Due to the size of the plant, which exceeds 1MW, the plant will obtain a permit granting energy infrastructure and procedures for electricity production, which requires permanently employing highly educated staff.

The following employees will be needed during all three shifts, which requires 4 persons per a particular position:

- 1 ATC engineer (boiler room mechanic, energetics engineer),
- 1 electrician (turbine operator),
- 1 loader

The following employees will be needed during the first shift:

- 1 technical director,
- 1 general administrative clerk,
- 1 chemical technologist
- 1 wood technician in charge of biomass weighing, sampling and analyzing, and storage monitoring,
- 2 port crane workers,
- 1 worker in charge of the facility for biomass attrition, ash containers, etc.
- 1 safety worker.

In total 20 permanently employed workers will be needed at the site. At least three workers will be present during any shift, and ten during the first shift.

#### **A.1.2.8. Required energy-generating products**

In compliance with the presupposed 8,000 working hours per year, it is estimated that the amounts of the required energy-generating products will be as following:

##### ***Fuel***

- Uncontaminated woody biomass in different forms (firewood, logs, ore wood, timber) or wood chips or wood waste from the wood industry (with the average moisture of 35% and the lower heating value of 3.2 kWh/kg) – 80,000 t
- Diesel fuel for loader drive – 30 m<sup>3</sup>

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- Diesel fuel for diesel aggregates (the use is expected only in emergency situations when the power grid or the generator for the electrical energy needed for shutting down the plant and system testing fail) – 2 m<sup>3</sup>

***Electrical energy***

- Electrical energy for the own needs of the plant will be supplied from the power plant itself – 7,900 MWh

***Water***

All needs of the plant (except for the drinking water) are covered by the well water on the site in the amount of 1.5 m<sup>3</sup>/h – 12,000 m<sup>3</sup> per year. The well water (from the well drilled on the site) will be used in following ways:

- Technological demineralized plant water for loss recovery in the entire steam-water system amounts to the maximum of 3% of jacket water (about 1 m<sup>3</sup>/h) – 8,000 m<sup>3</sup>.
- Water for combustion chamber slag ash cooling – 1,000 m<sup>3</sup>
- Hydrant network water for firefighting system. There will be a concrete container with the autonomous aggregate of the volume of – 120 m<sup>3</sup>.

The scheduled Activity is planned to be connected to the public water system of the village of Babina Greda. Until the planned water network is constructed, the drinking water will be provided via water machines.

***Heating and air-conditioning***

The heating of the closed parts of the facilities will be ensured through the heat from the biomass combustion production process. The personnel areas (control room, offices, lavatory, dressing rooms, etc.) will be conditioned if necessary by air conditioners with split-system.

***Compressed air***

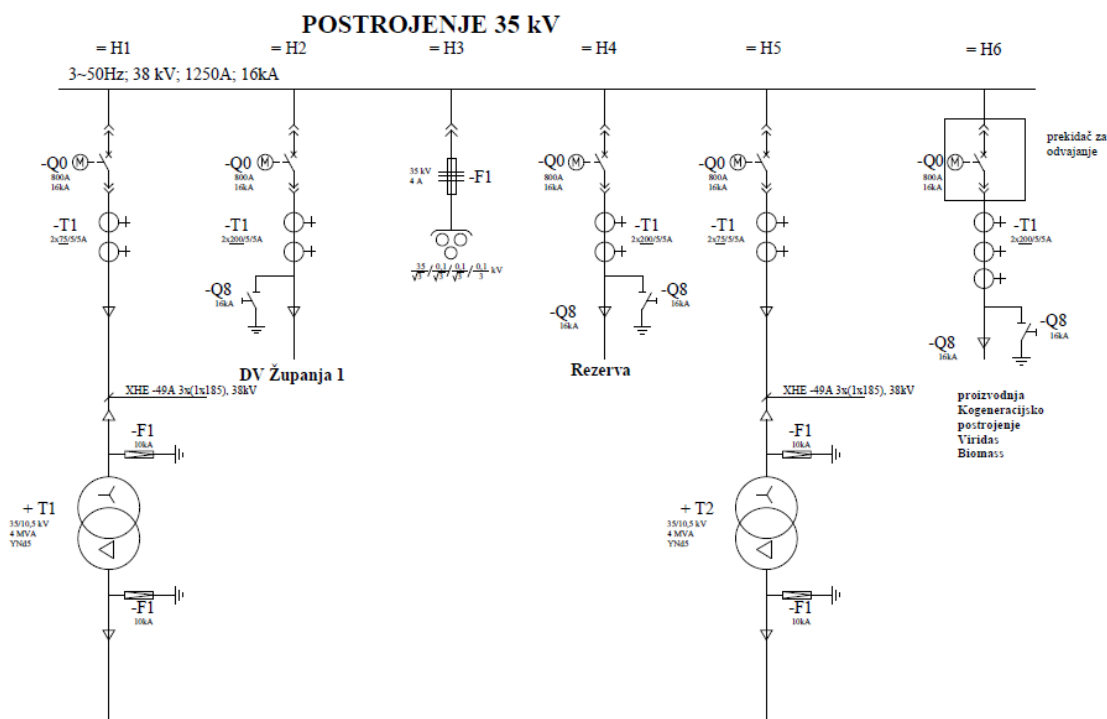
Needs of certain plant systems (boiler's exchange surface cleaning system, instrumentation air, desalination and blow-downing systems, etc.) will be met by integrating an installation of 8 bar compressed air connected to the compressor station (with two compressors) placed in the boiler room.

**A.1.2.9. Plant connection to the electrical grid**

In order to connect biomass cogeneration plant to the electrical grid the "Optimum technical solution of the connection to the electrical grid - 'Viridis Biomass (9500 kW)' cogeneration plant study report" is compiled. According to the report, the cogeneration plant should be connected to the nearest adequate substation. The nearest substation is in the village Babina Greda and it has the designation TS 35/10 kV Babina Greda. If necessary, it will be upgraded.

Approximate layout of the connection of the cogeneration plant to the electrical grid is shown in the **figure 2**.





**Figure 2. Layout of the connection of the cogeneration plant to the electrical grid**

## **B LIST OF ENVIRONMENTAL IMPACT INDICATORS**

The procedure of assessment or evaluation of the environmental impact of the activities is stipulated in the Environmental Protection Act (Official Gazette no. 110/07) and in the Regulation on environmental impact assessment (Official Gazette no. 64/08, 67/09). The constituent part of the Regulation are the Annexes with lists of the activities which require obligatory environmental impact assessment, the activities which are to be evaluated whether the environmental impact assessment is required (the evaluation is conducted by the concerned Ministry of Environmental and Nature Protection and the Ministry of Construction and Physical planning), and the activities which are to be evaluated whether the environmental impact assessment is required (the evaluation is conducted by the concerned governing body in the county, i.e., the city of Zagreb). Since the Activity concerned is not on any of the above mentioned lists (Annexes I, II and III), the procedure of assessment or evaluation of the environmental impact is not required in this case.

The indicators are an efficient way to monitor changes and accomplish goals of sectoral policies or strategies. The propositions of national indicators are compiled in compliance with the indicators of environmental protection as defined by EEA (European Environment Agency) and other relevant

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bodies of the EU (DG Environment, Eurostat), but also in compliance with the demands of the Government of the Republic of Croatia for information necessary for the vindicated planning of the policy for environmental protection and sustainable development. In order for the list of indicators for each environmental determiner be entirely in compliance with the actual situation and the needs to establish a data flow indispensable for indicator calculation, a committee, an expert and advisory body, has been established. On grounds of the elaborated background they have evaluated and recommended each separate indicator. In the outline of the National list of indicators (NLP – Nacionalna lista pokazatelja), the activities concerned and their effects can be associated with following indicators:

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| Environmental component/<br>Sectoral pressure | Indicator title                                                                                                             | Pollution source                                                                  | National standard                                                                                                                                                                                                                                                                                                   | EU standard                                                                                                                                                                                                       |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AIR</b>                                    | KZ 13 Nitrogen oxide emission - NO <sub>x</sub><br><br>KZ 15 Particle emission<br><br>KZ 17 – Carbon monoxide emission - CO | Furnace nozzle                                                                    | Air Protection Act (Official Gazette no. 178/04, 60/08)<br><br>Ordinance on Monitoring Pollutant Emissions from Stationary Sources into the Air (Official Gazette no. 01/06)<br><br>The Regulation on Limit Values of Pollutant Emissions From Stationary Sources into the Air (Official Gazette no. 21/07, 150/08) | Directive 2008/50/EC on ambient air quality and cleaner air for Europe<br><br>Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants |
| <b>WASTE WATER</b>                            | RO/PI 8 Waste water outlet and/or transfer                                                                                  | Polluted stormwater runoff from asphalt surfaces<br><br>Technological waste water | The Water Act (Official Gazette no. 153/09)<br><br>Regulation on limit values of hazardous and other substances in waste water (Official Gazette no. 94/08)                                                                                                                                                         | EU Water framework directive 2000/60/EZ<br><br>Council directive 91/271/EEZ concerning urban waste water treatment                                                                                                |

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| Environmental component/<br>Sectoral pressure | Indicator title                                                                                                                                                                                                                                        | Pollution source                                                          | National standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EU standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WASTE</b>                                  | <p>GO 2 Amount of hazardous waste produced</p> <p>GO 3 Amount of packaging waste produced</p> <p>GO 4 Amount of electronic waste produced</p> <p>GO 7 Amount of waste oil produced</p> <p>GO 9 Amount of waste batteries and accumulators produced</p> | waste produced during the standard operating and maintaining of the plant | <p>Waste Act (Official Gazette, no. 178/04, 111/06, 60/08, 87/09)</p> <p>Ordinance on waste management (Official Gazette no. 23/07, 111/07)</p> <p>Ordinance on Environmental Pollution Register (Official Gazette no. 35/08)</p> <p>The Waste Management Plan in the Republic of Croatia for the period 2007 - 2015 (Official Gazette no. 85/07, 126/10)</p> <p>Ordinance on packaging and packaging waste (Official Gazette no. 97/05, 115/05, 81/08, 31/09, 156/09, 38/10, 10/11)</p> <p>Ordinance on the management of waste electrical and electronic equipment and devices (Official Gazette no. 74/07, 133/08, 31/09, 156/09)</p> <p>Ordinance on the management of waste batteries and accumulators (Official Gazette no. 133/06, 31/09, 156/09)</p> | <p>Directive 2150/2002 on waste statistics and its amendments and addendums (574/2004, 783/2005, 227/2009, 849/2010)</p> <p>Law on the confirmation of Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Official Gazette no.-MU 3/94)</p> <p>Directive 94/62/EC packaging and packaging waste and its amendments and addendums (2004/12/EC and 2005/20/EC)</p> <p>Ordinance 2150/2002 on waste statistics and its amendments and addendums (574/2004, 783/2005, 227/2009, 849/2010)</p> <p>Directive 2002/96/EC on waste electrical and electronic equipment and its amendments and addendums (2003/108 EC, 2008/34 EC, 2008/112 EC)</p> <p>Directive 75/439/EC on the disposal of waste oils and its amendments and addendums (1987/101/EEC, 91/692/EEC, 2000/76/EC, 2008/98/EC)</p> <p>Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and its amendments and addendums (2008/12/EC, 2008/103/EC)</p> |

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| Environmental component/<br>Sectoral pressure | Indicator title                                                                                                                   | Pollution source | National standard                                                                                                                                 | EU standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENERGETICS</b>                             | <p>E 5 Electrical power production (amount, index)</p> <p>E 6 Thermal power plant and cogeneration plant fuel (amount, index)</p> | -                | <p>Law on Energy (Official Gazette no. 68/01, 177/04, 76/07, 152/08, 127/10)</p> <p>Regulation on energy balance (Official Gazette no. 33/03)</p> | <p>Ordinance (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics</p> <p>Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and its amendments and addendums, followed by the Directive annulment 2001/77/EC i 2003/30/EC</p> <p>Directive 2006/32/EC of the European Parliament and of the council on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC</p> |

## **C FINDINGS ABOUT ENVIRONMENTAL IMPACT**

### **C.1. IMPACT ON THE ENVIROMENTAL COMPONENTS**

#### **C.1.1. SOIL IMPACT**

Construction of the cogeneration plant is planned within the “Tečine” work zone in accordance with the spatial development plan of the Municipality of Babina Greda. According to the habitat map (**map 4**) at the moment the concerned area is used for agricultural purposes.

According to the regulations of the spatial development plan of the Municipality of Babina Greda, the concerned area is scheduled to be transformed into a work zone; therefore, the irrecoverable loss of the agricultural land is planned.

#### **During construction**

During the construction of the cogeneration plant soil may be polluted in the case of the disposal of the excess excavation material on the parcel that is not intended for it.

The impact of dust on soil due to long-term sedimentation in the immediate proximity of the Activity area is negligible; moreover, it is not harmful. The total dust sediment that may occur in the Activity area, i.e., in the contact area, will not have a significant effect on the soil quality.

It is possible to negatively affect the soil due to an increased amount of waste and its improper management. It is also possible that fuel and/or lubricant spill from the construction equipment and absorb into soil.

The above mentioned negative impacts are considered negligible, because their probability is limited by the duration of the works. Furthermore, with proper organization of the construction they may be reduced to minimum.

#### **During operation**

Negative impacts on soil are not expected during the regular operation of the cogeneration plant. Negative impacts may occur only in cases of accidents (such as fire, etc.).



### C.1.2. AIR IMPACT

#### During construction

During the construction **air pollution** is expected due to the flue gas from the equipment which will be used at the site and increased amounts of dust which will be released into the atmosphere during the construction works, truck and working machine running, etc.

Dust incurs during the works of transport vehicles, such as loading and transport and on the work surfaces. The amount of dust from the mentioned sources depends on different factors:

- in the case of transport vehicles on the construction site and the access road, it depends on the condition of the surface, velocity and load, as well as the state of tires on the vehicles
- atmospheric conditions, primarily humidity and wind speed

This negative impact will be minimal due to the limited duration and intensity of the works.

#### During operation

During the operation of the planned cogeneration plant, emissions of the polluting matter into the air (incurring from the firing equipment) are expected. The new cogeneration plant will be equipped with the state of the art flue gas cleaning device which will ensure that the emissions into the environment be low beneath the amount allowed by the regulations of the Republic of Croatia.

Regulation on limit values for pollutant emissions from stationary sources into the air (Official Gazette no. 21/07, 150/08) defines the allowed limit values for emissions which must not be exceeded. They apply to normative conditions (0°C temperature and 1013 mbar pressure, dry flue gases, volume content of oxygen of 11%). According to the article 111, paragraph 2 of the Ordinance on medium sized woody biomass-fired firing equipment, limit values for emissions are:

- |                                                |                       |
|------------------------------------------------|-----------------------|
| - Dust:                                        | 150 mg/m <sup>3</sup> |
| - Carbon monoxide (CO):                        | 500 mg/m <sup>3</sup> |
| - Nitrogen oxides expressed as NO <sub>2</sub> | 300 mg/m <sup>3</sup> |

According to the article 123 of the Ordinance, emission of pollutants in waste gases from the medium sized firing equipment is determined through occasional measuring, at least once a year.

Dust particles are the primary pollution in flue gases during the biomass firing. Since the concerned plant will be equipped with the adequate filters – multicyclone and electrostatic filter, which significantly decrease the amount of dust particles, it is assumed that **during the operation the Activity will not have negative impact on air quality.**

### C.1.3. WATER IMPACT

The **map 3** shows that the eastern border of the “Tečine” work zone location is placed along the existing watercourse (channel) Saonica.

#### During construction

The impact on ground and surface waters in the contact and wider area of the Activity can incur due to:

- refueling the transport vehicles, i.e., required repairs in the area of possible drainage, where it is not possible to conduct the dry cleaning process
- spilling of the fuel and/or lubricant for the machines and vehicles and their leakage into the subsoil

During the construction of the cogeneration plant there is a possibility of a negative impact on the Saonica channel on the eastern border of the industrial zone. The negative impact may arise due to the following operations:

- disposal of the construction and other materials (soil, other waste) into the bed of the channel
- damage of the bed of the channel due to heavy mechanization

An improper organization of the construction site may cause:

- interruption of the functional flow of the channel
- disturbance of the channel water regime
- channel plugging

If the construction site is organized properly and in compliance with the legislative regulation on environmental protection **there will be no negative impact on water environment** during the construction of the cogenerate plant.

#### During operation

Waste waters which occur during the operation of the activities are the following:

- polluted stormwater (conditionally clean and potentially oily because of the highways),
- technological waste waters (blow-downing and desalination of the boiler, and waste waters out of the chemical conditioning of boiler feed water)
- sanitary waste waters (from the lavatories)

Conditionally clean stormwater runs off the all asphalt surfaces over the settling beds and oil separators into the Saonica watercourse which is on the eastern border of the site.

Waste waters from the blow-downing and desalination of the boiler, and chemical conditioning of boiler feed water up to total of 1.5 m<sup>3</sup>/h (36 m<sup>3</sup>/day) require no other processing than cooling. After the cooling in the blow-down pit they are released into the Saonica watercourse.

Since the waste waters are released into a natural environment before the plant begins to operate, it is required to obtain a Water Right Permit, which is also stipulated by the Water Right Conditions (class: AP/I-325-01/12-07/1131, reg. no.: 374-3101-1-12-5) published by the “Hrvatske Vode” (Croatian public sector organization which deals with the management of Croatian water sources),

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The Water Management Department for the Sava River Basin District in Zagreb on 02/04/2012. Upon obtaining the use permit the investor is obliged to obtain the Water Right Permit, which will stipulate the maximum allowed amount of pollutants and the periodical control of the waste water quality in compliance with the existing regulations.

In order to collect sanitary waste waters, a waterproof collecting tank will be constructed, and the collected waste water will be periodically disposed of via an authorized legal person.

Under every oil and fuel tank a bund of adequate volume will be constructed and it will be emptied after any possible incident by special vehicles and the waste will be disposed of in accordance with the existing regulations.

After the planned public sewer network is constructed near the concerned Activity location, the activities will be permanently connected to the future network, in compliance with the conditions of the connection which will be subsequently published.

In conclusion, with the proper functioning of the cogeneration plant, which includes controlled collection of waste waters and their cleaning, **with an appropriate maintenance and application of the environmental protection measures there will be no negative impacts** on the ground and surface waters.

#### **C.1.4. WILDLIFE IMPACT, NATURAL PROTECTED AREAS**

##### **Natural protected areas**

In the wider area surrounding the planned cogeneration plant site there are neither existing nor planned areas/localities of protected natural values in compliance with the Nature Protection Act (Official Gazette no. 70/05, 139/08 and 57/11). **Therefore there will be no negative impact in the areas of the protected natural heritage (or areas that are planned to be protected) according to the Nature Protection Act.** Southeastward of the Activity location, about 2.5 km from the location, the area of particularly valuable cultivated landscape is placed, the area of the river Sava.

##### **Habitat map**

###### *Wider Activity area*

According to the national classification of habitats and the map of habitat types (**map 4**), there are following habitat types in the wider Activity area:

- **A.2.2.1., Occasional watercourses** – Watercourses where the course is interrupted during certain periods of the year, leaving the bed dry or leaving water puddles behind.
- **A.2.4.1.2., Channels with permanent course for the surface irrigation** - Permanent streams of anthropogenic origin which are most often built with the purpose of hydro-amelioration of agricultural areas, often with semi-natural plant and animal communities similar to those found near natural watercourses.
- **I.3.1. Intensely ploughed fields in land consolidated areas** – Homogeneous farmland of larger sizes intensely ploughed (multiple soil tillage, fertilization, biocide, etc.) with the

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purpose of mass production of arable annual crops and biennials. A hydro-amelioration network is often present, and it is usually placed along the borders between the parcels.

*Narrow Activity area*

The Activity area, i.e., the biomass cogeneration plant, is placed in the following type of habitat:

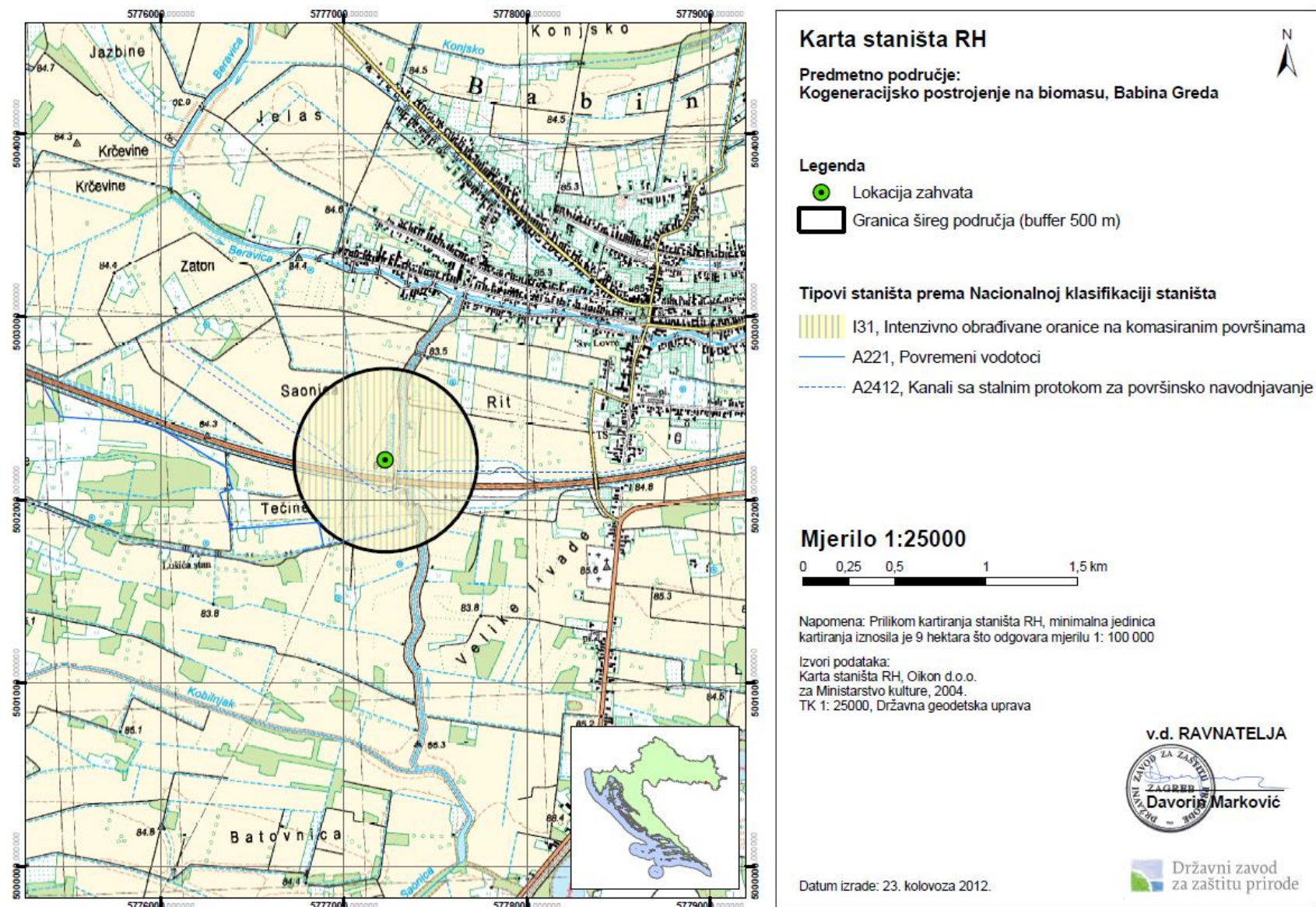
- I.3.1. Intensely ploughed fields in land consolidated areas

The planned biomass cogeneration plant will be in the rural, meliorated area which is, according to the spatial development documents, designated as the area for industrial zone development. The very Activity area is not a ploughed field. Around the Activity site there is ploughed farmland. Along the eastern edge of the parcel there is the Saonica channel.

The biomass cogeneration plant is not in the habitat listed in the Annex II of the Ordinance on the sorts of habitat types, habitat map, endangered and rare species (Official Gazette no. 7/06, 199/09), Endangered and rare species.

With the nature of the Activity taken into consideration, on the site previously defined by the spatial development documents, **there will be no unplanned occupying or converting of the surfaces so it may be concluded that the Activity will not have any impact on the habitat I.3.1. Intensely ploughed fields in land consolidated areas.**

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**Map 4. Habitat map of the wider Activity area (State Institute for Nature Protection, Zagreb, August 2012)**



## Ecological network areas

According to the excerpt from the ecological network map of the Republic of Croatia (**map 5**), the Activity area does not overlap with any ecological network areas. The nearest ecological network areas are 2.5 km away: the ecological network area **HR2000431 Sava – Štitar** (important area for wild species and habitat types) and the ecological network area **HR2001116 Sava** (important area for wild species and habitat types),

### **HR2000431 Sava – Štitar - important area for wild species and habitat types**

Habitat types for which conservation objectives are formulated and they are classified under the 'threatened' category in the ecological network HR2000431 Sava – Štitar are shown in the **table 1**.

**Table 1: Habitat types for which conservation objectives are formulated in the ecological network HR2000431 Sava – Štitar - important area for wild species and habitat types**

| <i>NCS code</i> | <i>NATURA šifra</i> | <i>Habitat type</i>                          |
|-----------------|---------------------|----------------------------------------------|
| C.2.2.          |                     | Wet meadows Central Europe                   |
| E.1.            | 91E0*               | Coastal flooded forests of willow and poplar |

### **Guidelines for applying protected area management HR2000431 Sava – Štitar**

- 100 Conserve water and wetland habitats in the most natural state, and, if necessary, help revitalization
- 101 Ensure a sufficient amount of water in aquatic and wetland habitat that is necessary for the survival of habitats and their important biological species
- 102 Preserve the sufficient physical and chemical properties of the water or improve them, if they are insufficient for survival of habitats and their important biological species
- 103 Maintain a favorable water regime for the conservation of wetlands
- 104 Preserve the favorable composition of the mineral and nutrient matter in the wetland water and soil
- 105 Conserve the diversity of habitats in rivers (unfortified coasts, shoals, rapids, waterfalls, etc.) and a favorable water dynamics (meandering, transfer and disposal of sediment, periodic natural flooding of backwaters, etc)
- 106 Conserve watercourse connection
- 107 Conserve biological species important for habitat type; do not bring foreign (allochthonous) species and genetically modified organisms
- 109 Avoid regulating watercourse and water regime of water and wetland habitats unless it is necessary for the protection of human lives and villages
- 121 Forest management should be conducted according to the principles of forest certification
- 122 During the final felling of the larger forest areas, where it is possible and appropriate, leave smaller uncut areas
- 126 Conserve biological species important for habitat type; do not bring foreign (allochthonous) species and genetically modified organisms
- 129 Afforestation, where the habitat conditions allow it, should be conducted with the indigenous tree species and in a composition which reflects the natural composition, using nature-friendly methods; afforestation of a non-forest area should be conducted only where justified, provided that there are no endangered and rare non-forest habitat types

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**HR2001116 Sava - important area for wild species and habitat types**

Habitat types for which conservation objectives are formulated and they are classified under the 'threatened' category in the ecological network HR2001116 Sava are shown in the **table 2**.

**Table 2: Habitat types for which conservation objectives are formulated in the ecological network HR2001116 Sava – important area for wild species and habitat types**

*Wild species*

| <i>Species name in English</i> | <i>Species name in Latin</i>    |
|--------------------------------|---------------------------------|
| White-finned gudgeon           | <i>Gobio albipinnatus</i>       |
| Souffia                        | <i>Leuciscus souffia</i>        |
| Asp                            | <i>Aspius aspius</i>            |
| European Bitterling            | <i>Rhodeus amarus</i>           |
| Kessler's gudgeon              | <i>Gobio kessleri</i>           |
| Streber                        | <i>Zingel streber</i>           |
| Vimba vimba                    | <i>Vimba vimba</i>              |
| Rutilus pigus                  | <i>Rutilus pigus</i>            |
| Striped ruffe                  | <i>Gymnocephalus schraetzer</i> |
| European crayfish              | <i>Astacus astacus</i>          |
| sabrefish                      | <i>Pelecus cultratus</i>        |
| Danube gudgeon                 | <i>Gobio uranoscopus</i>        |
| Ukrainian brook lamprey        | <i>Eudontomyzon mariae</i>      |
| Danube bleak                   | <i>Chalcalburnus chalcoides</i> |
| Balkan Loach                   | <i>Cobitis elongata</i>         |
| Common zingel                  | <i>Zingel zingel</i>            |
| Cobitis                        | <i>Cobitis elongatoides</i>     |
| <i>Sabanejewia aurata</i>      | <i>Sabanajewia aurata</i>       |

*Habitat types*

| <i>NCS code</i> | <i>NATURA code</i> | <i>Habitat type</i>                                                     |
|-----------------|--------------------|-------------------------------------------------------------------------|
| A.2.7.1.1.      |                    | Bare gravelly riverbanks (shoals)                                       |
|                 | 3150               | Natural eutrophic lakes with Hydrocharition or Magnopotamion vegetation |
| E.1.            | 91E0*              | Coastal flooded forests of willow and poplar                            |

**Guidelines for applying protected area management HR2001116 Sava**

- 5 Conduct carefully the regulation of watercourses
- 10 Ensure cleaning of the waste waters
- 100 Conserve water and wetland habitats in the most natural state, and, if necessary, help revitalization
- 101 Ensure a sufficient amount of water in aquatic and wetland habitat that is necessary for the survival of habitats and their important biological species
- 102 Preserve the sufficient physical and chemical properties of the water or improve them, if they are insufficient for survival of habitats and their important biological species
- 103 Maintain a favorable water regime for the conservation of wetlands
- 104 Preserve the favorable composition of the mineral and nutrient matter in the wetland water and soil
- 105 Conserve the diversity of habitats in rivers (unfortified coasts, shoals, rapids, waterfalls, etc.) and a favorable water dynamics (meandering, transfer and disposal of sediment, periodic natural flooding of backwaters, etc)

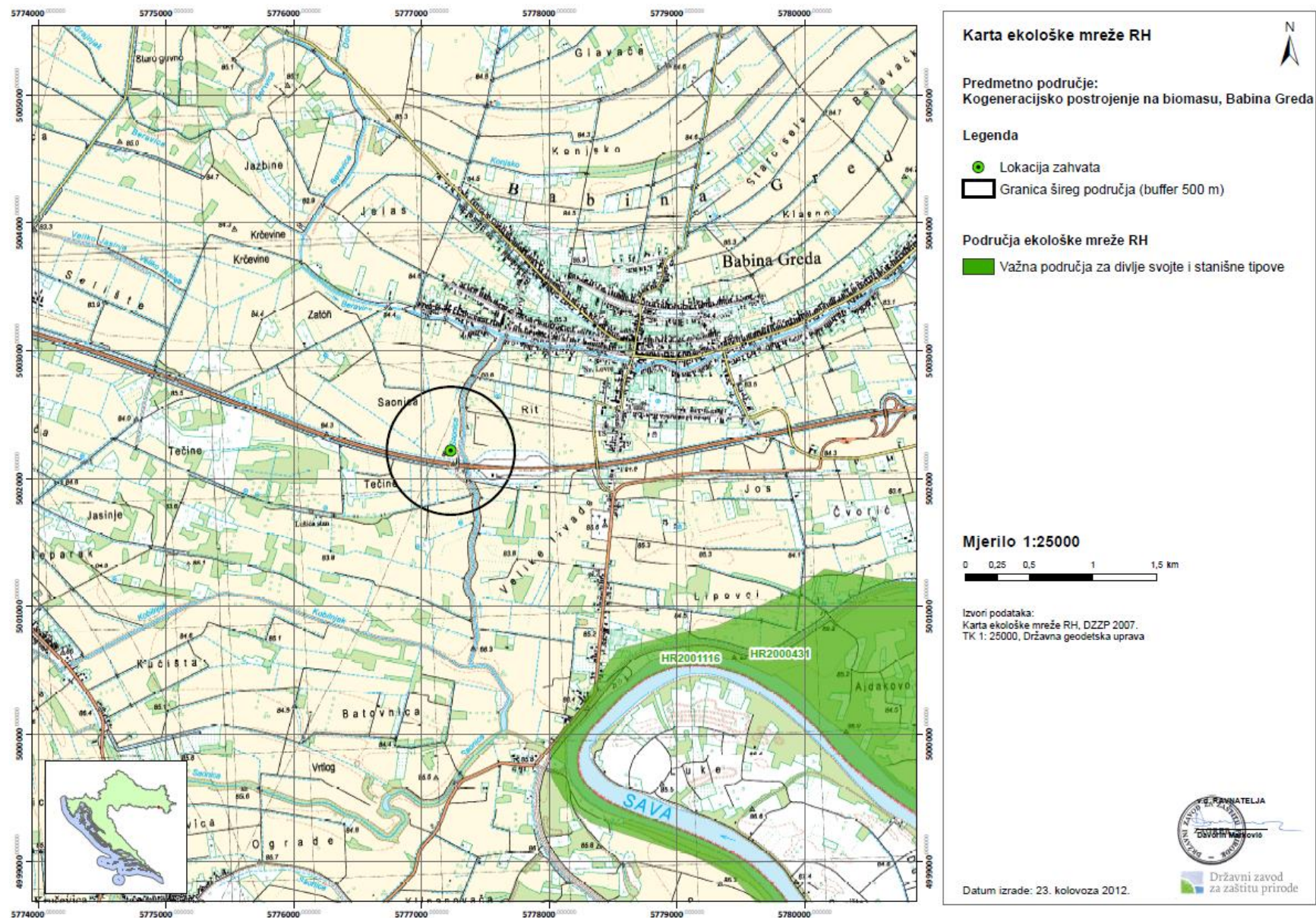


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- 106 Conserve watercourse connection
- 107 Conserve biological species important for habitat type; do not bring foreign (allochthonous) species and genetically modified organisms
- 109 Avoid regulating watercourse and water regime of water and wetland habitats unless it is necessary for the protection of human lives and villages
- 110 When managing harmful effects of water, prioritize using natural retention containers and watercourses as places to retain flood waters, i.e., to drain them.
- 111 Gravel extraction has to be performed on the elevated river terraces or in the inactive flooded area. Gravel extraction has to be avoided in the active river beds and floodplains.
- 112 Do not use sediments from river shoals.

Species for which conservation objectives are formulated that prevail in the above-mentioned ecological networks are the species which are, through their way of living and feeding, tied to water habitats, i.e., habitat types are tied to watercourses. Due to the location of the concerned Activity, the cogeneration plant, which is located outside the concerned areas of the ecological network and on sufficient distance from the mentioned areas, and due to the very nature of the Activity, it is considered that **there will be no negative impact on the totality of the concerned areas of the ecological network and on the species for which conservation objectives are formulated in the areas.**

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**Map 5. Ecological network map of the wider Activity area (State Institute for Nature Protection, Zagreb, August 2012)**

## C.2. ENVIRONMENTAL IMPACT LOAD

### C.2.1. IMPACT OF NOISE

#### During construction

##### Noise sources

**Regular construction activities** will be performed at the construction site, and the inevitably produced noise will be the result of the heavy construction machines and equipment operation (loader, dredge, crane, compressor, etc.), which is the part of the everyday process. Since the larger part of those noise sources are mobile, their positions change. The noise produced by the construction machine and truck engines depends on the engine condition and maintenance, vehicle load and the type of surface where the machines and/or trucks move.

The intensity of the noise in totality will vary during the day depending on the construction progress; however, **the duration of the construction works is limited**. The Activity site is about 800 m away from the residential area of the village of Babina Greda; therefore, it is considered that there will be no greater impact of noise on the residents.

##### Allowed noise levels

The highest allowed external noise levels that incur as a result of construction works are determined in the Article 17 of Regulation of the highest allowed noise levels in working and living environment (Official Gazette No. 145/04):

- The allowed equivalent noise level during daytime is 65 dB(A). From 8am to 6pm it is allowed to exceed the allowed level for additional 5 dB.

During the nighttime construction works, the equivalent noise level must not exceed 40 dB according to the Regulation of the highest allowed noise levels in working and living environment (Official Gazette No. 145/04).

In case when the technological process demands it, it is exceptionally allowed to exceed the allowed noise levels for 10dB during nighttime (up to one night, i.e., two days in a row within the period of 30 days). In the case of exceptional transgression of the allowed levels, the developer is obliged to notify in writing the sanitary inspection and make a note of the transgression in the construction diary.

#### During operation

During the regular plant operation the main noise sources are:

- preparation – biomass chipping (located within the facility),
- fans for suction of the outdoor air and boiler room exhaust (they are placed in the boiler room, where noise silencers are to be placed),
- fans for suction of outdoor air and engine room exhaust (they are placed in the engine room, where noise silencers are to be placed),
- exhaust fans for exhaust gas (placed in the engine room building),
- steam turbine (placed in the engine room),

- cooling tower (placed in the southern part of the site, near the highway).

The pieces of equipment which produce most noise (biomass chipper, steam turbine, fans) will be placed in closed areas (biomass preparation facilities, boiler rooms, engine rooms) which are not working areas, i.e., people spend only limited time in those facilities, during which they have to use personal protective equipment. Therefore the plant noise will not have an impermissible impact on the environment and people's health.

During the projection of the facility and the selection of the main equipment, the possibly produced noise level will be taken into consideration. Noise emission from the closed areas will be lowered through adequate construction solutions of the facility (walls, roofs) and the apertures (ventilation apertures, windows, doors).

In accordance with Regulation of the highest allowed noise levels in working and living environment (Official Gazette No. 145/04), the noise on the border of the construction parcel within the economic zone must not exceed 80 dB(A), i.e., on the border of the economic zone the noise level must not exceed the allowed noise levels of the zone it borders with.

Occasional noise source will be steam blowing from the safety vents in an incidental condition of the plant, which is why it is planned to install a noise silencer on the exhaust.

Noise level may also be amplified due to the increased traffic on the site and along the highways which will be used for transportation of the raw material. Through regular servicing and maintenance of the vehicles it is possible to avoid excessive impact on noise amplification from the increased traffic on the site.

With correct operation of the cogeneration plant and the application of all the noise protection measures, the negative impact from the amplified noise levels is not expected during the cogeneration plant operation considering the fact that all the noise producing equipment will be placed in closed facilities. It is also important to emphasize that the nearest residential area is 800m away from the plant.

There are exceptional situations when noise levels are not limited by law. The Article 2 of the Noise Protection Act (Official Gazette, no. 30/09) stipulates that the provisions of the Law are not applied to the noise produced during the elimination of the effects caused by natural disasters and other extraordinary events or circumstances that can cause greater material damage, jeopardize people's health and disturb human environment in greater extent.

### C.2.2. TRAFFIC IMPACT

#### During construction

A significant **traffic impact** is expected during construction due to:

- increased frequency of external transport of materials and technology; furthermore, a possible accidental damaging of public highways is expected
- **increased circulation** of trucks, dredges, bulldozers, etc. which will slow down the traffic; furthermore, there may be danger of material (gravel, earth, etc.) falling out of the vehicles, which may aggravate road conditions.

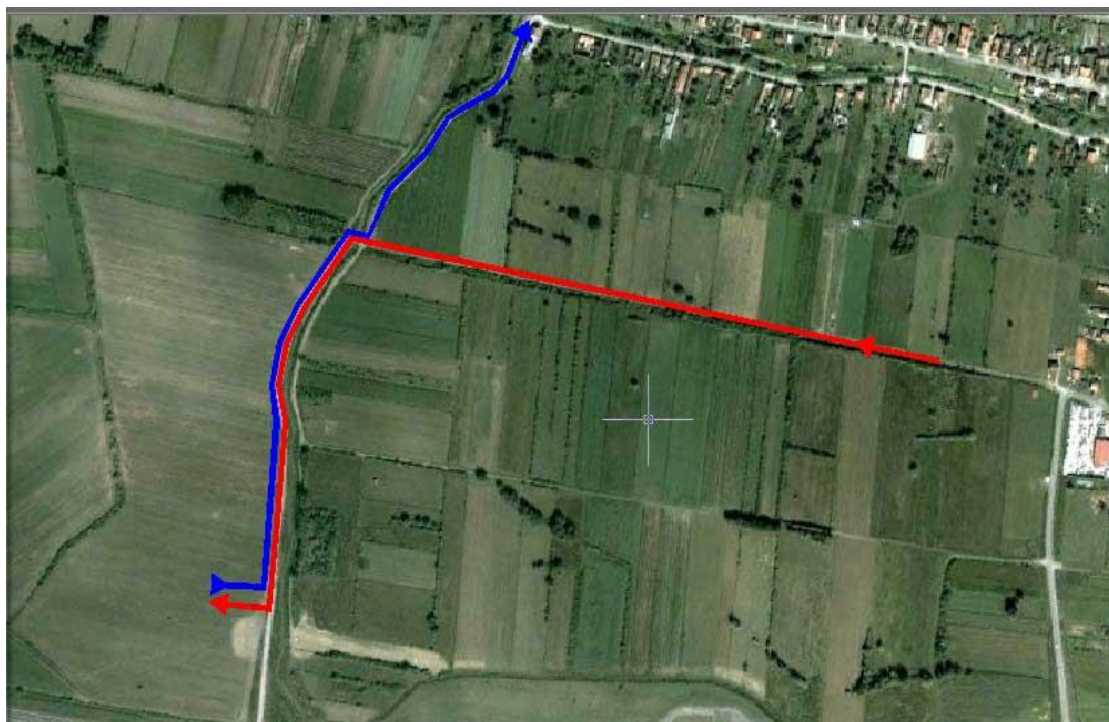


**During operation**

Trucks which deliver the fuel (forest biomass) for cogeneration plant operation will be constantly driving on the Activity site. It is estimated that the plant will require about 80,000t of wood chips per year, which means the maximum transit will be 8,000 truck rides per year (the wood chips of the required raw material has the lowest density).

The raw material (wood chips) will be supplied to the site by the dedicated trucks with capacity up to 5t, with trailers with capacity up to 5t. 8,000 truckloads of wood chips will be required per year. The wood chips will be supplied on daily basis with 20-30 rides per day. Trucks will be unloaded during the first two shifts. The passing of two trucks (or a truck and another vehicle) is possible on the access road.

When they are arriving to or leaving from the site, the trucks will use the local roads in one direction only, so the traffic load will be significantly decreased, which is shown in the following **Figure 3**.



**Figure 3. Demonstration of traffic solution for the truck arrival and departure from the cogeneration plant site, demonstrated on the orthophotograph (source: [www.arkod.hr](http://www.arkod.hr))**

Special traffic regulation rules on the access roads taken into consideration, a negative impact on traffic is inevitable; however it has been assessed as moderately negative and within acceptable limits for the zone of the Activity in question. That means that, during the regular operation, the traffic (in and from cogeneration plant) will not affect the normal traffic functioning in the Activity area and all traffic will be planned in advance. Negative traffic impact, incurring from the cogeneration plant operation, is possible only in cases of accidents when there can be vehicle rollover, crashes, traffic congestion and other accidents that may disturb normal traffic functioning.

### C.2.3. WASTE MANAGEMENT

#### During construction

During the construction of the cogeneration plant various types of **hazardous** (waste oil, oily shreds, oily plastic and metal packaging, etc.) **non-hazardous** (paper, glass packaging, PET packaging, etc.) and **construction waste** (earth, bitumen mix, wooden pallets, plastic film, paper and cardboard packaging, metal packaging, etc.) will be produced as by-products of construction. All waste is to be collected separately in places determined by the construction management and disposed of in cooperation with authorized specialized waste management companies.

According to the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (Official Gazette No. 50/05 and 39/09), the types of waste which will be produced during construction can be classified as the **following waste groups**:

- 13 02 gear wheel and engine lubricating oil waste
- 15 01 packaging (including separately collected packaging from communal waste)
- 15 02 absorbents, filter materials, absorption cloths and materials and protective clothing
- 17 02 wood, glass and plastic
- 17 03 bitumen mix, coal tar and products containing tar
- 17 05 dirt (including the dirt dug out of the polluted locations), rocks and dirt from excavating
- 17 09 other construction and demolition waste
- 20 01 separately collected components (aside from 15 01)
- 20 03 other communal waste.

Through correct construction site management, all potentially unfavorable impacts, primarily concerning the **inadequate disposal of construction, communal, non-hazardous and hazardous waste** will be reduced to **minimum**.

The final disposal of the waste will be done through cooperation with authorized specialized waste management companies, in accordance with the provisions on waste management.

#### During operation

The waste incurring from regular plant operation and maintenance will be disposed of in accordance with the Waste Act (Official gazette no. 178/04 111/06, 60/08 and 87/09) and the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (Official Gazette No. 50/05 and 39/09), for which authorized companies will be contracted.

In the Activity area, as a result of the plant operation, the following waste will be produced:

#### **Ash**

In the cogeneration plant process the waste is produced as a result of woody biomass combustion in the form of ash: incombustible residues and partially combusted biomass particles (with the ash amount less than 10 %). Total expected amount is about 1,000t per year, and it depends on the biomass characteristics (type of wood, bark proportion, etc.).

Ash is extracted from the process in the following places shown on the plant technological layout:

- ash sediment at the bottom of the combustion chamber grate (first passage of flue gas) and flue gas convective channels (second and third passage)
- ash extracted from the current of flue gas in the first part of the filter – multicyclone,



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- ash extracted from the current of flue gas in the electrostatic filter.

The ash extracted from the flue gas convective channels and from the multicyclone is taken into the adequate ash container using chain conveyor. The container is, after it has been filled, loaded into a truck and disposed of. According to the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (Official Gazette No. 50/05 and 39/09), this ash is classified as 10 01 01 – ash from the combustion chamber grate, sediment and dust from the boiler; therefore it can be disposed of at a communal depot and it is recommended for processing.

The ash from the electrostatic filter is taken into other closed ash containers which are, after they have been filled, loaded into a truck and disposed of. According to the Regulation, this ash is classified as 10 01 03 – fly ash produced from the peat and untreated wood combustion; it can also be disposed of at a communal depot. Before disposal the ash has to be conditioned, or pre-processed, i.e., the waste has to be prepared for easier handling (solidification).

The alternative is to use ash as a supplement in cement production or fertilizer production. In the beginning stage the ash will be taken away and disposed of through an authorized company, and later on, depending on the potential interests and ash qualities, its material features may be used for cement or fertilizer production.

***Waste from the technological process***

The sand from the combustion chamber grate, classified as 10 01 24, in the amount of about 1,000t, depending on the fuel quality, will be disposed of at a non-hazardous waste landfill.

***Occasional waste***

Waste made as a result of plant maintenance and overhaul will not be stored, but collected and passed on to an authorized collector which will dispose of the waste in a suitable way:

- Gear wheel and engine lubricants and oils (hazardous waste 13 02 08\*),
- Packaging polluted by hazardous substances (non-hazardous waste 15 01 10\*),
- Oil filters (hazardous waste 16 01 07\*),
- Sludge from the waste water separators (13 05 02),
- Paper and cardboard packaging (15 01 01),
- Electronic equipment (16 02 14),
- Other batteries and accumulators (16 06 05),

***Communal waste***

Combined communal waste produced in the plant area will be handed over to an authorized legal entity.

#### C.2.4. IMPACT IN CASE OF AN UNEXPECTED EVENT

##### During construction

Sudden events that can occur on the site may jeopardize the health and the lives of people on the site or can cause serious material damage in the area. Unexpected events can occur virtually at any stage of the technological process at the site.

In the case of uncontrolled actions during construction, **lesser accidents** are possible during material and waste product transport, and in the extreme cases of negligence, there is a possibility of fire. **Soil** can be **polluted** by fuel, mineral oils, lubricants, etc.

All elements of the works technology taken into consideration, the expected **sudden events** are:

- open area fires due to uncontrolled firing and technical fires in temporary installations
- accidents caused by crashes, truck and machinery rollovers, etc.,
- accidents during material loading, unloading and transport,
- accidents during machine operations,
- accidents caused by involuntary fuel leakage during filling the transport vehicles and machinery with fuel, or involuntary lubricating products leakage in the area where drainage is possible and the dry cleaning method is not ensured. These accidents can occur due to inadequate fuel and lubricant treatment, i.e., due to workers' negligent treatment of environment,
- Accidents caused by *force majeure* (extremely unfavorable weather, etc.), technical malfunction and/or human error

##### During operation

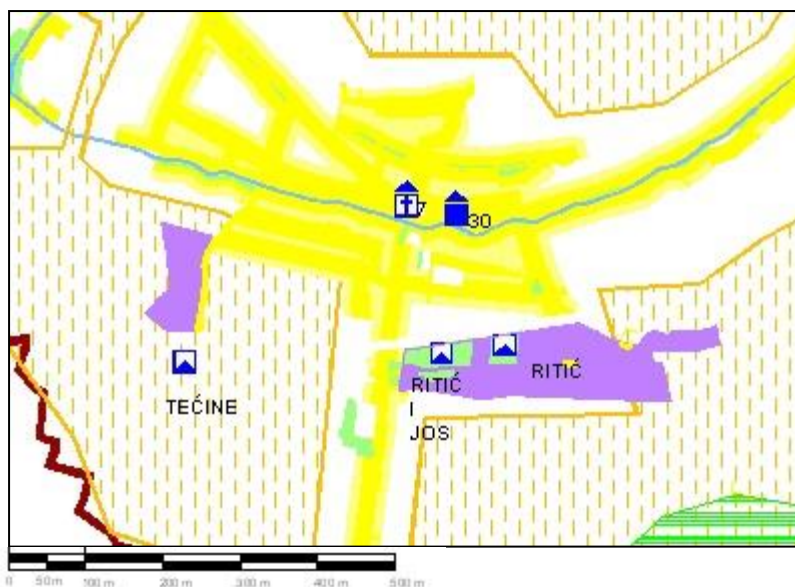
Accidents may result in following impacts:

- fire-caused negative environmental impact
- negative impact caused by interrupted operation due to equipment malfunction, unprofessional handling, electrical power outage, etc. Operation may be interrupted in any part of the system, and causes may vary. In case of interruption, the danger of weaker system operation increases, as far as duration and environmental impact are concerned. A temporary decrease of the quality of the discharged water is expected, which would not have a significant impact on the habitat conditions or the communities in the environment
- negative impact on ground waters due to faulty drains, in case the drainage system in the plant area and manipulative surfaces around the plant do not function
- negative impact on ground waters due to fuel and lubricant (technical oil, grease), and maintenance materials (lubrication) outpouring

### C.3. CULTURAL HERITAGE IMPACT

#### During construction

The closest cultural heritage locality is the archeological locality “Tečine”, a medieval site which is located around 50m from the southern border of the “Tečine” work zone, where the concerned Activity is planned (map 6).



**Map 6.: Part of the map of the Area of spatial planning – landscape, soil and archeological heritage;  
extract from the Spatial development plan of municipality of Babina Greda**

Due to the sufficient remoteness of the Activity site and the very nature of the Activity, **there will be no negative impact on the existing cultural heritage locality.**

## C.4. POSSIBLE INTERACTION WITH EXISTING AND FUTURE ACTIVITIES IN THE AREA

As mentioned before, the planned plant cogeneration plant will be constructed within the “Tečine” work zone.

Bearing in mind the strategic guidelines of the energy policy of the Republic of Croatia which committed to increase the renewable energy source share in its energy balance and considering that there are significant natural resources, the investor opted precisely for this type of plant.

In accordance with the commitment to help the local community develop their economy, the investor decided to take on the development of the biomass cogeneration electric power plant in the “Tečine” work zone. Furthermore, the investor plans to develop heat consumption activities, which will use the heat from the cogeneration plant, in order to maximize the energy efficiency. The purpose of the investment in additional facilities, and not solely the plant, is precisely the aim to ensure heat consumption on the site, which will ultimately contribute to the development of this rural part of Croatia, which is located in the area of special state concern, and open work posts and ensure development.

The investment in greenhouse cultivation of fruits and vegetables is planned on the location, which will help open new work posts for people living in Babina Greda and surrounding villages. Along with the zone development, additional development of thermal network (heating system) for the heating of the village of Babina Greda, which is located near the planned cogeneration, is planned.

Therefore the thermal energy from the cogeneration plant is planned to be used:

- for greenhouse space heating (primary thermal consumer)
- for cooling energy production in the absorption cooling system for refrigerator car (additional consumer)
- through heating system for village heating (additional consumer)

According to the *Land Use and Allocation (excerpt from Spatial development plan of municipality of Babina Greda)*, motorway route A3 passes along the southern border of “Tečine” work zone. The other nearest work zone is about 1.6km southeastward from the “Tečine” work zone, while the nearest tourist area is about 1.6km northwestward away from the “Tečine” work zone.

The “Tečine” work zone is situated next to the village of Babina Greda, which consists of the residential objects and local smaller economic enterprises and crafts.

## D ENVIRONMENTAL PROTECTION PROGRAM FOR THE ACTIVITY

Strategic goal 3. *Quality planning, modern infrastructure and preserved environment* of Development strategies of Vukovarsko-srijemska county 2011-2013 (May 2011) determined the priorities and measures which are related to the Activity:

STRATEGIC GOAL:

### 3. QUALITY SPATIAL PLANNING, MODERN INFRASTRUCTURE AND ENVIRONMENT PRESERVATION

PRIORITIES:

#### 3.4. Investing in renewable energy sources and their efficient use

MEASURES:

3.4.1. Encouraging energy production from renewable sources

3.4.2. Promoting energy efficiency

## **D.1. PROPOSAL OF MEASURES FOR ENVIRONMENT PROTECTION DURING CONSTRUCTION AND OPERATION, OR TERMINATION OF OPERATION, WITH PROPOSAL OF MEASURES FOR PREVENTING AND MITIGATING THE IMPACT OF POSSIBLE ENVIRONMENTAL ACCIDENTS**

### **D.1.1. PROTECTION MEASURES DURING CONSTRUCTION**

#### **D.1.1.1. Water and soil protection measures**

- Hazardous waste and substances should be stored in a watertight repository

#### **D.1.1.2. Noise protection measures**

- The working schedule at the construction site should be followed

#### **D.1.1.3. Protection measures in case of accidents**

- Ensure unrestricted access to fire trucks,
- The surface for machinery maintenance and tanking up fuel must have a roof and be surrounded by a watertight trench on a watertight surface.

#### **D.1.1.4. Waste management measures**

- Space and containers for separate collection of different types of waste should be ensured.

### ***D.1.2. MEASURES OF PROTECTION DURING OPERATION***

#### **D.1.2.1. General measures of protection**

- The plant and machinery should be regularly maintained and service according to the regulations in force and technical specifications of the manufacturer.

- Manipulative surfaces and inner transport pathways should be regularly washed and maintained.

#### **D.1.2.2. Air protection measures**

- The measurement of emissions during the activation of the cogeneration plant should be conducted.

#### **D.1.2.3. Water protection measures**

- Polluted precipitation from all paved surfaces is to be conveyed through settling tanks and oil separators into the Saonica watercourse which is on the eastern side of the location.

- Conditionally clean precipitation from roof tops should be conveyed directly into the Saonica watercourse.
- Waste waters from boiler blow-downing and desalination and feed water chemical preparations should be cooled in a blow-downing pit and conveyed into the Saonica watercourse.
- For sanitary waste waters drainage, build a collecting pit which needs to be periodically emptied by an authorized company.
- Under every oil or fuel tank build a bund of corresponding volume which would, in case of an incident, be afterwards emptied with special vehicles and stored according to regulations.

#### **D.1.2.4. Measures for protection from elevated plant noise levels**

- Significant noise sources should be isolated to prevent elevated noise levels.

#### **D.1.2.5. Measures for protection from accidents**

- Ensure appropriate fire protection according to the regulations in force.
- Ensure unrestricted access to fire trucks.
- The substances for plant maintenance (waste oils and lubricants) should be stored in the original packaging or adequate containers and tanks which should be placed in under a roof, protected and on a watertight surface.

#### **D.1.2.6. Measures for waste management**

- Ensure the space and containers for separate collection of different types of waste.

### **D.2. STATE OF THE ENVIRONMENT MONITORING PROGRAM**

#### ***D.2.1. AIR QUALITY MONITORING PROGRAM***

- Carrying out measurements of quality and composition of polluting substances in waste gases of medium-sized firing devices (cogeneration plants chimneys) according to the Regulation on limit values for pollutant emissions from stationary sources into the air (Official Gazette no. 21/07, 150/08), and the Order on monitoring pollution emissions from stationary sources into the air (Official Gazette no. 01/06).

#### ***D.2.2. MONITORING THE IMPACT ON WATERS***

- The last inspection hole before the vent for waste waters into the Saonica watercourse will be used for measuring pollution substance indicators according to the Water rights permit and Ordinance on limit values of wastewater emissions (Official Gazette no. 87/10).

#### ***D.2.3. MONITORING WASTE MANAGEMENT***

- During the construction and operation of the cogeneration plant, keep records of waste treatment – Waste creation and flow register, Monitoring form and Application form.



## E CONCLUSION

The subject matter of this Report is the equipment provision and the construction of biomass-based 9.99 MW *Viridas Biomass* cogeneration plant in the municipality of Babina Greda in Vukovarsko-srijemska county. UNI VIRIDAS Ltd. based in Zagreb is the project developer.

The scheduled Activity is located in cadastral plot no. 3649 in cadastral municipality of Babina Greda, within the work zone “Tečine“, in the area of the village of Babina Greda.

The Activity concerned involves the construction of a 9.99 MW biomass cogeneration plant. According to the environmental legislation in force - Regulation on strategic environmental assessment of plans and programs (Official Gazette no. 64/08 and 67/09), the obligation for carrying out either the assessment of environmental impact or the assessment of the need for the evaluation of environmental impact is not prescribed for the activities of the aforementioned capacity (Annex II of Regulation; Article 2.1 Plants for the production of electricity, steam and hot water of capacity greater than 10 MWel using renewable energy sources (except water and wind))

Regulation on the procedure for establishing integrated environmental requirements (Official Gazette no. 114/08) stipulates the activities which may cause pollutant emissions to the soil, air, water and sea in terms of Regulation, and among others specifies: Combustion power plants with nominal thermal power exceeding 50 MW. In the case of the Activity concerned, the nominal thermal power of the cogeneration plant amounts to 28.8 MW whereby the procedure for determining integrated environmental protection is not required.

The Activity concerned falls under the sector of potential investments within the measure 302, and they are prescribed by Regulations on the implementation of Measure 302 “Diversification and Development of Rural Economic Activities“ within IPARD program (Official Gazette no. 72/12 and 93/12). By the aforementioned Regulation, the Activity in question, pursuant to the article 14. falls into the sector of construction and/or reconstruction and/or equipping the plant which uses renewable power sources for the purpose of electrical energy production, i.e. cogeneration plants, in accordance with Annex VIII of the Regulation (list of eligible expenditures).

Pursuant to Annex VIII – List of eligible expenditure from the Ordinance on the *Implementation of Measure 302* for the Activity concerned, funding is requested for the following expenditures:

302.5 RENEWABLE ENERGY SOURCES

302.5.A. Construction and/or reconstruction of renewable energy based plants (solar power plants, hydroelectric power plants, wind power plants, biomass power plants, etc.), including the connection of the plant to the electrical grid and the connection of the plant to the facility.

302.5.B. Equipment provision for plants

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9.99 MW BIOMASS COGENERATION PLANT, MUNICIPALITY OF BABINA GRED**

| IMPACTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MEASURES                                                                                                                                | NATIONAL STANDARDS                                                                                                                                                                          | EU STANDARDS                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AIR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                         |                                                                                                                                                                                             |                                                                                                                                                                                                                              |
| <p><b>During operation</b></p> <p>During the operation of the planned cogeneration plant, air polluting emissions are expected, which are the byproduct of combustion unit. The new cogeneration plant will be equipped with a flue gas cleaning system which will ensure that the levels of emission into the environment are far below the tolerable values currently prescribed by regulations of the Republic of Croatia</p> <p>Basic pollutants in flue gas during biomass combustion are dust particles. Considering that the plant concerned will be equipped with adequate filters – multicyclone and electrostatic filters, which will significantly reduce the polluting content, it is assumed that the Activity during operation would not have any negative impact on the quality of air.</p> | <ul style="list-style-type: none"> <li>Carry out the measuring of emissions during the activation of the cogeneration plant.</li> </ul> | <p>Air protection act (Official gazette no. 178/04)</p> <p>Regulation on limit values for pollutant emissions from stationary sources into the air (Official Gazette no. 21/07, 150/08)</p> | <p>Council directive 96/62/EC on ambient air quality assessment and management</p> <p>Directive 2001/81/EC of the European parliament and of the Council on national emission ceiling for certain atmospheric pollutants</p> |

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| IMPACTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | NATIONAL STANDARDS                                                                                                                    | EU STANDARDS                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WATERS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                       |                                                                                                                                                                                                                                                  |
| <p><b>During construction</b></p> <p>The impact on ground and surface waters within the contact and wider area of action can be caused by:</p> <ul style="list-style-type: none"> <li>loading the means of transport with fuel, or conducting necessary repairs on the area which allows drainage, and cleaning is not ensured by dry-cleaning method</li> <li>outpouring fuel and/or lubricants from machines and vehicles and their leakage into the ground</li> <li>disposing construction and other materials (soil, other waste) into the bed of Saonica watercourse</li> <li>damaging the watercourse bed due to heavy machinery operation</li> <li>preventing the functional flow of the watercourse</li> <li>disruption of the water regime of the watercourse</li> <li>creation of sludge in the water flow</li> </ul> <p>By proper construction organization with the application of legal regulations on environmental protection, <b>there will not be any negative impacts on water environments during the construction of the cogeneration plant.</b></p> <p><b>During operation</b></p> <p>Waste waters which are produced during the operation:</p> <ul style="list-style-type: none"> <li><b>precipitation water waste (conditionally clean and potentially oiled from roads),</b></li> <li><b>technological waste waters (blow-downing and desalination of the boiler, and oiled waste waters from chemical treatment of boiler feed water)</b></li> <li><b>sanitary waste waters (lavatories).</b></li> </ul> <p>Considering that the waste waters are released into the natural environment before the plant is activated, it is necessary to get a water rights permit, which will prescribe the maximum of tolerable amount of pollutants and periodic control of waste water quality in accordance with the regulations in force.</p> | <p><b>During construction</b></p> <ul style="list-style-type: none"> <li>Dangerous waste and substances must be stored in a watertight repository</li> </ul> <p><b>During operation</b></p> <p>Polluted precipitation waste waters from all paved surfaces should be conveyed through settling tanks and oil separators into the Saonica watercourse which is on the eastern side of the location.</p> <ul style="list-style-type: none"> <li>Conditionally clean precipitation from roof tops should be conveyed into the Saonica watercourse.</li> <li>Wastewaters from boiler blow-downing and desalination of with feed water chemical treatment should be cooled in a blow-downing pit and conveyed into the Saonica watercourse.</li> <li>For the sanitary waste waters drainage, build a collecting pit which needs to be periodically emptied by an authorised company.</li> <li>Under every oil or fuel tank build a bund of corresponding volume which would, in case of an incident, be afterwards emptied with special vehicles and stored according to regulations.</li> </ul> | <p>Water Act (Official Gazette no. 153/09)</p> <p>Ordinance on limit values of wastewater emissions (Official Gazette no. 87/10).</p> | <p>Directive 2000/60/EC of the European parliament and of the Council by which a framework is established for Community action in the field of water policy</p> <p>Directive of the council 91/271/EEC concerning urban wastewater treatment</p> |

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| IMPACTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | MEASURES                                                                                                                                                       | NATIONAL STANDARDS                                                                                                                                                                   | EU STANDARDS                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>NOISE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                |                                                                                                                                                                                      |                                                                                      |
| <p><b>During construction</b></p> <p>The very intensity of total noise shall vary during the day, depending on the stage of construction, however, the duration of construction works is limited. The location itself is about 800m away from the first residential building of village of Babina Greda, so there shall be no negative noise impact on the local residents.</p> <p>During the construction work at night, the equivalent noise levels shall not exceed 40 dB according to Noise protection law (Official Gazette no. 145/04).</p> <p>As an exception, it is allowed that the noise levels exceed 10 dB during night, in case a technological process requires it. The process shall not extend to more than one night, or two days during a 30 day period. The contractor must inform the sanitary inspection in written form on this exception in noise levels, and it must be written in the construction log.</p> <p><b>During operation</b></p> <p>During the proper running of the cogeneration plant and with the application of all noise pollution prevention measures, there is no negative noise impact is expected, considering that the noise-polluting machinery will be situated in closed facilities. It is important to point out that the nearest residential buildings are about 800m away.</p> | <p><b>During construction</b></p> <ul style="list-style-type: none"> <li>Respecting the predetermined daily working hours at the construction site.</li> </ul> | <p>Noise Protection Act (Official Gazette no. 030/2009)</p> <p>Regulations of the highest allowed noise levels in working and living environment (Official Gazette no. 145/2004)</p> | <p>Directive 2002/49/EC on the assessment and management of environmental noise.</p> |

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| IMPACTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MEASURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | NATIONAL STANDARDS                                                                                                                                                                                                        | EU STANDARDS                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ACCIDENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                           |                                                                                                                                                                           |
| <p><b>During construction</b></p> <p>In case of uncontrolled operations during construction it is possible to have lesser accidents during the transport of materials and waste products, and in extreme cases of negligence there is a possibility of fire. It is also possible to pollute soil with fuel, mineral oils, lubricants, etc.</p> <p>Considering all elements of work technology, sudden events that can be expected:</p> <ul style="list-style-type: none"> <li>fires on open surfaces due to uncontrolled firing and technical fires in temporary facilities.</li> <li>accidents due to crashes, trucks and machinery turn over, etc.</li> <li>accidents during loading, unloading, and transport of materials.</li> <li>accidents during machine operation.</li> <li>accidents as a result of fuel leakage during loading transport vehicles and machinery with fuel, or accidental leakage of lubricants in the area which allows drainage, and dry-cleaning method is not ensured. These accidents can happen during improper treatment of fuel and lubricants, or worker's negligence towards the environment.</li> <li>accidents of force majeure (extreme weather conditions, etc.), technical malfunction, or human error.</li> </ul> <p><b>During operation</b></p> <p>Due to accidental situations, the following influences are possible:</p> <ul style="list-style-type: none"> <li>negative influence on the environment as a result of fire,</li> <li>negative influence caused by termination of work as a result of malfunctioning gear, unprofessional handling, loss of power, etc. Outage can appear in any part of the system, and causes can be different: in case of outage, the danger of weaker system performance is greatly increased, regarding its duration and influence on the environment. Short term decrease in quality of discharged water can be expected, but it shall not have significant impact on the changes in the conditions of the habitat, nor the community in the natural environment.</li> <li>negative impact on ground water due to faulty drains, in case the waste water discharging system from the plant area and the handling surfaces around the plant are not maintained.</li> <li><b>the negative influence on ground waters as a result of fuel or lubricant leakage (machine oil, grease), and the plant maintenance substances (lubrication).</b></li> </ul> | <p><b>During construction</b></p> <ul style="list-style-type: none"> <li>Ensure unrestricted access to fire trucks.</li> <li>The surface for tanking up fuel and maintaining machines has to be roofed surrounded by a watertight trench on a watertight surface.</li> </ul> <p><b>During operation</b></p> <ul style="list-style-type: none"> <li>Ensure the proper fire protection according to regulations in force</li> <li>Ensure unrestricted access to fire trucks.</li> <li>Resources for plant maintenance (waste oils and lubricants) are to be stored in original packaging or appropriate containers and placed on a secure, covered and watertight area.</li> </ul> | <p>Environmental Protection Act (Official Gazette, no. 110/07)</p> <p>Fire Safety Act (Official Gazette no. 92/10)</p> <p>Ordinance on fire apparatus access conditions (Official Gazette no. 035/94, 55/94 i 142/03)</p> | <p>Directive 2004/35/EC, of the European parliament and of the council on environmental liability with regard to the prevention and remedying of environmental damage</p> |

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| IMPACTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | MEASURES                                                                                                                                                                       | NATIONAL STANDARDS                                                                                                                                                                                                                                                                                                | EU STANDARDS                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WASTE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                        |
| <p><b>During construction</b></p> <p>During construction of the cogeneration plant as byproducts there will be different types of hazardous (waste oils, oily rags, oily plastic and metal packaging, etc), and non-hazardous waste (paper, glass packaging, PET packaging, etc.) and construction waste (dirt, bitumen mix, wooden pallets, plastic foil, paper and cardboard packaging, metal packaging, etc.) All waste needs to be separated and collected separately on repositories, determined by organizing the construction site, and disposed of by authorized companies.</p> <p><b>During operation</b></p> <p>The waste produced during standard plant operation and maintenance will be disposed of according to the Waste Act (Official Gazette no. 178/04, 111/06, 60/08, 87/09) and the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (Official Gazette, no. 50/05, 039/2009), and a proper agreement will be made with authorized companies.</p> | <p><b>During construction and operation</b></p> <ul style="list-style-type: none"> <li>▪ Ensure space for tanks for separate gathering of different types of waste.</li> </ul> | <p>Waste Act (Official Gazette, no. 178/04, 111/06, 60/08, 87/09)</p> <p>Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (Official Gazette no. 50/05, 039/2009),</p> <p>Ordinance on Waste management (Official Gazette no. 23/07 and 111/07).</p> | <p>Framework directive on waste 2008/98/EC</p> <p>Commission decision establishing a list of wastes 2000/532/EC, amended by decisions 2001/118/EC, 2001/119/EC and 2001/573/EC</p> <p>Regulation on waste statistics 2150/2002/EEC</p> |



## F LIST OF DOCUMENTATION MATERIAL, LITERATURE AND REGULATIONS

### LIST OF DOCUMENTATION MATERIAL

- Conceptual design of biomass cogeneration plant VIRIDAS BIOMASS 9,99 MW; Office of the certified mechanical engineer Marijan Hohnjec, Zagreb, February 2012
- Preliminary analysis of justification for construction of the plant and power grid connection with technological and economical data and data for spatial planning at the biomass cogeneration plant *Viridas Biomass* 6,5 MWel in Babina Greda, Enerkon Ltd, Zagreb, June 2011.
- Study report on the optimal technical solution for connection to the power grid – cogeneration plant *Viridis Biomass* (9500 kW), Končar – Institute of Electrotechnics, Zagreb, December 2011
- Spatial Development Plan of the municipality of Babina Greda (Official Gazette of Vukovarsko-srijemska county no. 7/04, 13/08, 16/11)
- Development Strategy for the Vukovarsko-srijemska county 2011. – 2013., Institute of International Relations and the Development agency of Vukovarsko-srijemska county, Hrast Ltd, May 2011.

### LIST OF REGULATIONS

#### 1. General

- Declaration of Environmental Protection in the Republic of Croatia (Official Gazette no. 34/92).
- Environment Protection Strategy (Official Gazette no. 46/02).
- National Environmental Action Plan (Official Gazette no. 46/02).
- Strategy for Sustainable Development of the Republic of Croatia (Official Gazette no. 30/09).
- Environment Protection Act (Official Gazette no. 110/07).
- The State Inspectorate Act (Official Gazette no. 116/08 and 123/08).
- Regulation on the Manner of Establishing Environmental Damage (Official Gazette no. 139/08).
- Regulation on the Establishment of the Environment Agency (Official Gazette no. 75/02)
- Regulation on Environmental Impact Assessment (Official Gazette no. 64/08 and 67/09).
- Ordinance on the Environmental Pollution Register (Official Gazette no. 35/08).
- Regulation on Implementation of the Measure 302 "Improvement and Development of Rural Infrastructure" within the **IPARD** program (Official Gazette no. 72/12 and 93/12)

#### 2. Spatial features

- Spatial Organization Strategy of the Republic of Croatia (June 1997).
- Program of Physical Planning of the Republic of Croatia (Official Gazette no. 50/99).
- Traffic development strategy of the Republic of Croatia (Official Gazette no. 138/99).
- Law on Local and Regional Self-Government (Official Gazette no. 33/01, 129/05, 109/07, 125/08 and 36/09).
- Act on the Territories of Counties, Towns and Municipalities in the Republic of Croatia (Official Gazette no. 86/06 and 16/07).
- The Physical Planning and Building Act (Official Gazette no. 76/07, 38/09, 55/11 and 90/11).

**3. Traffic and transport infrastructure**

- Public Roads Act (Official Gazette no. 180/04, 82/06, 138/06, 146/08, 152/08, 38/09, 124/09, 153/09 and 73/10).
- Law on Public Utility Management (Official Gazette no. 36/95, 70/97, 128/99, 57/00, 129/00, 59/01, 150/02, 26/03, 82/04, 110/04, 178/04, 38/09 and 79/09).
- Road Traffic Safety Act (Official Gazette no. 67/08).
- Regulation on Technical Conditions of Vehicles in Road Traffic (Official Gazette no. 51/10).

**4. Air**

- The National Strategy for Chemical Safety („Official Gazette“ no. 143/08).
- Air Quality Protection and Improvement Plan of the Republic of Croatia for the Period 2008-2011 (Official Gazette no. 61/08).
- Air Protection Act (Official Gazette no. 178/04, 60/08 and 130/11).
- Regulation on Emission Ceilings for Certain Pollutants in the Republic of Croatia („Official Gazette“ no. 141/08).
- Regulation on Limit Values of Polluting Particles (Official Gazette no. 133/05).
- Decree on the Quality of Liquid Petroleum Fuel (Official Gazette no. 53/06, 154/08 and 81/10).
- Regulation on Alert Thresholds Pollutant in Air (Official Gazette no. 133/05).
- Regulation on Designation of Zones and Agglomerations According to Categories of Air Quality (Official Gazette no. 68/08).
- Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette no. 21/07, 150/08)
- Regulation on Monitoring Pollutant Emissions from Stationary Sources (Official Gazette no. 01/06)

**5. Waters**

- Water Management Strategy (Official Gazette no. 91/08).
- State emergency response plan in case of and sudden water pollution (Official Gazette no. 05/11).
- Water Act (Official Gazette no. 153/09 and 130/11).
- Ordinance on Limit Values of Wastewater Emissions (Official Gazette no. 87/10)
- Regulation on Conditions for the Establishment of Water Protection Zones (Official Gazette no. 55/02).
- Decision on Determining Sensitive Areas (Official Gazette no. 81/10).

**6. Soil and agriculture**

- Agricultural Land Act (Official Gazette no. 152/08 and 21/10).
- Regulations on Protection of Agricultural Land from Pollution (Official Gazette no. 32/10).

**7. Biological and landscape diversity**

- Strategy and Action Plan for the Protection of Biological and Landscape Diversity of the Republic of Croatia (Official Gazette no. 143/08).
- Environmental Protection act (Official Gazette no. 70/05, 139/08 and 57/11).
- Regulation on Proclamation of the Ecological Network (Official Gazette no. 109/07).
- Regulations on Assessment of the Plan, Programs and Projects for the Ecological Network (Official Gazette no. 118/09).

- Ordinance on the Proclamation of Protected and Strictly Protected Wild Taxa (Official Gazette no. 99/09).
- Ordinance on the Sorts of Habitat Types, Habitat Map, Endangered and Rare Habitat Types as well as Safeguard Measures for Conservation of Habitat Types (Official Gazette no. 7/06 and 119/09).

## **8. Cultural and historical heritage**

- Cultural Resources Protection and Preservation Act (Official Gazette no. 69/99, 151/03, 157/03, 87/09, 88/10, 61/11 and 25/12).
- Ordinance on Archaeological Excavations (Official Gazette no. 102/10).
- Cultural Goods Protection and Preservation Act (Official Gazette, no. 37/01 and 4/08).

## **9. Noise**

- Noise Protection Act (Official Gazette no. 30/09).
- Ordinance on Activities Requiring the Implementation of Noise Protection Measures (Official Gazette no. 91/07).
- Regulations of the Highest Allowed Noise Levels in Working and Living Environment (Official Gazette no. 145/04).
- Method of Preparation and Content of Noise Maps and Action Plans and on the Method of Calculating Limit Values of Noise Indicators (Official Gazette no. 75/09).

## **10. Waste**

- Waste Management Plan of the Republic of Croatia (Official Gazette no. 130/05).
- Waste Management Plan of the Republic of Croatia 2007 – 2015. (Official Gazette no. 85/07, 126/10 and 31/11).
- Waste Act (Official Gazette no. 178/04, 111/06, 60/08 and 87/09).
- Regulation on Categories, Types and Classification of Waste With a Waste Catalogue and List of Hazardous Waste (Official Gazette no. 50/05 and 39/09).
- Ordinance on Construction Waste Management (Official Gazette no. 38/08).
- Ordinance on Waste Management (Official Gazette no. 23/07 and 111/07).

## **11. Sudden events**

- Law of Protection in the Workplace (Official Gazette no. 59/96, 94/96, 114/03, 86/08 and 75/09).
- Fire Safety Act (Official Gazette no. 92/10).
- Protection and Rescue Act (Official Gazette no. 174/04, 79/07, 38/09 and 127/10).
- Ordinance on Contents of Regulation for Temporary Workplace (Official Gazette no. 45/84)
- Construction Safety Act (Official Gazette no. 42/68 and 45/68)
- Work Safety Regulation for Working and Auxiliary Rooms and Spaces (Official Gazette no. 6/84, 42/05 and 113/06)
- Amendments to the list of selected professional and technically competent legal entities and natural persons which can eliminate the consequences of sudden pollution (Official Gazette no. 103/01 and 22/05).

## **12. International conventions, treaties, agreements, and European directives**

#### Soil

- Commission Communication entitled "European Thematic Strategy for Soil Protection" [COM (2006) 231 final - not published in the Official Journal]. Proposal for a European Parliament and Council Directive, setting out a Framework for Soil Protection and amending Council Directive 2004/35/EC
- Directive 2004/35/EC of the European Parliament and of the Council on environmental liability with regard to the Prevention and Remedying of Environmental Damage.

#### Air

- Air Quality Framework Directive (96/62/EC) amended by Regulation 1882/2003 with Ensuing Directives (1999/30/EC, 2000/69/EC, 2002/31/EC, 2004/107/EC)
- Directive on National Emission Ceilings for Certain Atmospheric Pollutants, 2001/81/EEC.
- Commission Decision establishing guidelines for Monitoring and Reporting of Greenhouse Gas Emissions in accordance with Directive 2003/87/EC of the European Parliament and of the Council (notified under document number C (2004) 130)

#### Waters

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy
- Directive concerning Urban Waste Water Treatment 91/271/EEC

#### Biological and landscape diversity

- Convention on Biological Diversity (*Official Gazette* No. IA-6/06)
- Convention on The Conservation of European Wildlife and Natural Habitats (Bern Convention)
- European Landscape Convention (*Official Gazette* IA 12/02 And 11/04)
- Council Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora, 92/43/EEC
- Council Directive 79/409/EEC on the Conservation of Wild Birds (**Council Directive 2009/147/EC On The Conservation Of Wild Birds-new Directive**)

#### Noise

- Directive 2002/49/EC of the European Parliament and of the Council Relating to the Assessment and Management of Environmental Noise

#### Traffic

- Directive 2004/35/EC of the European Parliament and of the Council on Environmental Liability With Regard to the Prevention and Remedying of Environmental Damage

#### Waste

- Waste Framework Directive 2008/98/EC

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- Decision of the Commission as Regards the List of Waste 2000/532/EC, amended by Decisions 2001/118/EC, 2001/119/EC i 2001/573/EC
- Council Directive 91/689/EEC on Hazardous Waste
- Council Directive 94/31/EC amending Directive 91/689/EEC on Hazardous Waste
- Regulation on Waste Statistics 2150/2002/EEC

Sudden events

- Directive 2004/35/EC of the European Parliament and of the Council on Environmental Liability with regard to the Prevention and Remedying of Environmental Damage

Cultural heritage

- Convention on the Protection of World Cultural and Natural Heritage (*Official Gazette*, IA 12/93)