

Advanced Technical Training Programme on the EU Verification and Accreditation Regulation, ECRAN - 58886

Introduction to the installation of the Thermal Power Plant Sisak

- Monitoring plan and calculation of CO₂ emissions



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Sisak, 21.04.2015.



Thermal Power Plant Sisak

- products: electricity and heat (steam)
- basic information regarding TPP Sisak:

Units		Fuel	Capacity	Capacity (th)	Year of commissioning
Unit A	Steam boiler A1	fuel oil / natural gas	210 MWeI	274 MW _{th}	1970.
	Steam boiler A2			274 MW _{th}	
Unit B	Steam boiler B1	fuel oil / natural gas	210 MWeI	274 MW _{th}	1976.
	Steam boiler B2			274 MW _{th}	
Auxiliary boilers (PK)	Auxiliary boiler PK1	fuel oil / natural gas	28 t/h	23 MW _{th}	1989.
	Auxiliary boiler PK2		28 t/h	23 MW _{th}	
Unit C	Gas Turbine aggregate GTA	natural gas	230 MWeI / 50 MW _t	457 MW _{th}	-
Gas station Unit C	Boiler 1 (for heating the gas)	natural gas	830 kW	0,907 MW _{th}	-
	Boiler 2 (for heating the gas)		830 kW	0,907 MW _{th}	

Thermal Power Plant Sisak



Monitoring and reporting regulation

➤ The EU ETS Directive

Commission Regulation (EU No. 601/2012) on the monitoring and reporting of greenhouse gas emissions

Croatian national regulation

➤ 01.01.2013 ⇒ TPP Sisak in EU-ETS ($> 20 \text{ MW}_{\text{th}}$)

➤ Monitoring plan ⇒ The permit for greenhouse gas emissions

Date	Obligation
01.01. – 31.12.	monitoring period
01.03.	get emissions report verified by an accredited verifier submit verified annual emissions report
30.04.	surrender allowances (amount corresponding to verified annual emissions) in Registry system
30.06.	submit report on possible improvements of the monitoring plan (if applicable)

Monitoring plan TPP Sisak

- A. Monitoring Plan versions
 - B. Operator & Installation Identification
 - C. Installation Description
 - description of the installation and its activities, estimated annual emissions, source streams, emission sources, emission points
 - D. Calculation Based Approaches
 - description of the calculation based approach for monitoring CO₂ emissions
 - measurement systems for determining the activity data, uncertainty assessment
 - calculation factors (default values, laboratories and methods used for analyses)
 - E. Source Streams
 - details on the applied tiers for activity data and calculation factors
 - K. Management & Control
 - responsibilities, data flow activities (data flow diagram)
 - control activities (risk assessment procedures, procedures used to: ensure regular reviews and validation data, handle correction and corrective actions, data archiving,...)
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Installation Description

➤ activity: combustion of fuels \longrightarrow GHG emitted: CO₂

➤ annual emissions TPP Sisak:

year	2006.	2007.	2008.	2009.	2010.	2011.	2012.	2013.
CO ₂ (t)	574.152	884.729	561.498	414.392	34.268	121.239	102.093	55.193

78.198 t

(annual average emissions: 2010-2013)

estimated annual emissions

+ 200.000 t (Unit C)

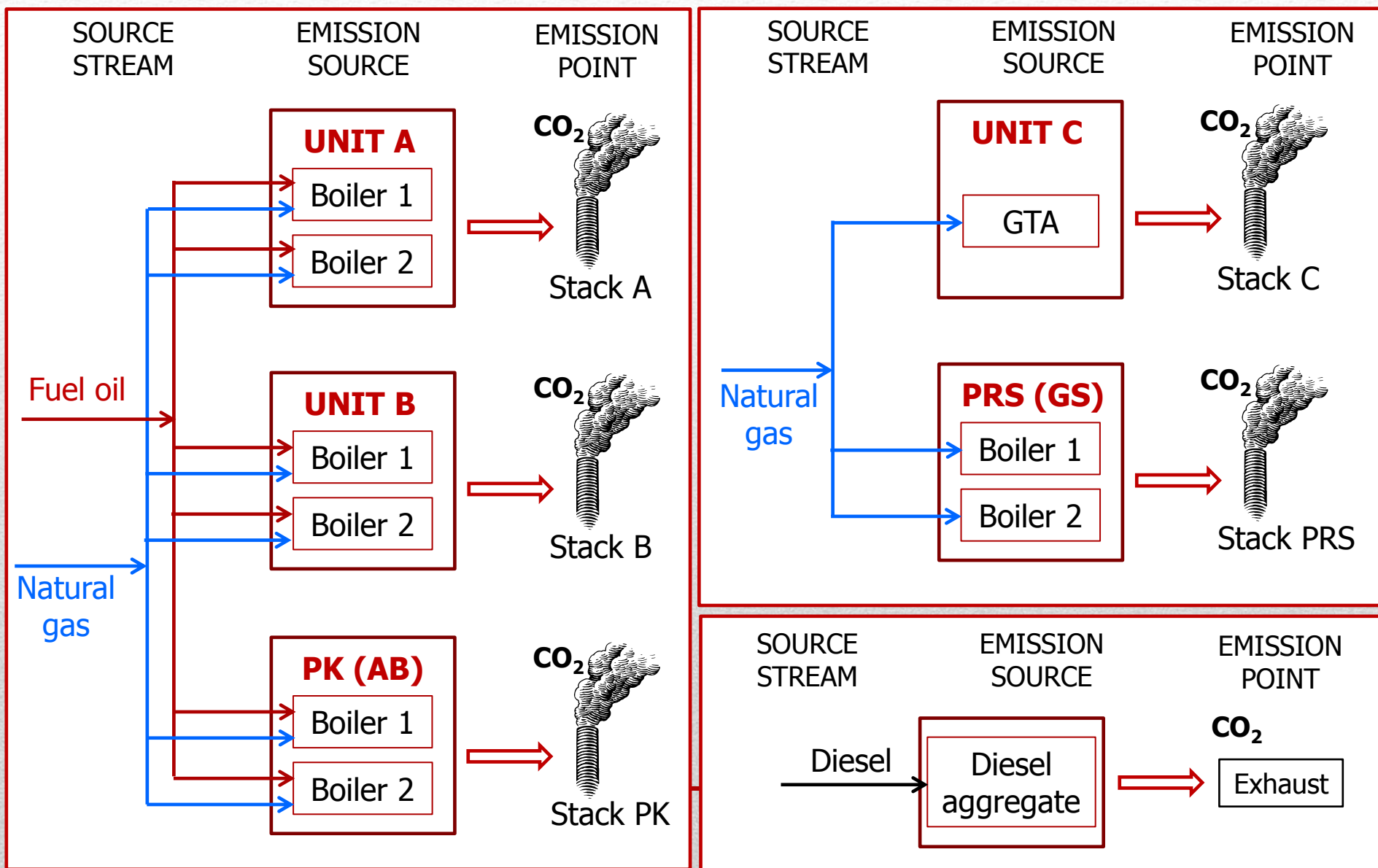
278.198 t

installation category: **B**

(less than 500.000 t, more than 50.000 t CO₂/year)



Source streams diagram





Source streams

- source streams list & clasification of all source streams in TPP Sisak

Source stream	Emission source	Estimated anual emissions	Source streams classification
NATURAL GAS	Boiler A1, Boiler A2 (Unit A) Boiler B1, Boiler B2 (Unit B) Auxiliary boiler 1, Auxiliary boiler 2 (PK) Gas Turbine Aggregate (Unit C) Boiler for gas heating 1, Boiler for gas heating 2 (Gas station Unit C)	241.463 t CO ₂	major
FUEL OIL	Boiler A1, Boiler A2 (Unit A) Boiler B1, Boiler B2 (Unit B) Auxiliary boiler 1, Auxiliary boiler 2 (PK)	36.733 t CO ₂	major
DIESEL	Diesel aggregate Diesel aggregate Unit C	1,5 t CO ₂	de-minimis

- less than 1.000 t of fossil CO₂/year or less than 2 % of the "total of all monitored items", up to a total maximum contribution of 20.000 t of fossil CO₂/year

Calculation Based Approaches

- monitoring methodology of CO₂ emissions – calculation based approaches (standard methodology)
- total emissions from the installation:

$$\text{CO}_2 (\text{total}) = \text{CO}_2 (\text{natural gas}) + \text{CO}_2 (\text{fuel oil}) + \text{CO}_2 (\text{diesel})$$

- calculation of emissions (combustion emissions):

$$\text{CO}_2 (\text{fuel}) = \text{fuel quantity} \times \text{NCV} \times \text{EF} \times \text{OF}$$



activity data



calculation factors

- **NCV** - Net calorific value
 - **EF** - Emission factor
 - **OF** - Oxidation factor
-

The tier system

- each parameter needed for the determination of emissions (activity data and calculation factors) can be determined by different “data quality levels” \Rightarrow tiers
 - required tiers \Rightarrow installation category and source stream classification
 - activity data (amount of fuel)
 - tiers relate to the required minimum uncertainty over the reporting period of the amount of fuel
 - calculation factors (NCV, EF, OF)
 - tiers relate to specific methodology set out in the MRR for the determination of each factor
 - determined as default values or by laboratory analyses
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Required Tiers

TPP Sisak

➤ installation category: **B**

➤ natural gas, fuel oil: major source stream



apply the highest tier defined for each parameter

Activity data, calculation factors	Required tier	NATURAL GAS	FUEL OIL
Amount of fuel, (m ³ , t)	4	Amount taken from invoices issued by the trading partner	Amount taken from invoices issued by the trading partner, annual level measurement in tanks (stock changes)
		Uncertainty shall not be more than $\pm 1,5 \%$	
Net calorific value, NCV (MJ/m ³ , MJ/kg)	3	Value from laboratory analyses (laboratory - accreditation in accordance with EN ISO/IEC 17025)	
		Required frequencies for analyses: weekly	Required frequencies for analyses: every 20.000 t, min. 6 analyses/year
Emission factor, EF (t CO ₂ /TJ)	3	Value derived from laboratory analyses (laboratory - accreditation in accordance with EN ISO/IEC 17025)	
		Required frequencies for analyses: weekly	Required frequencies for analyses: every 20.000 t, min. 6 analyses/year
Oxidation factor, OF	1	Default value, OF = 1	



CO₂ emissions – natural gas

➤ $\text{CO}_2 \text{ natural gas (t)} = \text{consumption (m}^3\text{)} * \text{NCV (TJ/m}^3\text{)} * \text{EF (t CO}_2\text{/TJ)} * \text{OF}$

FUEL CONSUMPTION

- amount taken from invoices issued by the trading partner (based on continual metering)
consumption (m³)/year = sum amounts from all invoices in the calendar year
- measuring instruments are under the control of the fuel supplier
- uncertainty assessment of measurement system \Rightarrow uncertainty < ± 1,5 %

NET CALORIFIC VALUE, EMISSION FACTOR

- determined by laboratory analyses
(the analysis is provided by the gas supplier with the invoice)
NCV or EF / year = weighted NCV or EF value
- laboratory - accreditation in accordance with EN ISO/IEC 17025
- sampling plan is approved by a competent authority

CO₂ emissions – fuel oil

➤ $\text{CO}_2 \text{ fuel oil (t)} = \text{consumption (t)} * \text{NCV (TJ/kg)} * \text{EF (t CO}_2\text{/TJ)} * \text{OF}$

FUEL CONSUMPTION

- supplied to the pipeline or railway tanks
- consumption of fuel oil is determined by the following formula:

$$\text{consumption (t)/year} = P - E + S_{\text{begin}} - S_{\text{end}}$$

P - Purchased quantity (invoices are used)

E - Exported quantity

S_{begin} - stock of the fuel at the beginning of the year (31.12. previous year)

S_{end} - stock of the fuel at the end of the year (31.12. current year)

- the instruments are not under the operator's control
- measuring instruments:
 - measuring tape, digital thermometer, areometer - to measure levels in all tanks (company accredited by ISO / IEC 17020)
 - wagon scale for delivery of fuel oil railway tanks
- uncertainty assessment of measurement system ➡ uncertainty < ± 1,5 %

CO₂ emissions – fuel oil

➤ $\text{CO}_{2 \text{ fuel oil}} (\text{t}) = \text{consumption} (\text{t}) * \text{NCV} (\text{TJ/kg}) * \text{EF} (\text{t CO}_2/\text{TJ}) * \text{OF}$

NET CALORIFIC VALUE, EMISSION FACTOR

- determined by laboratory analyses
(the analysis is provided by the fuel oil supplier with the invoice)

NCV or EF / year = weighted NCV or EF value
- laboratory - accreditation in accordance with EN ISO/IEC 17025
(the analysis method required is within the accreditation scope)
- sampling plan is approved by a competent authority
- the frequency of analyses for fuel oil
 - the number of analyses conducted per year depends on the number of deliveries of fuel oil meeting the following requirement: at least one analysis for 20.000 t of fuel

CO₂ emissions – diesel

- $\text{CO}_{2 \text{ diesel}} (t) = \text{consumption} (t) * \text{NCV} (\text{TJ/t}) * \text{EF} (t \text{ CO}_2/\text{TJ}) * \text{OF}$
- diesel – “de-minimis” source stream

Activity data, calculation factors	Required tier	Full text for applied tier
Amount of fuel, (t)	-	Estimation method (based on the annual operating hours of diesel aggregate)
Net calorific value, NCV (MJ/kg)	2a/2b	Default value NCV = 42,71 (Source: National Inventory)
Emission factor, EF (t CO ₂ /TJ)	2a/2b	Default value EF = 74,07 (Source: National Inventory)
Oxidation factor, OF	1	Default value, OF =1

Monitoring plan TPP Sisak

- supporting documents:
 - Description of the TPP Sisak
 - Source stream diagram
 - Calculation based approach for monitoring CO₂ emissions
 - Uncertainty assessment of measurement systems document
 - Risk assessment procedures
 - Invoices, analyses and certificate of measurement instruments
 - The sampling plans for fuel oil and for natural gas
 - The responsibilities and areas of competence for monitoring and reporting emissions
 - Data flow diagram
 - Abbreviations and definitions
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Thank you

