



**IMPLEMENTING FLUE GAS  
DESULPHURIZATION TECHNOLOGY IN  
AN EXISTING POWER PLANT**

**MIROSLAV WALIŠ, ENPRIMA  
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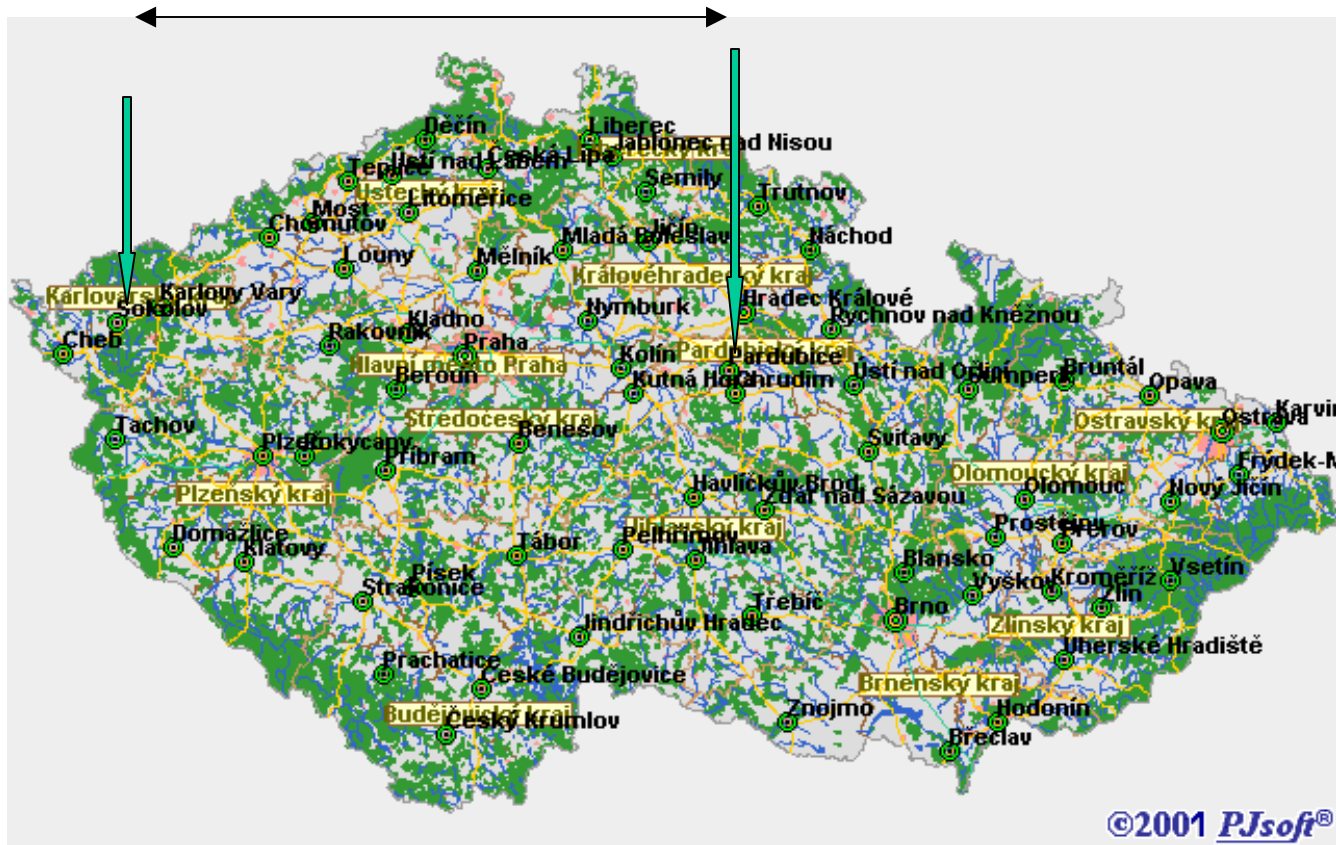
**UNECE Ad Hoc Group of Experts on Coal in Sustainable Development  
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**FLUE GAS DESULPHURIZATION TECHNOLOGY  
IMPLEMENTED IN POWER STATION -  
SOKOLOVSKA UHELNA, A.S., POWER STATION  
VRESOVA, CZECH REPUBLIC**

**TURN-KEY PROJECT BY ENPRIMA ENGINEERING**

# Project Location



## **Power Station Vresova; Main Information**

- ◆ **Built-up in 1967**
- ◆ **The installed capacity 125 MWe**
- ◆ **Burning Czech type of brown coal (Sokolov region), in 5 identical boilers; total 325 t of steam/ h**
- ◆ **Owner of Power Station Vresova is Sokolovska uhelna, a.s., in town Sokolov**

## Scope of Delivery

- ◆ **"Turn-key" delivery included:**
  - ◆ **Absorption system**
  - ◆ **Duct system, incl. ID fans**
  - ◆ **Limestone unloading and storage system**
  - ◆ **De-watering system**
  - ◆ **Automation and Control**
  - ◆ **Electrification**
  - ◆ **Civil work**

## Project Overview

- ◆ FGD process for the **whole Power Plant with designed flue gas inlet 1 510 000 Nm<sup>3</sup>/ h, and limitation to 1 661 000 Nm<sup>3</sup>/h as maximum overload**
- ◆ **"Turn-key" project**
- ◆ **Project value was EUR 31,8 million**
- ◆ **The project duration: since May 2000 to October 2002**
- ◆ **SO<sub>2</sub> removal efficiency 95 %, and higher, was achieved**

## Boiler Loads to FGD

		<b>maximum overload 110% of nominal</b>							
	<b>B3</b>	<b>nominal load 1 510 000 Nm<sup>3</sup>/h/ wet</b>							
	<b>B5</b>								
	<b>B4</b>								
	<b>B2</b>								
	<b>B1</b>	<b>boilers</b>							

## **Division of Scope; Main Categories**

### **Enprima Engineering:**

- ◆ **Responsible for:**
  - ◆ **Engineering (permit, basic, application, detail, manufacturing);**
  - ◆ **Procurement;**
  - ◆ **Erection;**
  - ◆ **Project Management;**
  - ◆ **Commissioning;**
  - ◆ **Training and Warranty Service**

# Project Main Schedule

Contract Signature	Site Mobilisat.	Start of Civil w.	Start of Mech. Erection	Mechan. Erect. Compl.	Commiss. Start	1st Flue Gas-in	Guar. Test start	Hand-over
3.5.2000	July, 2000	Sept.2000	Novemb.00	June,2002	July,2002	6.8.02	29.9.02	24.10.02



## Process Features Determined in the Contract 1/2

- ◆ **Determined were the main Contract process features:**
  - ◆ **One absorber; having 3 spray headers in use for the SO<sub>2</sub> load of 2,7 tons/h;**
  - ◆ **Gypsum de-watering, including tanks and pumps; consisting of two vacuum belt filters, each with a capacity of more than 100 % of the nominal load of flue gas (1 510 000 Nm<sup>3</sup>/h), and sulphur load of 4 008 kg/h of SO<sub>2</sub>; and gypsum (product) moisture 10 %;**
  - ◆ **Three gypsum slurry pumps to be used**
  - ◆ **Treated flue gases discharged into wet stack on the top of absorber**

## Process Features Determined in the Contract 2/2

- ◆ **The unloading capacity of limestone powder 4 wagons per 2 hours**
- ◆ **Limestone storage capacity 1 600 ton**
- ◆ **Limestone slurry tank, 1 piece, having 8 hour capacity at 4 008 kg/h SO<sub>2</sub>**
- ◆ **2 pieces of limestone slurry pumps to be used (1 as stand-by)**
- ◆ **One feeding line of limestone slurry, able to manage with a reserve of appr. 30% the nominal load of 4 008 kg/h SO<sub>2</sub>**

- ◆ **Selected main technical solutions:**
  - ◆ **The design of limestone unloading based on own experience, and experience of a local subsupplier.**
  - ◆ **Process pumps designed with alloy steel casings, impellers and wear plates.**
  - ◆ **Re-circulation pumps designed as rubber-lined for casing and alloy steel for impellers.**
  - ◆ **Wet stack for cleaned flue gases made of FRP, and anchored to the supporting steel structure.**
  - ◆ **Density control of gypsum slurry provided by the density meter on "radiometric" principle.**

## Process Features, as Own Solution

2/2

- ◆ **Slurry piping made of FRP; with final anti-abrasion layer.**
- ◆ **pH measurement provided by Endress-Hauser, with water wash.**
- ◆ **Only 1 tank after de-watering plant (filtrate tank and hydro-cyclone overflow tank combined together) used.**
- ◆ **Two ID fans were delivered instead of the original old two ID fans per 1 boiler; the adaptation to the control system of boilers in the Client's responsibility.**
- ◆ **Batch-wise operation of belt filters.**



## Project Scope and Division,

**Civil**

<b>CIVIL</b>	<b>Calculation/ Design/ Supply</b>
<b>Piles</b>	<b>All locally procured</b>
<b>Foundations</b>	
<b>Floors, Walls</b>	
<b>Steel structures</b>	
<b>Wall cladding</b>	
<b>Building complet.</b>	
<b>Roofs</b>	
<b>Roads</b>	
<b>Finalisation</b>	
<b>HVAC</b>	
<b>Electrification</b>	

# Project Scope and Division, Mechanical

	Supply	Erection	Commissioning		
<b>MECHANICAL</b>					
Absorber					
Wet stack					
Ducts					
Compressor unit					
ID fans					
Tanks					
Silo					
Limest unloading					
Transport					
Gyps. Storage					Local/ Package
Dewatering					
Pumps					Local
Agitators					
Mist eliminator					Imported
Spray headers					
FRP lining					Imported/ Pack.

## Project Scope and Division, Electro and I&C

ELECTRICAL PART	Supply	Installation	Commissioning
HV equipment	Local	Local	Local
LV equipment	Local	Local	Local
Cabling	Local	Local	Local
I&C PART	Supply	Installation	Commissioning
Control System	Local	Local	Local
Analysers	Local	Local	Local
Field instrumentation	Local	Local	Local
	Local		
	Imported		

## Process Parameters, Employer Inputs 1/3

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Fuel composition</b>				
Calorific value/ Qir	kJ/kg	16 280	17 390	
Average H2O content in original sample	% weight	17,5	15,88	
Average ash content in original sample/ Atr	% weight	22,7	20,85	
Sulphur content in original sample/ Sd	% weight			
average		0,9		
minimal		1,3		
maximal		0,6		
design		1,3	0,971	
Oxygen in original sample/ Odaf	% weight	21,1		
Sulphur in original sample/ Stdaf	% weight	1,38		
Main parameters, only.				

## Process Parameters, Employer Inputs 2/3

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Inlet flue gas</b>				
<b>SO2 content in original sample</b>	kg/h	4 008	2 498	3 055
<b>Flue gas volume</b>	Nm3/h	1 510 000	1 643 985	693 220
<b>Flue gas temperature at the inlet</b>	deg C	150-170	154,6	146,5
<b>Wet flue gas compos.</b>	% volume			
SO2		0,09		
O2		8,5	8,2	7,6
CO2		9,65		
Nox	mg/ Nm3	650 max		
Dust	mg/ Nm3	120	24,2	14,7
Cl-	mg/ Nm3	10 max	1,7	1,8
F-	mg/ Nm3	25 max	14,9	13,2
<b>Main parameters, only</b>				

## Process Parameters, Employer Inputs 3/3

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Limestone powder (informative composition)</b>	%weight			
CaCO <sub>3</sub>		90 min.	98,02	
MgCO <sub>3</sub>		4		
SiO <sub>2</sub>		2,9		
Al <sub>2</sub> O <sub>3</sub>		0,6		
Fe <sub>2</sub> O <sub>3</sub>		0,6		
MnO		0,03		
Others		1,87		
out of this SO <sub>3</sub>		0,02	80,29	
suma lim. fineness		80-88% finer than 0,045 mm		
<b>Process water (from cooling circuits)</b>				
Temperature	deg.C	14-25		
Pressure	bar	5		
Amount	l/s	50		
Main parameters, only				

## Process Parameters, Guarantee Values 1/4

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Desulphurised gas</b>				
<b>Emission values do not exceed the values:</b>	<b>mg/Nm<sup>3</sup></b>			
SO <sub>2</sub> content		500 max.	270	255
Cl- content		10 max.	0,6	0,5
F- content		6 max.	0,17	0,2
Dust content (valid for 6% O <sub>2</sub> , in dry gas)		50 max.	13	6
<b>Temperature at FGD outlet maximal</b>	<b>deg.C</b>	<b>55 min.</b>	<b>55,3</b>	<b>56,7</b>
<b>Liquid by-products</b>				
Quantity	m <sup>3</sup> /h	10 max.	2,5	
Solids content	%weight	5 max.	1,39	
pH		4 to 8	6,58	
Cl- content	ppm	7 000	726,5	
<b>Main parameters, only.</b>				

## Process Parameters, Guarantee Values 2/4

By-products - gypsum	Unit	Design value	Actual value WP1	Actual value WP2
Moisture	%weight.	10 max.	7	
Purity; as CaSO <sub>4</sub> .2 H <sub>2</sub> O content	%weight.	90	96,8	
suma CaCO <sub>3</sub> + MgCO <sub>3</sub> content	%weight.	1	0,571	
CaSO <sub>3</sub> content	%weight.	0,3	less than 0,05	
Cl- content	%weight.	0,03	0,0055	
F- content	%weight.	0,15	0,277	
MgO content	%weight.	0,16	0,0827	
SiO content	%weight.	2,5	0,171	
Alkali content as suma Na <sub>2</sub> O+K <sub>2</sub> O	%weight.	0,02	0,002	
Gaseous waste Solids quantity	mg/Nm <sup>3</sup>	25.l	1,77	
Main parameters, only.				

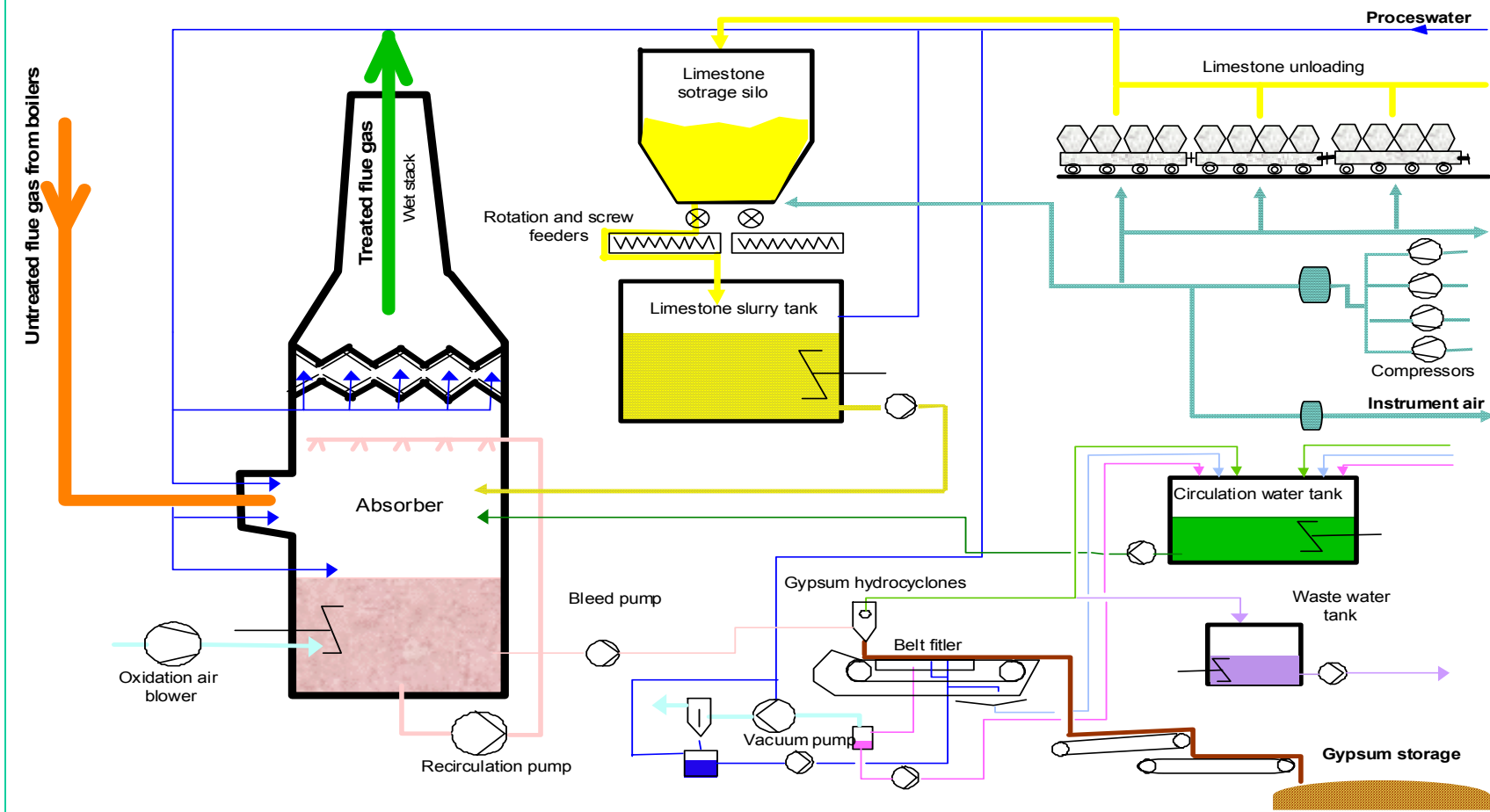
## Process Parameters, Guarantee Values 3/4

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Consumption and product.</b>				
Limestone powder (purity 90%)	t/h	6,268	5,962	
Process water from cooling system	m <sup>3</sup> /h	107,271	101,8	
Steam 0,5MPa, 170 deg.	t/h	fulfilled		
<b>Electric power</b>	kWh/h			
Absorber		1 555	1 410,84	
Common equipment		1 305	1 524,94	
Total (abs. + common)		2 860	2 935,78	
Limestone unloading		270	35,1	
FGD total consumpt.		3 130	2 970,88	
Absorber droplet concent. at all operation condit.	mg/Nm <sup>3</sup>	100 max.	51	
Main parameters, only.				

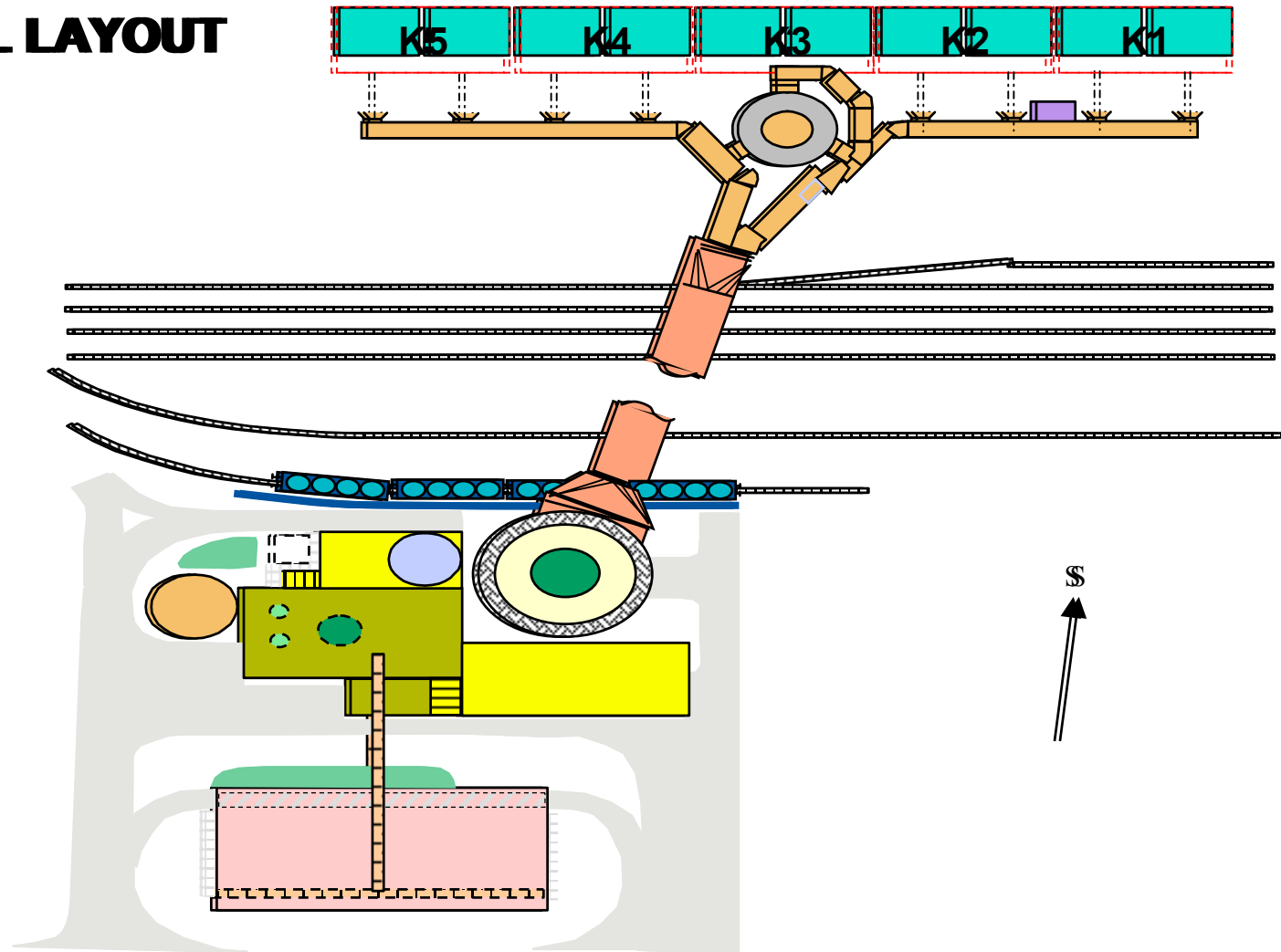
## Process Parameters, Guarantee Values 4/4

	Unit	Design value	Actual value WP1	Actual value WP2
<b>Total pressure loss</b>	Pa			
Guarantee test 1		2 000	1 170	
Guarantee test 2		2 100		
<b>Ducts</b>				
Guarantee test 1		1 100	160	
Guarantee test 2		1 100		
<b>Absorber</b>				
Guarantee test 1		900	acceptable	
Guarantee test 2		1 000		
<b>Annual availability</b>	%	to be evaluated during Guar. Test 2		
<b>Equivalent noise level</b>	dB (A)			
Control room		50	all values fulfilled	
Offices		65		
Plant area		85		
Outside				
day		70		
night		60		
Equipment		85		
<b>Main parameters, only.</b>				

## FGDP OPERATING PRINCIPLE



**GENERAL LAYOUT**



# ABSORBER LAYOUT

