INTECO

Fume Treatment System

Air pollution Controls in Steel Making Plants

Best Available Technology

Equipment Desing
Principles and application
Reference plants

01/09/2025

OUTLINE

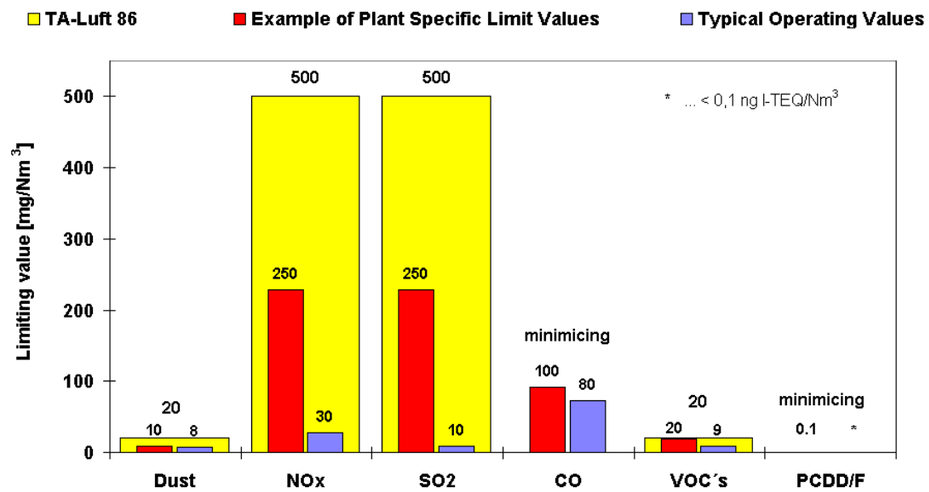
1. Background
2. Primary line
3. Secondary line
4. Filter
5. ID fans
6. Activated carbon injection
7. INTECO key features
8. References

BACKGROUND

Aim of Fumes Treatment System is collecting the emissions in the meltshop and reducing the content down, to preserve the employees working ambient and control the pollutants emitted in the environment.

POLLUTANTS limits TA luft 2002:

Particolate (Dust)	5 mg/m³
Dioxins	0,1 ng/m³
NOx	350 mg/m³
SOx	250 mg/m³
CO	100 mg/m³



For every metric ton of steel produced, 10 to 25 kilograms of dust generate.
There‘s no question that modern dedusting systems are crucial, but the costs and outlay for their operation should be no higher than absolutely necessary.

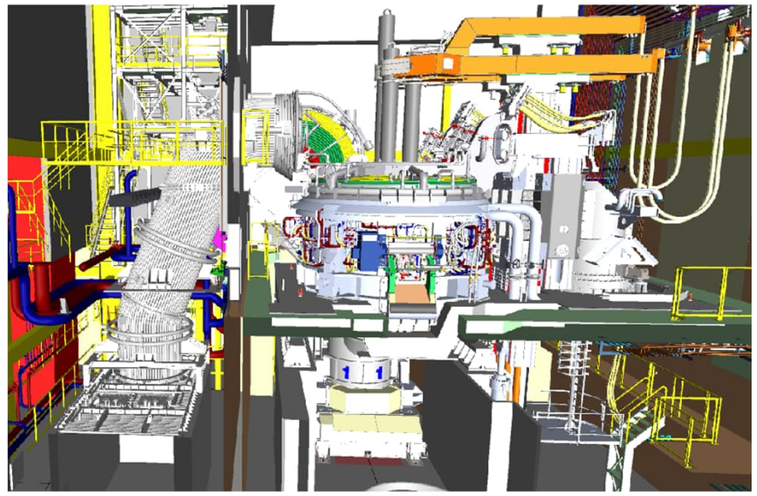
The most important goals are high reliability, strict compliance with prescribed threshold values and reasonable energy consumption (10 to 40 KWh/ton).

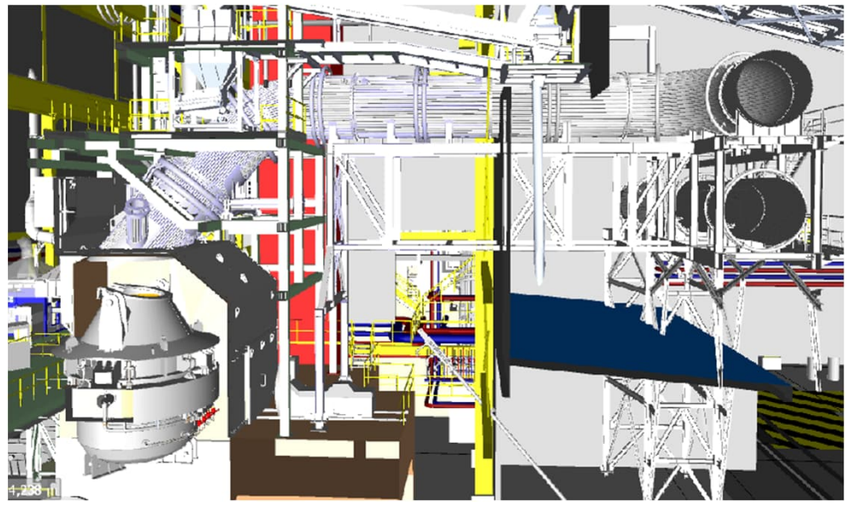
Emissions of dioxins and furans (PCDD/PCDF) can be limited using adsorbing powders.

This presentation goes through the EAF and FTS to show the main design principles and data.

BACKGROUND

- SOURCES
  - EAF
  - AOD Converter
  - Scrap preheater
  - LF
  - Additive Handling equipment
- EMISSIONS
  - Primary fumes (processed gas)
  - Secondary fumes





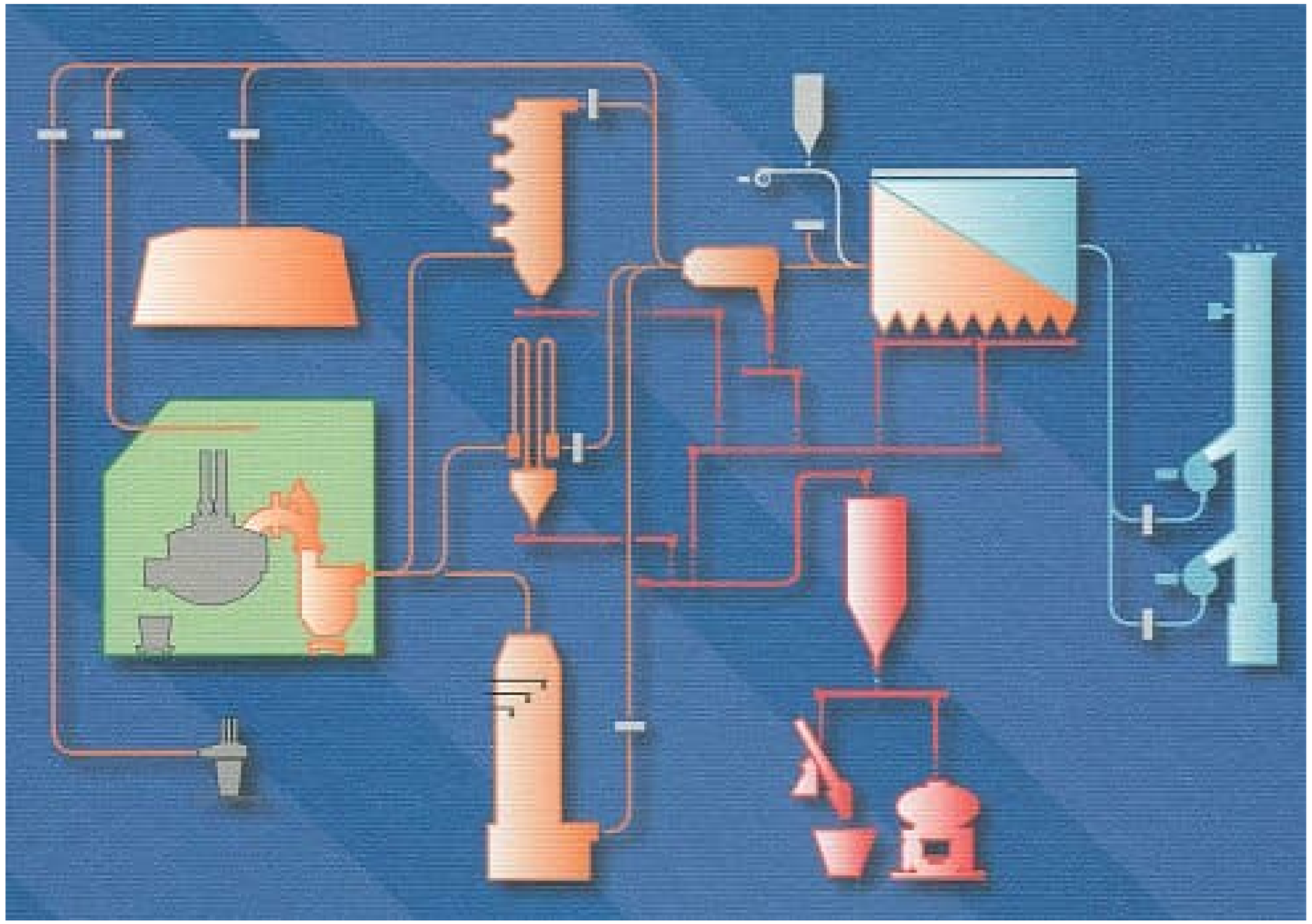
BACKGROUND

Fume Treatment System components:

Primary Line
- Water-cooled duct
- Combustion chamber
- Scrap preheater
- Coolers

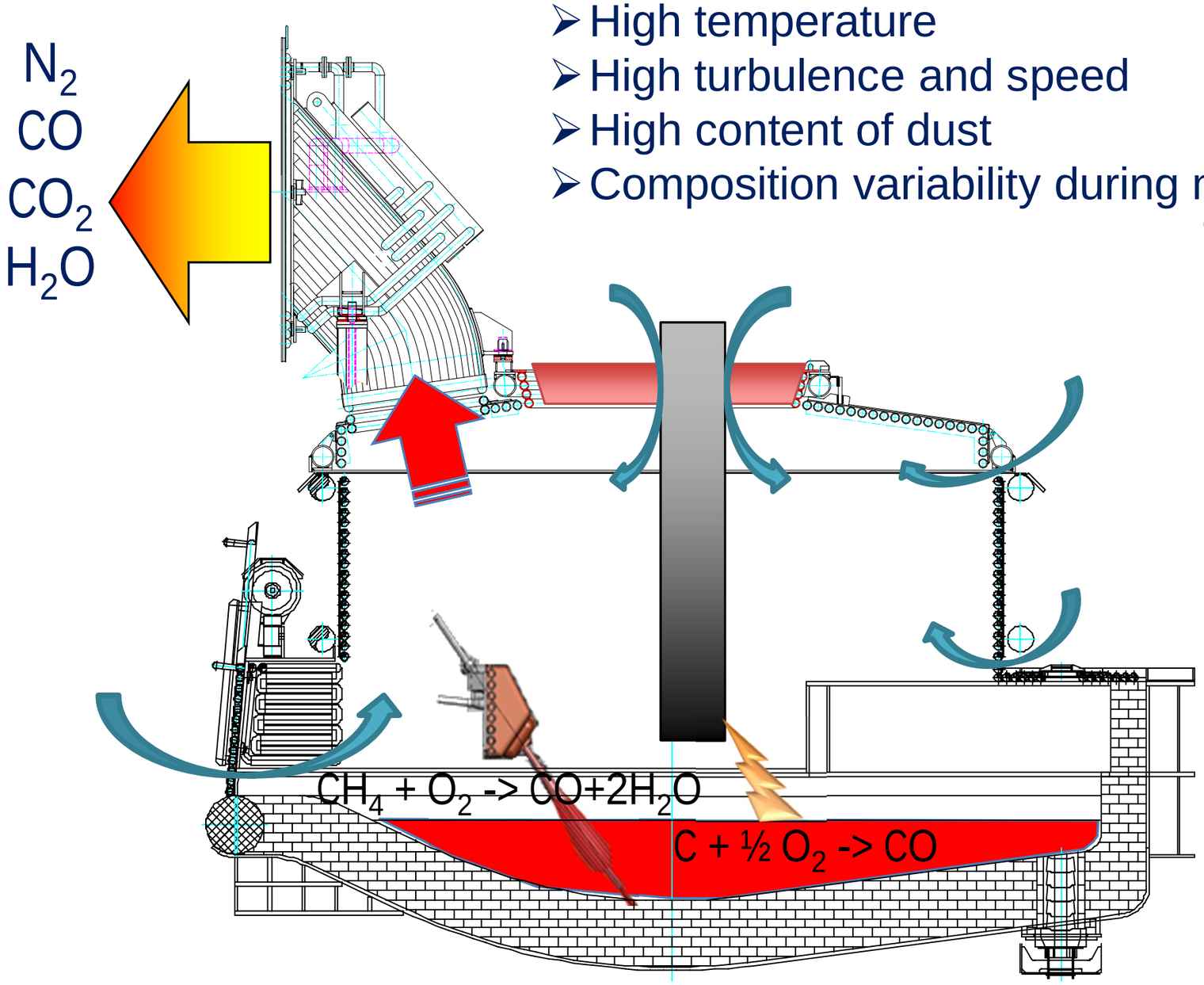
Secondary Line
- Canopy hood
- Local hoods
- Spark arrestor

Filter
Fans
Chimney
Noise enclosure



PRIMARY LINE

The most important volume of off gas form the melting process comes from the roof 4th hole.
The main elements find inside the gas are: N_2, CO, CO_2 and H_2O



The offgas is characterized by:

- High temperature
- High turbulence and speed
- High content of dust
- Composition variability during melting process

The offgas quantity depends on the process and equipment

- Gas coming for the arc plasma
- Burners
- Lances
- Air leakage from openings

Typical off-gas temperature
400 … 1400ºC
Typical fumes quantity
400.. 600 $Nm^3/h/ton$

With the flow and the gas speed 35-45 m/s is calculated the 4th hole area

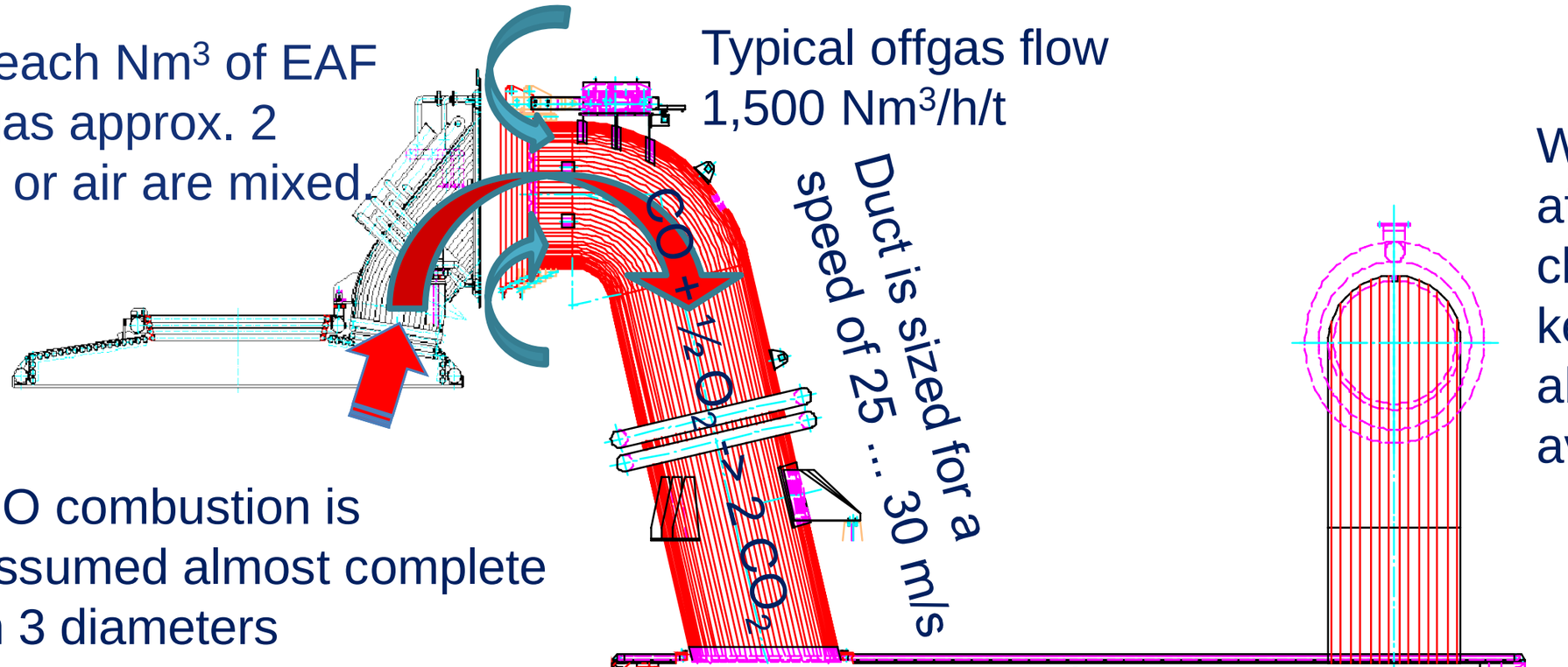
PRIMARY LINE

Between the 4th hole and the sliding sleeve is left a gap to:

1) allow the EAF roof movements
2) and keep intake air.

This air shall be enough to complete the CO combustion in every EAF phase and transitory time. CO not combusted can lead to explosions into the primary duct.

For each Nm^3 of EAF off-gas approx. 2 Nm^3 or air are mixed.



Typical offgas flow 1,500 $Nm^3/h/t$

Water cooled duct after the combustion chamber is sized to keep the gas speed above 16 m/s to avoid dust settling

CO combustion is assumed almost complete in 3 diameters

Thermal load is comparable to EAF shell, due to the CO combustion radiation

Duct is immediately descendant to settle the possible slag or steel pieces sucked from the EAF

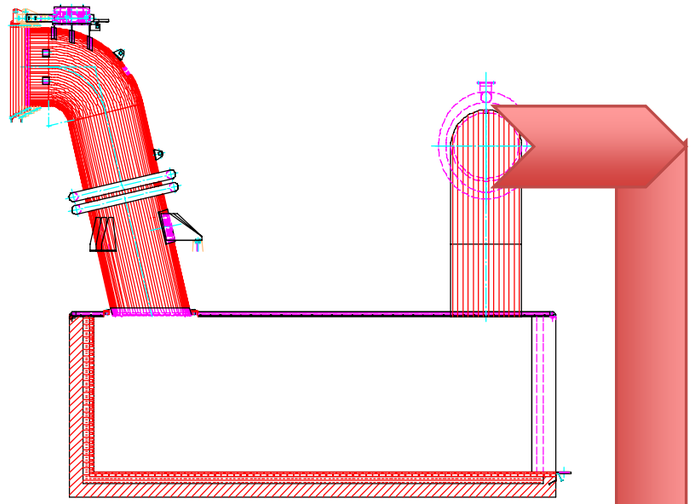
Combustion chamber hold the gas at temperature above 780° to complete the carbon monoxide reaction with the oxygen.
Typical retention time is 1,5 seconds.

PRIMARY LINE

Primary gas are cooled in
- Hot quenching tower
- Hairpin coolers.

NOTE: Force draft cooler are not use anymore for the huge maintenance requested.

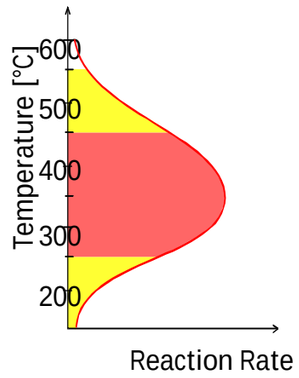
Primary gas are cooled by means of evaporative water atomized inside the gas flow



To end WCD the temperature of the gas shall be less than 650 °C

Primary gas are cooled by means of air to air exchange

The temperature drop is much faster: 0,4 sec.

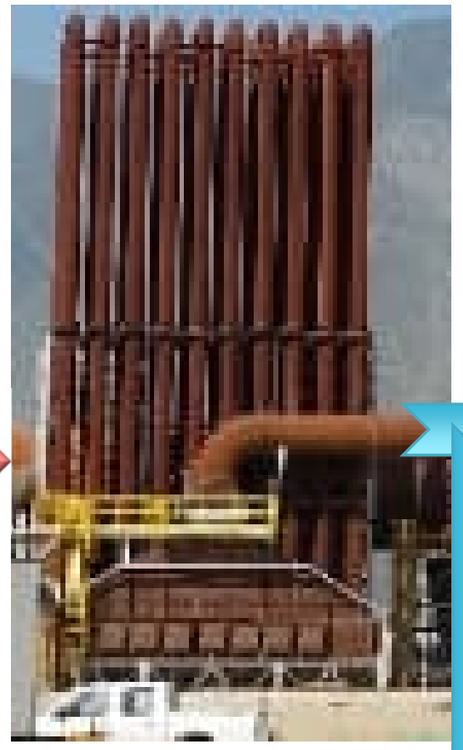


De novo synthesis of dioxin is reduced

The water cooled duct after the combustion chamber is 20 .. 60 m long

Temperature 900°C

Temperature 600°C



Typical temperature 240°C

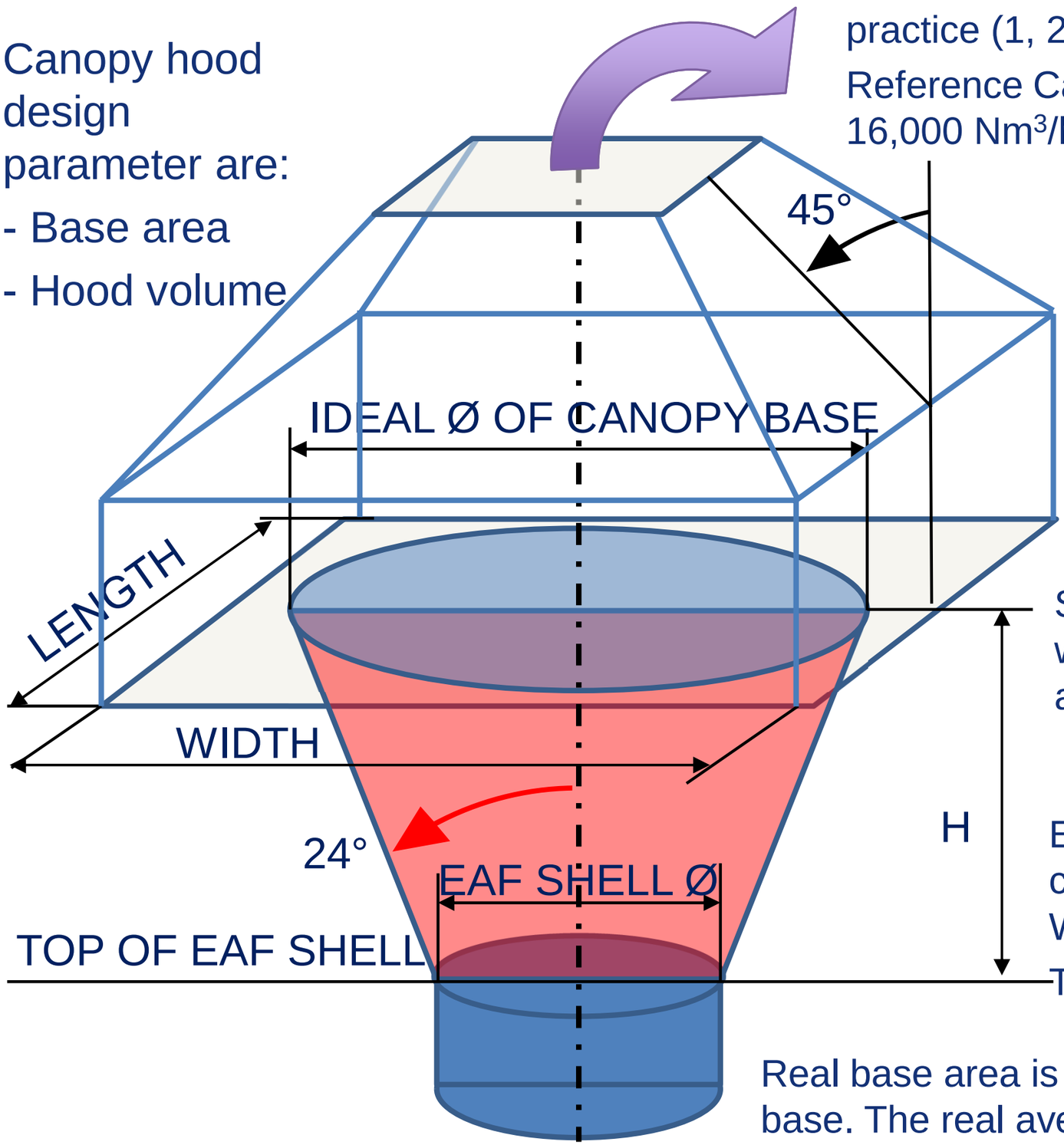
Fumes are collected to the secondary line

Typical temperature 300°C

SECONDARY LINE

Canopy hood design parameter are:

- Base area
- Hood volume



Hood volume is defined by volume of fumes generated during charging and the resident time. —INTECO—

The standard fumes generated by the scrap is very variable factor due to the scrap quality and charging practice (1, 2, 3 baskets) and hot heel weight.

Reference Captation Flow (RCF) parameter is 8,000 … 16,000 $Nm^3/h/t$ where t is the tapping capacity.

Minimum Resident Time (MRT) is the time of the fumes stay in the hood waiting to be collected. Typical values are 10 … 15 sec.

Minimum Canopy Volume is RCF/3600 x MRT

Flow may be calculated in two methods:

1) RCF x tapping capacity.

2) The hood base is the plane above the overhead bucket charging crane.

Starting form the top of the EAF shell project a cone with an angle of 24° to the hood base. The top circle area is the Base Hood Nominal Surface (BNS)

$$BNS = \frac{(2xHxtan\ 24° + Ø_{SHELL})\pi}{4}$$

EPA/452/B-02-001 define a range of speed to capture the plume of 1.0 .. 2.5 m/s,
We select 1.25 as reference value.

The secondary flow becomes: BNS x 1.25 / 3600

Real base area is the outline rectangle of the ideal round canopy base. The real averages speed shall be never be below 0.65 m/s.

Secondary duct is defined keeping the gas speed in a range of 20 … 26 m/s

FILTER

Filter is sized according the air to cloth ratio.

Today BAT requests 5 mg/m3 dust concentration at the stack.

The achieve this result the air to cloth shall be maximum 1.5 $m^3/min/m^2$.

Filtering surface results as:

Dedusting system flow [m^3/h] / 1.5 [m/min] / 60

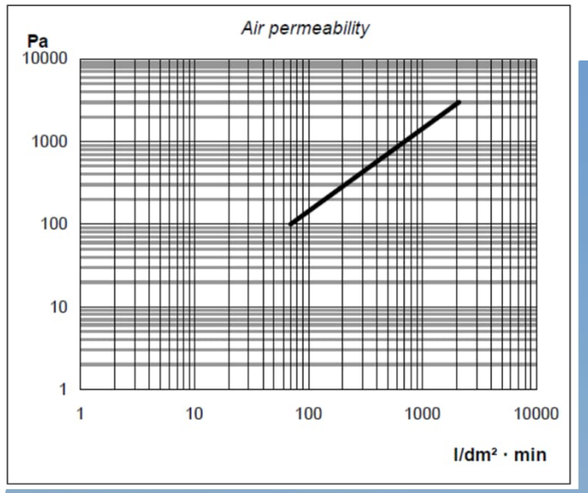
Filtering media is needled polyester

- Weight: 550 g/m2
- Air permeability @ 200: Pa 120 … 200 l/dm^2min
- Operating temperature: 125 … 150°C

Bags used diameters are 150 or 160 mm

Bags length is 6 to 12 meter.

Compartment cleaning is offline to assure improved and effective bags cleaning.



ID FANS

Induced Draft Fans shall be airfoil type, heavy duty, high efficiency, 82 … 84 %.

To work always at the best efficiency conditions nowadays the fans are inverter driven.

Fans speed are adjusted according EAF phase and Meltshop requirements.

Adsorbed power is evaluated as:

$$P = \frac{Flow\ x\ Delta\ pressure}{efficiency}$$

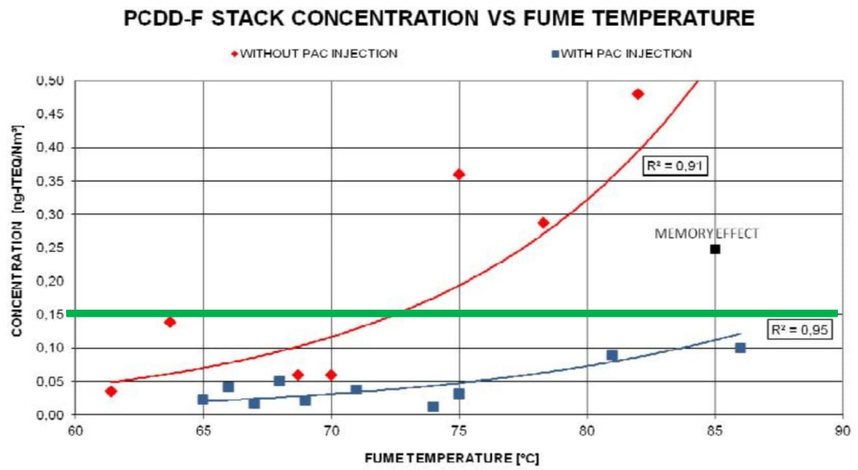
Flow is defined by the equipment and by the process.

Delta pressure is a consequence of the duct layout and ductwork design. Typical values are 4,000 … 6,000 Pa.

ACTIVATED CARBON INJECTION

To ensure the reduction of the dioxins according to the environmental standards requirements the installation of a system of activated carbon injection is recommended, to reach the limit of 0.1 ng/m^3

Activated Carbon Powder is blown in the gas flow and collected in the filter bags surface.
The dioxins into the fumes passing thought the cake on the bag surface are captured by the carbon powder.



PAC specific consumption: 20 ... 100 mg/m^3

E.G.:

FTS capacity 1,200,000 m^3/h flow

Specific injection 40 mg/m^3

Injected powder 1,200,000x40/1,000,000 = 48 kg/h

With the bags cleaning, the dioxins are collected with the dust in the dust handling system and treated as waste.

KEY FEATURES

INTECO has the more than 40 years of experience in metallurgical plant engineering.

Engineering and supply of equipment and process technology for melting and casting in the steel industry and auxiliary plant, like **Fume Treatment Systems**

- Engineering
  - 3D engineering
  - CFD analysis
  - Planning & feasibility studies
  - Project management & technical assistance
- Partners
  - Highly qualified manufacturing plants
  - Experts for process modelling & simulation
- Expert Know How
  - in all fields of the steel industry
- providing SOLUTIONS for you

  equipment and process technology from one single supplier

REFERENCES

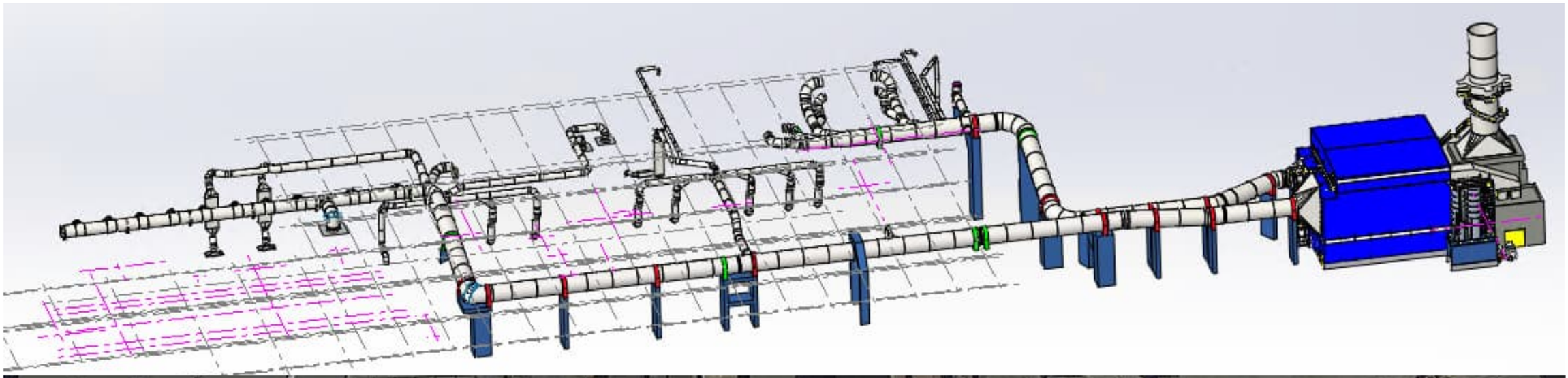
Customer: Buderus

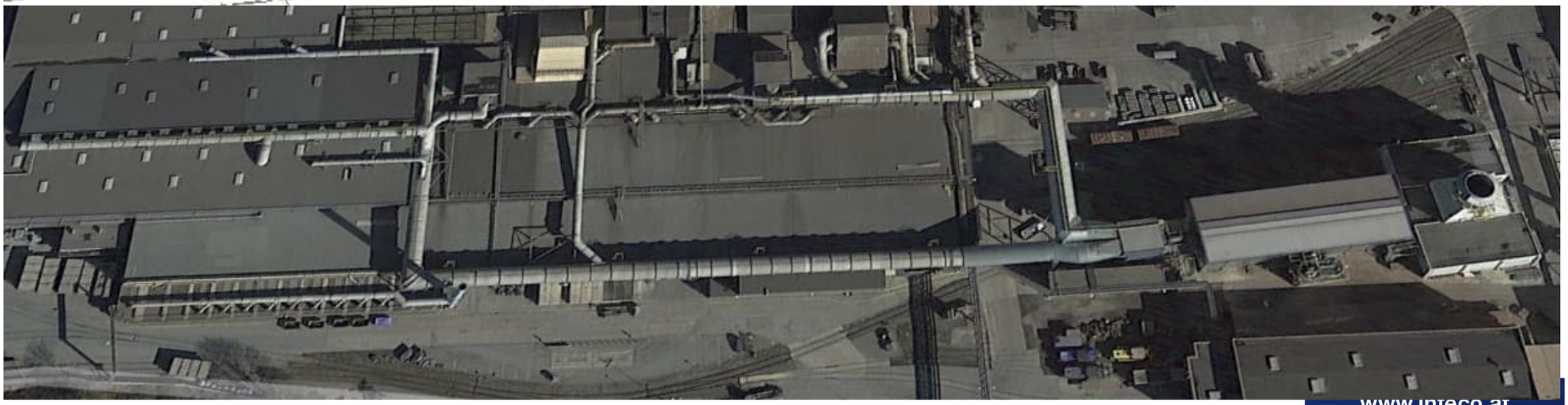
Location: Wetzlar - Germany

Project ID: 13-203/51-011 Automatic Teeming System / Fumes Treatment System

Description: Study of installation of a new dedusting system

Status: start up 2012





REFERENCES

Customer: Frisa

Location: Mexico

Project ID: 13-234 New meltshop

Description: Complete new dedusting plant - In cooperation with Bascotecnia (Spain)

Status: startup 2017

REFERENCES

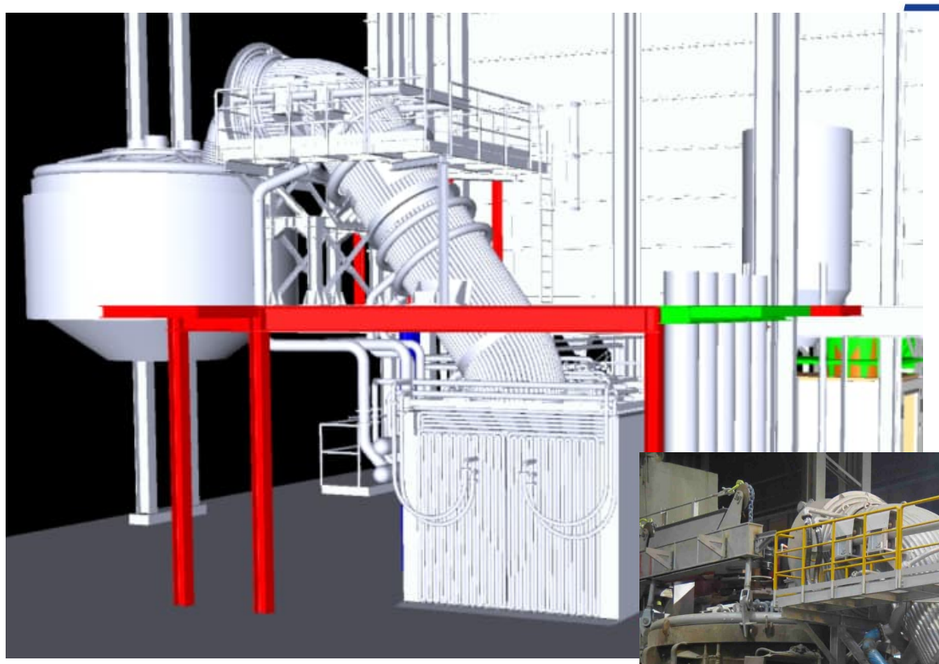
Customer: Gloria Steel

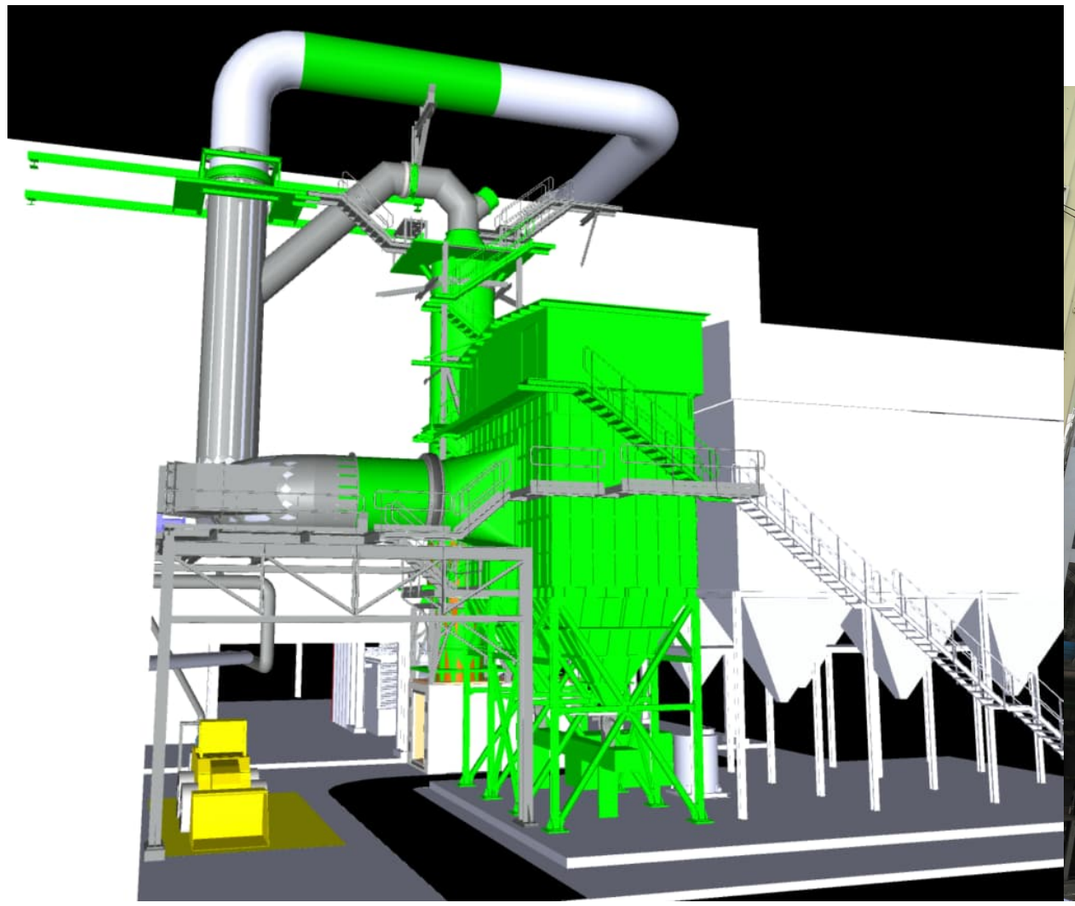
Location: Taiwan

Project ID: 13-210 / 51-017 Meltshop / Fumes Treatment System

Description: Revamping of primary line with new quenching tower

Status: start up 2018





REFERENCES

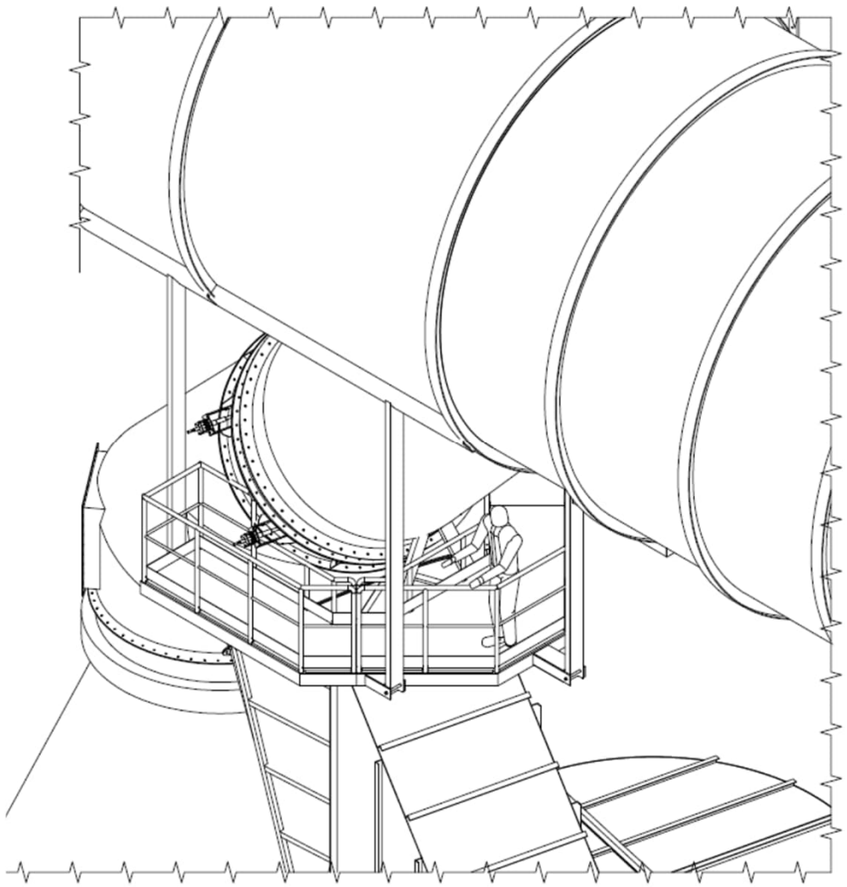
Customer: AFV Beltrame Vicenza

Location: Italy

Project ID: 51-021 Primary line by-pass

Description: Revamping of primary line

Status: start up 2019



Before installation

After installation

REFERENCES

Customer: AFV Beltrame Vicenza

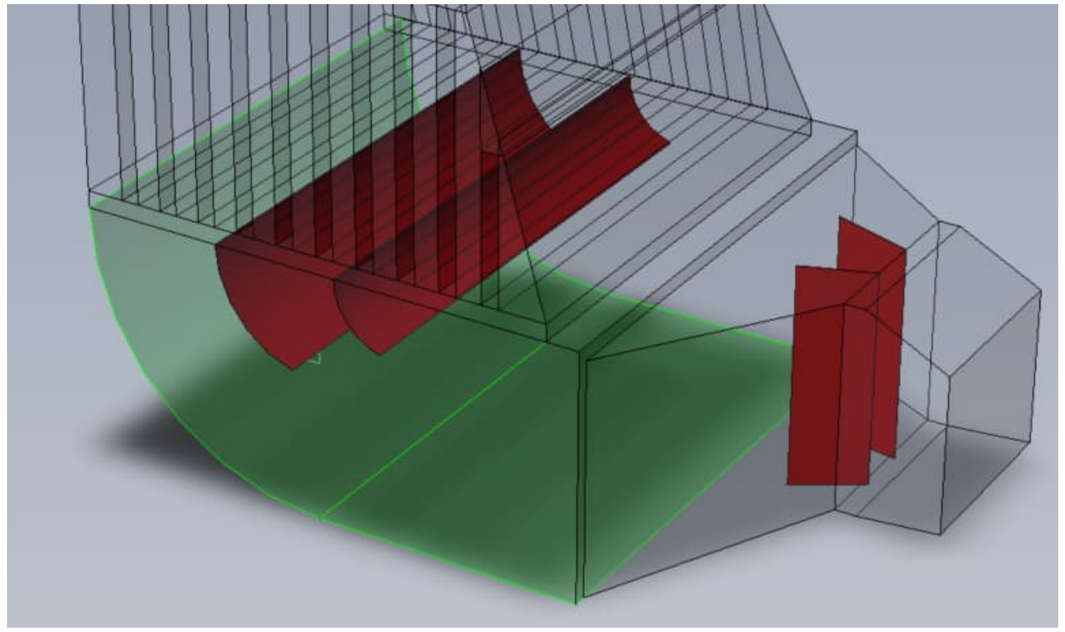
Location: Italy

Project ID: 51-026 Stack improvements

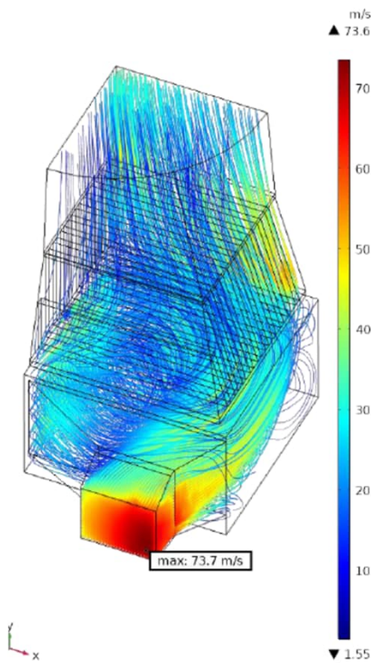
Description: Pressure drop reduction for electrical energy saving

Status: start up 2020

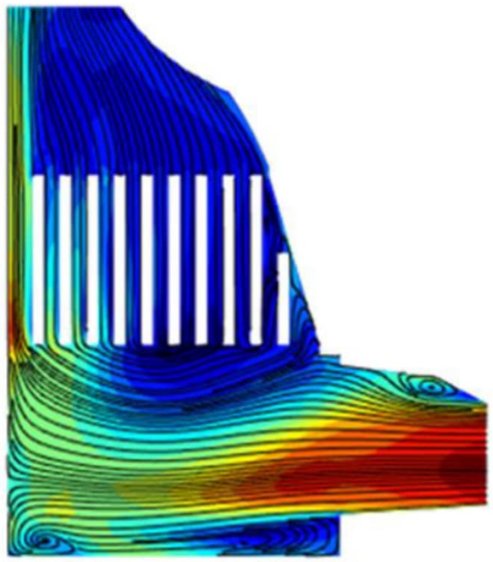
Proposal



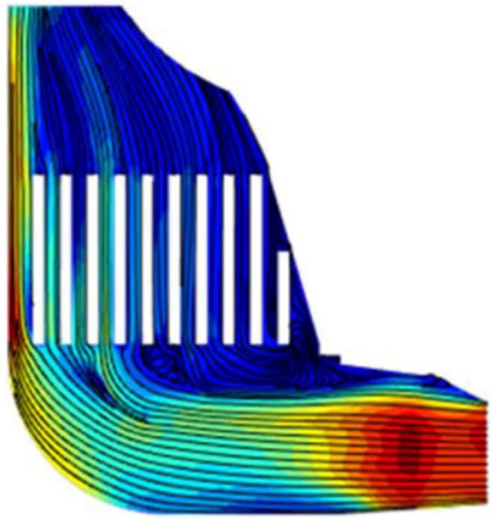
CFD analysis



Before optimization:



After optimization:



After installation

Payback less than one year!

REFERENCES

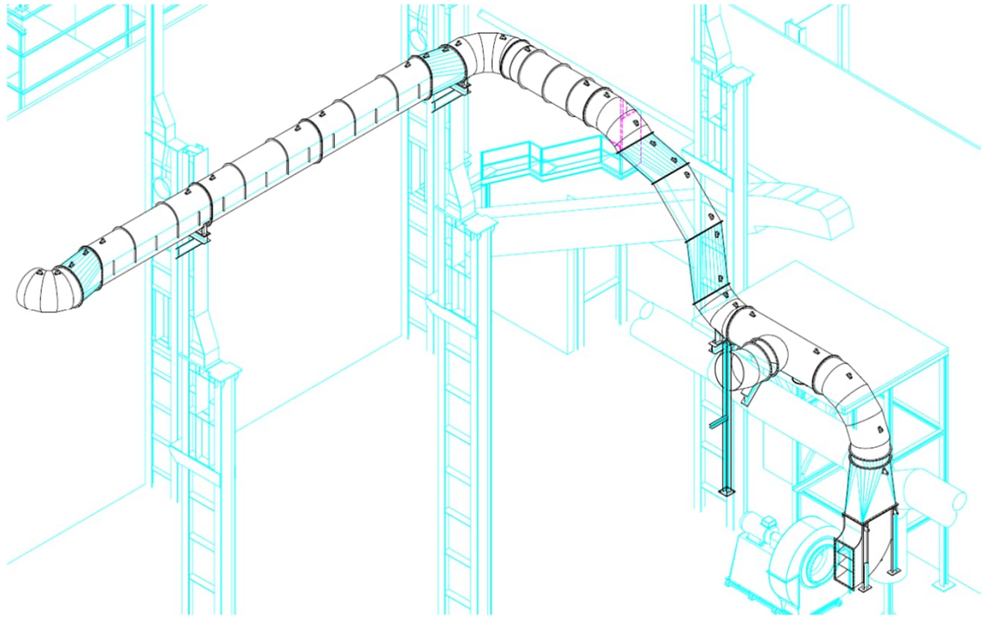
Customer: AFV Beltrame Vicenza

Location: Italy

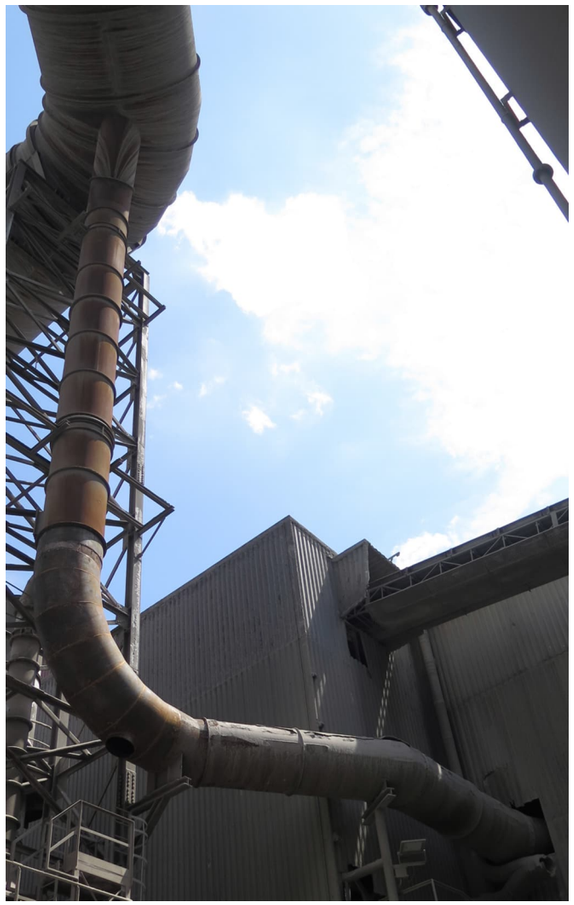
Project ID: 51-027 New LF dcut

Description: Rerouting of the existing LF duct

Status: start up 2021

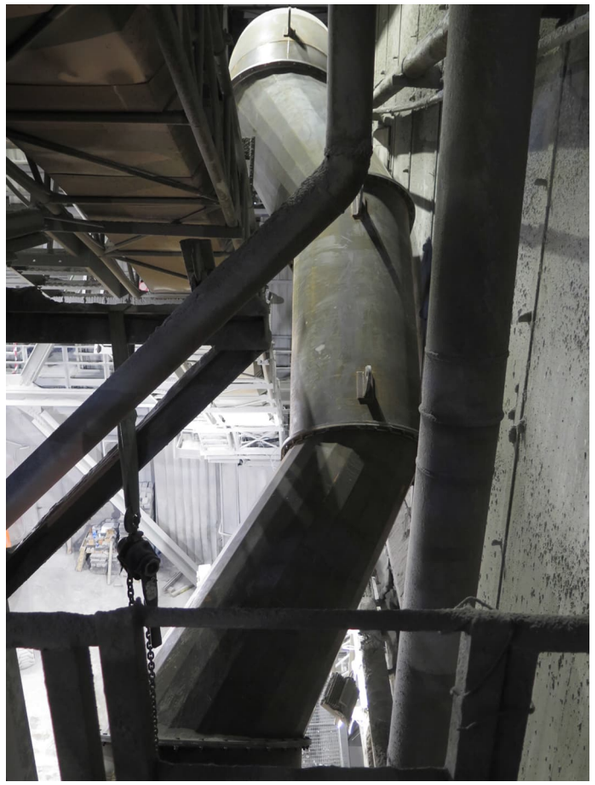


Connection to FTS



Obround shape to reduce print foot

Deviances to avoid collisions



REFERENCES

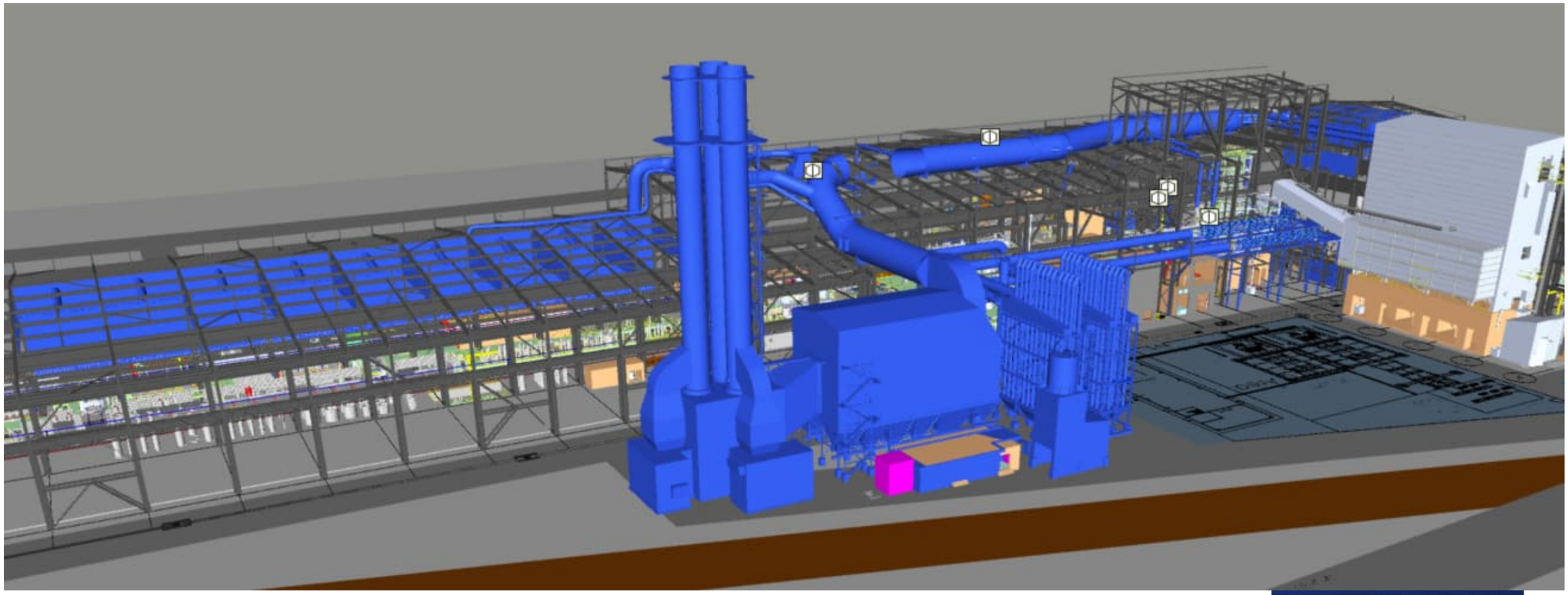
Customer: Gloria Steel

Location: Taiwan

Project ID: 13-210 / 51-017
Meltshop / Fumes Treatment System

Description: Supply and installation of a new dedusting system

Status: Startup July 2024



REFERENCES

Customer: Meltshop Isfahan

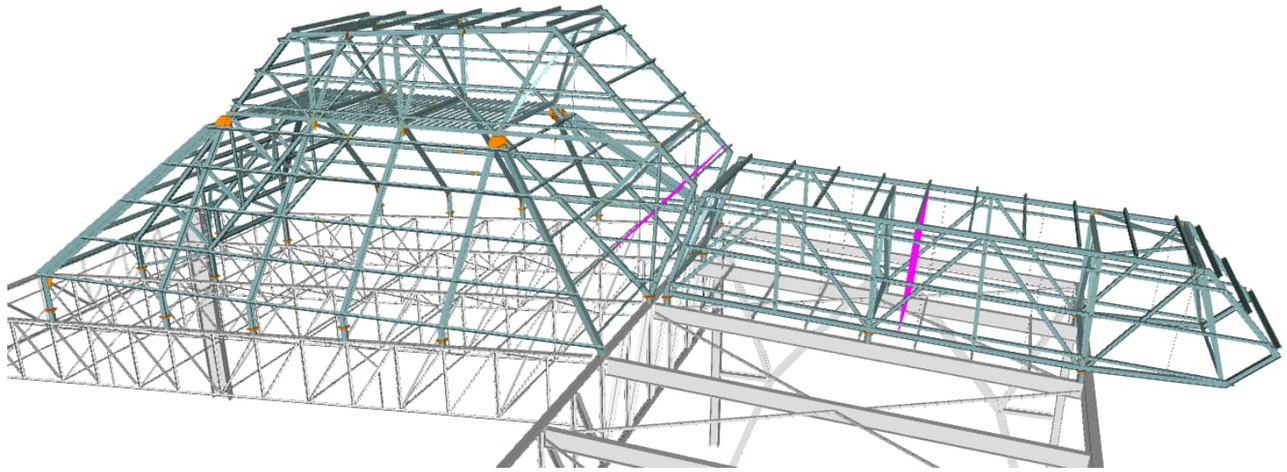
Location: Iran

Project ID: 51-033 FTS improvement

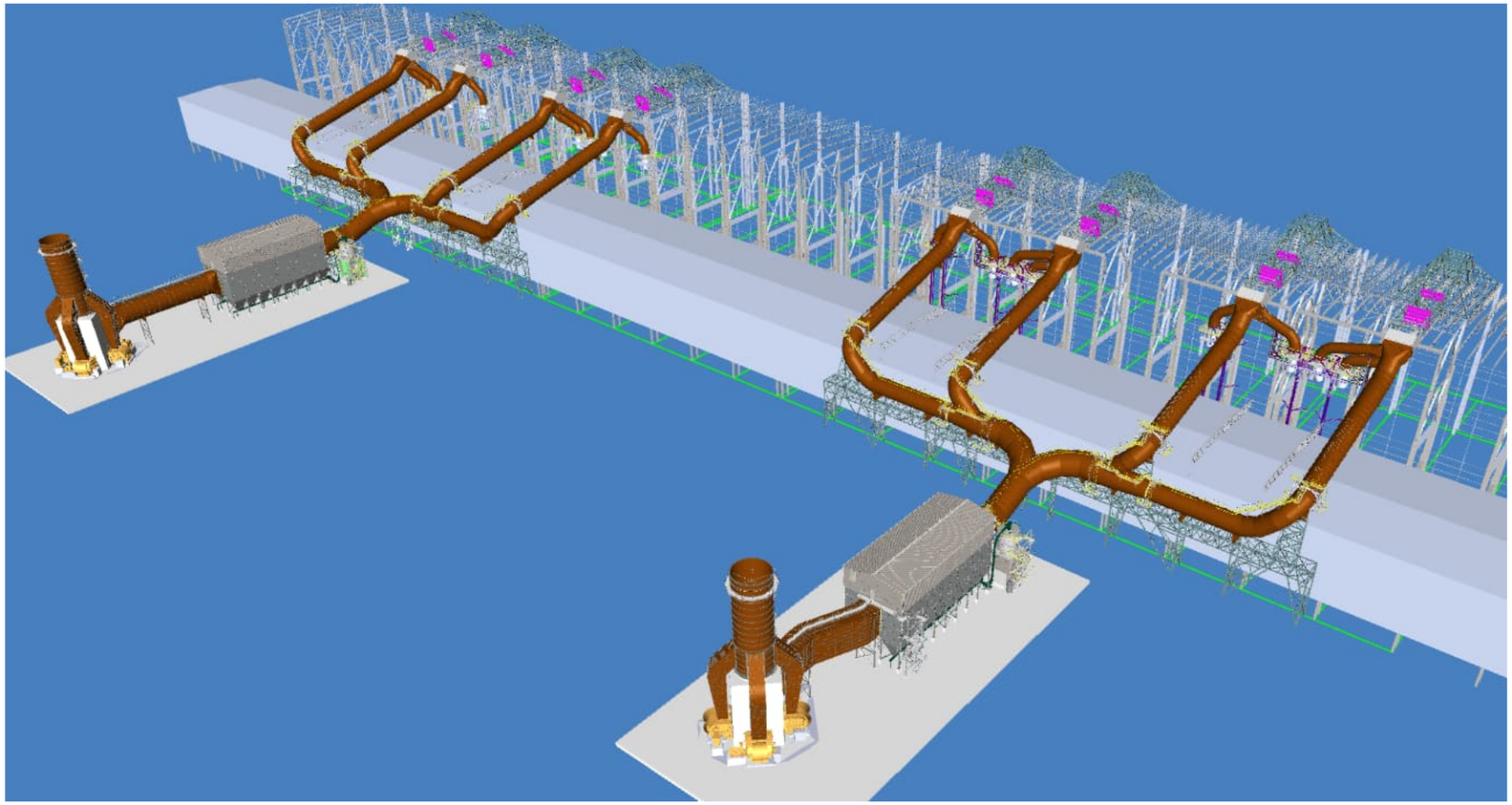
Description: Increasing of suction capacity for the canopy hoof of 8 electric arc furnaces

Status: on-going

New canopy hood with truncated pyramid design



Connection form the eight hoods to the filters



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Thank You

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