Tata Steel Nederland

Steel & Copper – Power Quality in a transitioning industry

3rd of February 2026

Content

- About Tata Steel
- Steel making now & green steel
- Current Copper & more Copper

About us

Piet Knol

- Working for Projects & Engineering [P&E] department as Principal Engineer High Voltage since 2019
  - Lead Engineer new High Voltage Infrastructure for the Green Steel project
  - Member of CIGRE B3 and NEC27/TC 27 IEC 60683
  - Before Tata Steel: 19 years at Qirion

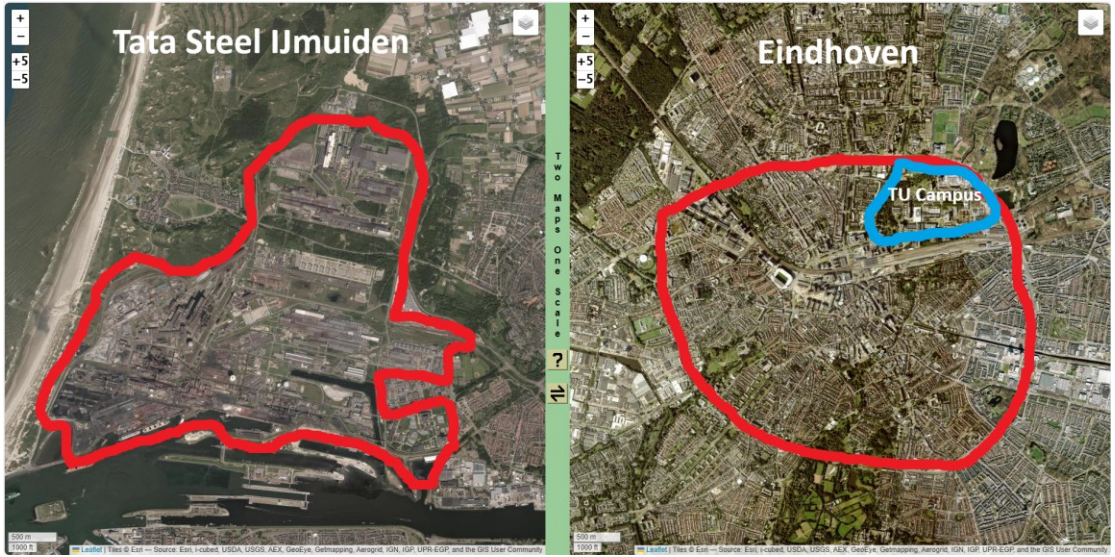
Menno Spitteler

- Working for Projects & Engineering [P&E] department as Project Engineer Power Quality & Grid studies since 2024
  - Member of CIGRE C4 and NEC8 /TC8 WG11 Power Quality
  - Graduated TU/e on Supraharmonics, supervised by Jeroen van Waes

About Tata Steel IJmuiden

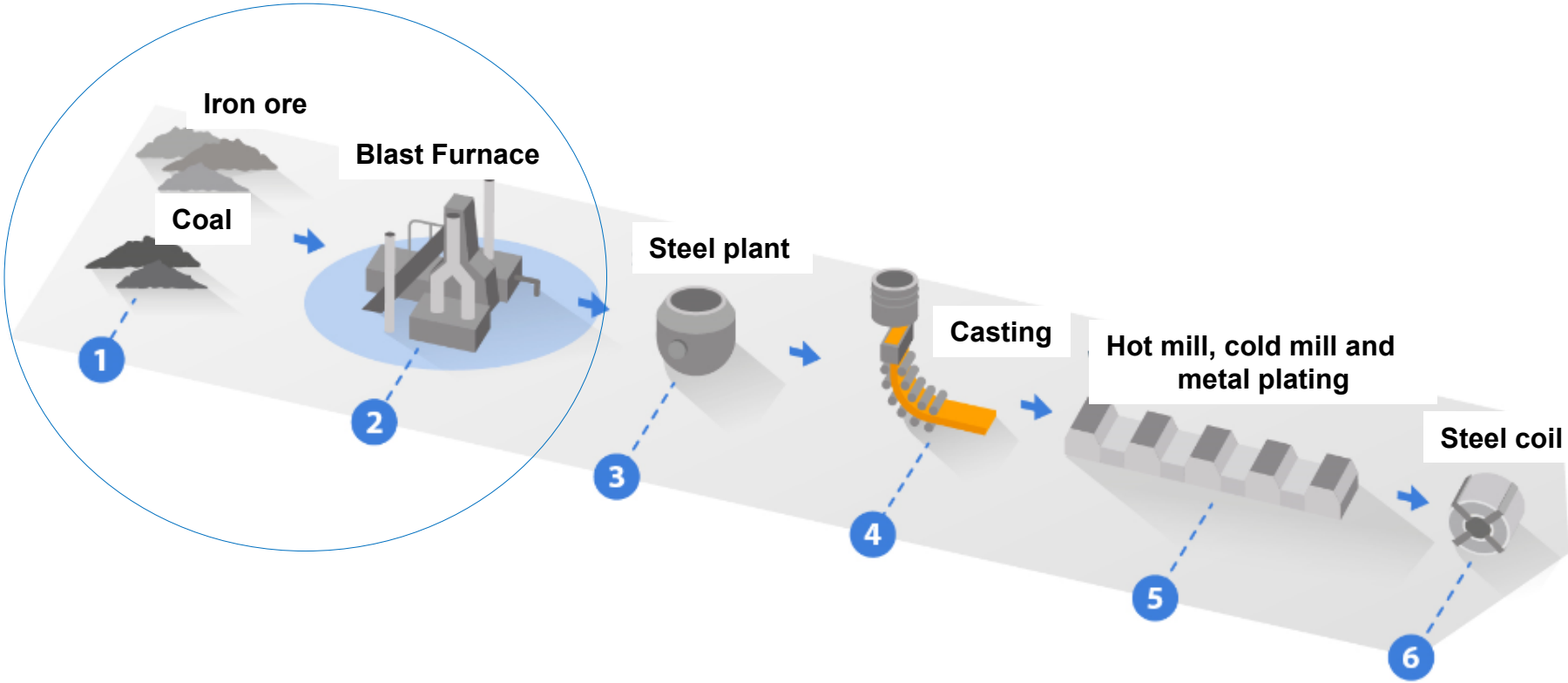
- One of the most CO_2-efficient steel plants in the world. In 2023, we have been recognized as a Steel Sustainability Champion by World Steel Association for the sixth consecutive year.

- Integrated steel plant -> From raw iron ore to painted, galvanized or other treated Steel Coils.

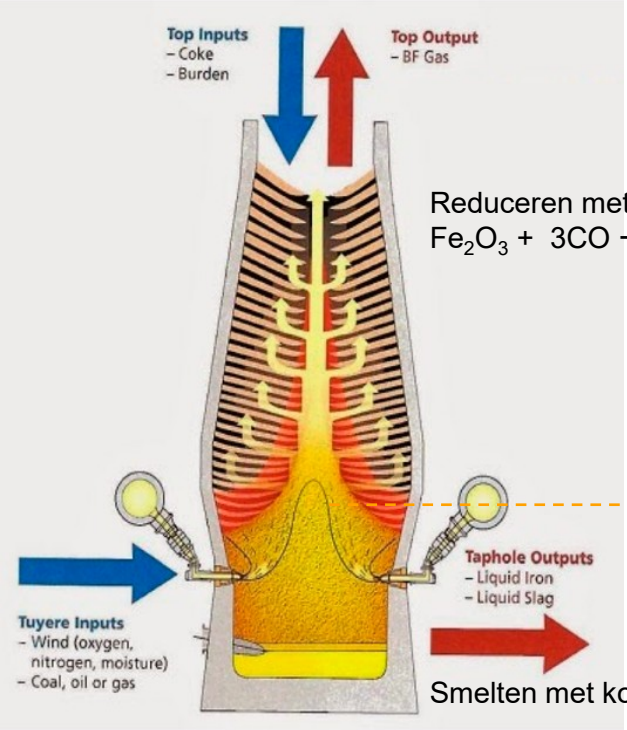


Steel Making Process

Most CO_2 emissions originate from this area



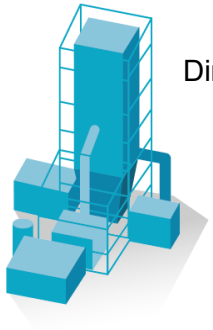
Vervangen van de hoogoven door een Direct Reduction Plant (DRP) in combinatie met een Electric Arc Furnace (EAF)



Reduceren met kolen

$Fe_2O_3 + 3CO \rightarrow 2\,Fe + 3CO_2$

Smelten met kolen



Direct Reduction Plant

Reduceren met aardgas

$4Fe_2O_3 + 3CH_4 \rightarrow 8Fe + 3CO_2 + 6H_2O$

Reduceren met waterstof

$Fe_2O_3 + 3H_2 \rightarrow 2\,Fe + 3H_2O$

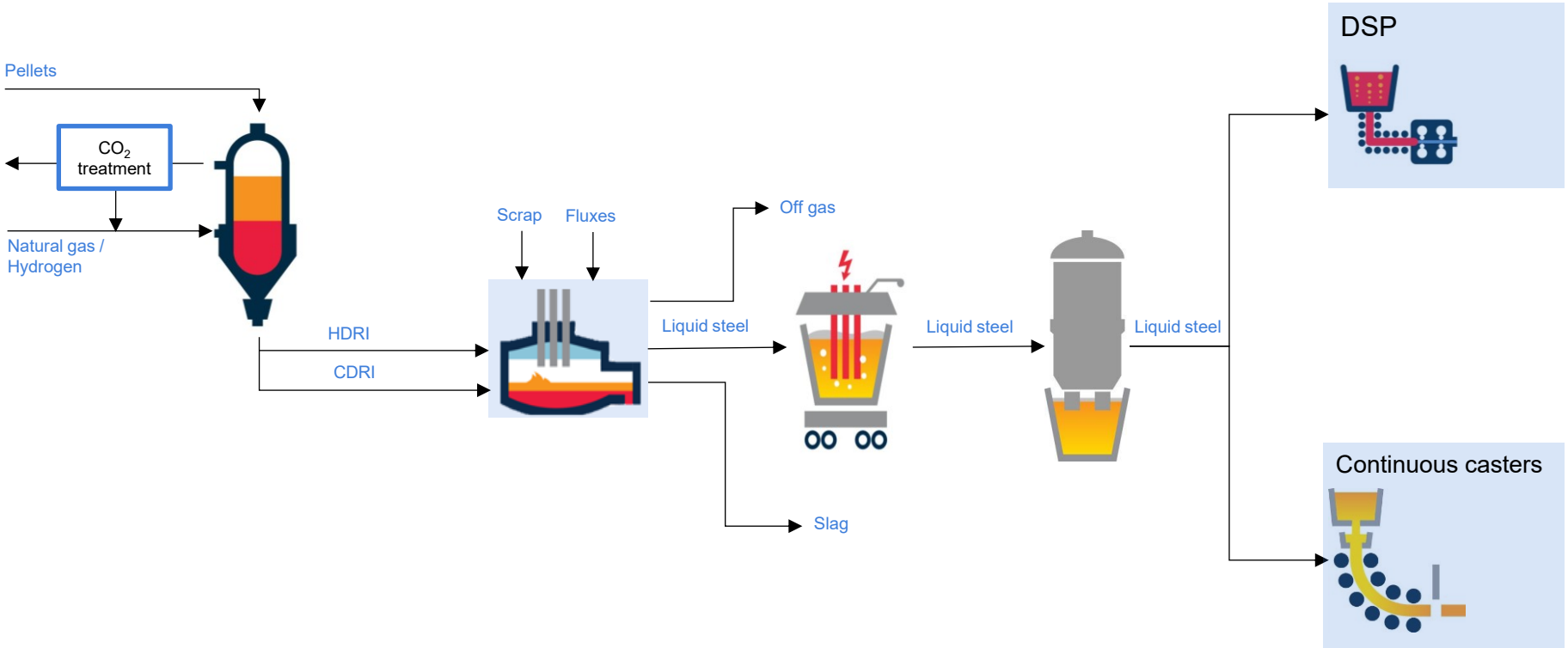
Reduceren

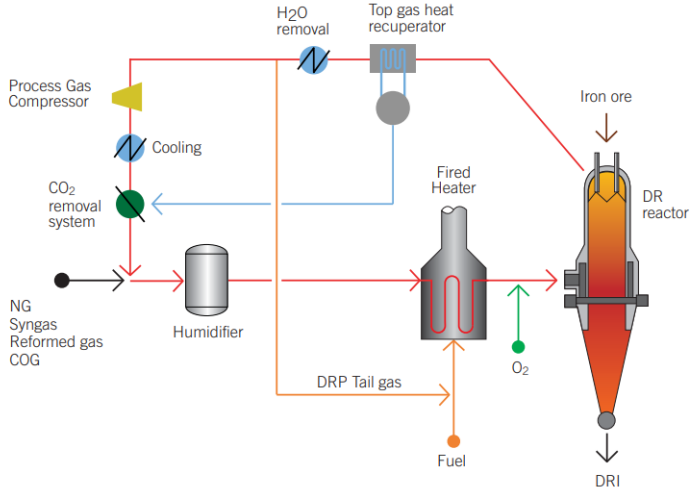
Smelten

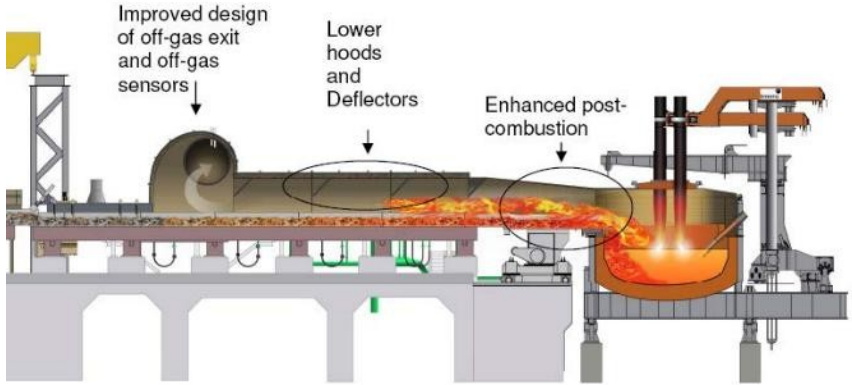
Electric Arc Furnace

Smelten met Elektriciteit

Het nieuwe proces




H_2O removal
Top gas heat recuperator
Process Gas Compressor
Cooling
CO_2 removal system
Iron ore
Fired Heater
DR reactor
NG
Syngas
Reformed gas
COG
Humidifier
O_2
DRP Tail gas
Fuel
DRI

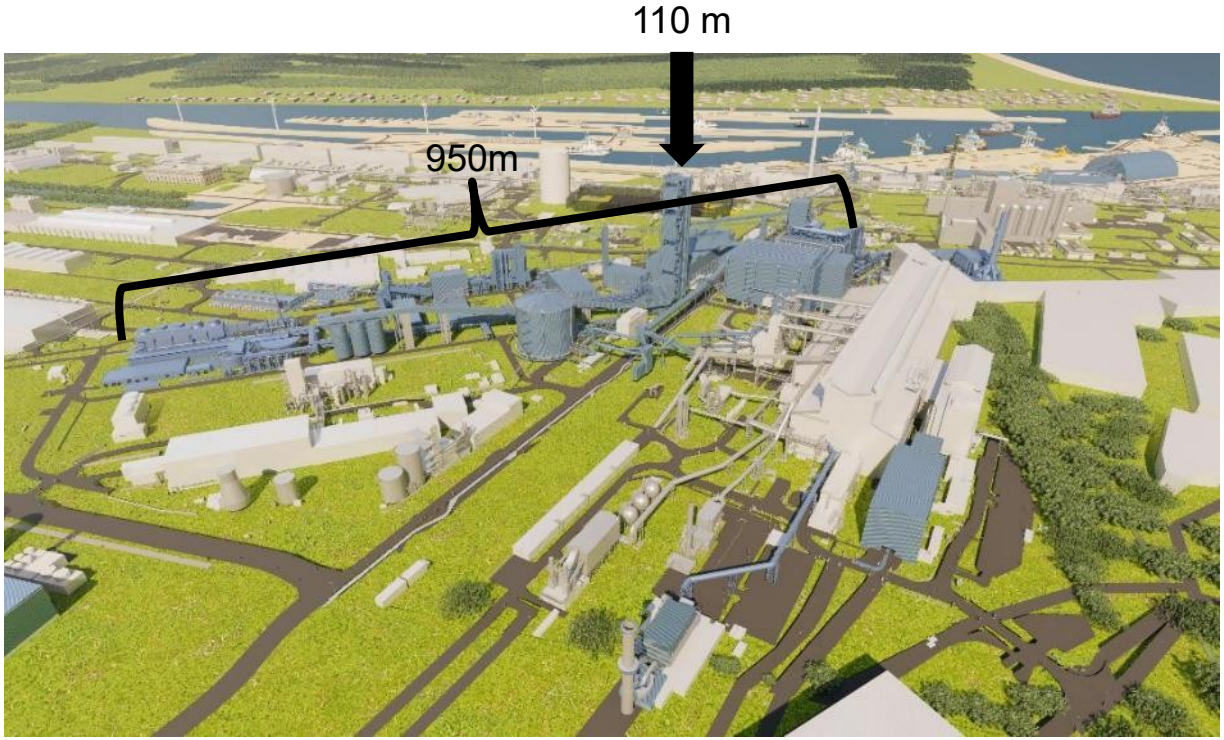

Improved design of off-gas exit and off-gas sensors
Lower hoods and Deflectors
Enhanced post-combustion


tenova

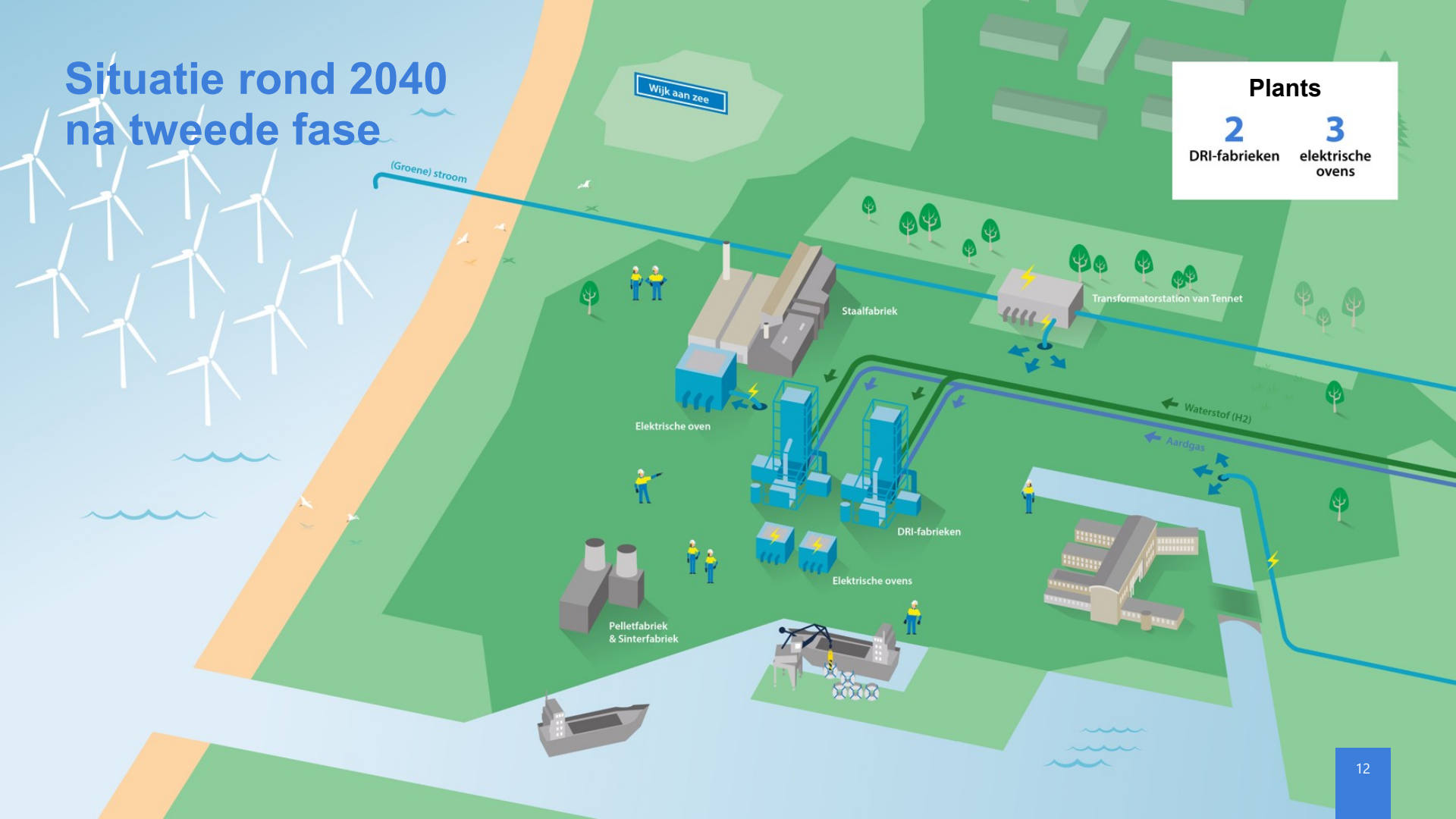
Impression of the HeraCless phase 1 project

Highest point 110 m
Main site approx. 950m x 150m

All in blue is new

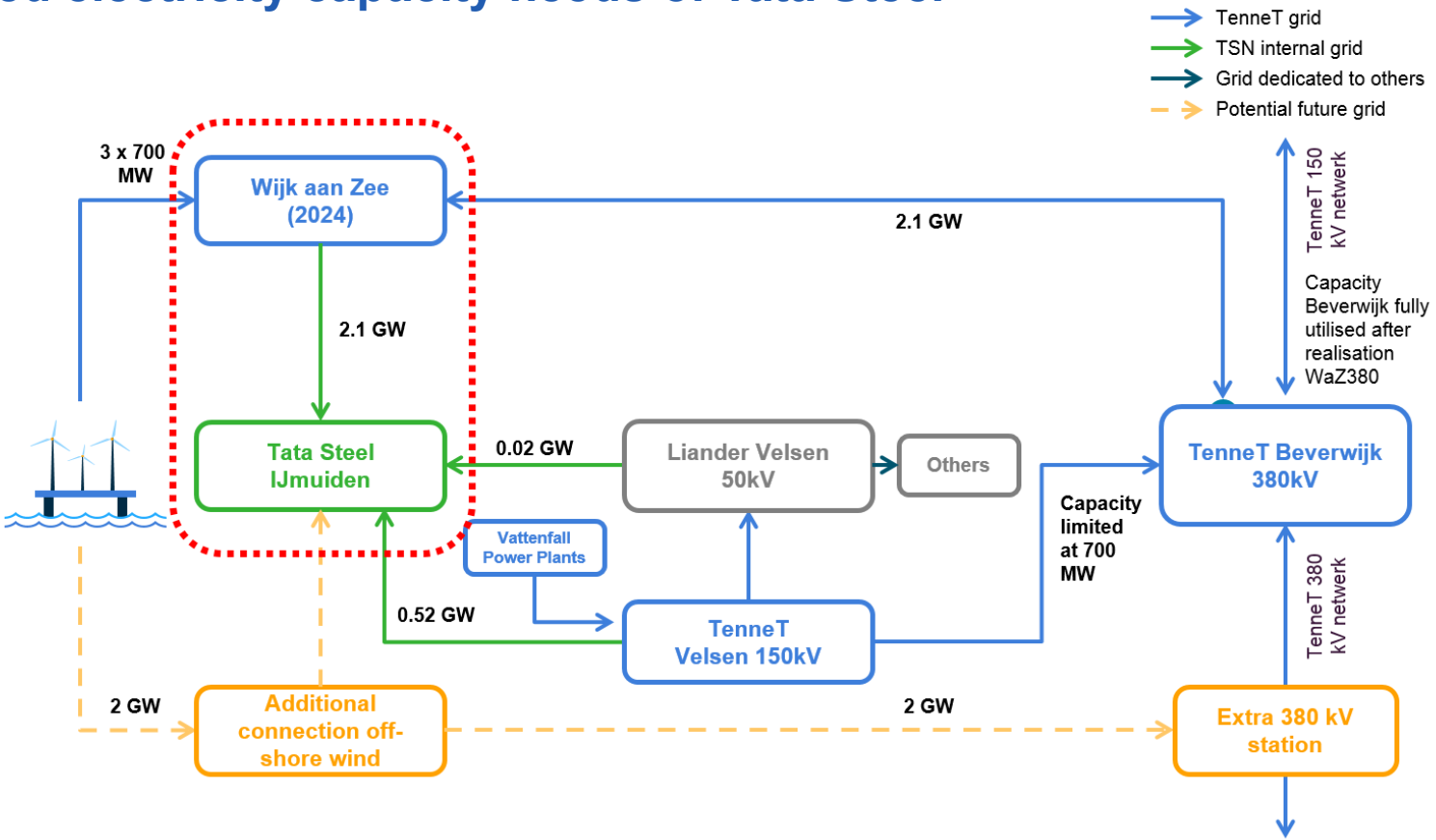


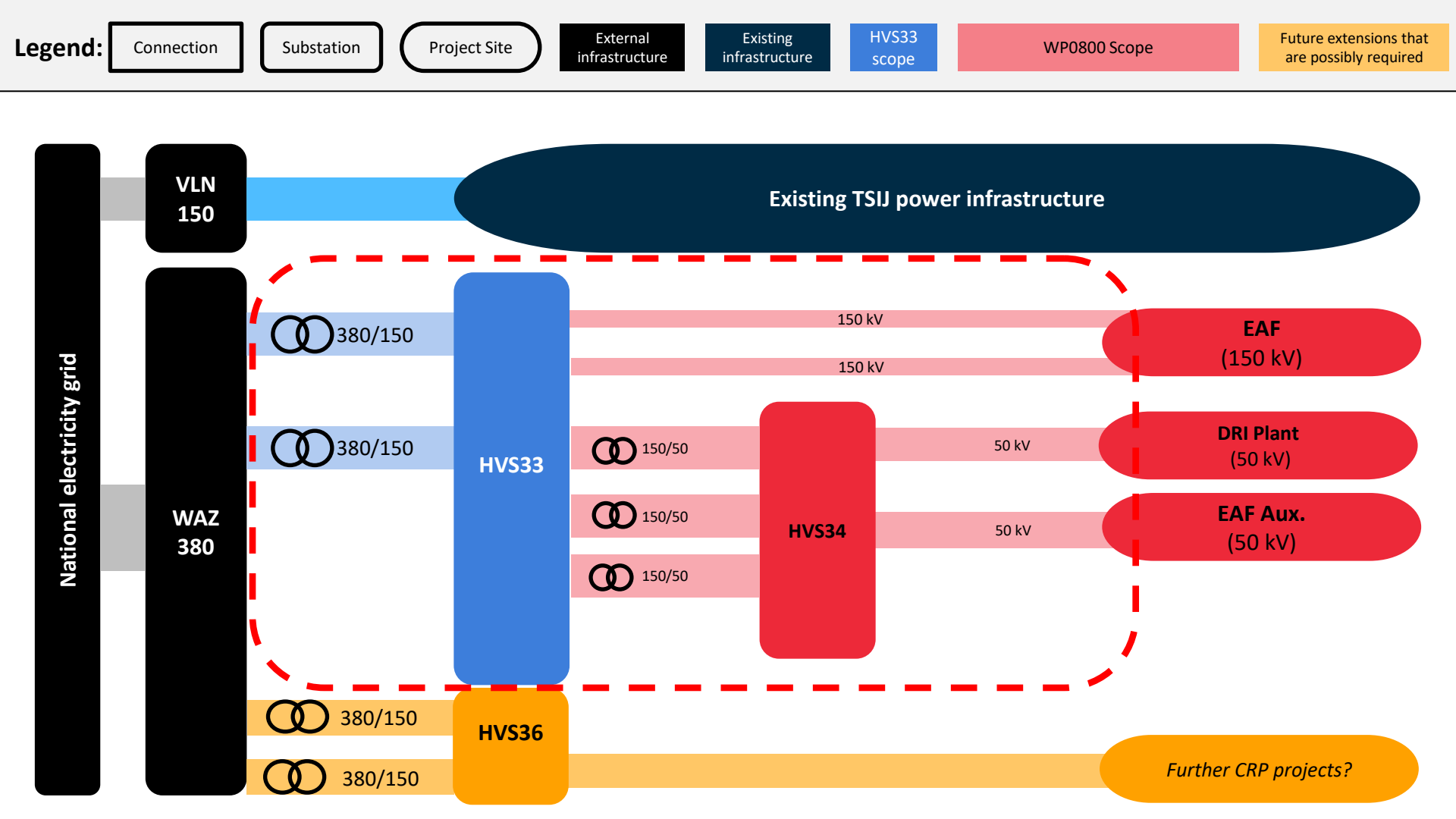
Situatie rond 2040 na tweede fase



Green Steel & More Copper

Grid developments in IJmond area can support the increased electricity capacity needs of Tata Steel



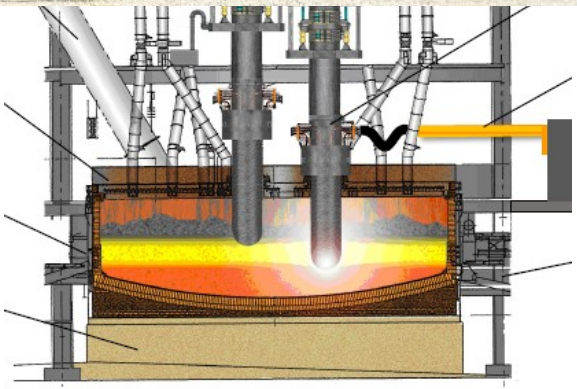

Legend:
Connection
Substation
Project Site
External infrastructure
Existing infrastructure
HVS33 scope
WP0800 Scope
Future extensions that are possibly required
National electricity grid
VLN 150
WAZ 380
Existing TSIJ power infrastructure
380/150
380/150
HVS33
150 kV
150 kV
150/50
150/50
150/50
HVS34
50 kV
50 kV
EAF (150 kV)
DRI Plant (50 kV)
EAF Aux. (50 kV)
380/150
380/150
HVS36
Further CRP projects?

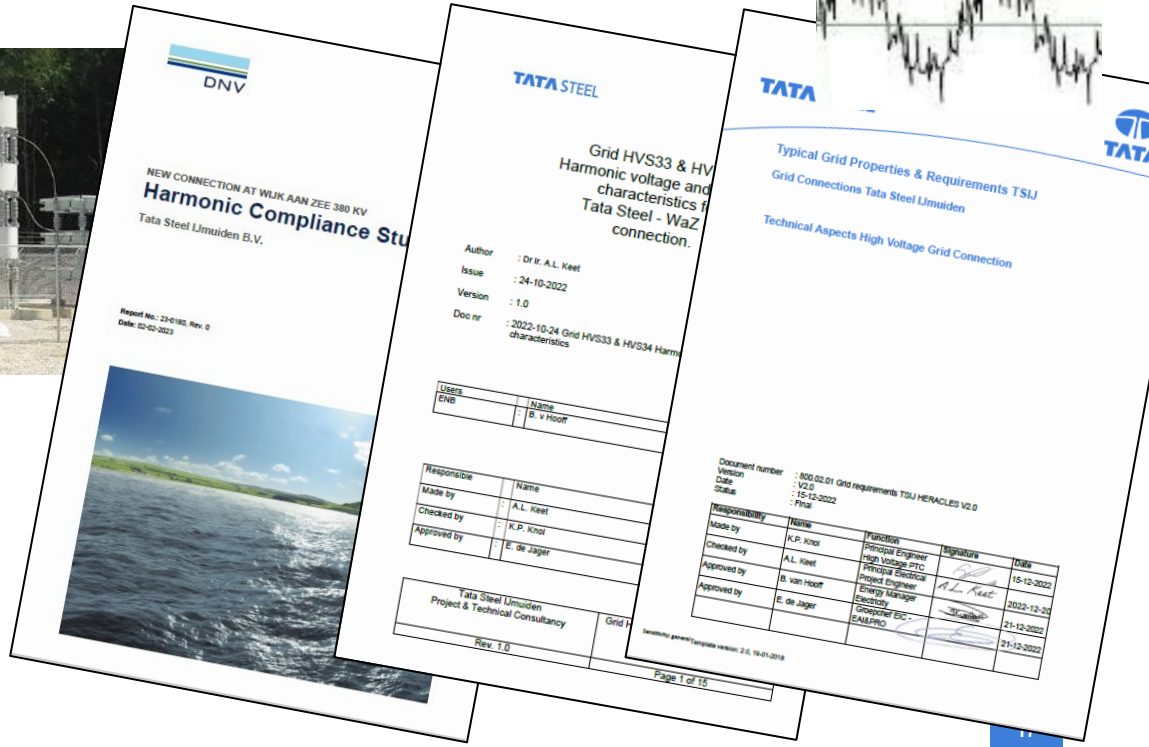
Extension TSIJ Grid 500MW ➔ ++2000MW

Tennet
Sub Station WAZ 380kV

Power Quality

Due to non-linear loads: A Major Topic





Tata Steel has an own grid code

- Transposition of TSO limits downstream to each user based on rated power

TATA STEEL

Grid Properties & Requirements TSIJ

TATA

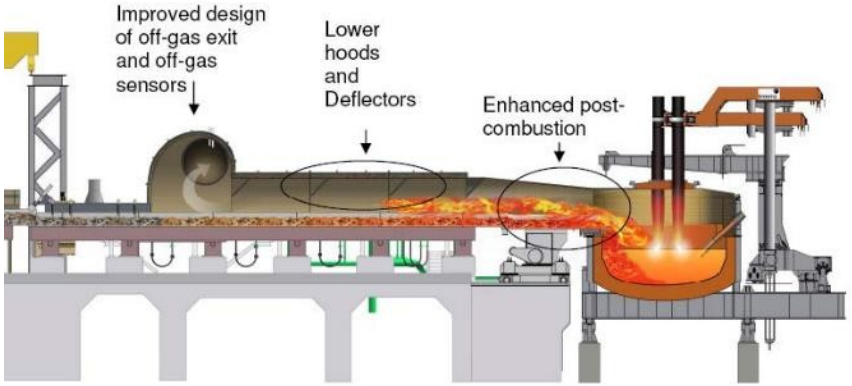
Document number : 800.02.01 Grid requirements TSIJ
Version : 3.0
Date : 3-8-2023
Status : Final

Responsibility	Name	Function	Signature	Date
Made by	K.P. Knol	Engineering Fellow High Voltage PTC		03-08-23
Checked by	P.K.Maity	Senior Project Engineer High Voltage PTC		04-08-2023
Checked by	J. de Man	Senior Project Engineer High Voltage PTC High		04-08-2023
Approved by	B. van Hooff	Energy Manager Electricity ENB		03-08-23
Approved by	E. de Jager	Department Head - EAM/PRO		04-08-23

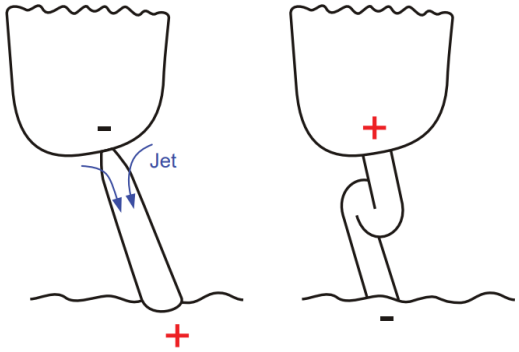
Template version: 2.0, 18-01-2018

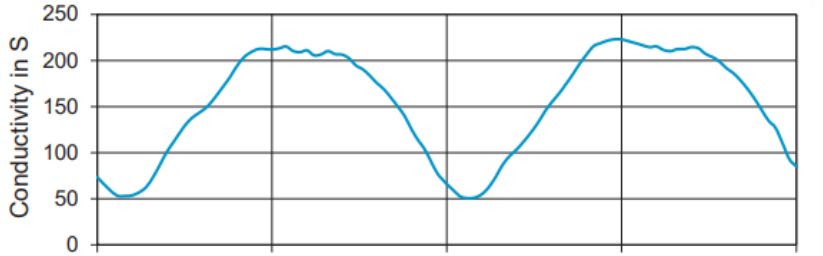
Electric Arc Furnace is of main concern

- 325 MVA
- Load Profile: 45 min on, 15 min off (for taping and reloading)
- Flicker
- Sub- inter-, even- and ‘normal’ harmonics



Even harmonic generation by Arcing



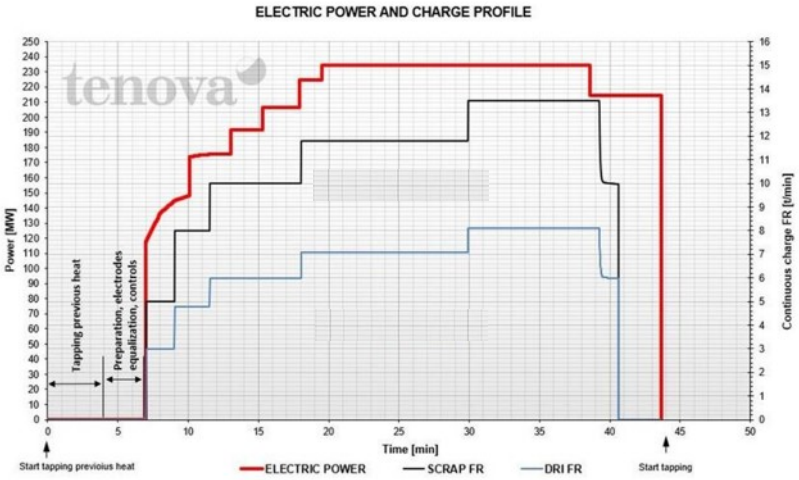


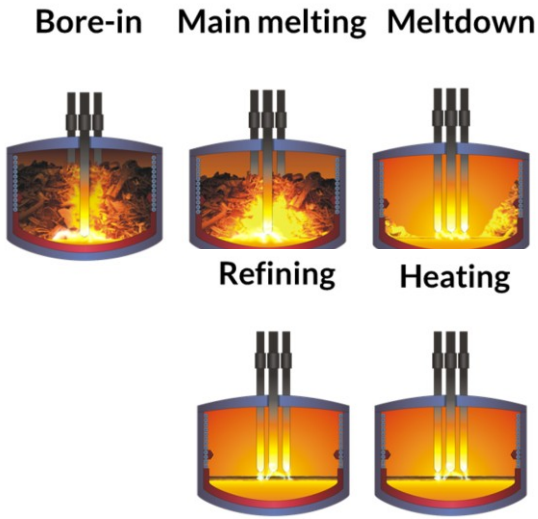
Figures from IB Klaus Krüger

- Asymmetrical sine wave due to physics of the direction of the arc
- Leads to even harmonics
- Arcing current between 50- 100 kA

Flicker

- Generated due to changes in (reactive) power
- Power fluctuations due to shifts in material:
  - sudden shorts
  - sudden loss of conductivity
- Once material is in liquid bath, flicker reduces significantly
- TATA STEEL will operate the EAF with some liquid always remaining in the furnace for this reason





Subharmonics

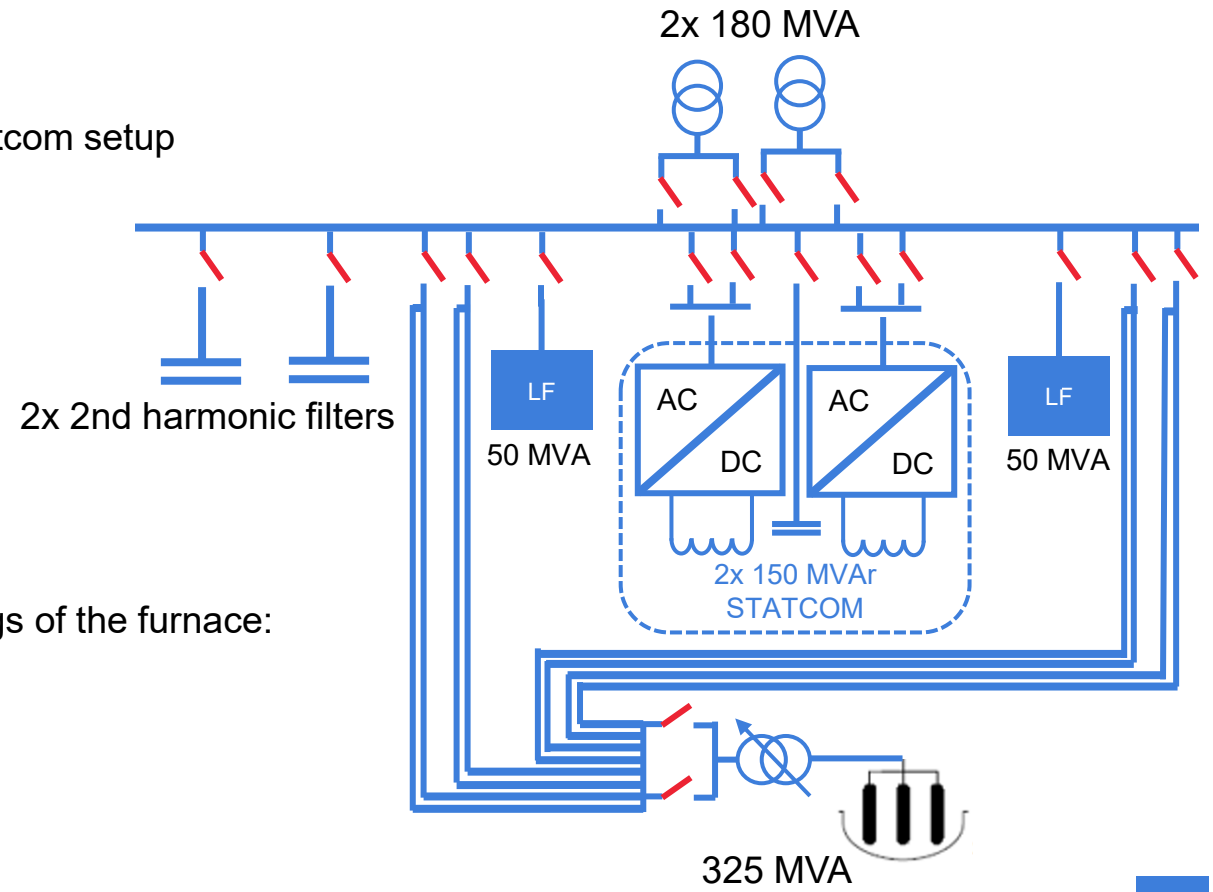
- Waveform is also distorted with frequencies less then 50 Hz due to non-linear V-I characteristic of the arc.
- If a fourier analysis is done on these signals 'subharmonics' start to appear.
- **Does a fourier analysis on a stochastic signal even maken sense?**
- No standards on subharmonic emission or immunity
- No measurement & analysis methods defined

- Risks:
  - Interactions in the grid

STATCOM

- 300 MVAr continuous dual Statcom setup
- 480MVAr Dynamic

- Multi Modular Converters



- Mitigate Reactive Power Swings of the furnace:
  - Power Factor Correction
  - Reduces Flicker
- Injects anti phase harmonics
  - Reduces harmonics

We continue to invest in our company

To maintain our leading position, we continue to innovate. This is why we are constantly looking for the best ideas and technologies. These are implemented today to realise our ambitions for tomorrow.

CO_2-neutral steel production

We invest to change the very heart of our production process, for future steel production using biomethane and/or hydrogen.

Environment & Community

We invest millions to accelerate the reduction of our impact on the living environment in the short term.

Strategic investments

Investments in new installations that will continue to improve our production process and our products.

Do you have any questions?

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Green, cleaner and circular

What does this mean effectively?

- **Green:** 40% less CO_2 emmissions = CO_2 footprint of 385.000 Dutch citizens a year.
- **Cleaner:** the reduction of fine dust emissions by roofing a large part of our raw materials needed for green steel.
- **Circular:** The use of scrap will be increased from 17% to about 30% from 2030 onwards

Current situation

Situation after step 1

Plants

1 DRI plant	1 electric oven
1 blast furnace	1 coke plant

Situation after final step

Plants

2	3
DRI plants	electric ovens