Experience as Owners Engineer in multinational Project Teams

Speakers:
Benedikt Tressner (Department Manager Consulting)
Thomas Will (Head of Steam Generation)




Employment Record Benedikt Tressner

2015 – present	Steinmüller Engineering GmbH, Germany Department Manager Consulting
2013– 2015	Steinmüller Engineering GmbH, Germany Process Engineering, Heat Exchangers and Project Management
2011 – 2013	Tressner Engineering Services GmbH , Germany Self-employed Engineer, CEO
2009 – 2011	EnBW Kraftwerke AG, Germany Project Coordinator /Project Engineer
2007 – 2009	Steinmüller Engineering GmbH, Germany. Process Engineer for steam generation and development of thermal solar technologies.
2007	Steinmüller Engineering GmbH, Germany Degree Diploma in thermal solar technology at University of Applied Sciences Cologne, Campus Gummersbach, Germany

Consulting at Steinmüller Engineering - Overview

TPP Stanari – Time Schedule

TPP Stanari – Scope of the Owner’s Engineer

TPP Stanari – Boundary Conditions & Experience

TPP Stanari – Benefits for the Client

Consulting. From the first Idea to Operation

Steinmüller Engineering performs consulting works in all project phases:

Project development phase
(conceptual engineering, feasibility studies, social impact assessments)

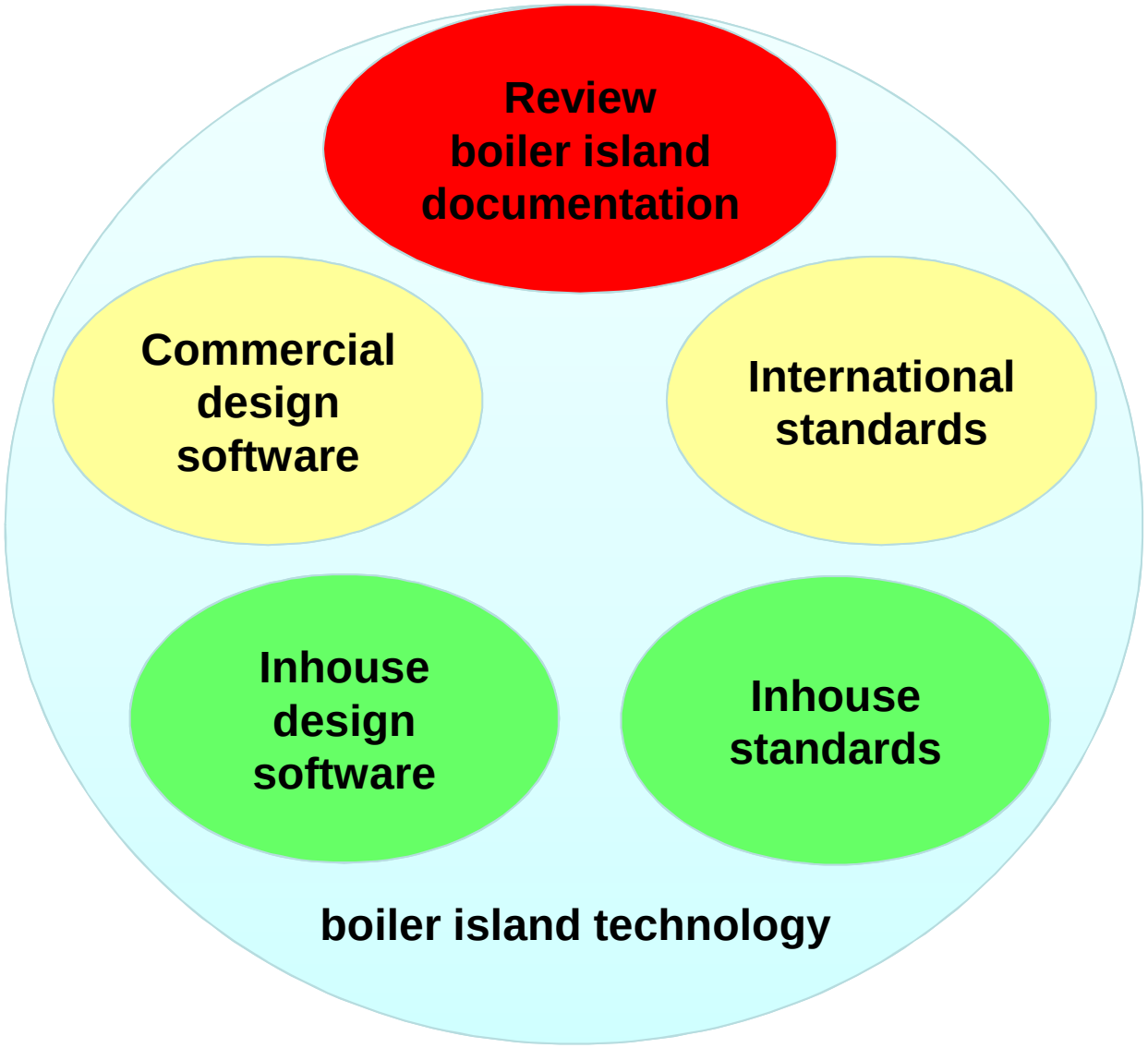
Tender and Contracting Phase
(specifications, bid evaluations, contracting strategy, contract negotiations)

Project Execution Phase
(Owner‘s Engineer, Design review, QA&QM, Supervision)

Operation Phase
(Case studies, Optimization of operation, Monitoring)

But Steinmüller is an extraordinary consulting company!

Consulting. Gain Experience from Engineering and Supply Tasks



Standard consulting

Technical consulting

Consulting with supplier‘s know how

Consulting. Best Technical Solution requires Technology Overview

Consulting. Best Technical Solution requires Technology Overview

Hard figures:

- Power plant technology know how
- Overview of the complete power plant process
- Structured and experienced project management
- Engineering and Supply know how
- Professional commercial software
- International standards
- Professional inhouse software
- Inhouse standards

-> SE‘s advantage: As a supplier for combustion systems, steam generators and flue gas cleaning all this hard skills are available.

Consulting. Multinational Team for International Projects

Soft figures – Challenges in international teams

- Different work management
- Different quality philosophy
- Different languages
- Differences in cultures and behaviors

Formula for success

- Interest and knowledge in different cultures
- Intensive contact to all stakeholders keeps a good understanding of the different requirements / interests

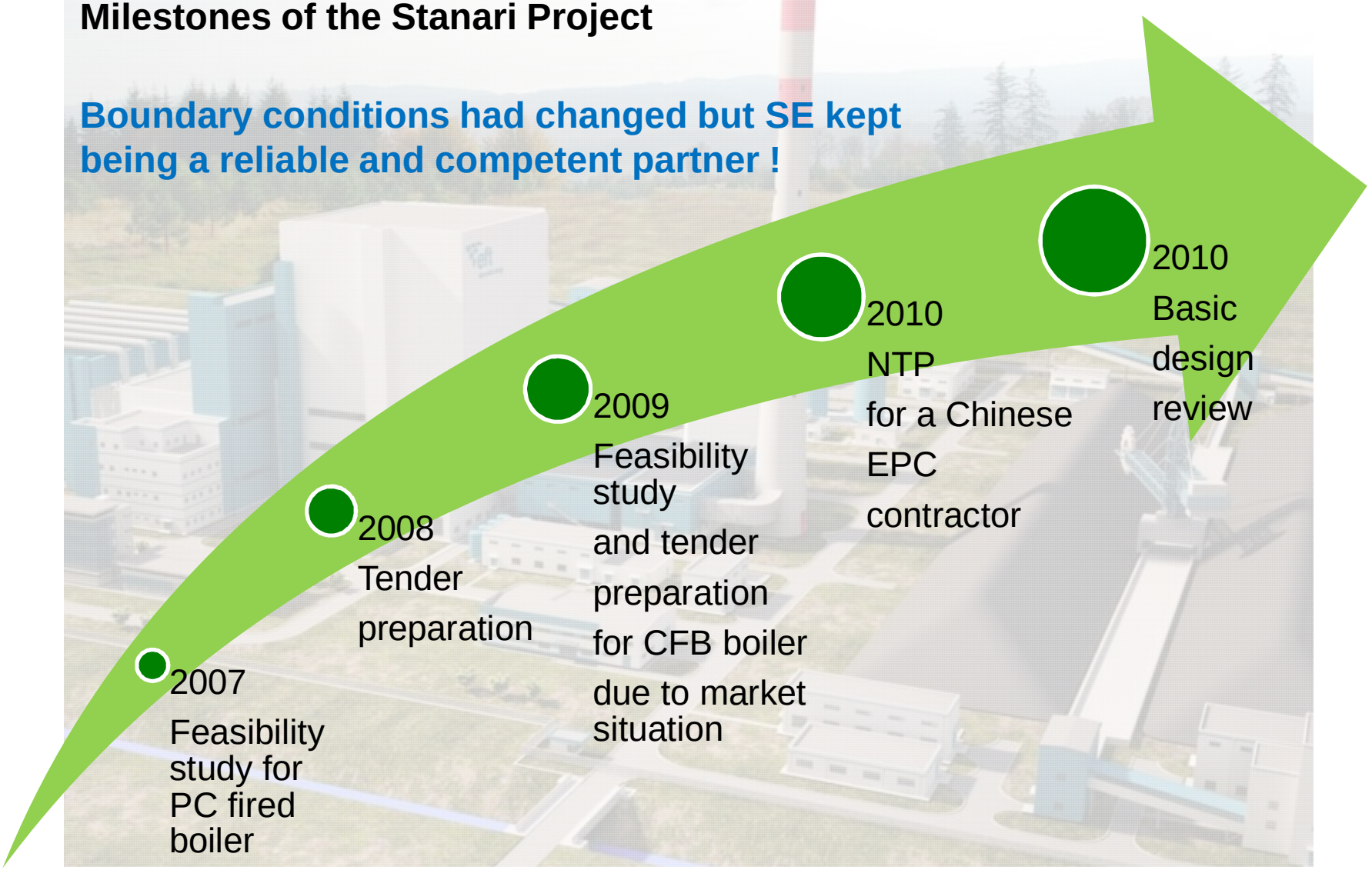
-> SE‘s advantage: Multinational staff and international experiences turns the cultural challenge to an enrichment.

1. Consulting at Steinmüller Engineering - Overview
2. TPP Stanari – Time Schedule
3. TPP Stanari – Scope of the Owner’s Engineer
4. TPP Stanari – Boundary Conditions & Experience
5. TPP Stanari – Benefits for the Client

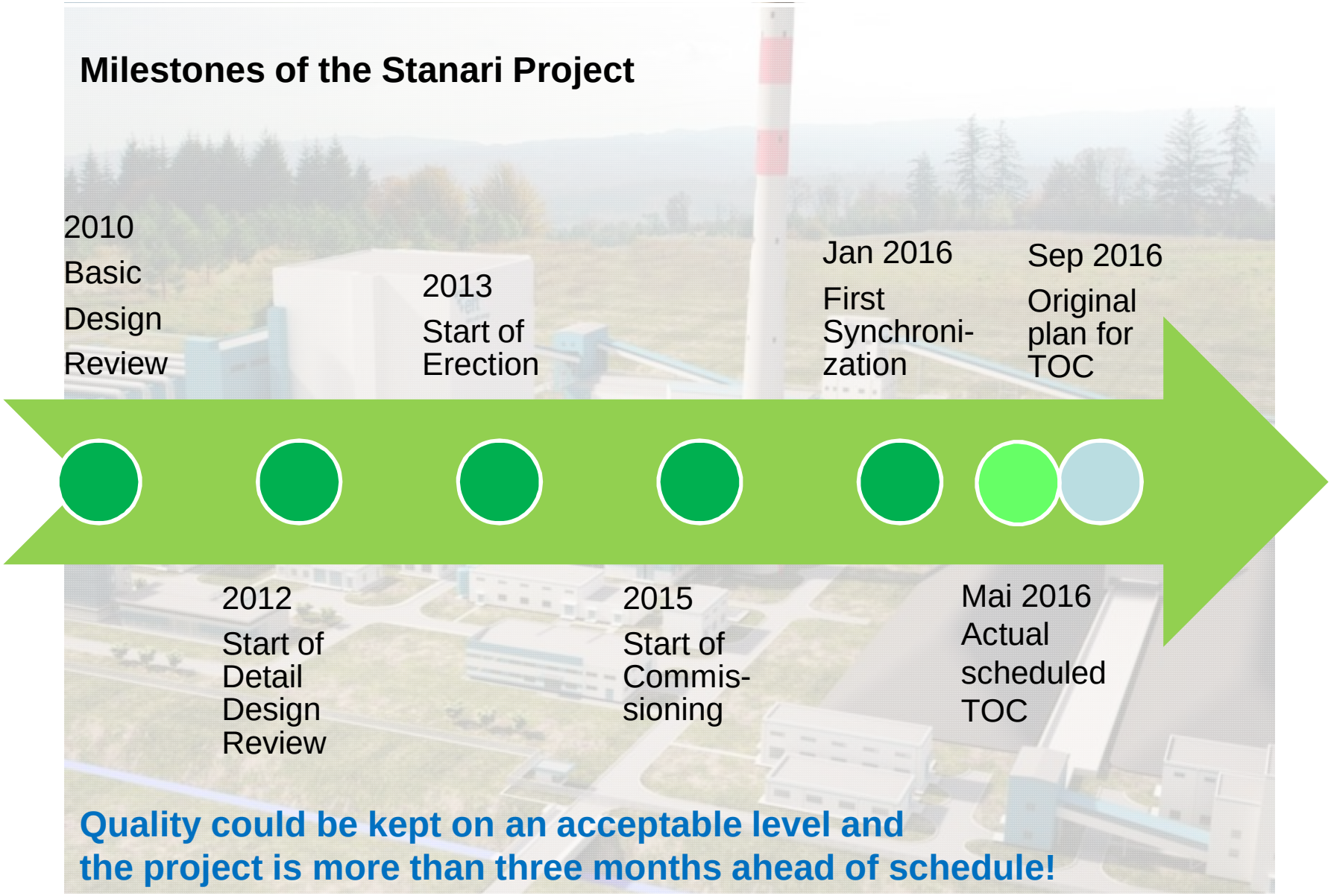
TPP Stanari – Owner‘s Engineer in Consortium with AF Consult

Milestones of the Stanari Project

Boundary conditions had changed but SE kept being a reliable and competent partner !



TPP Stanari – Owner‘s Engineer in Consortium with AF Consult



Consulting at Steinmüller Engineering - Overview

TPP Stanari – Time Schedule

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TPP Stanari – Tasks of the Owner‘s Engineer in the Stanari project

Selection of important tasks

- Design Review
- Review of all technical documents of the EPC-contractor
- Specification of quality assurance company
- Review of quality manufacturing book
- Workshop inspections
- Witness of factory acceptance tests
- Supervision of quality assurance on-site
- Supervision during erection phase
- Supervision during commissioning phase
- Supervision during acceptance test

SE is responsible for the complete boiler island including the coal handling.

Consulting at Steinmüller Engineering - Overview

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TPP Stanari – Boundary Conditions

Basic conditions

- Usage of different design standards like:
  ASME, NFPA or DIN-EN but also Chinese standards
- Contract language: English
- European standards (e.g. emission levels)
- EPC – Contractor is the manufacturer of the main components (boiler, turbine, generator)
- Design works = 1st subcontractor
- Construction works = 2nd subcontractor
- Commissioning works = 3rd subcontractor
- Operation team = 4th subcontractor
- DCS = 5th subcontractor
- Auxiliary components = more subcontractors

TPP Stanari – Experience during Design, Construction & Commissioning

Design

- International standards -> stronger position of owner
- Chinese standards -> less expensive than international standards

→ Optimisation between international and Chinese standards is useful

- Achievement of a proper documentation is difficult

→ Clear documentation requirements needs to be defined in the contract

→ Review process should be strictly executed by an adequate workflow

- Company structure of Chinese suppliers causes more battery limits

Construction & commissioning

- Strong quality control is required.
- Flexible strategy is required to keep the project in the time schedule.
- Different philiosophies regarding health, saftey & environment
- Different philosophies regarding long term quality issues e.g.
  - Corrosion protection
  - Quality documentation /
  - Conditions for cleaning procedures
- Automation of the plant is difficult due to several battery limits

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TPP Stanari – Example for Benefits of the Client

	Owner of TPP Stanari / EFT	Assistance of Steinmüller Engineering
Design e.g. • Adjustment of thermal design • Recalculation of ASME pressure part but DIN EN drum	**Standard Chinese power plant**	**Maintainability e.g.** • Manholes • Position of valves • Access for inspections
Manufacturing QA e.g. • Welding parameters at pressure part • Corrosion protection of steel structure	**Erection supervision** • Installation of platen wall • Hanger concept • Refractory dry out	**Commissioning supervision** • Boiler protection system • Boiler cleaning

TPP Stanari – Example for Benefits of the Client

	Owner of TPP Stanari / EFT	Assistance of Steinmüller Engineering
Design e.g. • Adjustment of thermal design • Recalculation of ASME pressure part but DIN EN drum	**Standard Chinese power plant** **adapted to European requirements**	**Maintainability e.g.** • Manholes • Position of valves • Access for inspections
Manufacturing QA e.g. • Welding parameters at pressure part • Corrosion protection of steel structure	**Erection supervision** • Installation of platen wall • Hanger concept • Refractory dry out	**Commissioning supervision** • Boiler protection system • Boiler cleaning

TPP Stanari - Impressions

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TPP Stanari - Impressions

Employment Record Thomas Will

Since 2010	Steinmüller Engineering GmbH, Gummersbach, Germany Engineering and Supplies for Power Plants Current position: Head of Steam Generation
2003 – 2009	Alstom Power Energy Recovery GmbH, Düsseldorf, Germany Engineering and Supply of Equipment for Recovery of Thermal Energy in Chemical and Industrial Applications Final position: Technischer Leiter (Technical Manager)
2000 – 2002	Babcock Borsig Power GmbH, Oberhausen, Germany Engineering and Supplies for Power Plants Product developer
1981 – 1999	L. & C. Steinmüller GmbH, Gummersbach, Germany Engineering and Supplies for Power Plants Technical-Scientific Programmer
1975 – 1980	University Köln Academic studies of Mathematics/Physics Degree: Diplom-Mathematiker (M.Sc.)

Membership in Professional Affiliations:

Steering committee for heat transfer and fluid dynamics at FDBR (Fachverband Dampfkessel-, Behälter- und Rohrleitungsbau e.V.)

Eskom - Overview

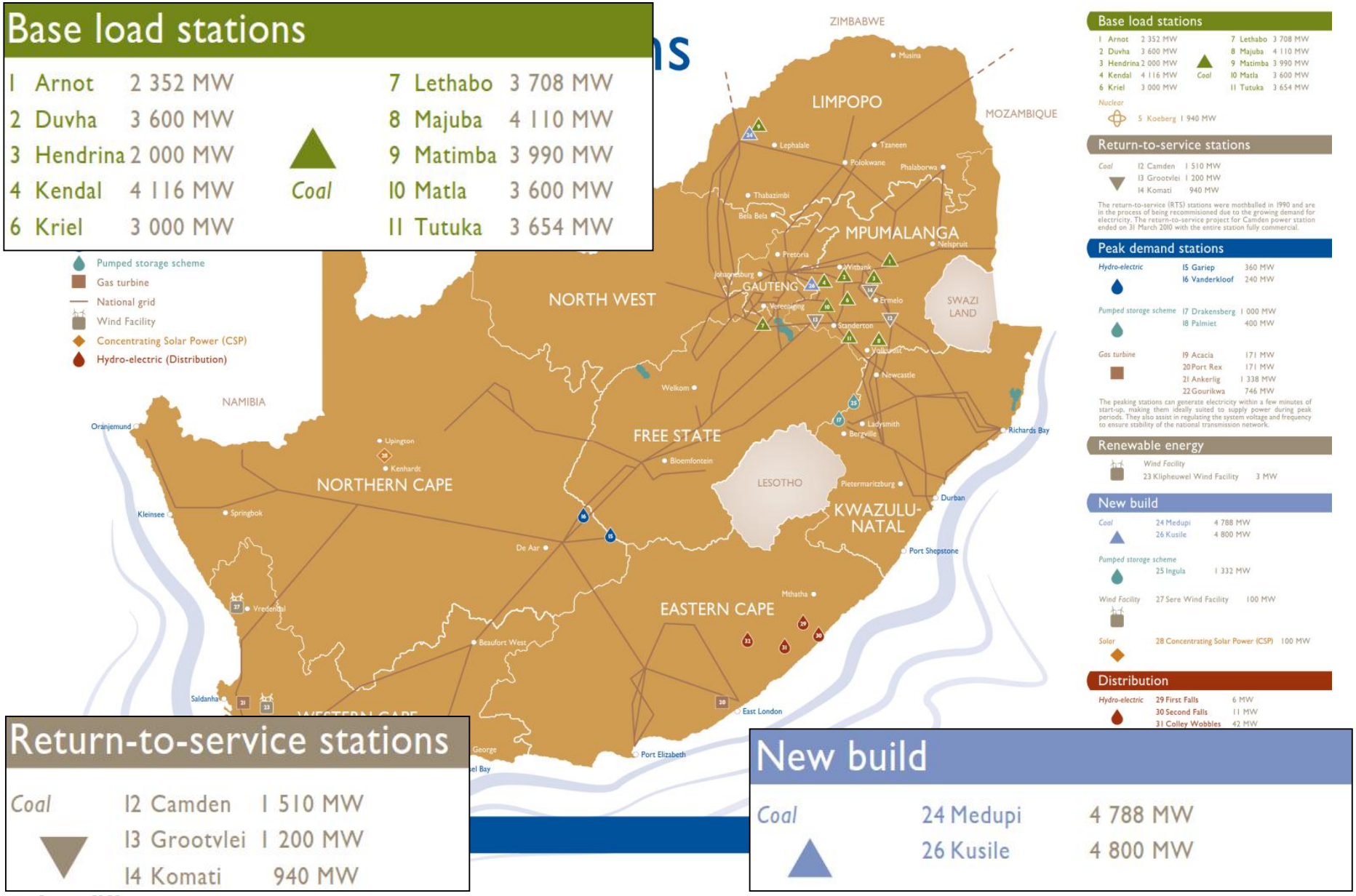
Camden PS Burner Retrofit

Fleet SOx Concept Design

Kusile Construction Management

Skills Development and Localisation (SD&L)

Eskom Power Stations



Base load stations
1 Arnot 2 352 MW
2 Duvha 3 600 MW
3 Hendrina 2 000 MW
4 Kendal 4 116 MW
6 Kriel 3 000 MW
Coal
7 Lethabo 3 708 MW
8 Majuba 4 110 MW
9 Matimba 3 990 MW
10 Matla 3 600 MW
11 Tutuka 3 654 MW
Nuclear
5 Koeberg 1 940 MW
Return-to-service stations
Coal
12 Camden 1 510 MW
13 Grootvlei 1 200 MW
14 Komati 940 MW
The return-to-service (RTS) stations were mothballed in 1990 and are in the process of being recommissioned due to the growing demand for electricity. The return-to-service project for Camden power station ended on 31 March 2010 with the entire station fully commercial.
Peak demand stations
Hydro-electric
15 Gariep 360 MW
16 Vanderkloof 240 MW
Pumped storage scheme
17 Drakensberg 1 000 MW
18 Palmiet 400 MW
Gas turbine
19 Acacia 171 MW
20 Port Rex 171 MW
21 Ankerlig 1 338 MW
22 Gourikwa 746 MW
The peaking stations can generate electricity within a few minutes of start-up, making them ideally suited to supply power during peak periods. They also assist in regulating the system voltage and frequency to ensure stability of the national transmission network.
Renewable energy
Wind Facility
23 Klipheuwel Wind Facility 3 MW
New build
Coal
24 Medupi 4 788 MW
26 Kusile 4 800 MW
Pumped storage scheme
25 Ingula 1 332 MW
Wind Facility
27 Sere Wind Facility 100 MW
Solar
28 Concentrating Solar Power (CSP) 100 MW
Distribution
Hydro-electric
29 First Falls 6 MW
30 Second Falls 11 MW
31 Colley Wobbles 42 MW

Eskom Power Stations

Return-to-service stations

Coal	12	Camden	1 510 MW
	13	Grootvlei	1 200 MW
	14	Komati	940 MW

Base load stations

1	Arnot	2 352 MW	7	Lethabo	3 708 MW
2	Duvha	3 600 MW	8	Majuba	4 110 MW
3	Hendrina	2 000 MW	9	Matimba	3 990 MW
4	Kendal	4 116 MW	10	Matla	3 600 MW
6	Kriel	3 000 MW	11	Tutuka	3 654 MW

Coal

New build

Coal	24	Medupi	4 788 MW
	26	Kusile	4 800 MW

Activities for Eskom's Fleet of Coal Fired Power Stations

Power Station	DimBo model	Boiler design review	Fleet SOx	Fleet NOx	LNB Basic Design	FFP conversion parameters	Special Task	Topic
Arnot	x		(x)	x			x	Biomass study, coal & mill assessment
Camden	x	x					x	LNB firing system implementation
Duvha	x	x	x	x		x	x	Boiler 3 investigation after 2014-03 incident
Grootvlei	(x)	(x)						
Hendrina	x	x	(x)	x			x	Life time extension & capacity increase study
Kendal	x		x	x				
Komati							x	Investigation of firing system on unit 1-3
Kriel	x	x	(x)	x	(x)			
Kusile	(x)	x					x	Design review, construction management
Lethabo	x		x	x				
Majuba	x	x	x	x	x		x	UCG co-firing study, Waterberg coal study
Matimba	x		(x)	x				
Matla	x	x	(x)	x	x	x		
Medupi	(x)	x					x	FGD retrofit, RH1 installation, blow through
Tutuka	x	x	x	x	x	x	x	ESP Study, Waterberg coal study

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Camden PS Burner Retrofit - Overview

Camden PS – Eight Units

- 8 x 200 MW_{el} (design)
- Boiler type: BS 1113
  (Manufactured by : International Combustion Africa Ltd)
- Thermal input 659 MW_{th} (design)
- Steam : 817 t/h (11MPa, 543°C)
- Operation 1960-1990
- Return to service 2006

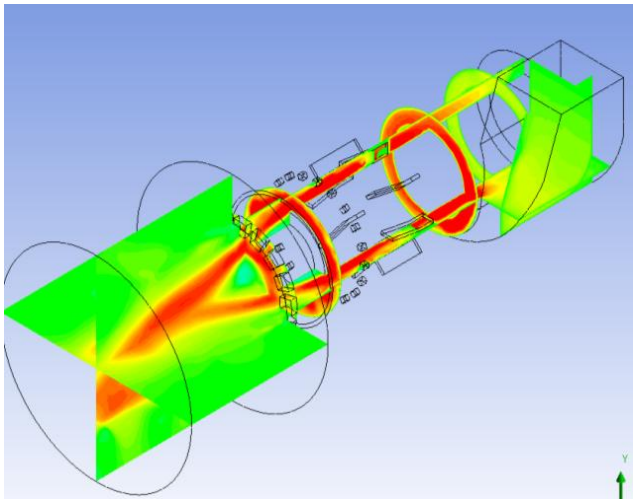
Combustion/Fuel System

- Fuel: Bituminous coal (21 MJ/kg design)
- „R“ type burners
  (Manufactured by: International Combustion Africa Ltd)
- 20 Burners on 5 levels (16 at full load)
- 5 LM 14/3P Mills (4 at full load)

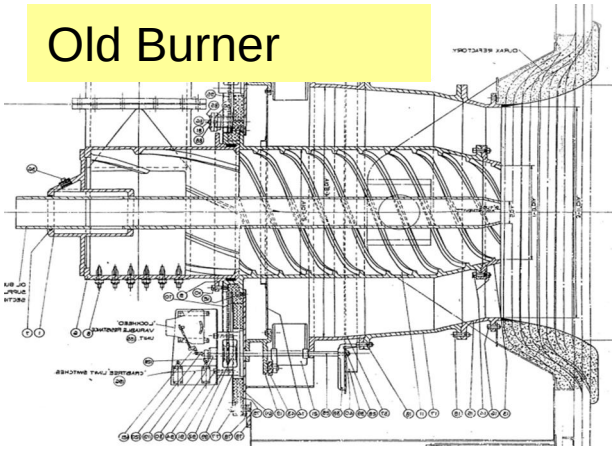
Scope	Start	Finish
Detail design	May 2011	Dec 2011
Technical input for manufacturing and installation	Jun 2012	Sep 2012
Additional support	Nov 2012	Dec 2012
Support during manufacturing, installation and commissioning	Feb 2014	ongoing

Camden PS Burner Retrofit - Engineering

Design of the Camden burner was a joint operation between Eskom Engineering and SE, including know-how transfer of Low-NO_x burner design.

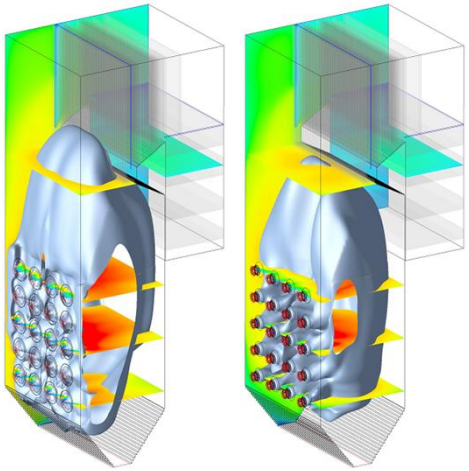


Old Burner



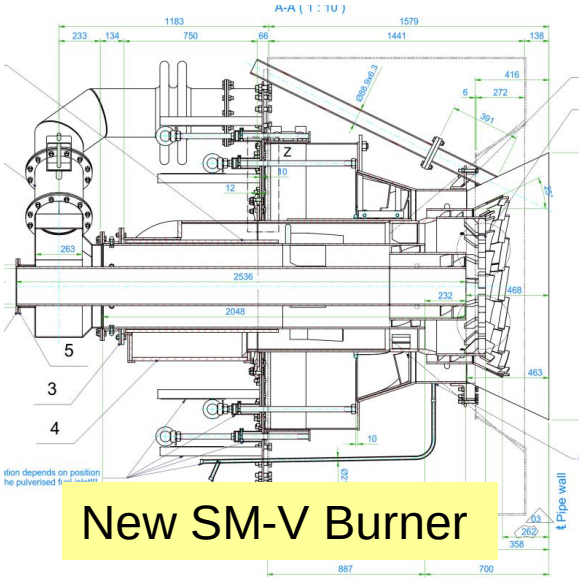
Challenges

- Configuration of PF pipes (tangential PF inlet – modification very expensive)
- Common windbox – special approach to ensure even air distribution
- Too large opening of the existing “R type” burner for capacity
- Limited access/space around the burners
- Limited boiler documentation



Basis simulation SE – variant 2

	Baseline Simulation	Variation-SE02
Furnace Exit (36.8 m) Temp. [°C] (Mean/Maximum)	1418/1500	1350/1435
CO [mg/Nm3]	62	75
NO_X [mg/Nm3]	1143	722
NO_X (at 6% O2) [mg/Nm3]	1020	652
Unburned Carbon in Ash [%]	5.0	6.2
Air excess ratio	1.21	1.21



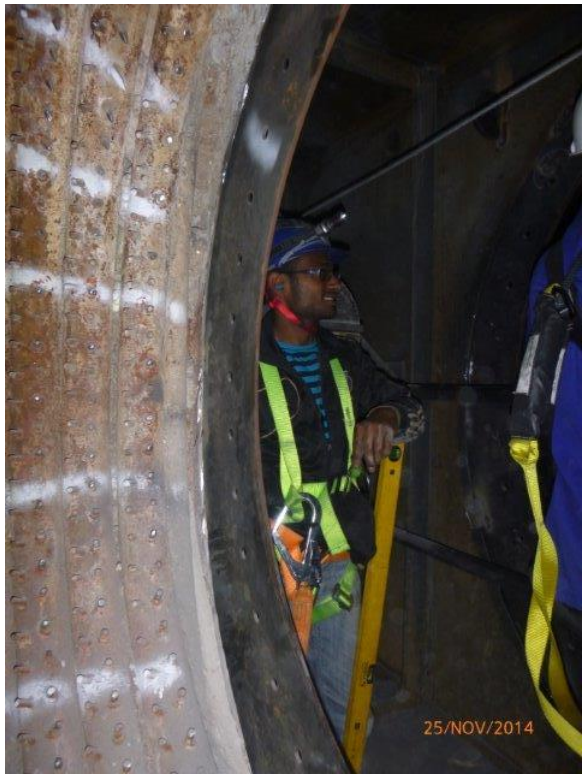
New SM-V Burner

Camden PS Burner Retrofit - Manufacturing

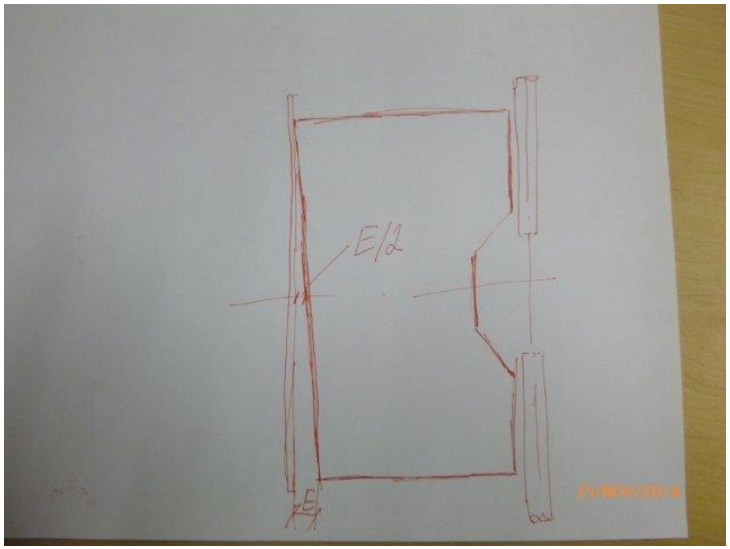
Camden LNB Retrofit Project - Manufacturing

- Oversight support during fabrication
- Fabrication training
- Back office support for technical queries, review and release of quality documentation

Camden PS Burner Retrofit - Installation



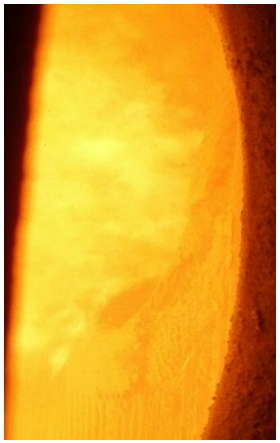
Design modification as windbox back plate was sloped (gap: 5 cm)



Camden PS Burner Retrofit - Commissioning & Optimisation

First Oil Flame at Camden PS with New SM-V Burner

First coal flame at Camden PS with new SM-V Burner



NO_x level test: 592 mg/Nm3 10% O_2 (about 40% reduction)

Eskom - Overview

Camden PS Burner Retrofit

Fleet SOx Concept Design

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Eskom - Fleet SOx Concept Study - Motivation

Minimum Source Emission Standards published in terms of Section 21 of the National Environmental Management: Air Quality Act (Act No 39 of 2004) define SOx emissions limit (STP, 10% O_2):

- 500 mg/m^3 for new plants with effect from 2010
- 3500 mg/m^3 for existing plants by 2015
- 500 mg/m^3 for existing plants by 2020

Eskom's Target for existing plants:

- 400 mg/m^3 for existing plants by 2020

Note:

400 mg/m^3 @10% O_2 corresponds to

656 mg/m^3 @3% O_2

Technology	
WFGD	Wet Flue Gas Desulphurisation with Limestone Suspension as Sorbent
SDA	Spray Dry Absorption with Hydrated Lime Suspension as Sorbent
CFB FGD	Circulating Fluid Bed Flue Gas Desulphurisation with Hydrated Lime as Sorbent
DSI	Duct Sorbent Injection with Hydrated Lime as Sorbent

Rating Criteria	Weighting
SO_2 Removal Efficiency	20
Ca/S mole ratio	18
Pressure Drop Impact	2
Effect on Chimney Liner	5
Power consumption of plant utilities	5
Effects on Waste Water Treatment System	5
Capital Cost (CAPEX)	20
Maintenance Costs (OPEX)	15
Water Usage	5
Estimated construction time frames	5
Total	100

Eskom - Fleet SOx Concept Study – Priority stations

Power station	Flue gas flow per boiler in m³/h (STP, wet, act. O_2)	Remaining operational years	Required SO_2 removal efficiency in %
Majuba	2 781 173	45	85
Kendal	2 540 714	38	83
Duvha	2 653 618	28	81
Tutuka	2 536 716	32	85
Lethabo	2 517 358	34	83


Kendal
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Tutuka
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Majuba
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Lethabo
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Duvha
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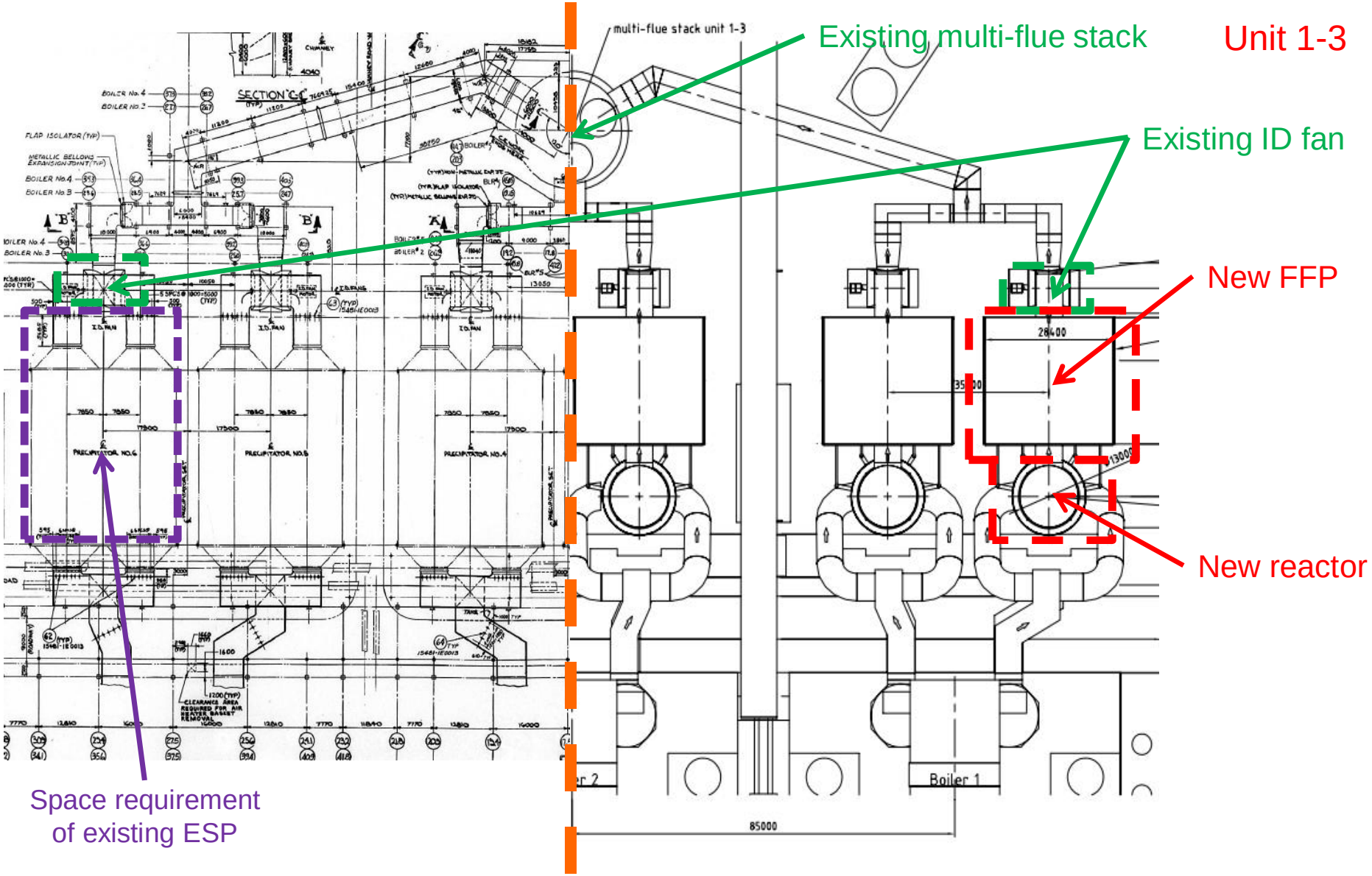
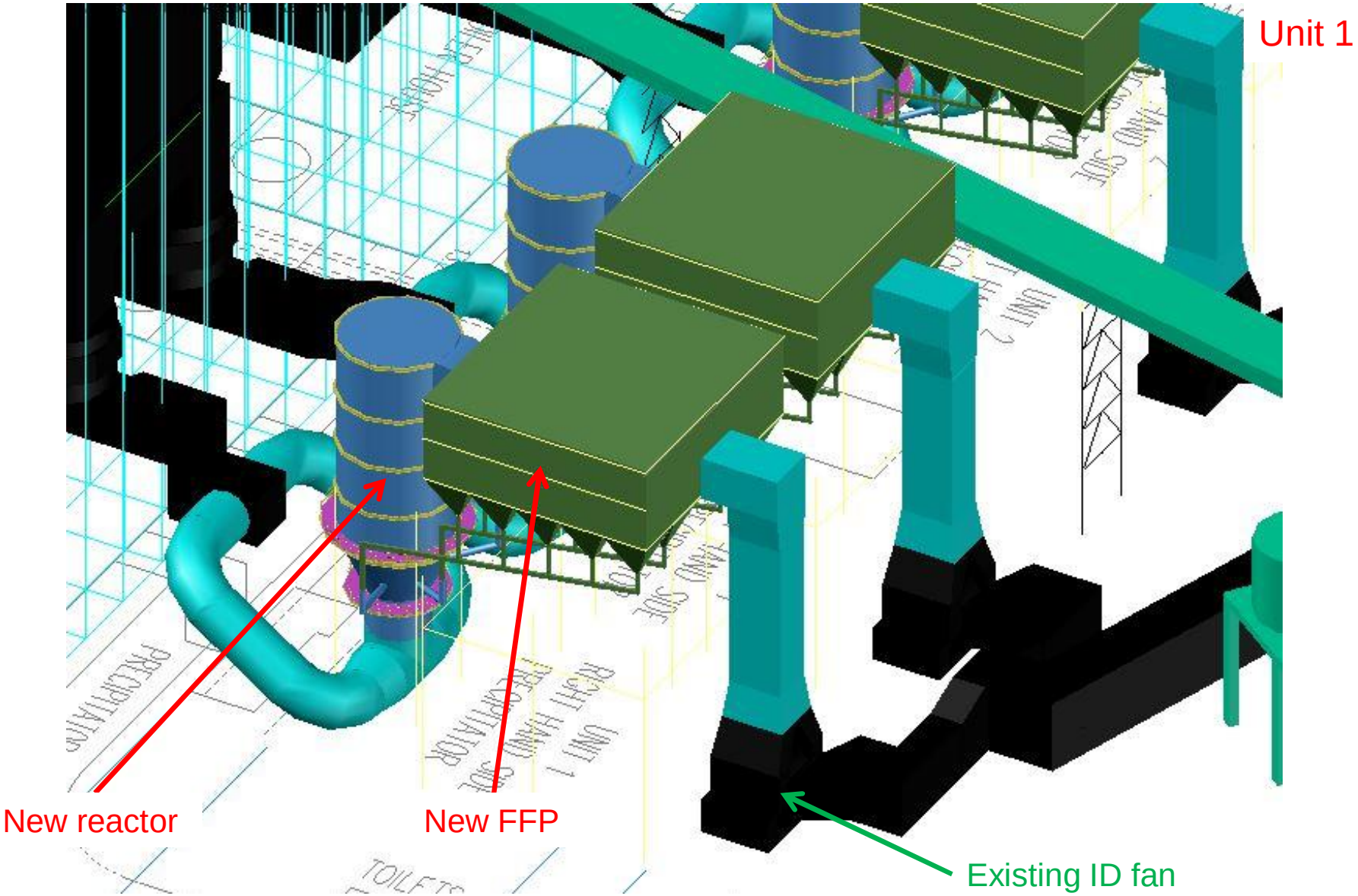
CFB FGD Optimization Option - General Arrangement



CFB FGD Optimization Option – 3-D model



Fleet SOx - Recommendation

	Analysed technology	Recommendation
Majuba	WFGD CFB FGD SDA DSI	WFGD
Kendal	WFGD CFB FGD SDA	WFGD CFB FGD
Duvha	WFGD CFB FGD SDA	WFGD
Tutuka	WFGD SDA DSI	WFGD
Lethabo	WFGD CFB FGD SDA	WFGD

WFGD = Wet Flue Gas Desulphurisation with Limestone Suspension as Sorbent
SDA = Spray Dry Absorption with Hydrated Lime Suspension as Sorbent
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Integration into the Kusile Execution Team

Kusile Power Station

- 6 x 800 MW_{el}
- Coal fired
- Tower type boiler
- Steam parameters:
  - HP 564°C / 258 bar
  - RH 572°C / 53,6 bar
- Air cooled condenser (ACC)
- 1st Power Station in South Africa with FGD (Flue Gas Desulphurisation)

Once completed, Kusile will be the fourth-largest coal-fired power station in the world.

Total cost: EUR 7.000.000.000

Fig. 1: Kusile WFGD Plant

Integration into the Kusile Execution Team

1. Kusile FGD plant

On-site and back office support during construction, commissioning, start-up and optimization phases of the project. Activities:

- On-site construction and mechanical engineering support
- On-site commissioning, start-up and optimization support
- Review of OEM's operating and commissioning procedures
- Input to planning and scheduling
- Back office engineering support

The support effort will place a strong emphasis on "on the job" training, mentoring and knowledge transfer to the Eskom engineers.

2. Construction management support

A team consisting of 12 experts at site is integrated in the KET (=Kusile Execution Team) to cover amongst others the following scope:

- Construction project management
- Technical support boiler and BOP (mechanical, electrical, C&I)
- Commissioning and optimization support
- Quality management
- Commercial management

Back office engineering support is ensured from SE's head office in Gummersbach.

Integration into the Kusile Execution Team

Eskom - Overview

Camden PS Burner Retrofit

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Skills Development and Localisation (SD&L)

SD&L - IP Transfer to Eskom

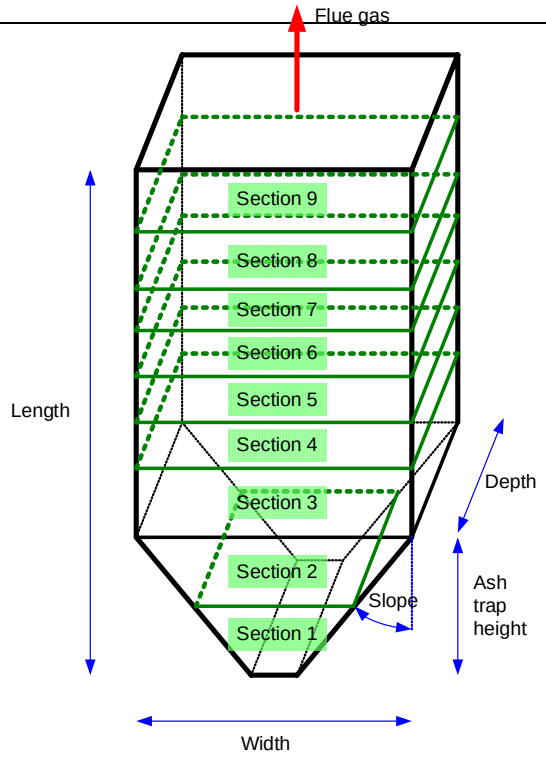
2009 Design manuals & design tools
- Firing systems
- SCR
- ESP
- FGD

2011 Biomass co-firing
- Sectional furnace model for DimBo

2013 Circulating fluidised bed combustion
- Design manuals
- Design tool DimCFB

2014 Fleet SOx study
- CFB Desulphurisation

2016 Boiler Technology
- Boiler pressure parts design
- Boiler diagnostic/advisory system



Partnership with Eskom

Summary

- Long term cooperation with Eskom for almost 10 years
- Various cooperation areas
  - Engineering
  - Consulting
  - Project management
  - Know how transfer
- All core competences of Steinmüller Engineering are included in the cooperation
  - Combustion Systems
  - Steam Generation
  - Flue Gas Cleaning

Targets

- Continuation with Eskom
- Transfer of the model to other customers and markets

Thank you for your attention