CFB boiler's conversion

Technology Modernization & Upgrade
Reference Projects

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Agenda

SHI FW Company introduction

CFB Bio-100 conversion project

CFB BIO & RDF conversion project

Q&A

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SFW | Powering a decarbonized world for everyone

1 800
employees
across the globe

20+
locations
around the world

130+
years of
experience

800 +
successful references worldwide

122 Americas | **344** Europe | **419** Asia

4
businesses

- Energy Generation
- Circular Carbon
- Energy Storage
- Services

5
values of SFW

- Respect for people
- Committed to customers
- Passion to innovate and grow
- Ownership of results
- Safety, integrity and teamwork

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SFW Services

Global operator in energy market services

Products and Services

Basic Maintenance (BM)

- Maintenance (outages, hourly rated works, condition monitoring, emergency services)
- Pressure equipment and pressure part replacements
- Steam and condensate pipings
- Auxiliary equipment services and renewals
- Spare parts
- Inspection and specialist services
- EIC Services
- Process, EIC and mechanical designing

Technology, Modernizations and Upgrades (TMU)

- Fuel range expansions and conversions
- Capacity upgrades and process improvements
- Fluidized bed boiler retrofits
- Environmental upgrades
- Plant optimization and feasibility studies

LTSA (Long Term Service Agreement)

- Daily maintenance, outage maintenance
- Boiler condition monitoring
- Nominated plant organization
- Spare Parts & Materials
- Technical advisors on-shore
- Expert services off-shore

Digital Services

- Envelope
- Bed Management and Hotloop Diagnostics
- Grid Condition Monitoring
- Fouling Management
- Leakage detection
- Reporting

Own Manufacturing facilities
SFW laboratory services

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Our Manufacturing Network

We Deliver Quality Products for New Equipment and After Market Service

China

Established: 1997
Location: Xinhui City, PRC
(95 km NW of Hong Kong)
Production Area: 50,000 m^2
Capacity: 1,200,000 man-hours
Certifications: ASME code certifications S & PP, China Boiler Manufacturing Certificate Level A, ISO 9001

Poland

Established: 1880
Location: Sosnowiec, Poland
Production area: 33,000 m^2
Capacity: 400,000 man-hours
Certifications: ISO 9001, ISO 14001, OHSAS 18001, PED, ASME S & U stamp, Germany and Poland service cert (HPO, UDT), EN 1090, lab cert EN ISO/IEC 17025

Thailand

Established: 2000
Location: Chonburi, Thailand
Production area: 4,000 m^2
Capacity: 160,000 man-hours
Certifications: OHSAS 18001, ISO 18001, ASME Code Certification S,R,NB Stamp

Finland

Established: 1860
Location: Varkaus, Finland
Production area: 4,000 m^2
Capacity: 100,000 man-hours
Certifications: ISO 9001, ISO 3834-2, ISO 14001, OHSAS 18001

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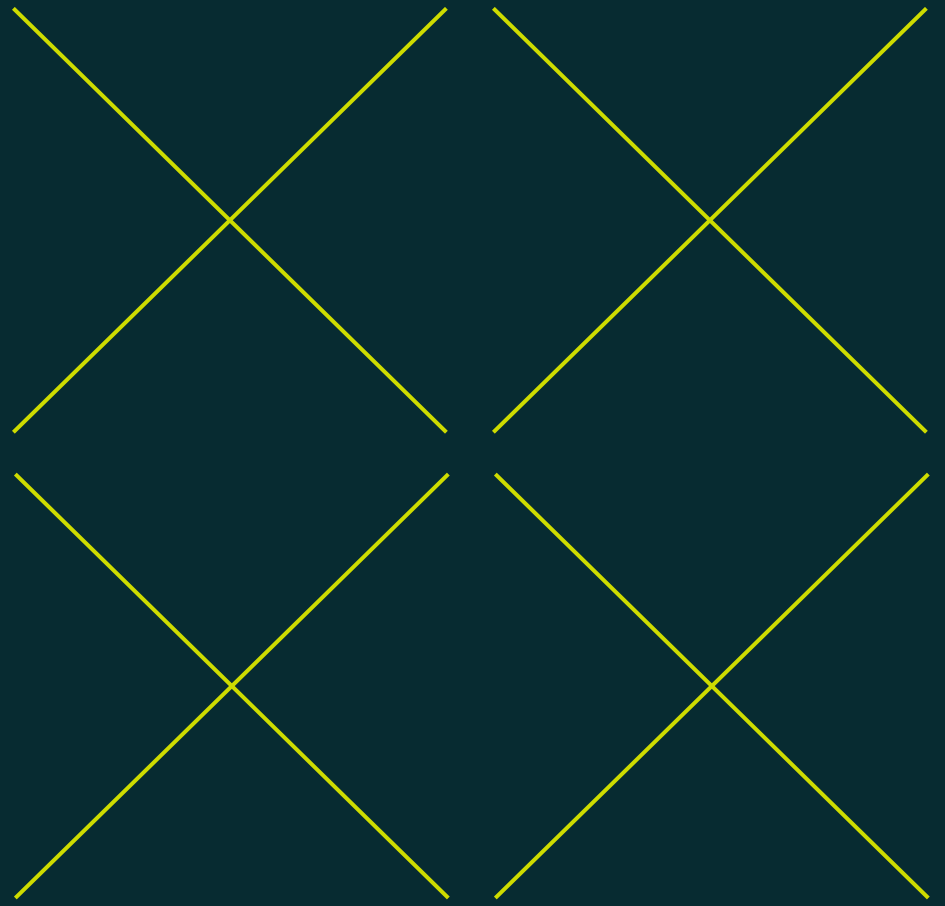
CFB Bio-100 Conversion Reference Project

Fortum Czestochowa CFB boiler biomass conversion



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CFB boiler Island conversion to 100% biomass

Original fuel parameters :

Fuel (by heat input):

– Bituminious coal	65 – 100%
– LHV	20,4 – 23,1 MJ/kg
– Total moisture	5 – 15%
– Ash	20 – 25%
– Biomass	0 – 35% (wood chips, energy willow)

Boiler after modernization:

Fuel (by heat input):	100% certified biomass, (90% forest-based and 10% agro-based wood chips)
– LHV	6,5-15MJ/kg
– Total moisture	20-55%
– Ash	1-12%
– PSD	P63 and F10 acc to EN ISO 17225-1, max size ≤350mm
– Impurities	Non-fluidized particles ≤0,1%ds, max size ≤50mm

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CFB Bio-100 conversion

CFB Boiler parameters

Original CFB boiler parameters:

Steam capacity: MCR = 77.2 kg/s (278 t/h)

Steam parameters: 111 bar(a), 515°C

Boiler after modernization:

Steam capacity: reduced to ~ 75% MCR,
max ~57.9 kg/s (208 t/h)
min ~30.9 kg/s (111 t/h)

Steam parameters: 111 bar(a), 515°C

Continuous sand feeding to the boiler required

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Guarantees

Heat to steam:	@ max load: 144.5 MW and @ min load: 77.2 MW
Steam pressure	111 bar(a) ±2 bar
Steam temperature at max load	515°C ± 5°C
Steam temperature at min load	≥ 450°C
SO2 emission	max 30 mg/m^{3}n
NOx	max 120 mg/m^{3}n
Dust	max 10/5 mg/m^{3}n
CO	max 50 mg/m^{3}n
NH3	max 10 mg/m^{3}n
HCl	max 10 mg/m^{3}n
HF	max 1 mg/m^{3}n
Hg	max 5 ug/m^{3}n
Consumables	ammonia water, aux power, sorbent, activated carbon, sand, pressurized air
Boiler efficiency	>91%
Noise emission	indoor and outdoor
Availability	
Vibrations	

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Basic scope of D&E modernization project

1. New fuel feeding system + conversion of coal silos into biomass **STAGE 2**
2. Step grid **STAGE 1**
3. Bottom ash removal system upgrade **STAGE 1**
4. Flue gas recirculation **STAGE 2**
5. Secondary air system modifications **STAGE 2**

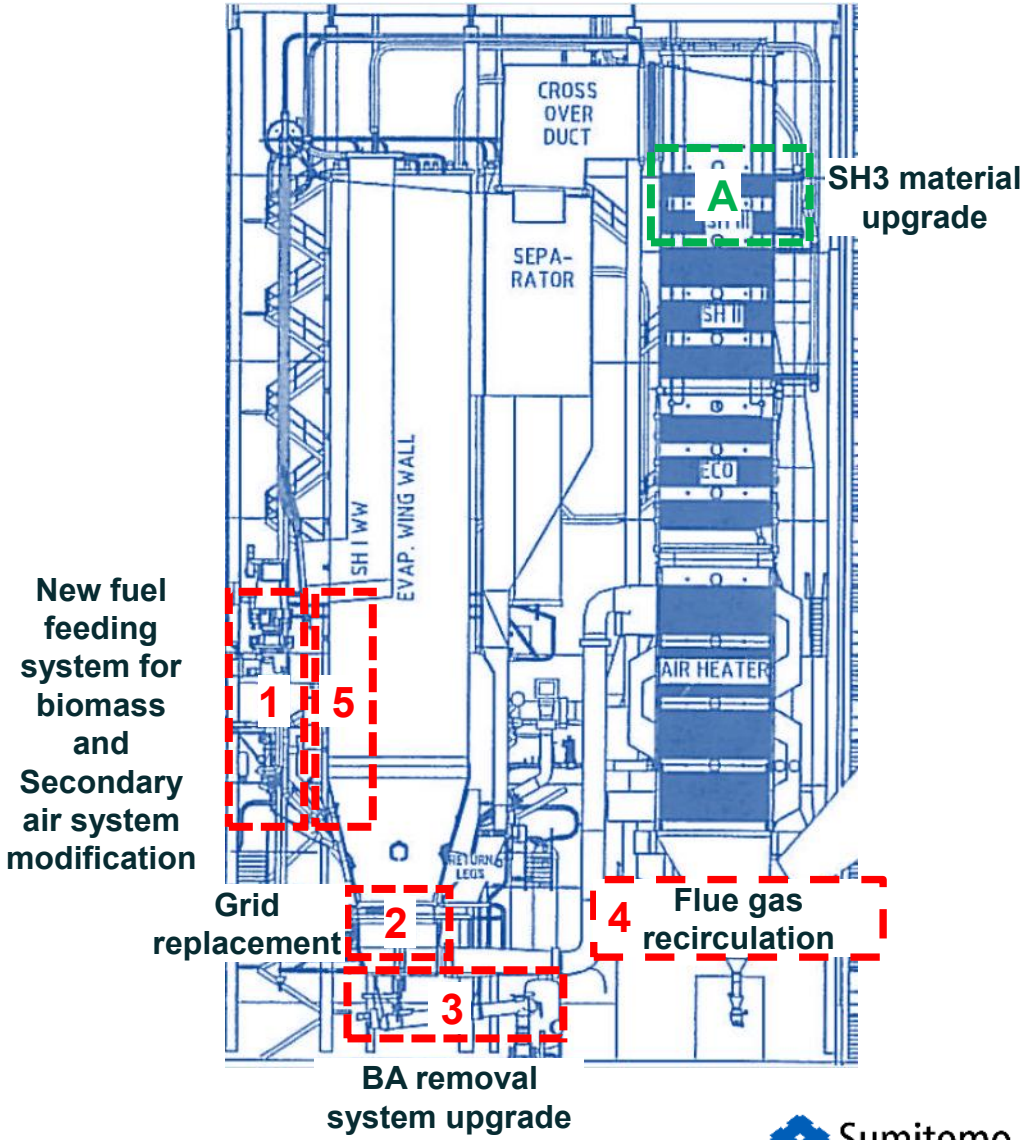
A. Delivery of tertiary superheater tube bundles **STAGE2**

Cost effective concept

1 No INTREX SH

2 No separator type change

3 No changes to existing AQCS



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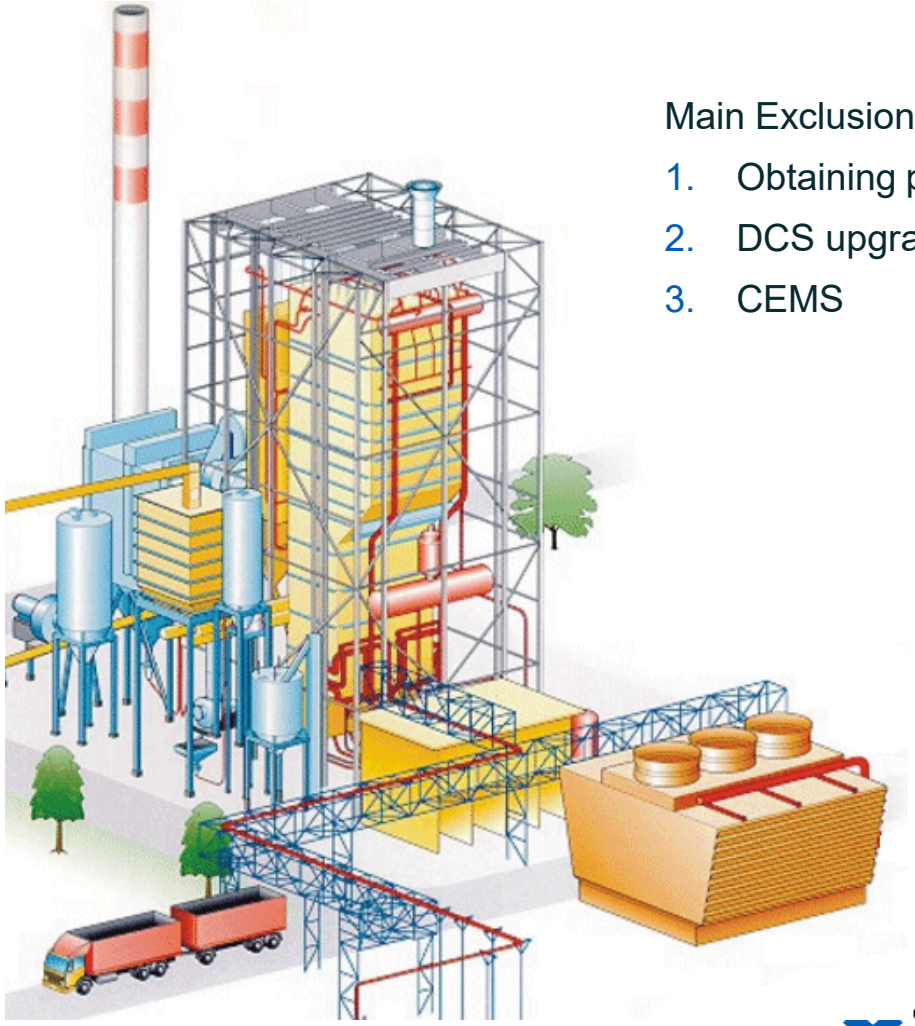
Remaining scope of D&E formula modernization project

- Boiler Pressure parts (STAGE 1)
- Refractory (STAGE 1)
- Auxiliary steam systems (STAGE 2)
- Thermal and noise insulation (STAGE 1&2)
- Fire water and service water systems (STAGE 1&2)
- Closed cooling water system (STAGE 1&2)
- Pressurized air system (STAGE 1&2)
- Central vacuum cleaning (STAGE 2)
- Powering and electrification (STAGE 1&2)
- Instrumentation up to field boxes (STAGE 1&2)
- Land development & roads & green in term of architectural, structural and civil scope (STAGE 1)
- Foundation works for new buildings & structures (STAGE 1&2)
- Building adaptation to EuroCode (STAGE 1)
- Input documentation for obtaining permits (STAGE 1)



Main Exclusions

1. Obtaining permits
2. DCS upgrade
3. CEMS

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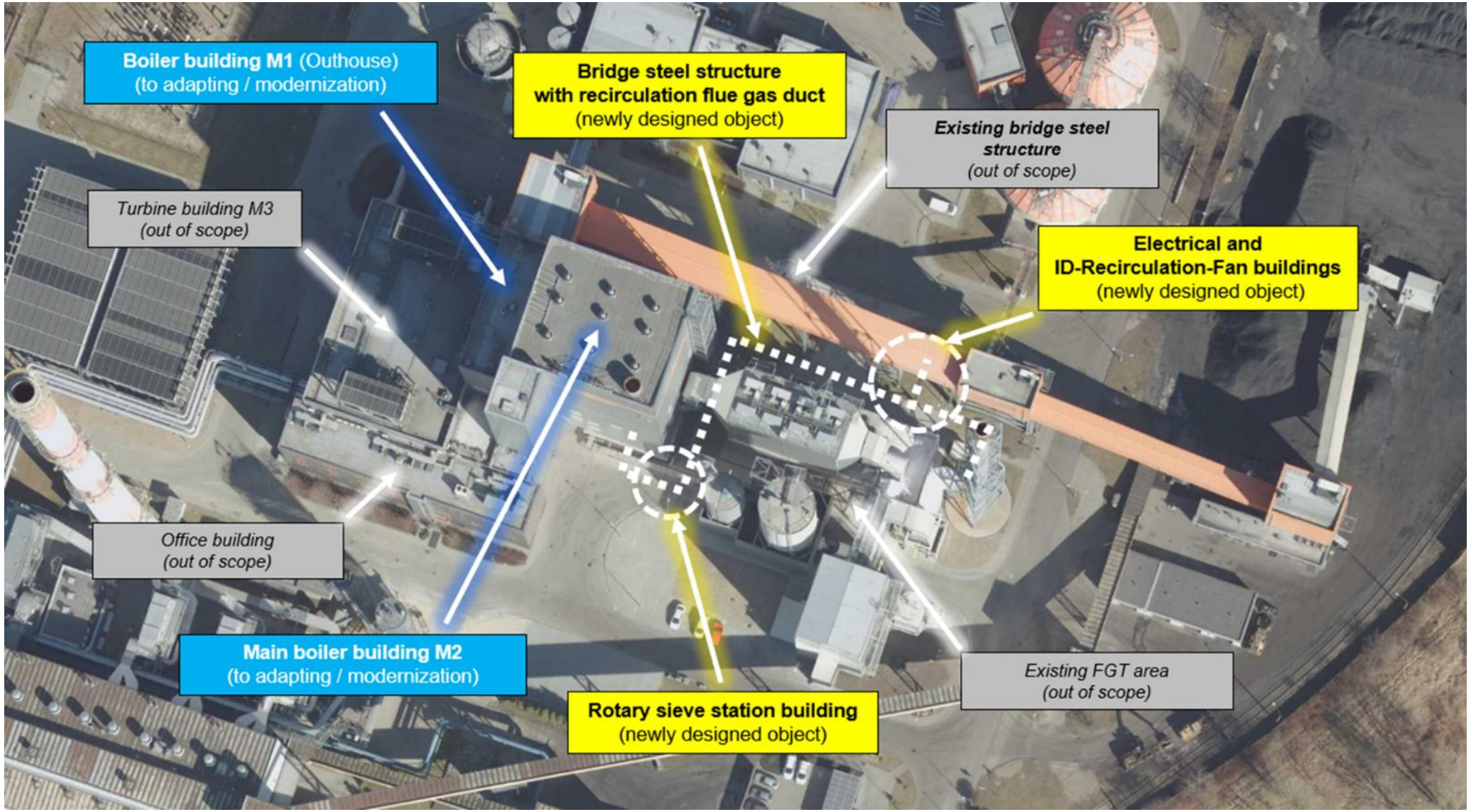
Satellite / Top view with modernization concept for civil & architectural scope



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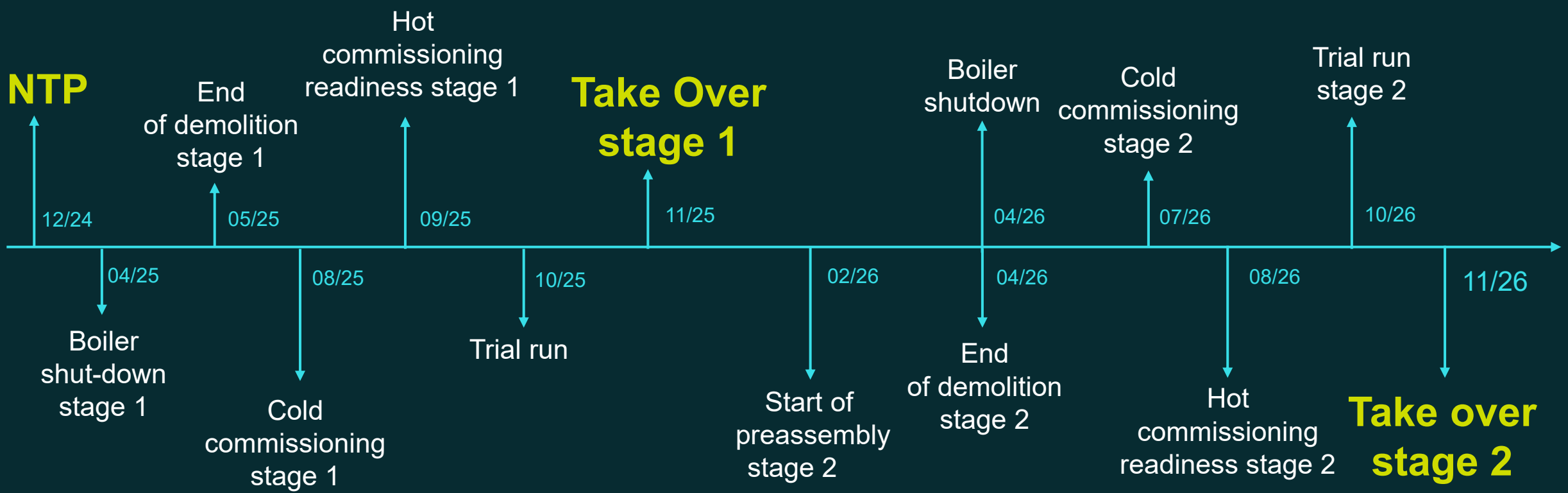
Execution milestone schedule



Duration	1st stage	2nd stage	Total boiler shutdown
	9 months	9 months	9 months

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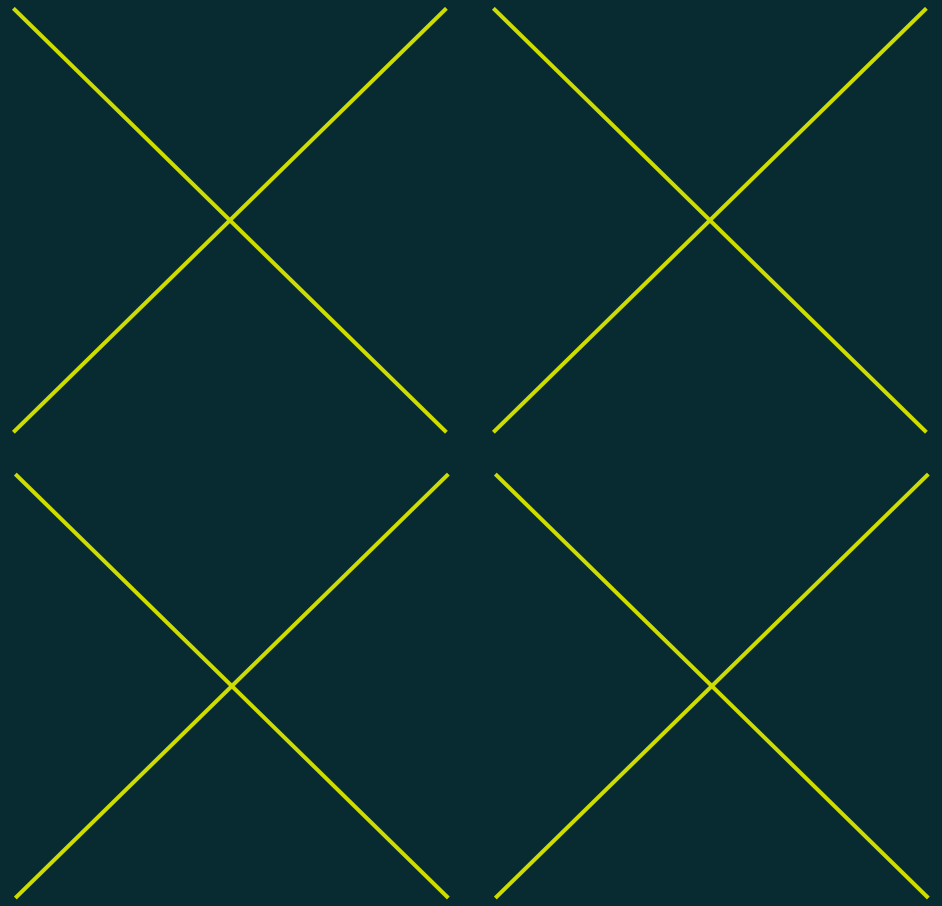
Reference Project

CFB Bio & RDF conversion



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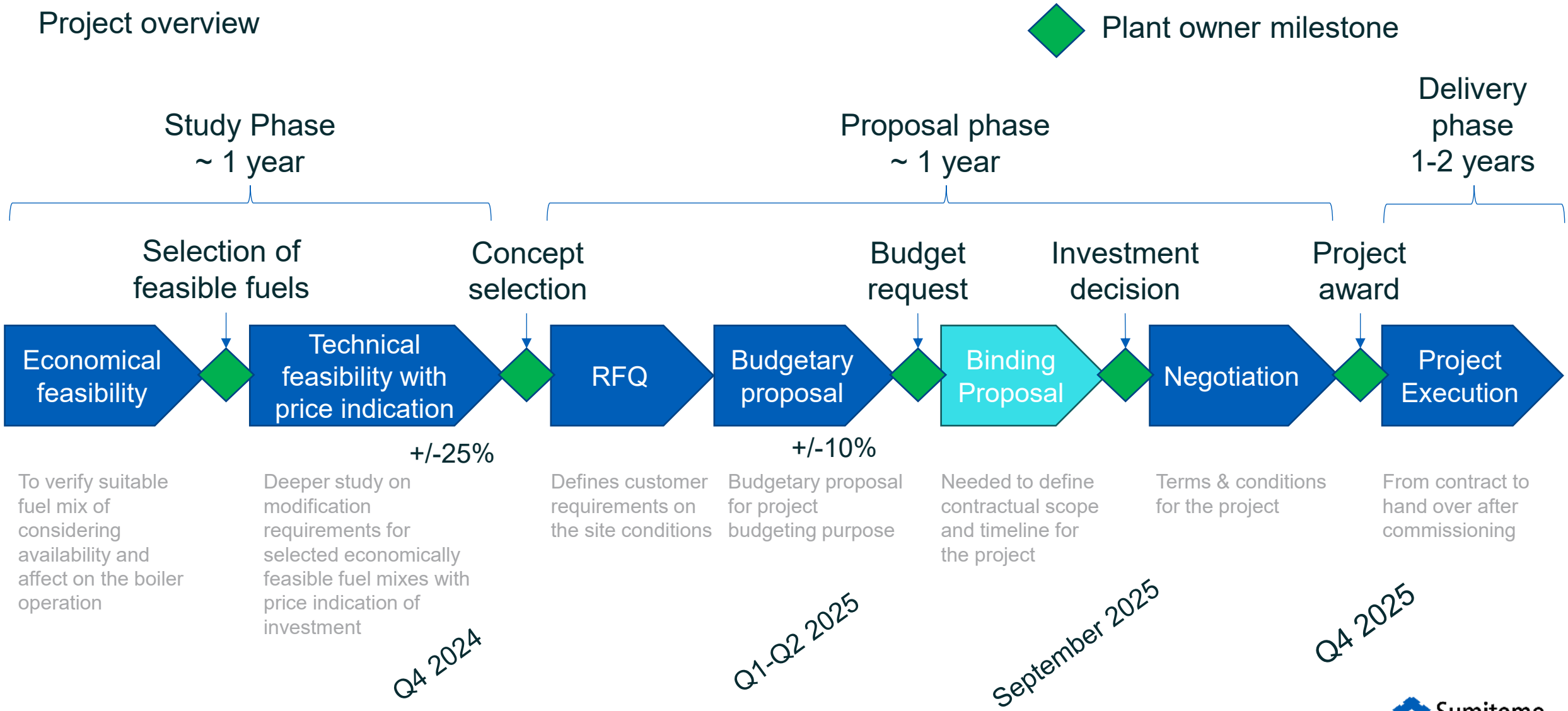
Fuel conversion project development: milestones

Project overview



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Boiler operating parameters

	Original Design	After Conversion
Boiler type	Circulating Fluidized Bed	
Heat to Steam	203 MW_{th}	around 175 MW_{th}
MAX HP-steam flow	270 t/h	min. 233,6 t/h
MIN HP-steam flow	108 t/h	108 t/h
HP-steam pressure	92 bar(a)	92 bar(a)
HP-steam temperature	536°C	525°C
Boiler load	60% ÷ 100%MCR	50% ÷ 86,5%MCR
Fuel Mixtures (% - heat input)	• 100% bituminous coal; • 60% bituminous coal 40% RDF	• 100% biomass; • 70% biomass 30% RDF

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Guarantees

Steam flow	min 233,6 t/h max 108 / 162 t/h
Steam pressure	92 bar(a) ±2 bar
Steam temperature at max load	525°C ± 5°C
Steam temperature at min load	≥ 500°C
SO2 emission	max 67 / 70 mg/m^{3}n
NOx	max 206 / 180 mg/m^{3}n
Dust	max 10 / 12 mg/m^{3}n
CO	max 135 / 160 mg/m^{3}n
NH3	max 17 / 15 mg/m^{3}n
HCl	max 10 / 9 mg/m^{3}n
HF	max 1 / 1 mg/m^{3}n
Hg	max 12 / 5 ug/m^{3}n
Boiler efficiency	~91%
Noise emission	indoor and outdoor
Availability	
Residence time	850C / 2s
Consumables	sand, ammonia water, auxiliary power

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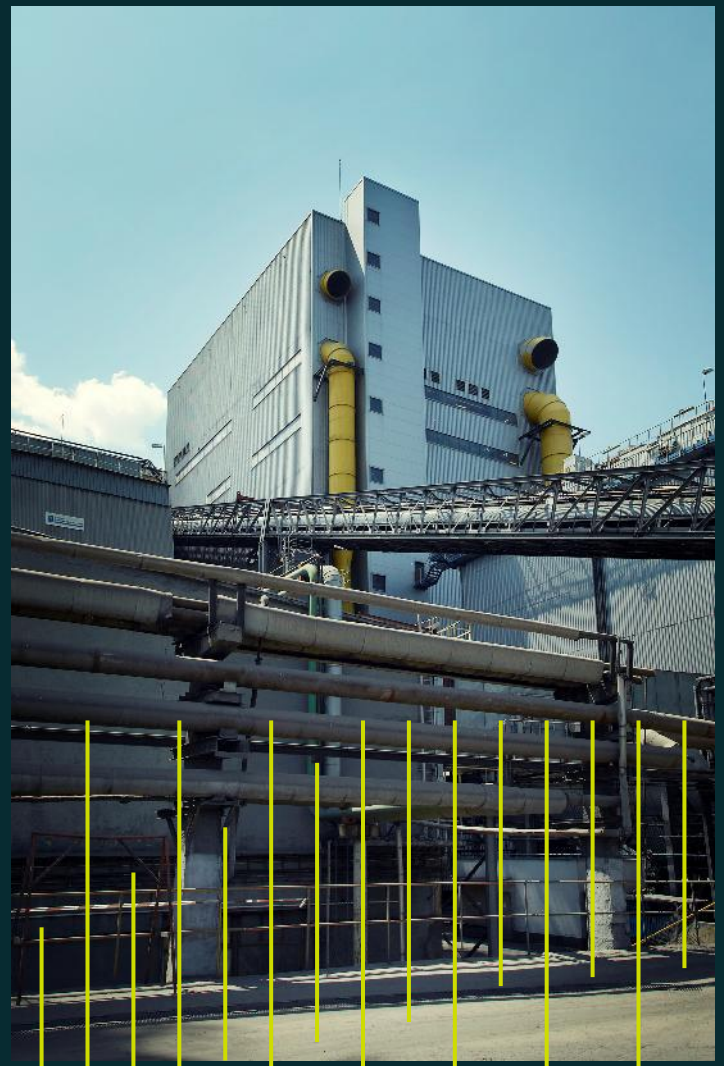
Project Scope

- Boiler island D&E scope
- Technology modernization
- EIC part
  - Power supply for new equipment (motors with FC, cable pulling, swichgears, etc.)
  - Necessary instrumentation (sensors, transmitters, actuated valves) and related accessories (only for delivered by SFW new equipment)
  - BPS/BMS upgrade
  - SFW deliveries only Functional Description + Logic Diagrams + IO list (DCS upgrade excluded)
- Civil
  - Adaptation of the existing boiler building to Eurocode EN standard
  - Steel structure modifications for new equipment (supports, platforms, reinforcements)
  - Cladding and roof opening for crane lifts
- Dismantling and Demolitions works within the scope of works



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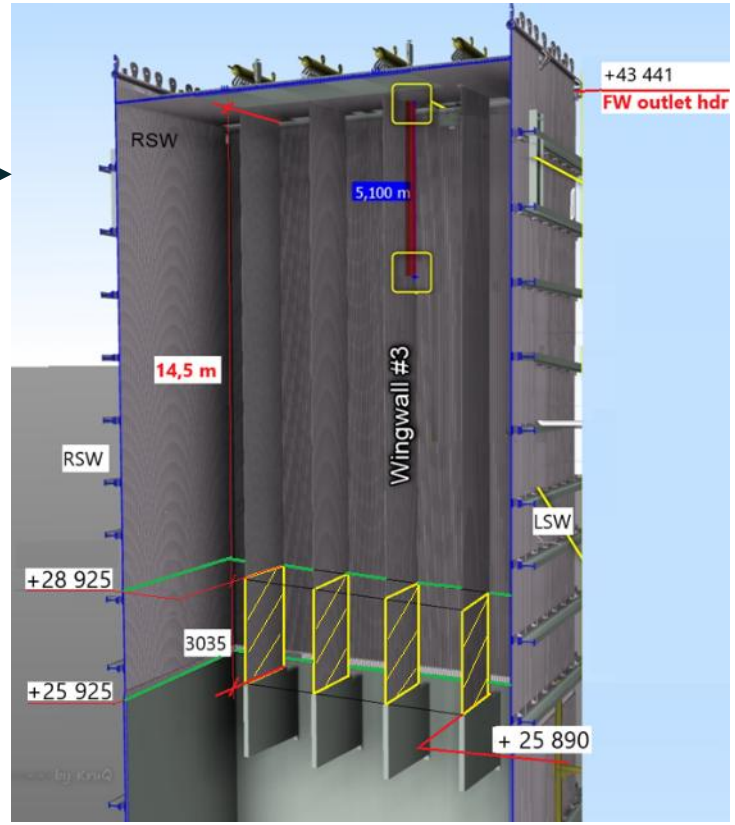
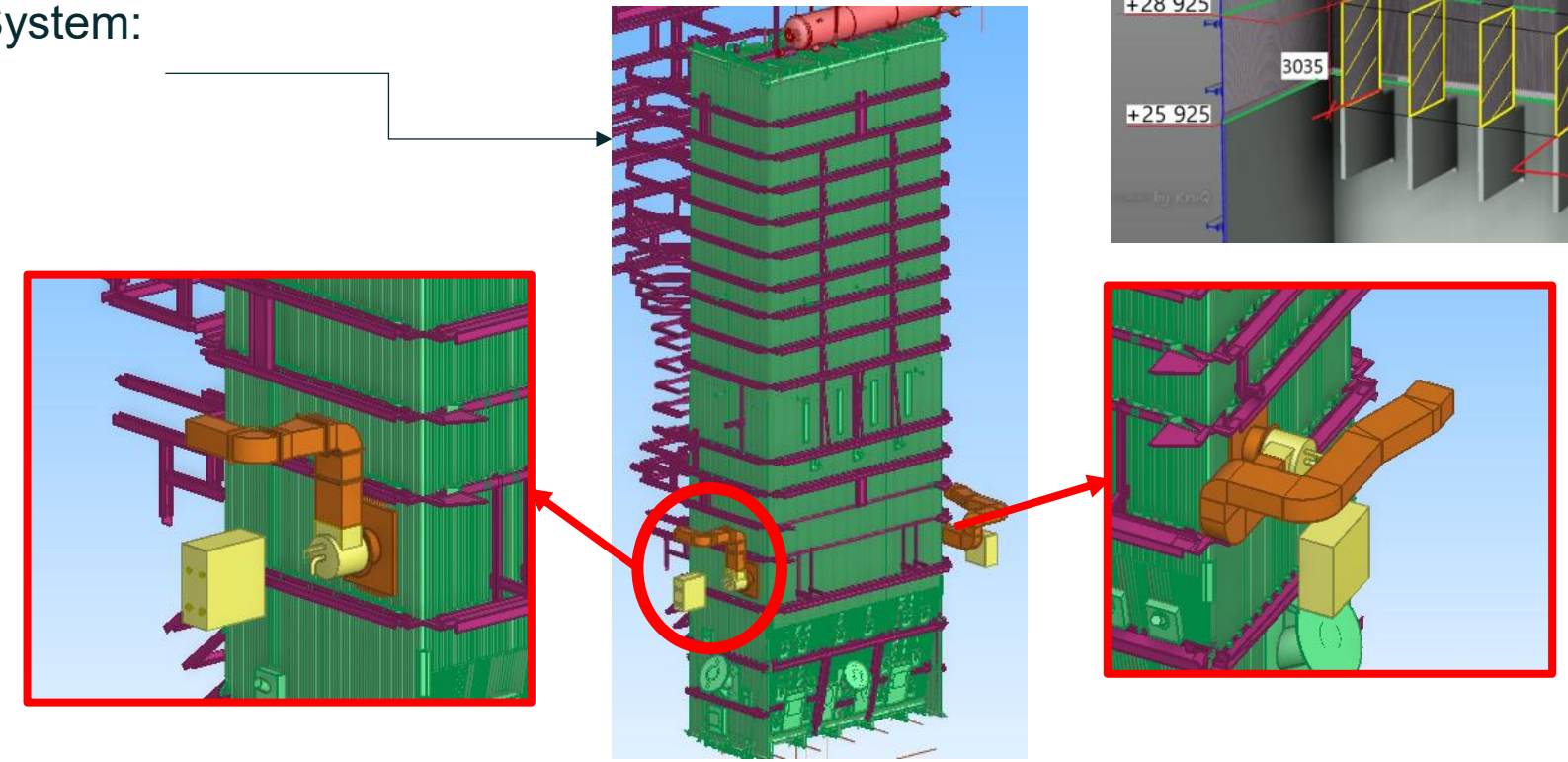
Technology Scope

Main Technology Systems:

a) Boiler:
- Furnace => additional refractory inside furnace
- Replacement of SH I with new material

b) Load Burners System:
- New 2 burners





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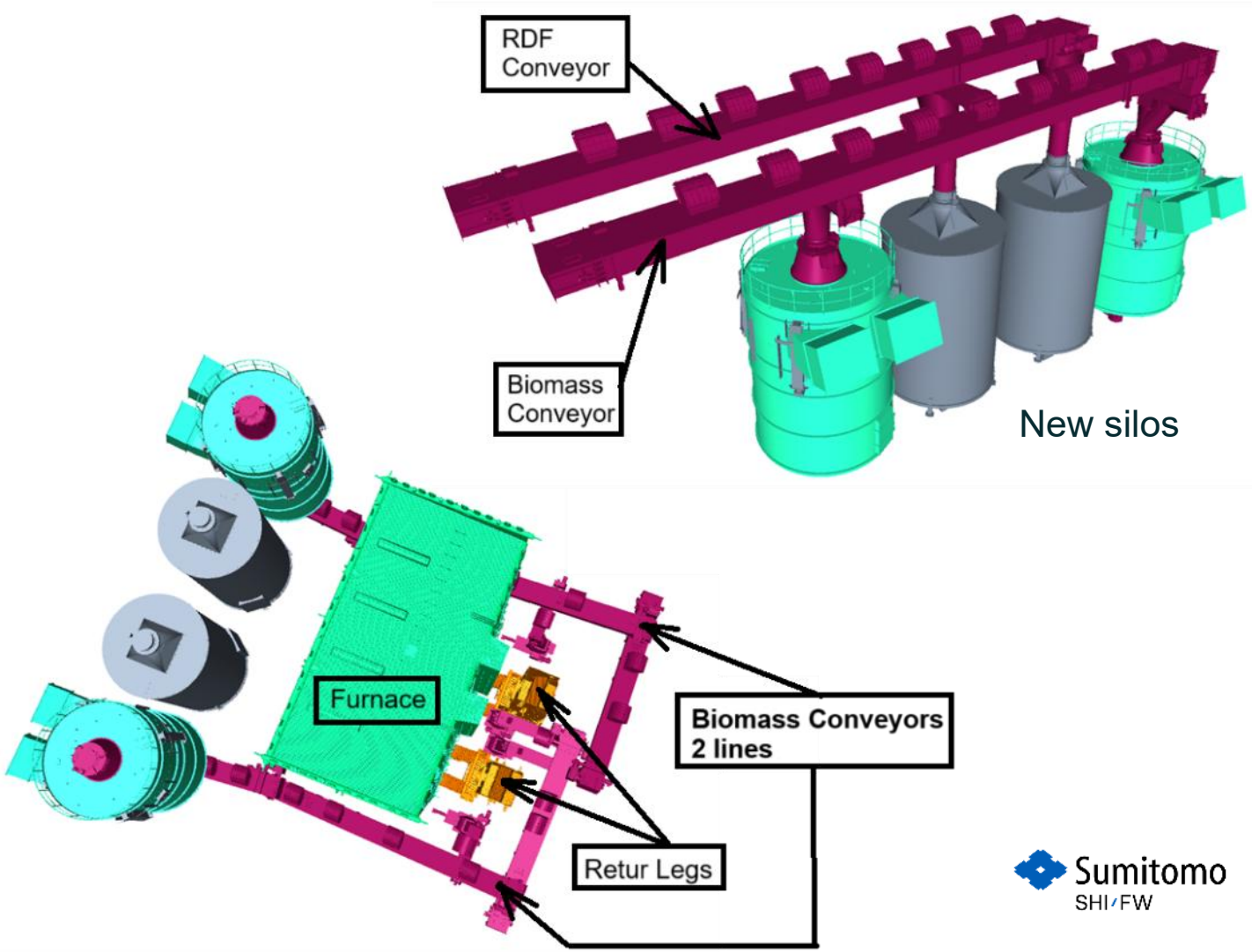
SFW's Scope

Main Technology Systems:

c) Fuel Feeding System into the silos:
   - New biomass conveyor
   - New RDF conveyor

d) Biomass Fuel Storage system:
   - New biomass silos

e) Fuel Feeding System into the boiler



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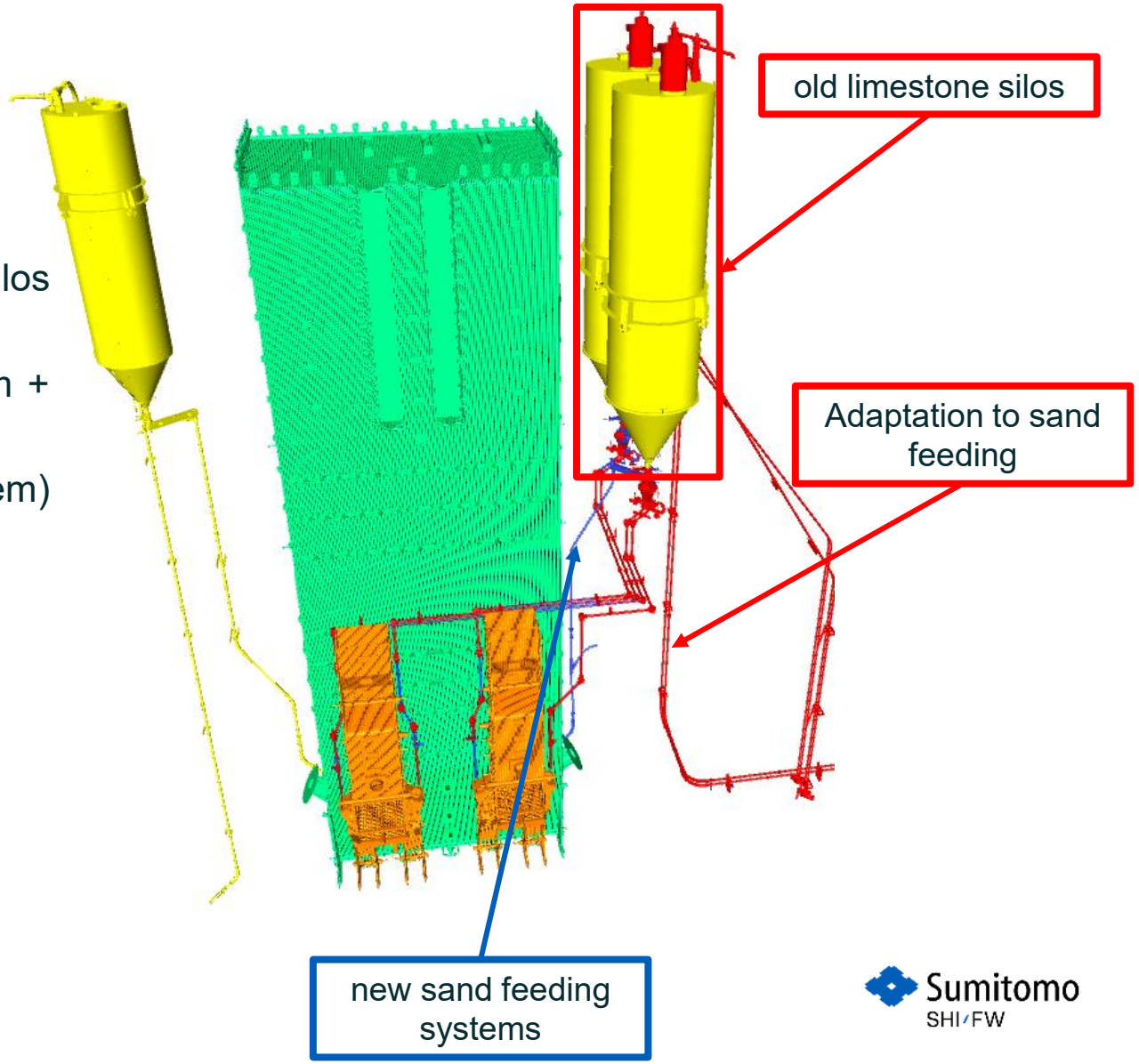
SFW's Scope

Main Technology Systems:

f) Sand Feeding System:

- New sand feeding equipment below old limestone silos (two new sand feeding systems)
- Primary system: 2 points on side walls (existing system + new system)
- Secondary system: 4 points at return legs (new system) (alternatively can be used for kaolin feeding)



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SFW's Scope

Exclusions:

- Obtaining public permits necessary to provide the Works
- Adaptation of the building structure to fire safety requirements;
- Civil works (earth works, foundations, relocations of underground existing facilities, roads, etc.)
- Building equipment (HVAC, VC, lifts, etc.)
- DCS and DCS upgrade;
- External fuel handling system;

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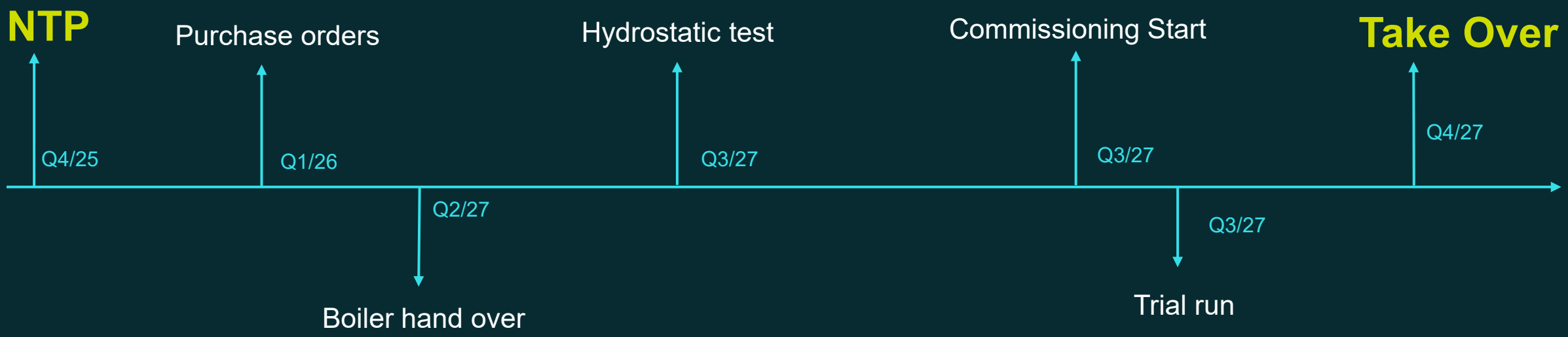
Execution milestone schedule



Duration

Execution

25 months

Total boiler shutdown

5 months

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Q&A

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Thank you

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