

Employer
SAKO BRNO A.S.

Project
Modernization of WtE Plant SAKO Brno

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PART III, APPENDIX C1

REVIEWABLE PROJECT AND DESIGN DATA



PART III, APPENDIX C1 REVIEWABLE PROJECT AND DESIGN DATA

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Ramboll
Hannemanns Allé 53
DK-2300 Copenhagen S
Denmark

T +45 5161 1000
F +45 5161 1001
www.ramboll.com/energy

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1. GENERAL

This appendix describes the objective for Reviewable project and design data, which the Contractor shall submit for Employer review and commenting.

Reviewable project and design data shall serve as one of the Employer's methods for reviewing and monitoring the Line progress of the Contractor and verification of compliance with the requirements and conditions set out in the Contract.

The Contractor's progress on delivering the Contract Object will be reviewed and monitored using both a quantitative and qualitative approach.

Reviewable project and design data shall comply with the agreed content and be delivered within the agreed milestones.

The provisions of this schedule shall apply whenever any item, document or course of action specific to design is required to be reviewed, approved or otherwise processed as part of the Contract.

1.1 Documents to be reviewed

The Contractor shall prepare a document plan as part of the Contract Object, which the Contractor shall keep updated during the project execution. The Employer will, in addition to the documents in the reviewable data packages listed herein, select any further documents from the Contractor's document plan for review.

Reviewable project and design data shall be prepared for the following categories:

- Reviewable Project Data - Project Management (PD)
- Reviewable Design Data – Layout (LD)
- Reviewable Design Data – Buildings and Civils (CD)
- Reviewable Design Data – Mechanical Equipment (MD)
- Reviewable Design Data – Electrical Equipment (ED)
- Reviewable Design Data – Automation (AD)

Each category has more than one Reviewable design data package. The Contractor shall submit updated data from previous packages to the extent deemed necessary by the Employer.

All documents that have been changed compared to previously submitted packages shall be resubmitted again as part of next Reviewable project and design data packages within the relevant category.

Reviewable design data shall be delivered according to the milestones specified in this Appendix and in Part II.i *Contract Programme*.

1.2 Delivery and Process of Reviewable project and design data

When the Reviewable project and design data have been delivered by the Contractor the procedure for the Employer's review and acceptance of the Reviewable project and design data is as follows, unless otherwise is specified:

- The data shall be received by the Employer in compliance with the milestone in the Contract Programme and in accordance with the requirement of the Contract.
- Within the next 20 working days the data is reviewed by the Employer.
- The Employers comments are handed over to and agreed with the Contractor at a workshop arranged at the end of the reviewing period.
- At latest 10 working days after the workshop the Contractor shall submit corrected data to the Employer, if the Employer cannot accept the received data at the milestone.

2. PROJECT MANAGEMENT (PD)

Reviewable Project data for Project Management are selected documents and information, which the Contractor shall deliver to the Employer for the Employer's overall project planning and coordination as well as his follow-up on project progress.

The Reviewable Data for project management includes selected key information about organisation, progress, health and safety, quality assurance, CE-marking, functional safety, manufacturing, training, Site and commissioning.

The Reviewable Project Data for project management is divided into five packages. In addition, the contractor shall deliver a number of documents monthly and a number of specific documents delivered before Contract signing and before first invoice.

The Reviewable Project Data is not an exhaustive list of documents the Contractor is requested to submit to the Employer. The Employer may, in addition to the listed documents in the table, select any further documents from the Contractor's document plan for review. In addition, certain documents shall be issued to the Employer for review on ad-hoc basis as they occur; for example, the Contractor shall provide the Employer with technical specifications and supplier responses as a result of Contractor enquiries for all larger components prior to the Contractor's purchase of such larger components, e.g. the technical specifications for selected equipment to be Subcontracted.

2.1 Required Documents

Documents to be delivered as part of Project Management Data (PD) are listed in the table below. Milestones for delivery are stated in Part II.i *Contract Programme*.

In the table the following abbreviations are used:

- M:** First delivery at milestone date. Henceforth monthly delivery of the document in the monthly report.
- T:** Template to be agreed beforehand.
- W:** First delivery at milestone date. Henceforth weekly delivery of the document in the respective project phase.
- X:** Delivery of completed and final document at milestone date, but when information in documents is changed, the documents shall be updated and re-issued in due time, at the latest together with the next following monthly report.
- Draft:** Is indicated where this is requested.
- Ad hoc:** Is indicated for documents which shall be delivered as soon as they are ready for review.

	Document	Before Contract signing	PD1 1 month from Effective date	PD2 6 months before mechanical erection	PD3 3 months before mechanical erection	PD4 3 months before commis.	PD5 Before Trial run
	Organization						
1.1	Organisation plan	X					
1.2	Organisation chart	M					
1.3	Staffing schedule	M					
	Reporting						
2.1	Monthly Reports	T	M				
	Programme						
3.1	Detailed programme	M ¹					
3.2	Six-week programmes for construction and erection			T	W		
3.3	Six-week programme for commissioning			T		W	
	Documents						
4.1	Document Plan	M					
4.2	Complete list of standards, codes and regulations used for design, fabrication, inspection and testing	M					
	Quality Assurance						
5.1	QA Manual	X					
5.2	Quality Control Plan		M				
	Health & Safety						
6.1	Health and safety plan	X					
6.2	All necessary input to Employer's HSE coordinator for construction		T	X			
6.3	Access and maintenance study		T	Draft	X		
6.4	COSHH data sheets / Material SDS			X			
	Management of Materials and Wastes						
7.1	Materials and Wastes Plan	T	M				
	CE-marking						
8.1	CE-plan	Draft	X				
8.2	Declaration of Conformity		T			Draft	X
8.3	User manual		T			Draft	X
8.4	Risk assessments		T+M				
8.5	Interface list		M				
8.6	Technical File					Draft	X

	Document	Before Contract signing	PD1 1 month from Effective date	PD2 6 months before mechanical erection	PD3 3 months before mechanical erection	PD4 3 months before commis.	PD5 Before Trial run
	ATEX						
9.1	Explosion properties and assumptions		X				
9.2	Hazardous area classification (Document and drawings/modelling)		Draft	X			
9.3	Ignition source assessment			Draft	X		
9.4	List of equipment in hazardous areas					X	
9.5	Verification Document					Draft	X
	Functional Safety						
10.1	Functional Safety Management plan		X				
10.2	Safety Requirement Specifications		T	Draft	X		
10.3	SIL Assessment		T	Draft	X		
10.4	SIL Verification					X	
10.5	SIF Validation plan including FAT and SAT				T ²	X ²	
10.6	Proof-test procedures				T	X	
	Manufacturing						
11.1	Plan for subcontracts		M				
11.2	Inspection and test plan		X				
11.3	Technical Procurement Specifications		Ad hoc	Ad hoc	Ad hoc		
11.4	List of Makes (standardisation)		M				
11.5	List of Wear- and Spare Parts	Draft				X	
	Construction and erection						
12.1	Site Plan	Draft			X		
12.2	Construction and erection progress reporting				T+W		
12.3	Plan for – Construction Completion					X	
12.4	Construction Completion Certificate					T+X ³	
	Commissioning						
13.1	Plan for Commissioning			T		X	
13.2	Commissioning progress reporting					T + W	
13.3	Reports for Cold and Warm test					T	Ad hoc

	Document	Before Contract signing	PD1 1 month from Effective date	PD2 6 months before mechanical erection	PD3 3 months before mechanical erection	PD4 3 months before commis.	PD5 Before Trial run
13.4	Performance Test Concept and Programme					T	X
	Training						
14.1	Training Programme			Draft	X		
14.2	Training Documents				Draft	X	
	Operation and Maintenance Documentation						
15.1	Operation and Maintenance Documentation			T		Draft ⁴	
	Performance testing						
16	Detailed performance testing plan						Draft ⁵

- 1: The contractor shall produce a detailed baseline schedule for ongoing review and comparison for the duration of the Contract Object.
- 2: SIF Validation plan including FAT and SAT shall be completed before commencement of FAT as determines which are witnessed.
- 3: Final Construction Completion Certificate shall be delivered before start commissioning.
- 4: Final Operation and Maintenance Documentation shall be delivered before Preliminary take over.
- 5: The Contractor shall prepare and submit to the Employer for its approval a detailed Performance test plan not later than [4 weeks] prior to the planned date for Trial run.

3. LAYOUT (LD)

Reviewable design data – Layout (also referred to as LD) are divided into five packages; LD1, LD2, LD3, LD4, and LD5, corresponding to the development stage of the project. The required content of each package is defined below. Note the content listed is indicative and not considered exhaustive.

The Contractor shall submit a change log together with the 3D model to ensure the Employer can easily identify changes from previous 3D model iterations. The Contractor shall clearly state which parts of the 3D model are close to design freeze and where the Contractor expects the Employer to give comments for the Contractor in due time to agree to changes in the design.

After submission of LD5, the Contractor shall submit an updated 3D model monthly until the Contractor has completed the detailed design for the Line as agreed by the Employer.

After completed detailed design of the Line, an updated 3D model shall be submitted by the Contractor once deemed necessary by the Employer.

The 3D model shall always be forwarded both in open original file format and as a file readable in Navisworks 3D viewer

3.1 Required Documents

3.1.1 LD1 (2 MONTHS FROM EFFECTIVE DATE)

LD1 comprises:

- Updated 3D model including all discipline models and shall include minimum
 - Foundation and concrete structure
 - Steel structures
 - Facade and roof structure
 - Position and size of rooms
 - Staircase towers
 - All rooms with preliminary doors, gates etc.
 - All major process components
 - All major pipes and ducts
 - All main cable routings
 - Main galleries, stairs etc.
 - Service crane coverage area and lifting shafts, etc
 - Traffic study
 - Site infrastructure with e.g. access, roadways, fencing, barriers, other buildings, landscaping, other infrastructure
- 2D-drawings shall include main dimensions including elevations, modular grid and names of components etc.

3.1.2 LD2

LD2 comprises:

- Updated 3D model including all discipline models and shall include minimum
 - Foundation and concrete structure
 - Steel structures
 - Facade and roof structure
 - All rooms with doors, gates etc.
 - Plinths
 - Pump pits and collection pits
 - Space reservation for ventilation and other building service installation.
 - All large openings in facade, roof, walls and floors
 - Drainage and utilities connections
 - All process components including main armatures and access openings (hatches, manholes)
 - All major pipes and ducts
 - All major cable routing
 - Galleries, stairs etc.
 - Service crane coverage area and lifting shafts, etc
 - Erection openings
 - Hazardous areas (ATEX classified areas)
 - Schedule of colours for Line elements (RAL code)
 - Site infrastructure with e.g. access, roadways, fencing, barriers, other buildings, landscaping, other infrastructure
- Updated 2D drawings for all main levels, longitudinal and cross sections corresponding to the 3D-model.

3.1.3 LD3

LD3 comprises:

- Updated 3D model including all discipline models and shall include minimum
 - Foundation and concrete structure
 - Steel structures
 - Facade and roof structure
 - All rooms with doors, gates etc.
 - Plinths
 - Pump pits and collection pits
 - Ventilation systems and other building service installation
 - All openings in facade, roof, walls and floors
 - Drainage and utilities connections
 - All process components including main armatures and access openings (hatches, manholes)
 - All pipes and ducts, including armatures
 - All cable routing
 - Galleries, stairs etc.
 - Service crane coverage area and lifting shafts, etc
 - Erection openings
 - Hazardous areas (ATEX classified areas)
 - Schedule of colours for Line elements (RAL code)

- Site infrastructure with e.g. access, roadways, fencing, barriers, other buildings, landscaping, other infrastructure
- Updated 2D drawings for all main levels, longitudinal and cross sections corresponding to the 3D-model.

3.1.4 LD4

LD4 comprises:

- Updated 3D model including all discipline models and shall include minimum
 - Foundation and concrete structure
 - Steel structures
 - Facade and roof structure
 - All rooms with doors, gates etc.
 - Plinths
 - Pump pits and collection pits
 - Ventilation systems and other building service installation
 - Buildings electric wiring, earthing, illumination
 - All openings in facade, roof, walls and floors
 - Drainage and utilities connections
 - All process components including main armatures and access openings (hatches, manholes)
 - All pipes and ducts, including armatures
 - All cable routing
 - All lifting equipment
 - Galleries, stairs etc.
 - Service crane coverage area and lifting shafts, etc
 - Erection openings
 - Hazardous areas (ATEX classified areas)
 - Schedule of colours for Line elements (RAL code)
 - Site infrastructure with e.g. access, roadways, fencing, barriers, other buildings, landscaping, other infrastructure
- Lifting concept. The Contractor shall provide a lifting concept in form of drawings and tables. The lifting concept shall illustrate how all components will be removed / lifted / transported in case of maintenance (service or replacement).
- Updated 2D drawings for all main levels, longitudinal and cross sections corresponding to the 3D-model.

3.1.5 LD5

LD 5 comprises:

- Final 3D model
- Final 2D drawings for all main levels, longitudinal and cross sections corresponding to the 3D-model

4. BUILDINGS AND CIVILS (CD)

The Contractor shall supply details sufficient for the Employer to monitor and review the basic and detailed civils and building design stages of the Contract Object as carried out by the Contractor and associated Subcontractors. The Employer will examine and comment upon all civil engineering and building design drawings and specifications of the Contract Object for compliance with the Employers Requirements, and to comment on the implications of any amendments.

All design data shall be prepared in accordance with the requirements of this Contract and according to the valid legislation requirements according but not limited to the Act No. 183/2006 Coll. (Building Act) and Regulation 499/2006 Coll. on Construction documentation as amended. Before its submission by the Contractor, the Reviewable design data shall be sufficiently developed and detailed to enable the Employer to appropriately conduct a review of its design, function, space requirements, quality and compliance with this Contract.

The Contractor shall latest 1 months from Effective date provide a document delivery plan for Reviewable design data – Buildings and Civils (also referred to as CD). Unless otherwise agreed the Buildings and Civils Data are to be divided into five packages; CD1, CD2, CD3, CD4, and CD5, corresponding to the Contractors development stage.

CD1: 3 months from Effective date

The documents included in each package is to be defined by Contractor in minimal extend according to the description below.

The Contractor shall maintain all Documentation up to date during the entire period of Contract and to the expiry of the Contract. Note the content listed is indicative and not considered exhaustive.

4.1 Documentation on Building permit

The Contractor's shall obtain all necessary approvals and statements from public authorities and other entities, including obtaining Building permit for the Line in accordance with Act No. 183/2006 Coll. (Building Act) as amended and in accordance with related legislation.

For this reason, the Contractor shall prepare the relevant documentation according to the binding extend prescribed in Annex No. 12 to Regulation No. 499/2006 Coll. as amended.

The contractor is obliged to submit this documentation to the Employer for approval at minimum as a part of CD 1.

4.2 Required Documents – civils

The Contractor's civils deliverables for review by the Employer shall include, but not be limited to, the following documents:

- List of Key Suppliers
- Design philosophy
- Demolition Works
- Temporary Works philosophy and design (if applicable)
- Design calculations and assumptions list for all civils parts of the Contract Object
- Geotechnical Investigation Reports
- Geotechnical Design Reports
- Ground Investigations Factual Reports
- Weights and loadings data and diagram
- Vehicle movement study (internal and external)
- All Documentation required for local authority sign off – including discharge of planning conditions and Building regulation approval
- Noise studies, dispersion study etc. (based on Authorities requirements)
- Fire plans and approval from insurers
- Design life assessment
- Reinforcement schedules
- Holding down bolt schedules
- Room schedules and data sheets
- Internal finishes schedule
- Test certificates
- All civils drawings including those from all specialist Subcontractors. Drawings shall be with dimensions in millimetres and shall be at a maximum scale of 1:100. Drawings to cover minimum of:
 - General civil arrangement drawings and field drawings covering Line area showing buildings and structure at grade level
 - Ground floor layout
 - Plans at each intermediate floor
 - Views on all principle elevations
 - Sectional views throughout the Line
 - Roof layout
 - Architectural drawings
 - Foundation layout and design including bunker / pits
 - Ground remediation including gas protection
 - Bulk earth works
 - Bunker / pit water ingress / egress control
 - Water drainage drawings and underground piping including attenuation, interceptors etc.
 - Utility connections
 - Infrastructure drawings with termination points
 - Building framing drawings, including cladding details and roofing material profile
 - Structural steel works fabrication drawings and static calculation
 - Precast concrete floors and staircases
 - Reinforcement detail drawings
 - External layouts of Line
 - Landscaping

The Contractor's Architectural deliverables for review by the Employer shall include but not be limited to the following documents:

Architectural Drawing Series	General Description of Series
Existing Conditions	Existing Conditions / Demolitions
General Site Plans	Location Plans
	Scale 1:500/1:250 (Alphabetical & Numerical Zones)
	Grid Plans
GA Floor Plans	Key Floor Plans (Small Scale – 1:200 / 100 / as appropriate.)
	Detail Plans (1:50s)
Setting Out / Profile Plans	
Reflected Ceiling Plans /Soffits	
GA Elevations	Scale 1:200 / 1:100
GA Sections	Scale 1:200 / 1:100
Internal Elevations / Sections	Scale 1:50 to 1:20
	Numbered as required in 000's series
	1001, 1002 etc. Wall Sections
	2001, 2002 etc. Internal Elevations
Building Details	Numbered as required in 000's series
(section / plan / etc.)	1001, 1002 etc. Builders works
	2001, 2002 etc. Metalworks
	3001, 3002 etc. Cladding
	Misc details
Floor Finish Plans	Scale 1:100/1:50 Numbered as per A02 series
	Details
Fitout Plans (Furniture Layouts)	Furniture Layout Plans
	1001, 1002 etc. Fixture 1
	2001, 2002 etc. Fixture 2 (as appropriate.)
Cores (Stairs, Escalators, Lifts)	Core Plans and Sections
	Core Details
Wet Area Details	Wet Areas: Plans & Elevations
	Wet Areas: Details
Joinery Details	Wall & Ceiling Details
	Cladding Details
General Metalworks eg balustrades	Plans
	Details
Doors	Schedules
	Plans (as required)
	Details
Windows	Schedules
	Plans (as required)
	Details
Finishes	Interior/Exterior Schedules
Specifications	Detail Architectural Specifications

Where appropriate to the completed design stage, the above Documentation shall be submitted for review and commenting by the Employer.

4.3 Required Documents - Building Services

The Contractor's design responsibilities in relation to the building services Mechanical, Electrical and Public health systems are defined in its minimum extend within Regulation No. 499/2006 Coll. as amended.

The Contractor's design responsibility and deliverables for review by the Employer shall include, but not be limited to, the following documents for all building services systems:

- List of Key Suppliers
- Mechanical specifications
- Electrical specifications
- Design calculations assumptions list for all Building Services systems
- Design calculations for all building of Line
- Fire Strategy and related fire design
- All Documentation required to achieve local planning sign off
- Energy performance models and certification as required for building regulations
- Technical equipment schedules and datasheets
- Cable and instrumentation schedules and datasheets
- Control philosophy and specification
- Internal finishes schedule
- Room schedules and data sheets
- Detailed drawings including but not limited to:
 - Line and switch room layouts and sections
 - General arrangement drawings (all systems)
 - Design schematics (all systems) including Wiring and circuit diagrams, Hardware configuration / Rack layouts
 - External services
 - Detailed builders drawings of Line
 - Full spatial coordination including details and sections of confined or restricted areas of the main services distribution routes
- Production of operation and maintenance manuals at completion.

5. MECHANICAL EQUIPMENT (MD)

Reviewable design data – Mechanical Equipment (also referred to as Mechanical data or MD) are divided into 3 packages; MD1, MD2 and MD3, corresponding to the development stage of the project. The Contractor shall submit the required content of packages MD1, MD2 and MD3 as defined below. Note the content listed is indicative and not considered exhaustive:

MD1 Mechanical data based on basic engineering.

Reviewable design data for key components and systems based on basic engineering by the Contractor and his Subcontractors.

MD2 Mechanical data based on initial detailed engineering.

Reviewable design data for components and systems based on detailed engineering by the Contractor and his Subcontractors.

MD3 Mechanical data based on completed detailed engineering.

Reviewable design data for components and systems based on completed detailed engineering by the Contractor and his Subcontractors.

The quality and quantity of all data submitted by the Contractor shall in principle be “100 %” i.e. a completed submission reflective of the current project design stage. In addition, the Contractor shall provide regular progress updates for specific documents at the Employers request.

5.1 Required Documents

	Document	MD1	MD2	MD3
	Process Technology			
1.1	Process descriptions	X	X	X
1.2	Capacity Diagram	X		
1.3	Detailed Guideline for P&ID creation including list of P&IDs	X		
1.4	Process Flow Diagrams	X	X	X
1.5	P&I Diagrams	X	X	X
1.6	Sizing calculations and design basis	X	X	
1.7	Energy and mass balance	X	X	
1.8	Media specifications	X	X	
1.9	Static and dynamic strength calculations of steel structures (for crane, boiler etc.)	X	X	
1.10	Heat transfer calculations	X		
1.11	Pressure loss calculations	X		
1.12	CFD analysis	X		
1.13	Interface list with interface specifications	X	X	X
1.14	Pressure drop study	X		
1.15	Noise and vibration study	X		

	Document	MD1	MD2	MD3
	Equipment			
2.1	General arrangement of equipment	X	X	X
2.2	Detailed drawings of equipment		X	X
2.3	Component specifications		X	X
2.4	Equipment data sheets		X	X
2.5	Compressed air consumer list	X	X	X
2.6	Dimensions of all piping, incl. pressure loss calculations		X	X
2.7	Isometrics and stress calculations for piping systems		X	X
2.8	Piping classifications		X	X
2.9	Piping and pipe component list		X	X
2.10	Piping supports and spring suspensions		X	X
2.11	Piping routing layout with plans and sections, incl. connections at interfaces		X	X
2.12	Insulation calculation and specifications	X	X	
2.13	Nozzle specifications		X	
2.14	Design life assessment	X	X	
2.15	Refractory design including the selection of relevant materials	X	X	
2.16	Pressure equipment list according to PED	X	X	
2.17	Approval documentation of boiler, piping and pressure vessels			X
2.18	Emission Source List	X	X	
	Installation			
3.1	Cleaning and passivation concept for water-steam cycle			X
3.2	Installation manuals for components and part systems		X	X
3.3	Welding procedures, qualifications, logs and location maps			X
	Test			
4.1	FAT and SAT procedures	X	X	
4.2	FAT plans		X	X
4.3	SAT plans		X	X

Further Description of Selected Required Documents:

- 1.1 Description of a process includes the interdependency of process, operation, and consumption data, performance data from various operational phases, requirements for auxiliary facilities/service systems, etc. The descriptions comprise the KKS function and aggregate level.
- 1.2 Capacity diagram defines the operating window and includes detailed definitions and limitations of all operational conditions of the process.

- 1.3 The Guideline for PID creation governs the production of the Process & Instrumentation Diagrams (PID's) in terms of form, content and application. Specifications of diagrams and graphical symbols are to be described taking the standards stated in Appendix A14.7 *Documentation* into account. Page layout and readability is to be suggested, including headers, footers, drawing headers, arrangement of components, font sizes, etc. Representation of Standard E&IC-functions, typicals and coding are to be proposed. Local Operator Stations, Local Controls and Black Boxes (if any) are included into the description.
- 1.4 Process Flow Diagrams shall be prepared in accordance with the standards stated in Appendix A14.7 *Documentation* including schedules with data at all points of interfaces, including pressure, temperature, quantities, etc.
- 1.5 Process and Instrumentation Diagrams.
The diagrams shall be prepared according to the standards stated in Appendix A14.7 *Documentation*, including tag numbers for all pipes, instruments, valves and other equipment.
- 1.6 Sizing calculations and design basis includes data for dimensioning of components, i.e. characteristics of feed systems, pumps, blowers, valves and heat exchangers, travel time calculations for crane systems, steam turbine design and performance curves etc.
- 1.7 Energy and mass balance
As a general requirement mass and energy balances cover all media which are processed throughout the entire Line; this includes e.g. water, steam, condensate, air, flue gas, bottom ash, reagents, liquids, suspensions, ash, residuals, compressed air, etc.

The balances of the process are to be closed including all in-going and out-going media streams. The balances shall refer to relevant flow diagrams so that the media flow can be easily identified on the diagrams and in data tables.

The applicable units and standard conditions (e.g. standard temperature 273.15 K or 0 °C, standard pressure 101 325 Pa) are to be stated clearly.

One balance shall be provided for each load case, i.e. for the nominal load case and the relevant other design load cases. Relevant design load cases are minimal and maximal design loads representing the complete operational window. E.g. for the boiler the mass and energy balances are calculated according to the capacity diagram. The steam-water-cycle calculations take clean and fouled heat exchanger conditions into account.

Water balances include quality parameters like chemical concentrations and temperatures.

Relevant peak flows and the corresponding durations of the peak flow in question are to be calculated and stated.

- 1.13 The Interface list includes specifications covering data for connection points for all media, incl. position xyz-coordinates and orientations, media specification, pressure and pressure losses, temperatures, flows, forces, moments, material choices and specification of flange or other connections, including necessary tolerances etc.

The list shall include normal operation data and design data. Special care shall be taken to

specify maxima and short time peaks, e.g. for determination of necessary buffer volumes for utilities.

- 2.4 Equipment data sheets (typically data sheets from Subcontractors) include project data for components, e.g. technical specifications, dimensions, weight, materials, performance curves etc.
- 2.5 Compressed air consumer list containing peak values, cycle time, consumption per cycle, maximal mean value, effective average consumption, minimum compressed air quality and pressure, and compressed air consumption at blackout or other trip situations.
- 2.18 Emission source list and noise source list with specification of sound level, sound pressure, position, surface, frequency spectrum for the largest noise emitters.

6. ELECTRICAL EQUIPMENT (ED)

Reviewable design data – Electrical (also referred to as Electrical Data or ED) are divided into 3 packages; ED1, ED2 and ED3, corresponding to the development stage of the project. The Contractor shall submit the required content of packages ED1, ED2 and ED3 as defined below. Note the content listed is indicative and not considered exhaustive.

ED1 Electrical data based on initial basic design

ED1 consists of documents, which are fully adapted to the current project, and which are designed to an extent as close as possible to the final documents. The documentation is binding on the Contractor.

ED2 Electrical data based on final basic design

ED2 consists of documents, which are designed in detail and released for construction, implementation and manufacturing as well as for detailed design.

ED3 Electrical data based on final detailed design

ED3 consists of documents, which are designed in detail and released for construction, implementation, manufacturing and installation.

The quality and quantity of all data submitted by the Contractor shall in principle be "100 %" i.e. a completed submission reflective of the current project design stage. In addition, the Contractor shall provide regular progress updates for specific documents at the Employer's request.

6.1 Required Documents

The electrical Reviewable design data shall include, but shall not be limited to, the data described in table below and detailed after.

	Document	ED1	ED2	ED3
	General			
1.1	Process flow diagram	X	X	X
1.2	PID diagrams	X	X	X
1.3	Technical specifications and requirements	X	X	
1.4	Overall single line diagram	X	X	
1.5	Consumer lists	X	X	X
1.6	Load calculations		X	X
1.7	Consumers (>90 kW) detailed datasheets	X	X	X
1.8	Functional description		X	X
1.9	Emergency and safety systems	X	X	
1.10	Distribution switchboard feeders typical	X	X	
1.11	MCC and ACC typical		X	X
	Equipment			
2.1	Switchboard, detailed single line diagrams		X	X
2.2	Switchboards layout drawings		X	X
2.3	Circuit diagrams		X	X
2.4	Terminal and termination diagrams		X	X
2.5	Heat loss calculations	X	X	
2.6	Electrical calculations		X	X

	Document	ED1	ED2	ED3
2.7	Cable, busbar calculations		X	X
2.8	Discrimination verification		X	X
2.9	Short circuit calculations	X	X	X
2.10	Voltage drop	X	X	X
2.11	Harmonic content	X	X	X
2.12	Cable plan	X	X	X
	Installation			
3.1	Equipment location, layout and dimensions	X		X
3.2	Main cable routing layout	X	X	
3.4	Cable lists		X	X
3.5	Cable types	X		
3.6	Installation manuals for components and part systems	X	X	X
	Test			
4.1	FAT and SAT procedures	X	X	
4.2	FAT protocols		X	X
4.3	SAT protocols		X	X
4.4	Additional test reports		X	X
	Other			
5.1	Grid company requirements		X	X

Further Description of Selected Required Documents:

1.3 Technical specifications / requirements

Any technical specifications intended to be used for subcontracting of items of equipment from Subcontractors.

1.4 Overall single line diagram

Power system layout with system voltages and system earthing, identification of all generators, transformers, switchboards, distribution boards, battery systems and major consumers. Single line diagram / consumer list for all switchboards and consumers, with information of switchboard connections, consumer rating, cable dimensions and setting of protective devices. Rating of generators (kVA/kW), all transformers (kVA), any major consumers (kVA/kW), capacity of battery and charger for battery systems.

1.5 Consumers lists

The list of consumers shall provide information such as: consumer identification, installed power, efficiency, power factor, absorbed power, current, load factor, start condition, emergency operation, diagram etc. All consumers shall be listed and the power summarised for each switchboard, for emergency supply and total for the Line.

1.6 Load calculations

Power load analyses for all operation modes of the system including emergency power supply and UPS power supply systems. Considerations concerning size of the emergency supply for energising the necessary distribution transformers and capability of operating the required consumers during emergency supply.

1.7 Consumers (>90 kW) datasheets

Specific datasheets for power consumers with rating exceeding 90 kW.

1.8 Functional description

Description explaining functionality and operation of local, remote and automatic control of the switchboard (e.g. protection, interlocks, redundancy, trips and shutdowns, other safety actions, standby start).

1.9 Emergency and safety systems

Information of emergency stop, safety, safety operation precautions, interlock systems etc. showing fail-to-safe functionality.

2.1 Switchboards, detailed single line diagrams

Single line diagram / consumer list for all switchboards and consumers, with information of switchboard connections, consumer rating, cable dimensions and setting of protective devices. Rating of generators (kVA/kW), all transformers (kVA), any major consumers (kVA/kW), capacity of battery and charger for battery systems. Power cables and bus bar dimensions internal in the equipment including circuit protection. Table with switchgear rating for power circuits (e.g. making and breaking capacity).

2.2 Switchboards Layout Drawings

External and internal layout drawings showing arrangement of components of panels, parts of switchboards, motor starters etc. Location of instruments and devices for operation (front panel layout).

2.3 Circuits Diagrams

Separate power and control schematic circuit diagrams. Specifying all connections of an installation. The circuit diagrams must provide information about the internal electrical connections of a unit or assembly of units. Providing information on protection synchronisation, breaker interlocks, under voltage trips, remote control circuits, interfaces to other item of equipment. Including component lists with information of manufacture, type, component reference marking, cross reference etc.

2.4 Terminal Diagrams

Diagrams showing the terminals, terminal rows, and the internal and/or external conductors connected to them shall be provided.

2.4 Termination Diagrams

Diagrams representing the connections between the various units of an installation shall be provided. The connection diagrams must provide information about the external electrical connections between units of equipment.

For each function (e.g. a motor control, a valve, a measuring point, etc.) a connection diagram must be supplied showing the external wiring and components and connection points with cable number, cable type, core number, or colour.

For connection to field equipment, the complete external wiring to the field equipment is also shown on the drawing. For each connection to another panel the drawing shows one terminal in the other panel, with panel and drawing number reference.

2.5 Heat loss calculations

For all items of equipment, switchboards, generators, transformers, power converters, motors etc., heat losses shall be listed in tables and informed. Total heat losses for items of

electrical equipment located in the same room shall be summed and summarized in separate tables.

2.6 Electrical calculation

Short circuit levels (peak value and symmetrical root mean square at 0.5 cycle) for all switchboards in the distribution system. Two phase and Earth fault currents shall also be noted.

Voltage drop calculation. Both stationary values as well as voltage drop when starting large consumers (e.g. voltage drop main switchboard to the motor terminals)

Content of voltage harmonic distortion due to more than 20% of connected load is by semi-conductor assemblies, in relation to connected generating capacity. Harmonic distortion should be given for all operating modes of the system.

2.7 Cable, busbar calculations

Calculations for cables and busbar systems, used between electrical components and internal in switchboards. With respect to voltage drop, current carrying capacity, respecting ambient conditions, installation method, short circuit withstand capacity etc.

2.8 Discrimination verification

Discrimination for feeders in the distribution system including list of settings of protection for short circuit, overcurrent and earth fault. The analysis shall include main switchboards, emergency switchboards, and all sub-distribution systems including battery /UPS systems. Minimum and maximum short circuit currents, as well as generator decrement curves should be stated in the discrimination analysis.

2.12 Cable Plan

A layout drawing showing the unit or the installation with additional marking of cable routes and cable numbers shall be provided.

3.1 Equipment location, layout and dimensions

Drawings providing information for equipment, location of equipment parts, e.g. motors, actuators, etc., terminal blocks, plugging units, sub-assemblies, modules, etc. Information of dimensions for equipment. The drawings must show the item designations applied in related diagrams and the coordinate codes.

3.2 Cable routing layout

Drawings providing information for routing layout and cross section of cable trays systems etc.

3.4 Cable List

The list of cables must include all cables to/from panel, equipment and junction boxes. The list of cables must include at least the following information:

Cable number, cable type, cable dimension, from unit or panel, to unit or panel and coordinate codes, if applicable, voltage, no. of cores and length.

3.5 Cable types

Information for the provided for the cables intended to be used in the system. Maker, cross sectional drawing, field of application, voltage class root mean square U_o/U , cable type and number of cores - conductor cross-sections (mm^2), number of strands in each conductor,

insulation thickness (mm), sheath thickness inner and outer (mm), braiding core diameter (mm), overall diameter (mm), insulating material, insulating screening, material inner sheath, material outer sheath, material outer braid, compliance standards.

4.1 FAT procedures.

Test procedures for routine tests and tests planned at the manufacturer's facility. (e.g. start, stop, protection, interlocks, redundancy, trips and shutdowns, other safety actions, alarms).

4.3 SAT protocols

Test procedures for tests and tests planned at SAKO premises. (e.g. start, stop, protection, interlocks, redundancy, trips and shutdowns, other safety actions, alarms).

4.4 Other test protocols

Test procedures for tests and tests planned at SAKO premises in combination with other parties. (e.g. Grid company requirements test etc.).

5.1 Grid company requirements

Documentation and calculating to gain full compliance with grid company requirement - Including system stability analyses, discrimination analyses etc.

7. AUTOMATION (AD)

Reviewable design data – Automation (also referred to as Automation Data or AD) are divided into 3 packages; AD1, AD2 and AD3, corresponding to the development stage of the project. The Contractor shall submit the required content of packages AD1, AD2 and AD3 as defined below. Note the content listed is indicative and not considered exhaustive:

AD1 Automation data based on initial basic design

AD1 consists of documents, which are fully adapted to the current project, and which are designed to an extent as close as possible to the final documents. The documentation is binding on the Contractor. Object library (Typicals) and hook-up's can be based on prior projects if necessary, at this stage.

AD2 Automation data based on final basic design

AD2 consists of documents, which are designed so all principles are clarified and ready to be released for detail design, construction, implementation or manufacturing.

AD3 Automation data based on final detailed design

AD3 consists of documents, which are designed in detail by the Contractor and released for construction, implementation, manufacturing and installation.

The quality and quantity of all data submitted by the Contractor shall in principle be "100 %" i.e. a completed submission reflective of the current project design stage. In addition, the Contractor shall provide regular progress updates for specific documents at the Employers request.

7.1 Required Documents

The automation Reviewable design data shall include, but shall not be limited to, the data described in table below:

	Document	AD1	AD2	AD3
	General			
1.1	Process Control Description and Philosophy (CDP)	X	X	
1.2	Process flow diagram	X	X	
1.3	PID diagrams	X	X	X
1.4	Technical specifications/requirements	X	X	
1.5	Programming manual	X	X	X
1.6	CMS topology/configuration	X	X	
1.7	CMS typical SW (standard modules for motor, valves etc.)	X	X	
1.8	CMS typical (HW) circuit diagrams (standard diagram for motor, valves etc.)	X	X	
1.9	Instrument lists (with type indicated block/ redundancy philosophy / location)	X	X	
1.10	Signal list or other list, including signal list from MCC etc.	X	X	
1.11	Signal lists/bus and RIO design		X	X
	CMS Equipment			
2.1	Loop diagrams with verbal description	X	X	
2.2	Control flow charts and sequences		X	X
2.3	Functional design specifications		X	X
2.4	Single drive control loop sheets		X	X
2.5	Closed loop control loop sheets		X	X
2.6	Operator HMI presentation		X	

	Document	AD1	AD2	AD3
2.7	Operation and environmental reports		X	X
2.8	CMS texts		X	X
2.9	IO interface cabinets/units			X
2.10	Process station cubicles (PLC) / hardware			X
2.11	CCTV system cubicles/ racks/ hardware			X
2.12	PLC - program listing	X	X	X
2.13	Measuring points (instruments) – data sheets	X	X	X
2.14	List of parameters for components	X	X	X
2.15	Calibration certificates for instruments	X	X	X
	Installation			
3.1	Control equipment location, layout and dimensions (RIO cabinets, network cabinets, CMS cabinets)	X		X
3.2	Signal list allocation (z,x,y coordinate)			X
3.3	Instrument hook-up	X		X
3.4	Field instrument locations			X
3.5	Cable routing layout	X	X	
3.6	Cable types			X
3.7	Cable lists			X
3.8	Cable termination		X	X
3.9	Settings of parameters and limit values			
3.10	Complete CMS products descriptions, system manuals, instructions etc.		X	X
3.11	Software descriptions		X	X
3.12	Back-up copies of all programs			X
	Tests			
4.1	CMS FAT procedures	X	X	
4.2	CMS SAT procedures		X	X

Further Description of Selected Required Documents:

1.1 Process Control Description and Philosophy (CDP)

The Contractor shall prepare a CDP to explain in plain (i.e. non-technical) language to the Employer how the process and Line will be operated. The CDP shall contain the overall control and operational philosophy of the Line, including description of the start/stop procedures as well as description of interactions between the sub-systems and processes during operation. Furthermore, the CDP shall contain the control philosophy of each process section of the Line and descriptions of the general and specific operational modes and automatic functions throughout the Line. The CDP shall contain references to the process and instrumentation diagrams and shall include tables and data summarising the content in appendices, if appropriate to support the descriptions. The CDP shall serve as basis for the Contractor's detailed design and preparation of the detailed functional descriptions of all dedicated systems.

1.4 Technical specifications / requirements

Any technical specifications intended to be used for Subcontracting of items of equipment from sub suppliers

1.5 Programming manual

The programming manual shall address all items relevant for the engineer who shall programme automation for the Line.

The programming manual shall be finished at the end of basic design. The programming manual is vital for coordination so a milestone can be included to make it possible to help ensure a quality assured version is issued when the last corrections are completed.

1.7 CMS typical SW

Description of library of standard software modules.

1.8 CMS typical circuit diagrams

Circuit diagram/loop diagrams showing interface between CMS and MCC/ACC/RIO etc.

Instrument lists with info needed for design. Type, bus / traditional, unit / common, needed split because of process requirements / redundancy etc.)

The list shall include all data needed to create the single drive and closed loop control loop diagrams.

1.11 Signal lists / bus and RIO design

Design of buses and other IO interface based on input from the CMS typical circuit diagrams.

2.1 Loop diagrams with verbal description

Loop diagrams with verbal description shall be used for designing master controller implementation with the Employer, and as a tool to communicate with all technical disciplines in a simple and practical way.

2.2 Control flow charts and sequences

The flow charts shall show and describe the structure of the various control sequences in a simple way.

2.3 Functional design specification (FDS) and control schedules

The FDS and control schedules shall include all information necessary for coding / programming of the CMS.

Where the Line include a local control panel a functional description and a description of the local control and operation facilities shall be included.

The FDS shall include a verbal description of the Line, functions, operational sequences and interlocks covering both normal and abnormal operation.

Control schedules are to include:

- For each motor control, valve control, etc.: All conditions for automatic start / stop, manual start / stop, emergency stop, etc.
- For each group control: All conditions for activating the group start and group stop sequences, for continuing to next step of the sequence, etc. and the feedback signal to the "head" of the group control from all motor controls, etc. activated by the group start and stop sequences.
- For each measuring point or other input: cross references to all functions where the signal is used for analogue inputs with specifications of all limit values.

2.4 Single drive control loop sheets:

The typical documentation shall be based on that agreed in the CMS typical circuit diagrams (analogue part) (HW) and shall include all information required for each component to facilitate debugging / investigation of failures (i.e. not info split across multiple documents)

2.5 Closed loop control loop sheets

The documentation shall be based on that agreed in the CMS typical circuit diagrams (other than analogue part) (HW). The documentation shall include all information required for each component to facilitate debugging / investigation of failures (i.e. not info split across multiple documents)

2.6 Operator Human Machine Interface (HMI) presentation

Samples of Operator HMI (Graphics). Principles to be approved by Employer.

2.7 Operation and environmental reports

First issue is generic examples to be presented for the Employer for comments. Second issue is generic reports to be approved by the Employer.

2.8 CMS texts

The texts to be used on graphics for motors, valves etc.

2.9 IO interface cabinets/units

All design and technical info about all cabinets.

2.10 Process station cubicles (PLC) / hardware

All design and technical info about all cabinets.

2.11 CCTV system cubicles / racks / hardware

All design and technical info about all cabinets.

2.12 PLC - program listing

Complete Documentation of the entire PLC-program including.

2.13 Measuring points (instruments) – data sheets

Manufacturer data sheets and technical specifications. Hook up drawing showing the instrument installation with all mechanical details for mounting.

2.14 List of parameters for components

List showing all parameters, which may be changed/selected in microprocessor based components.

2.15 Calibration certificates for instruments

Certificates for each instrument providing information on precision, linearity, calibration condition, etc. shall be included.

3.1 Control equipment location, layout and dimensions

All info needed to install, pull cables and terminate cables.

3.2 Signal list allocation

All info needed to install, pull cables and terminate cables.

3.4 Location drawing of field instrumentation

The location drawing must contain detailed information on location of instruments and control equipment. The location drawing must show the item designations applied in related diagrams and the co-ordinate codes of instrumentation.

3.6 Cable types

First draft of cable routing is requirements and principles. Second draft is initial layout to coordinate details.

3.7 Cable lists

Cable types to be approved before construction.

3.10 CMS product descriptions

Complete descriptions of the used hard- and software products, system manuals, instructions etc. for the CMS

3.11 Software descriptions

Program Documentation, software descriptions with summaries and indexes, designation / explanation of file names etc.

3.12 Program back-up copies

Back-up copies of all programs, including compilers – for maintenance, restoring, reconfiguring and modification of the CMS System