Interreg CENTRAL EUROPE

European Union
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ENTRAIN

TT5: QM system basics and extension
Webinar, 23. 11. 2021

QM system details

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SPECIAL QM DOCUMENTS

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To be found in the Q-Guidelines!

- Q-plan main document (template)
- Q-plan (template)
  - summing up basic data/indicators
  - Comparison of all planning stages and operating periods
- Q-plan annex (template)
- Checklist for milestones
  (just to support the work of Q-managers)

Other documents

- (System selection for heat production)
- Hydraulic and control solution (template)
- Concept for operational optimisation

Q-PLAN (PAGE 1)

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Project short name or project number	TEMPLATE EUR		
		Plan	Is, MS5
Heat demand of all heat consumers	MWh/a	398	
of which via the heating grid	MWh/a	306	
District heating grid losses	MWh/a	30	
Total heat demand (incl. district heating grid losses)	MWh/a	428	
Heat capacity of all heat consumers	kW	209	
of which via the heating grid	kW	143	
Heat losses district heating grid	kW	13	
Total heat capacity	kW	222	
Length of district heating grid (incl. house connections)	Trm	224	
Nominal power of the biomass boiler(s) with reference fuel	kW	239	
Nominal power of the heat production with other energy sources:	kW	99	
Total nominal power of heat production	kW	338	
Percentage of heat produced from biomass	%	87	
Heat produced from biomass	MWh/a	372	
Net size of the storage silo	m³	76	
Filling level of the storage silo	%	80	
Gross size of the storage silo	m³	95	
Energy content per cubic meter	kWh/LCM	750	
Annual fuel consumption of the biomass boiler(s)	LCM	584	
Costs			
Investment costs of heat production	EUR	395,500	
Investment costs of heating grid	EUR	124,500	
Temperature specification in the design point			
Temperature of the main supply flow	°C	80	
Temperature of the main return flow	°C	60	

Key figures

Temperature of the main return flow		°C	60	
Key figures	**Agreed value**			
E.2.6 Full load operation hours of the heat consumers	-	h/a	1,904	
E.3.3 Linear heat density		MWh/(a.Trm)	1.4	
E.3.3 District heating grid losses (% of the heating demand of the customers)		%	10	
E.3.3 District heating gird losses (% of the delivered heat)		%	9	
Heat distribution cost per Trm		EUR/Trm	556	
E.3.3 Specific investment costs of heating grid		EUR/(MWh/a)	407	
E.4.10 Specific investment costs of heat production		EUR/kW	1,782	
E.4.4 Total full load operating hours of the biomass boiler(s)		h/a	1,558	
E 4.6 Total full load operating hours of other heat production units		h/a	562	
E.4.5 Storage silo size: coverage of full load operation for number of days (+ 30 LCM)		days	5	
The fields with a grey background are input fields				

Q-PLAN ANNEX (PAGE 1)

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QM Holzheizwerke QMstandard

Q-plan: Annex

Short project name	Example for MS2 ....
Project number	....
Milestone	2........................

Recommended procedure: 1) Preparation of the annex by the Q-manager on the occasion of each milestone, if necessary, in consultation with the main planner. 2) Decisions and signature of the plant owner. 3) Acknowledgment and signature of the main planner. 4) Signature of the Q-manager.

Quality Management for Biomass District Heating Plants®, **QMstandard** and **QMmini** are registered trademarks.

G Submitted documents

- ☐ The planning data (also updated values in MS 5) was submitted as an EXCEL table.
- ☐ All other required documents have been submitted

☐ The following documents are missing: ....

....

....

H Examination of the previous project process

☐ The previous project procedure was carried out according to the main document or previous additional documents.

☐ The previous project procedure deviates (with description of the consequences): ....

....

....

J Quality inspection on the basis of the documents submitted

The following statements refer to the submitted documents and are based on the assumption that the project is actually planned or performed according to these documents (no on-site inspection).

- ☐ No deviations from the agreed quality were found.
- ☐ Insignificant deviations from the agreed quality were found
- ☐ Significant deviations from the agreed quality were identified

Q-PLAN ANNEX (LAST PAGE)

Numbers	Assessment and recommendation of the Q-manager	Plant owner's decision
	Recommendation:	
212	**EXCEL table for Q-plan** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
213	**Proof of economic profitability** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
214	**Time schedule** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	

K Final assessment by the Q-manager

....

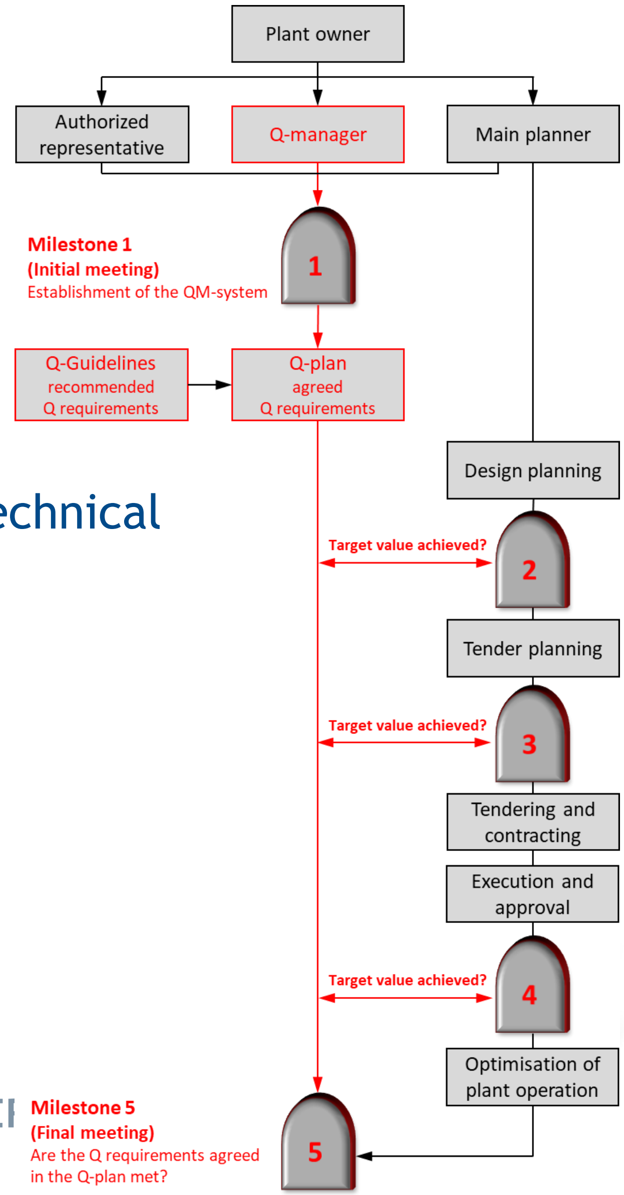
....

The plant owner's authorised representative confirms the implementation of the marked recommendations and accepts the resulting changes from previous agreements. Place and date: .... Signature:	**The main planner** confirms the acknowledgement of the report and will see to the implementation of the changes listed above. Place and date: .... Signature:	**The Q-manager** (documented in the official register of "QM Holzheizwerke") confirms the correct execution of the Q-check according to the Q-guidelines. Place and date: .... Signature: ....

QM-process in detail

MORE DETAILS OF MILESTONE 1 - 3

- Milestone 1
  - Contract with quality manager
  - Kick-off meeting to establish QM process
  - Q-Plan ⇨ updated in every milestone!
- Milestone 2
  - Consumer list, heat demand, …
  - Technical planning (components, layout plans, technical description, heat loss calculation, …)
  - Economic data
  - Q-plan annex (report of Q-manger) ⇨ updated in every milestone!
- Milestone 3
  - Start of construction
  - Site visit of quality manger + report
  - Documentation of changes



CHECKLIST DOCUMENTS MILESTONE 2

- Project phase 2 "Design planning" completed
- Q-checks/Q-control at the "design planning" level

- Q-plan annex
  - signed by the plant owner, main planner and Q-manager
  - Contains the plant owner's decision as to which recommendations of the Q-manager are to be implemented
  - The Q-manager creates the document for MS2
    - based on the information/documents provided by the main planner
    - Possible deviations in the course of the project
    - Result of the Q-checks
    - Recommendations to the plant owner
- Checklist is used by the main planner to compile the necessary documents and deliver them to the Q-manager; it must be filled and attached to the documents.

CHECKLIST MILESTONE 2 (201 - 203)

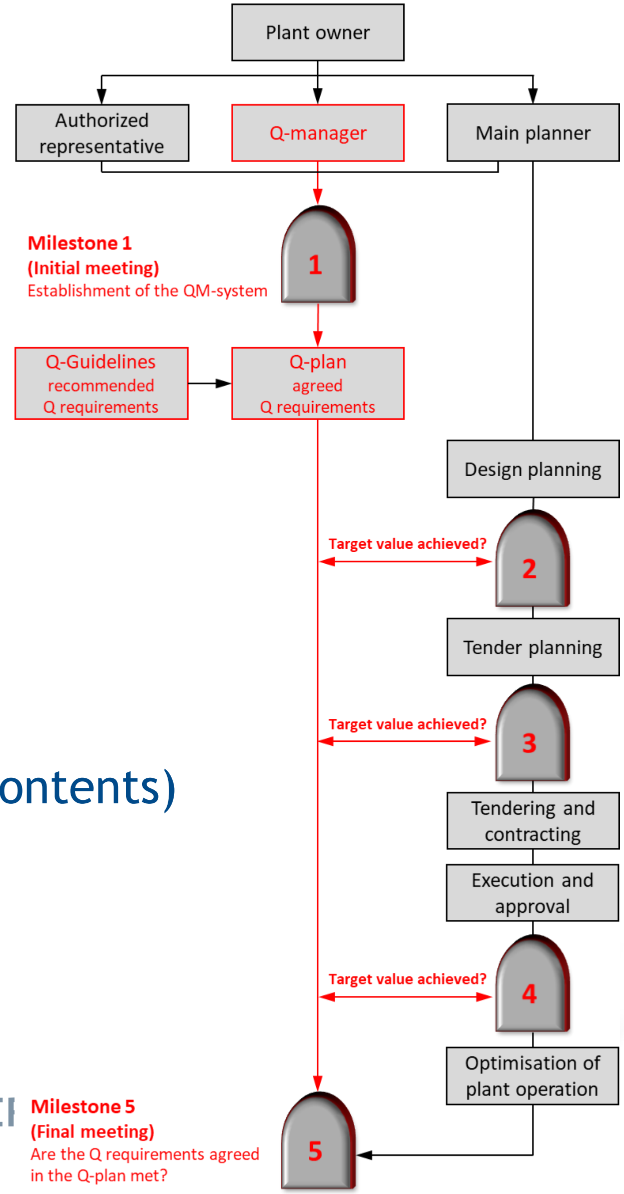
No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
201	**General system description** It should give the outsider a quick overview regarding: – Purpose of the plant – Operating times (year-round, heating season only, etc.) – Heat production capacity, individual boiler capacity		☐ As requested here
202	**List of heat consumers** For each heat consumer must be specified: – Date of connection to the grid – Status ("contract signed", "open", etc.) – Annual heat demand At least 70% of the annual heat demand must be secured by written documents → In the simplified version of QMstandard, the requirement of MS3 applies: At the start of construction, at least 60% of the annual heat demand must be secured by signed heat supply contracts Minimum linear heat density for customers secured by written documents (MS3: heat supply contracts): – Full-year operation 2.0 MWh/(a.Trm) – Heating period without water heating 1.0 MWh/(a.Trm)	D.2 Evaluation of possible heat consumers E.1.1 Arrangements MS1	☐ Document of plant owner available ☐ Document of main planner available
203	**District heating grid (if available)** – District heating grid plan with location of the central heating plant and heating grid route – Heat loss calculation for district heating grid	E.3 District heating grid	☐ No heating grid ☐ As requested here

CHECKLIST MILESTONE 2 (204 - 205)

204	**Demand assessment and appropriate system selection** Use the EXCEL table [8]. The situation must be recorded according to the state of knowledge of Milestone 2. At Milestone 3 at the latest, all details are required (for the simplified version, all details are already required here). – Annual heat demand for each heat consumer divided into space heating, domestic hot water and process heat – Heat capacity for each heat consumer divided into space heating, domestic hot water and process heat – Temperature requirement for each heat consumer – Energy reference area for each heat consumer – Date of connection ("in the first expansion stage", "in the final expansion stage") For the main heat consumers, indicate how the data was obtained (fuel consumption to date, calculation according to a given standard, measurement over a given period, estimation based on energy reference area, etc.).	E.2 Status-quo analysis	☐ As requested here
205	**System selection for heat production** The system selection made must be explained. The following main elements of heat production shall be described: – Monovalent or bivalent system: – Number of biomass boilers and their minimum and nominal thermal output with reference fuel (incl. flue gas condensation) – Selected furnace system for the biomass boiler (underfeed furnace, grate furnace, pellet furnace) – Number of other heat production units and their minimum and nominal heat output (incl. flue gas condensation) – With or without heat storage tank (if necessary, with storage volume) – Winter operation or all-year operation (low load operation) – If particle filters are used, they must be selected and designed according to the state-of-the-art technology (number, design, mode of operation, functional description with measurement and control concept).	E.4.1 State of the art E.4.2 Expansion options E.4.3 Heat, power and temperature requirements E.4.4 System selection Table 15	☐ As requested here

MORE DETAILS OF MILESTONE 4 - 5

- Milestone 4
  - Final investment costs
  - Final consumer list + plant components
  - Site visit + certificate (that plant/components are in operation)
  - Commissioning log
  - Optimisation concept
- Milestone 5
  - First annual operating report
  - Plant monitoring / evaluation of operation
  - Technical documentation of the plant (table of contents)
- Completion of QM process
  - Regular update of consumers, plant components
  - Annual operating reports for 10 years



Efficient and low emission plant operation

System selection

WHAT IS AN EFFICIENT AND LOW EMISSION PLANT OPERATION?

- Boiler heat output follows the setpoint specification
- Boiler heat output corresponds to the average load demand
- Few stop and go or Stand-by-operation*? ('runs through')
- Furnace is operated within designed/guaranteed conditions
- High utilisation of the biomass boiler(s)
- In all load ranges
  - Low flue gas temperature (downstream boiler)
  - Low excess air ratio (oxygen content in the flue gas)
  - Complete combustion (good burnout quality)

*during standby of the furnace the firebed on the grate is maintained and the furnace stays warm in order to allow a quick restart

HOW TO ACHIEVE AN EFFICIENT AND LOW EMISSION PLANT OPERATION?

- Experienced planner(s)
- Use existing know-how
  - **Critically review of** planning and all relevant information
  - Do not make decisions at the regulars' table
- Demand assessment and appropriate system selection
  - Plausible and reliable planning basis
  - Selection of suitable system configuration and furnace technology
    - depending on demand assessment
    - Depending on the defined fuel quality
- Investment costs versus operating costs
  - Cost savings? Yes, but please do it in the right way!

TECHNICAL EMISSION REDUCTION MEASURES

Primary measures

- Low excess air ration in the fuel bed (air staging)
- Appropriate total excess air ration
- Flue gas recirculation and suitable combustion temperatures
- Uniform distribution of the combustion air in the fuel bed
- Complete combustion (ash AND flue gas!)
- Combustion technology suits to fuel quality

Secondary measures

- Dry electrostatic precipitator (ESP)
- Baghouse filter
- (SCR/SNCR for NOx-reduction)

Do not consider flue gas condensation primarily as a dust precipitation measure!

INFLUENCE OF PLANT CONFIGURATION AND DIMENSIONING

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- Technical emission reduction measures do not work, if the system configuration is inappropriate
  - Frequent start/stop and part load operation
  - Optimal combustion conditions can not be maintained
  - Flue gas cleaning system might turn off/be bypassed

- The results are
  - Increased emissions
  - “Visible” flue gas (black plume)
  - Odour problems in the area
  - “Visible” emissions int the area (dust, black snow, …)

- Many additional issues
  - Lower efficiency
  - Higher maintenance effort (e.g. boiler cleaning)
  - Reduced lifetime of plant components

STANDARD SYSTEM SOLUTIONS FOR HIGH EFFICIENCY AND LOW EMISSIONS

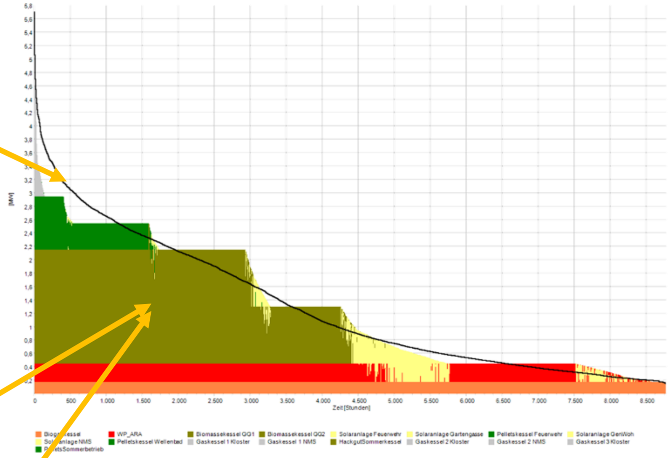
Demand assessment

Heat demand

System selection

System configuration (number of units, monovalent/bivalent,...)

Dimensioning of heat production units



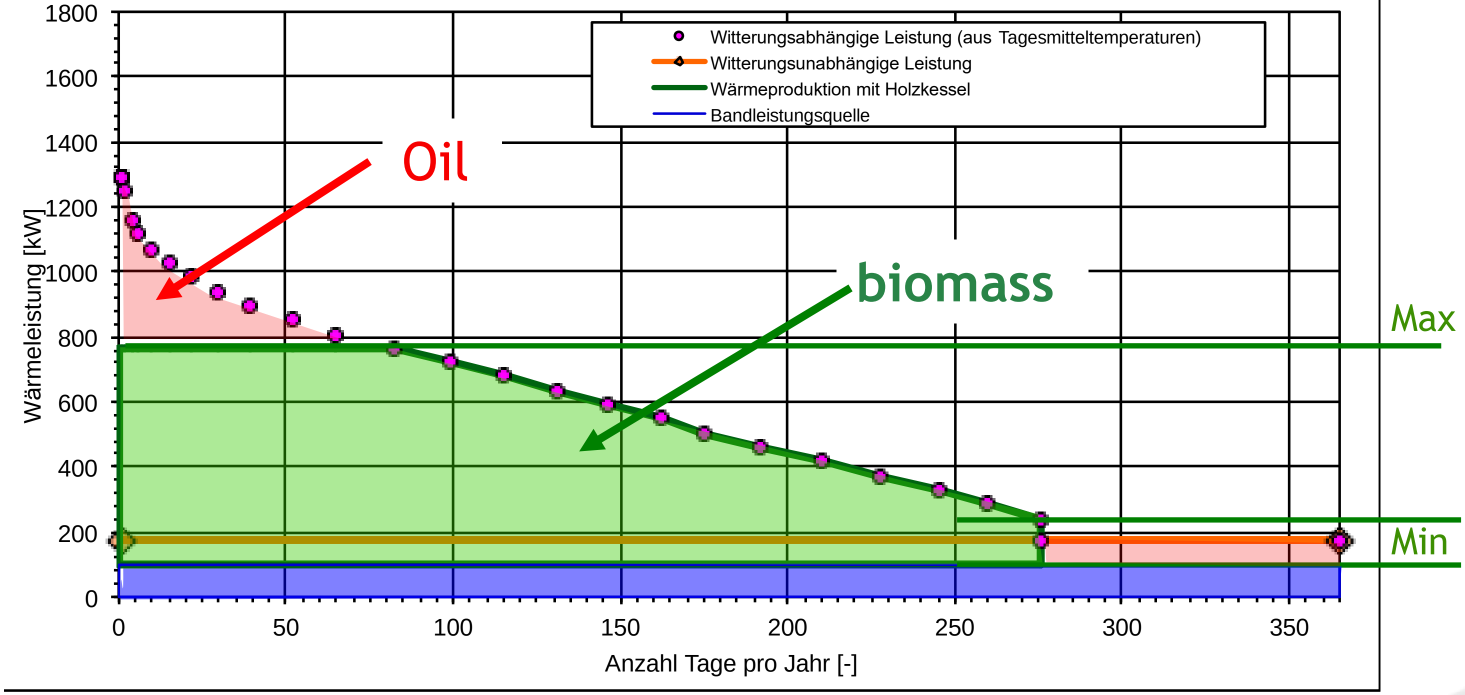
Standard hydraulic solution

Hydraulic scheme

Control strategy

DEMAND ASSESSMENT AND APPROPRIATE SYSTEM SELECTION

Klimastation:	Zürich-SMA (CH), 556 m ü. M.	Vorgabe:	Effektiv:
	Min. mittlere Holzkessel-Tagesleistung [kW]:	140	142
	Max. mittlere Holzkessel-Tagesleistung [kW]:	700	666
	Max. mittlere Bandquellen-Tagesleist. [kW]:	100	100



Source: ARGE QM Holzheizwerke, Jürgen Good

Dimensioning

Q-requirements heat production

Standard hydraulic schemes

MINIMUM AVERAGE DAILY HEATING LOAD WITH LOW LOAD OPERATION

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(Table 16 in annex to Q-Guidelines)

Furnace type→	Grate furnace					Underfeed furnace		
	With automatic ignition		with stand-by (fire bed maintenance)			with automatic ignition		with stand-by (fire bed maintenance)
With/without storage recommendations ↓	w ≤ 35%	w ≤ 35% w ≤ 45%	w ≤35%	w > 35% w ≤ 50%	w > 50%	w ≤ 35%	w > 35% w ≤ 45%	w ≤ 50%
Without storage	20%	25%	20%	25%	40%	15%	20%	20%
With storage	15%	20%	15%	20%	30%	10%	15%	15%
Important note: The values may vary slightly depending on the biomass boiler manufacturer. The values and recommendations of the biomass boiler manufacturer are always decisive.								

Example: Biomass boiler maximum output = 1000 kW; heat requirement in summer operation = 1500 kWh per day; storage and transmission losses in summer operation = 1000 kWh per day.

minimum daily average load = (1500 kWh + 1000 kWh) / (24 h x 1000 kW) = 0.10 = 10%

When using good quality dry wood chips (w ≤ 35%), summer operation with underfeed furnace should be possible with this system if automatic ignition and a storage are available.

For systems without summer operation, operation must meet the same requirements during the spring/autumn period. It is therefore often necessary to first use the oil/gas boiler (if available) or the small biomass boiler (for monovalent systems) for low load operation.

Q-REQUIREMENTS HEAT PRODUCTION (STANDARD HYDRAULIC SCHEMES)

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Set-up	Description	Total heat capacity 100...500 kW	501...1000 kW	> 1000 kW
1 biomass boiler + 1 oil/gas boiler with storage WE4 (WE14/16 with 1 biomass boiler)	Annual heat production with biomass	80...90%		→ For systems without summer operation, it is possible that only 1 biomass boiler + 1 oil/gas boiler can be useful for
	Design of wood boiler capacity	50...60%*		
	Design of oil/gas boiler capacity	Min. 70%, max. 100%		
	Number of full load operating hours of wood boiler	> 3500 h/a Target 4000 h/a		
	Low load operation	If Table 16 not fulfilled by oil/gas boiler		
*Guiding value				

Set-up	Description		
2 biomass boilers with storage WE6	Annual heat production with biomass	→ Realisation of monovalent summer operation may only be	100%
	Design of biomass boiler capacity 1		33% without load peaks
	Design of biomass boiler capacity 2		67% without load peaks
	Number of full load operating hours biomass boiler 1+2		> 2000 h/a
	Low load operation		Compliance with Table 16 with the small biomass boiler usually [illegible]

Set-up	Description			
2 biomass boilers + 1 oil/gas boiler with storage WE8 (WE14/16 with 2 biomass boilers)	Annual heat production with biomass			80...90%
	Design of biomass boiler capacity 1			17...20%*
	Design of biomass boiler capacity 2			33...40%*
	Design of oil/gas boiler capacity			Min. 100% - small biomass boiler, max. 100%
	Number of full load operating hours biomass boiler 1+2			> 3000 h/a Target 4000 h/a
	Low load operation			Compliance with the Table 16 with the small biomass boiler or oil/gas boilers
	Automatic ignition?			For the small biomass boiler
	Fuel			No restriction; for automatic ignition W ≤45%
	Expansion reserve			Possible through oil/gas boilers (with reduction of the biomass coverage ratio)
	Storage capacity			≥ 1 h related to rated output of large biomass boiler

FUNDAMENTALS

1. One proven hydraulic circuit per system configuration
2. Heat generation can be extended hydraulically and in terms of control technology as desired
   - Exception: Minimum solution for monovalent wood heating system without storage tank*
3. Leading boiler and following boiler not hydraulically defined
   - Exclusively parallel circuits
4. The main control variable is for systems without storage tank, the main flow temperature for systems with storage tank, the storage tank charging status

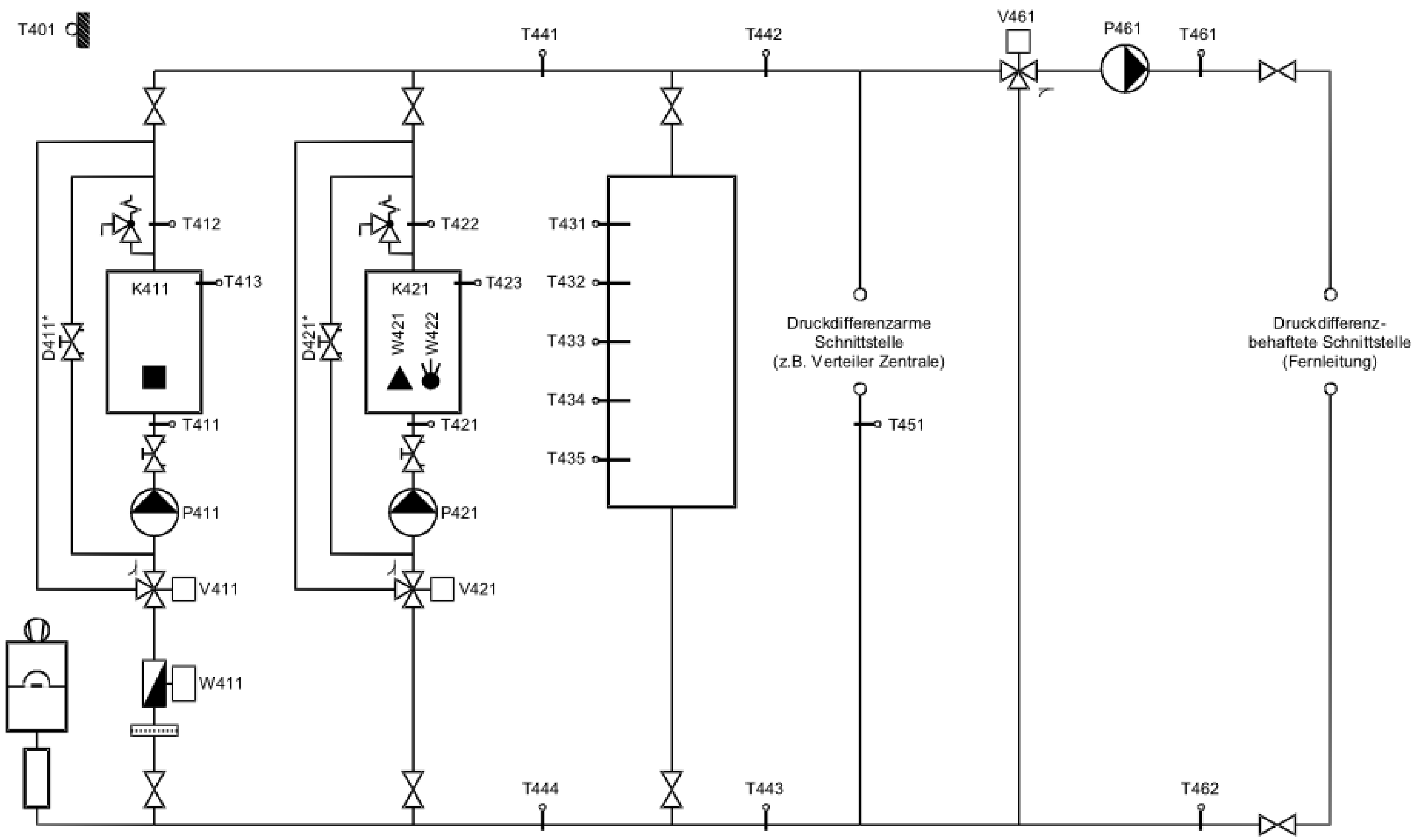
FUNDAMENTALS

5. The main control variable is always the setpoint of the firing rate
   (e.g. sequence: Boiler 1 on/off controll - Boiler 1 modulating - Boiler 2 on/off controll - Boiler 2 modulating) – see next slide!
6. Strict coupling of hydraulic circuits with low pressure difference
   - There is always a generously dimensioned bypass between two hydraulic circuits.
7. All heat consumer circuits designed for lowest possible return temperatures
   - Heating plant with pressure-less connection
   - In the DH network with min. differential pressure for each connection
8. Compliance with minimum valve authorities
   - Three-way valves ≥ 0.5
   - Globe valves ≥ 0.3

TO BE CONSIDERED

- Requirements of boiler manufacturer must be met!
  - Flow rates, water quality,…
- Solutions without storage are NOT recommended any more
  - Only for special applications!!
- Load and storage management are common weak points
- Who is responsible?
  - Control strategy and interfaces
  - Programming/ realizing the control system
  - Monitoring and data aquisition

WE4 BIVALENT WITH STORAGE



* D411/D421 kann entfallen (siehe Abschnitt 4.2.2)

DISCLAIMER

- Savety devices have to be installed according to national standards and regulations!!
  - E.g. savety valves, thermal savety discharge device, savety pressure switch,…

- This is the reason why savety devices are not included into the standard hydraulic schemes !

THANK YOU!

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