

WP 5 Industrial Application of the FFW system

D 5.1.- Work Plan for the Technological Deployment

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FFW addresses Í Liquid and gas Fischer-Tropsch
fuel production from olive industry waste: fuel from wasteÍ
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Summary

The following figure shows the overall concept deployed in the FFW project. Focus of the Work Plan will here be on the process description.

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1. Introduction

This document describes the system architecture of FFW system.¹ In the next chapters, the reader will find the description of the FFW technological deployment laid out in the chapters:

- Relation and Dynamics between the FFW components
- Summary of the work progress and working plan for developing demonstration activities in the scope of WP5.
- Positioning of the FFW system elements.
- Next steps to be developed From M18-M24.
- Expected measures in case of unforecasted events.

The goal of this document is to give a non-technical orientated reader an understanding of the overall architecture and its functional behaviour, the work plan for the technological development of FFW innovations, including the required equipment, the expected timetables, next steps and WPs responsible of these tasks, for a successful development of demonstration activities.

¹ See also www.fuelfromwaste.eu

2. Relations and Dynamics between components

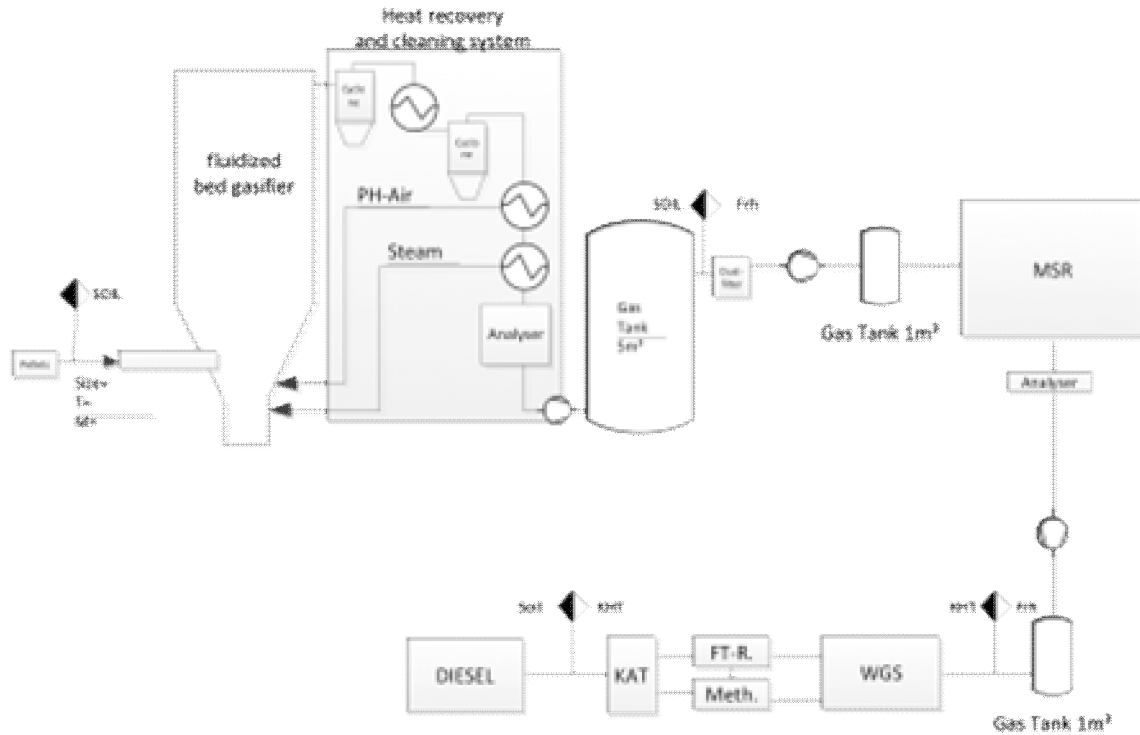


Figure 1 Process Overview

3. Summary of the work progress and Working Plan:

In order to fulfill all tasks in WP5, following tasks were necessary in the previous workpackages:

- WP2, SOIL received 300 kg of pellets and 300 kg of olive residues. This input material was analysed and stored on-site for the gasifications tests.
- WP3, Syngas with a suitable H₂/CO ratio was produced as well as the pick-up of the optimal olive residues blend for demonstration activities.
- WP4:
 - The relation between liquid and gas fuels (diesel/SNG ratio) has been defined.
 - WP4: FT-Catalyst was selected and already produced.
 - WP4: A process flow diagram has been defined for the whole fuel synthesis.
 - Set-up of the overall equipment (Measurements, Fittings and technical Components).

Work progress in WP5:

- P&ID and a list of components were designed.
- Space for the FFW-System has been reserved within Soil-Concept's facilities.
- Demonstration at Soil-Concept facilities will start with wood chips, then with compost and once the system is stabilized with FFW pellets.
- The concept for demonstration activities was designed according to the amount of biomass, quantity of syngas and catalysts types available.
- Significant progress has been made in order to define the implementation strategies for demonstration tasks, together with WP3/WP4 partners.
- There were defined the materials, valves, pipings, gas tightness concept, safety devices, safety equipment and electrical devices (el. Supply units).
- It was stated that in order to stabilize the process, conventional material and shredded material will be gasified before proceeding with gasification of FFW pellets.
- It was stated that 2 hours are enough to stabilize the catalysts performance for the FT and methanation stages.

It was agreed that feedback from WP5 regarding impurities, coming from scaling-up activities using conventional material, will be met with requirements stated in WP4 regarding suitable gas levels for the FT reactor, in order to adapt/optimize MSR performance. Depending on the results on gas composition after gasification

campaigns of available pelletized and shredded material, it will be defined if additional purification steps before FT synthesis are needed.

A set of parameters to be monitored during WP5 activities started being defined (e.g. MSR: CO, O₂, Methane: that could be monitor using the usual gas analyzer of Soil Concept, Additional monitoring has to include tars, HCl, sulfur and ammonia. It is necessary to define how to measure these compounds before and after gas cleaning system.

WP5: industrial application of the FFW system												
FFW-Schedule	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
Task 5.1 Integration of FFW System M13-M22. 90%												
Implementation strategies with WP3/WP4 (definition of interfaces)												
Operating procedures: define industrial application for WP3/WP4 (definition of interfaces)												
Choice of materials, valves, pipings, gas tightness concept, safety devices, safety equipment and electrical devices (el. Supply units)...												
Design of fuel storage, pre-treatment, transport and feeding systems.												
Task 5.2 Demonstration of technological system M18-M30. 15%												
Integration/adapting of the results out of WP3/WP4 in gas cooling and cleaning system in industrial application gasification plant												
Integration of chemical pretreatment technology (WP3)												
Integration of the MSR Prototype (WP4)												
Integration of FT and Methanation Reactors (WP4)												
Task 5.3 Control system and monitoring M19-M34. 15%												
Definition of parameters and control philosophy												
Control and automation												

Description of the Gantt Chart

Concerning WP 5, following work has been undertaken.

- Task 5.1 is almost completed and D 5.1.-Work Plan for the technological deployment. Has been submitted to the coordinator in M18 and improved according to feedback received by involved partners in the 18M meeting.
- Task 5.2 is still on-going and has been completed at around 15%. D5.2. - Demonstration of the technological system set up of implementation strategies will be delivered in M24.
- Task 5.3 is still on-going and has been completed at around 15% as well. D5.3. - Application of smart monitoring and control system will be submitted in M24.

4 Positioning of the elements:

For the pilot installation pilot, SOIL is planning a 5m² area with a height of 8 meters. The area has been limited by handrails and floors have been installed. Following facilities are already available: electric power, steam, water, cooling water, compressed air, and waste water disposal.

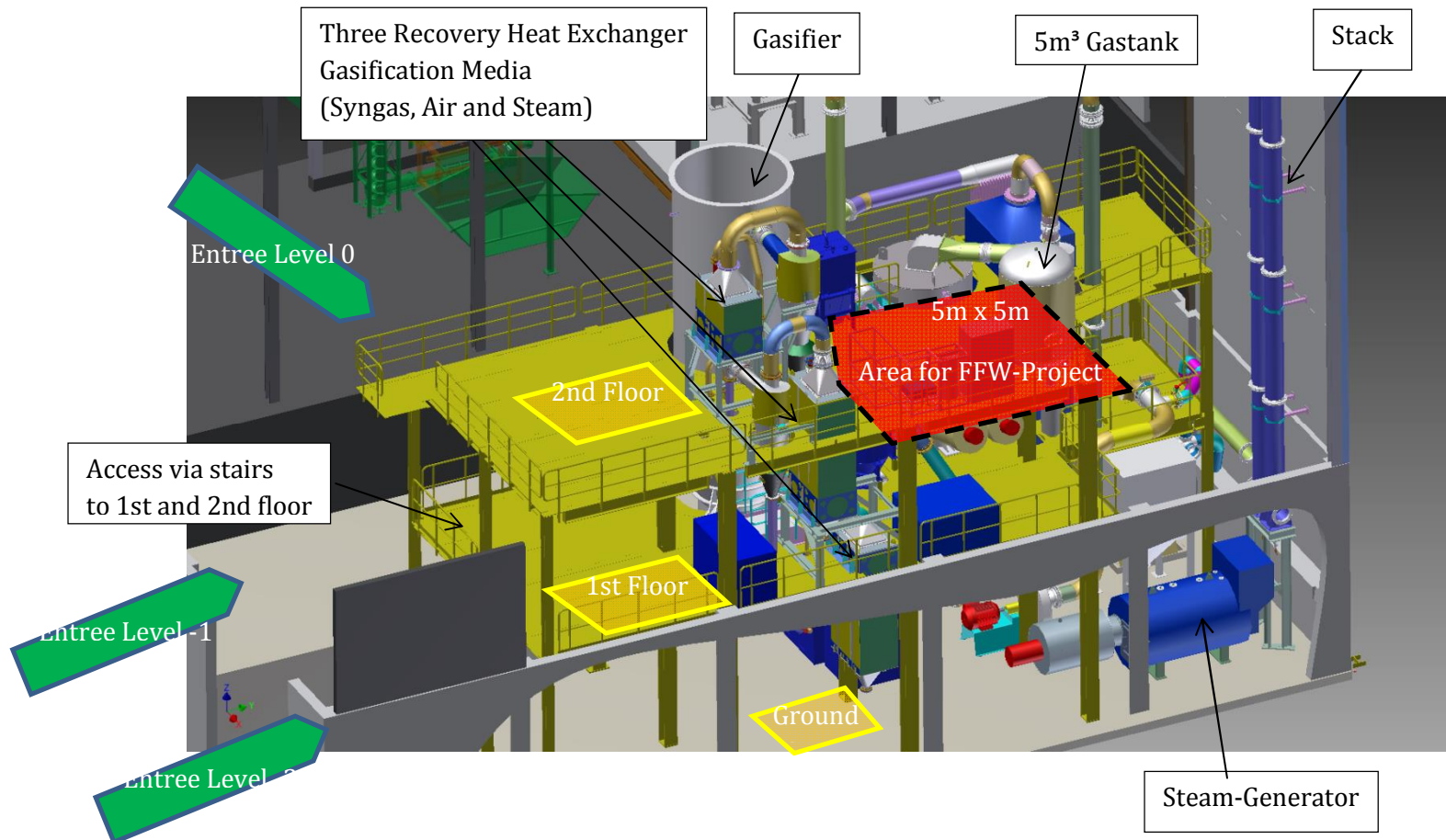


Figure 3 FFW Project Area Overview

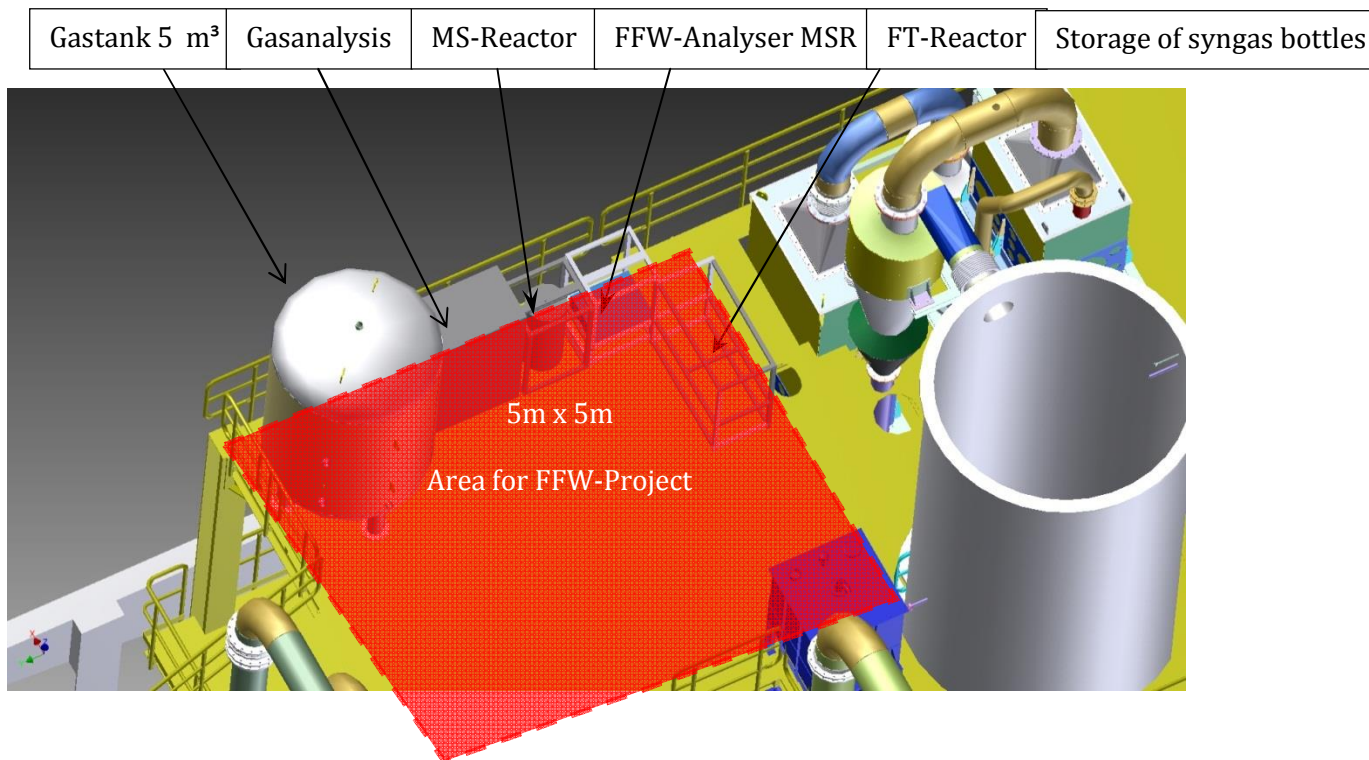


Figure 4 Initial FFW Project Area Overview (view from above)

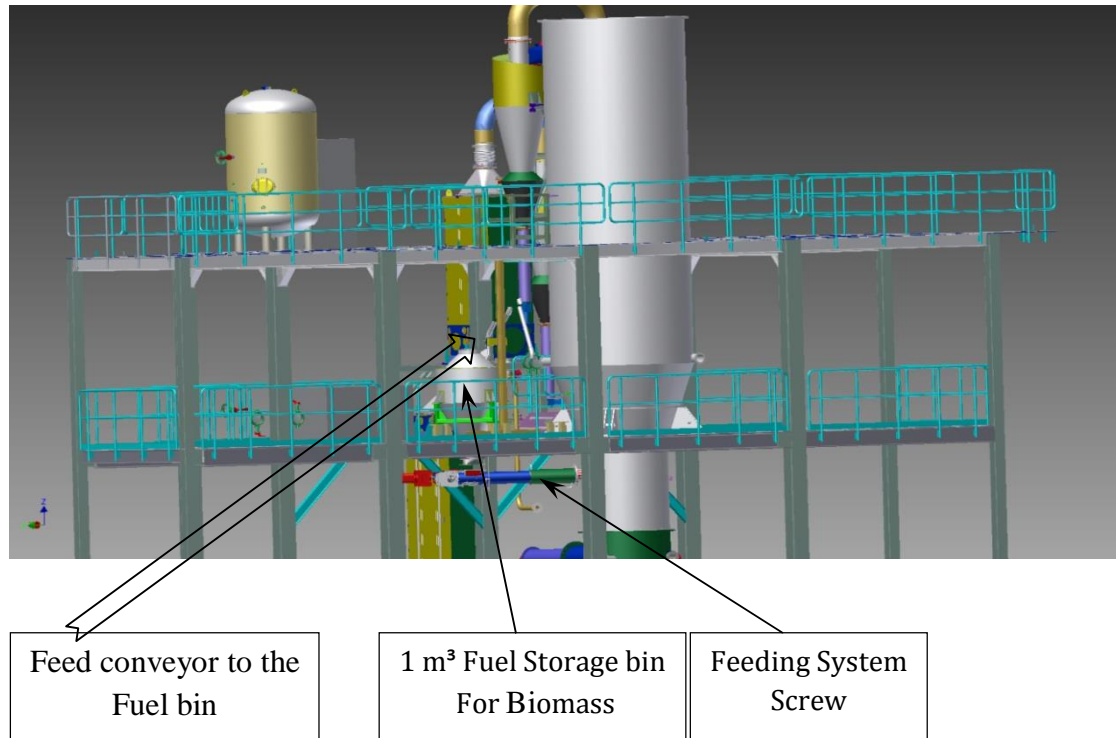


Figure 5 FFW Project Area Overview (view from the side)

The incoming fuel material goes over conveyor to the fuel bin (1m³); a feeding screw put the biomass to the gasifier.

5. - Next Steps M18 Æ M24:

The following Gantt Chart presents the activities to be performed from M19 to M34.

Activity/WP Involved	Working Plan From M19-M30											
	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30
	April	May	June	July	August	September	October	November	December			
WP3: hot gas cleaning develop.			T3.3		D3.3							
WP 3: Simulation of pretreatment proc.							D3.4					
WP 3: compressor (rent for 4 weeks)												
WP 4: design of metanation reactor												
WP 4: production of catalyst for meth.												
WP 4: design of FT reactor												
WP 4: definition of monolith geometry, ordering, product.												
WP 4: P&ID diagram												
WP 5: Order of required equipment (10-12 weeks)												
WP 5: Integration of MSR and FTR into Soil facilities								set up				
WP 5: Integration of Control Unit								control sys.				
WP 5: stabilisation of gasification Process								test				
WP 5: start gasification for FFW-Project									start	start		
WP 5: monitoring and optimisation of FFW-process										m	m	m
WP 5: stabilish of Soil Concept gasification												

Description of the Gantt chart

Task 5.2:

1.1. Initially, SOIL would receive the following reactors that shall be installed in the respective process units in the rig:

- 1.1.1. MSR: Molten-Salt reactor
- 1.1.2. FTR: Fischer-Tropsch reactor

1.2. SOIL shall set-up the necessary equipment in the final location and make sure that the reactors and auxiliaries will be properly connected. (See table above > order of required equipment).

1.3. SOIL will start-up the gasifier first using clean wood chips in order to reach optimum process conditions (media and temperatures) before feeding the olive residues for generating the synthesis gas for processing.

Task 5.3:

1.4. After cooling in the heat-recovery system part of the synthesis gas produced will be drawn from the gas-tank cleaned and compressed to 10 bars and stored in a 1m³ buffer tank. The max. quantity of gas stored for processing will be about 10 Nm³. The rest of the gas can be burned or otherwise used.

1.5. From the pressure tank syngas will be analyzed and brought at a rate of approx. 500 L/h (at standard conditions) to the MSR reactor for removing sulfur and chlorine compounds and residual tar components. The gas leaving the MSR will be analyzed again. Measurements of residual tar concentrations are necessary before feeding the gas into the MSR reactor. Tests will be performed until the concentration rate is optimum.

1.6. Before the syngas can be processed in the F.T-reactor water and CO₂ has to be removed. To achieve optimum conditions the gas will then further be compressed to 40 bar and the H₂/CO-molar ratio will be raised by WGS before the gas is fed-into the F.T- reactor for the catalytic conversion of the syngas components CO and H₂ to liquid components. Diesel is the favored end product of the project.

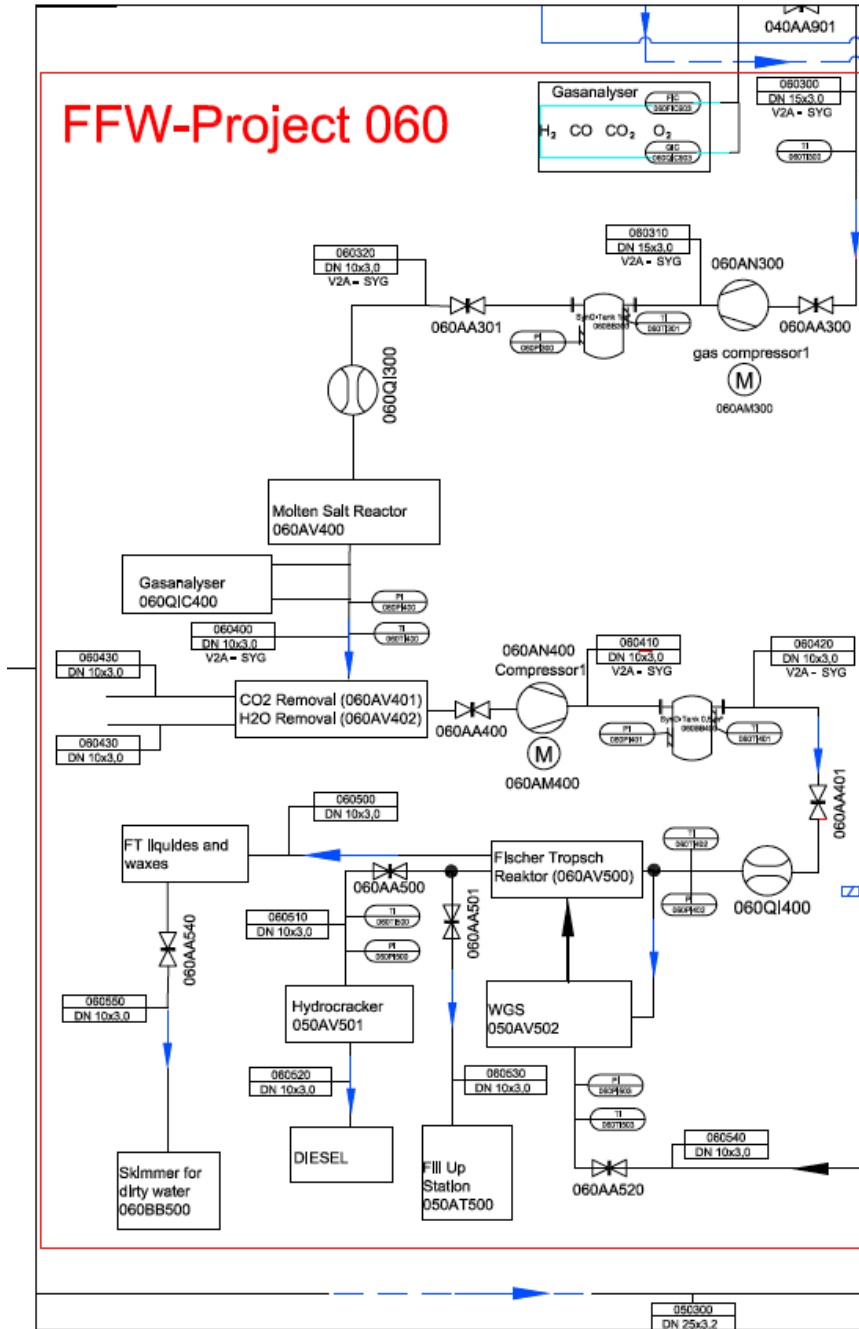


Figure 2. - Detailed Process Overview

6. Expected measures in case of unforecasted events

- ISAFoM can only deliver 300 kg of pellets. This will require downscaling the gasifier production rate leading to lower gas production. The solution we agreed on is to use a gas tank for real-time usage.
- SOIL is receiving the catalyst from KHT but the remaining equipment to connect the individual components needs to be ordered. SOIL asked for component prices, and is waiting for feedback.
- Tar concentration: it should not be an important issue since the operating time is reaching 10 hours. Delays should not be an issue here.

7. Annexes

Annex 1: List of components

List of Components

Quantities		P&ID #
	Pipes	
1	Piping subsequent to the 5 m ³ Tank (040BB901)	060300
1	Piping subsequent to the compressor1 (10 bar)	060310
1	Piping subsequent to the 1 m ³ Tank (060BB300)	060320
1	Piping subsequent to the MS-Reactor	060410
1	Piping subsequent to the 1 m ³ Tank (060BB400)	060420
1	Piping for liquids and waxes	060500
1	Piping subsequent to the FT-Reactor	060510
1	Piping subsequent to the Hydrocracker (060AV501)	060520
1	Piping to the Fill Up Station	060530
1	Piping from Steam Generator	060540
1	Piping to the waste water tank	060550
	Measurements	
1	Temperature	060TI300
1	Temperature	060TI301
1	Pressure	060PI300
1	Flow	060QI300
1	Temperature	060TI400
1	Pressure	060PI400
1	Temperature	060TI401
1	Pressure	060PI401
1	Flow	060QI400
1	Temperature	060TI402
1	Pressure	060PI402
1	Temperature	060TI500
1	Pressure	060PI500
1	Temperature	060TI501
1	Pressure	060PI501
	Fittings	
1	Valve	060AA300
1	Valve	060AA301
1	Valve	060AA400
1	Valve	060AA401
1	Valve	060AA500
1	Valve	060AA501
1	Valve	060AA520
	techn. Components	

1	gas compressor1 (10 bar)	060AN300
1	gas tank 1 m ³ (10 bar)	060BB300
1	gas compressor2 (40 bar)	060AN400
1	gas tank 1 m ³ (40 bar)	060BB400
1	Gasanalyser	060QIC903
	diverses	
1	Molten Salt Reactor	060AV400
1	Gasanalyser / Tar-analyser	060QIC400
1	CO2 Removal System	060AV401
1	H2O Removal System	060AV402
1	Fischer Tropsch Reactor	060AV500
1	Hydrocracker	060AV501
1	Fill Up Station	060AT500

Annex 2: P&ID Diagram í FFW-Project+

