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TECHNICAL SPECIFICATIONS FOR THE SUPPLING OF AN HYDROGENATION PILOT PLANT

Trisaia Research Center

ROTONDELLA (MT)

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Courtesy Translation

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1. INTRODUCTION

A new hydrogenation pilot plant will be installed in ENEA research center of Trisaia in Rotondella (Matera), Italy. The aim of the plant is to hydrogenate hydrocabon oligomers containing double bonds in order to obtain product with low iodine value.

2. SCOPE OF THE PROJECT

The scope of this document s to provide all the technical information required for the preparation of a quotation for all hardware and related services for the supply of a skid mounted hydrogenation pilot plant and associated issues as laid down in this document. Furthermore, the parameters for the assessment of technical aspects of the offer are also reported.

3. TECHNICAL BASIS

3.1. DESIGN BASIS

The pilot plant shall be designed for the following feed characteristics

Temperature	Ambient
Physical state	Liquid
Typical composition	Hydrocarbon oligomers with C-C double bonds
Mass liquid flow-rate	About 15 kg/h
Hydrogen molar rate	About 0.20 kmol/h
Liquid phase density	880 kg/m3 at 40 °C 840 kg/m3 at 100 °C
Liquid phase viscosity	100-800 cP at 40 °C 15-100 cP at 100 °C
Iodine value of liquid phase	Feed: 20 gI_2/100g Product: <2 gI_2/100g

3.2. PROCESS SCHEME and OPERATING CONDITION

The scheme of the process is reported in Figure 1

- The pilot plant shall include n.1 liquid storage tank (V1) and n.1 product storage in order to feed continuously the pilot plant for at least 72 hours at max capacity.
- The hydrogen will be supply by cylinders.

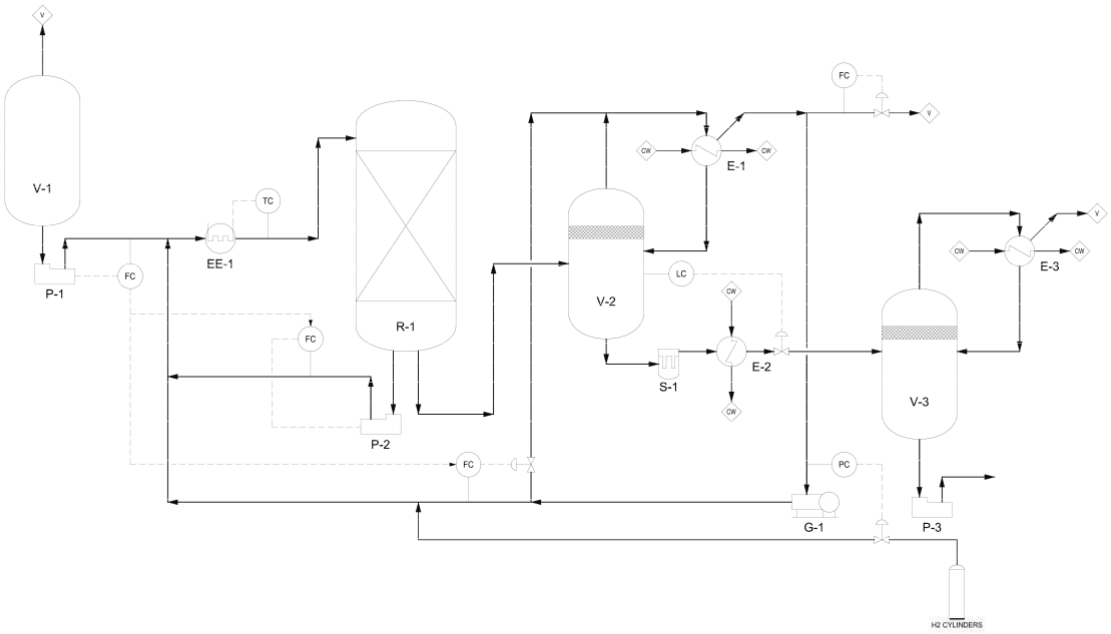

Figure 1 – Scheme of the process

- The reactor (R-1) is a trickle-bed or up-flow type;
- About 15 kg/h of liquid phase stream (unsaturated hydrocarbon oligomers)
- Operation pressure: min 10 barg/norm 30 barg/ max 60 barg;
- Operating temperature: min 100 °C/norm 200°C/ max 300 °C;
- Weight Hourly Space Velocity (WHSV): 0.2-0.5 $kg_{hydrocarbon}/kg_{catalyst} \cdot h^{-1}$;

- The catalyst are spheres 1/16'' nominal diameter and apparent bulk density of 850 kg/m3;
- The reactor should be able to operate also under recycling conditions for both liquid and gas-phase streams in order to kept the reactor under isothermal conditions. In particular, the hydrogenated liquid may be recycled at the reactor inlet with a ratio (recycled liquid mass flowrate/fresh liquid mass flowrate) between 0 (no recycle) and 0.2.
- The hydrogen should be separated from condensables in V2 and recycled at the reactor inlet by using a recycle compressor and mixed with fresh hydrogen in order to keep a hydrogen molar flow in the reactor inlet of about 0.20 kmol/h.
- Heat exchangers, pumps, compressors and vessels should be included in the quotation.

3.3. PILOT PLANT AREA

The Vendor shall indicate with its technical offer the plot plan area and weight of the skid in order to preliminary evaluate the requirement for the installation of the new pilot plant unit.

4. CONSTRUCTION MATERIALS

The construction materials for all process components and lines shall be AISI 316L in accordance to the design temperature of the plant components.

Line sizes, materials and tubing/piping will be indicated on the P&Id according to Vendor's standard. For tubing and associated products metric sizes Swagelok will be applied in accordance with Swagelock guidelines.

Material certificates will be supplied as required from PED regulation.

5. INSTRUMENTATION AND CONTROL

The pilot plant shall be equipped with all necessary instrumentation on all vital points in order to monitor or control where necessary.

For safety interlock purposes, separate instrumentation shall be installed. Details on instrument installation to be places in hazardous area will be specified during finalization of the project.

The new hardware and software to be supplied by the Vendor is summarized as follows:

- PLC installed in field

6. PROCESS FRAME

Process components, piping and cabling will be mounted on a rigid carbon steel, box/Hbeam structure, painted accordingly to the client coating spec (to be provided by Client).

The Vendor shall indicate a preliminary overall dimensions and weight of the frame layout of the DCR pilot plant (including the storage tanks and analyzers) with the technical proposal documentation in order to preliminary evaluate the installation area of the unit.

Main features of the frame design are: the optimal accessibility and operability of pilot plant, optimized to facilitate easy maintenance, service and training, minimal

interconnections between process frames for effective assembly and disassembly of the unit.

7. SPARE PARTS

An ample selection of spares and consumables shall be included in the scope of supply, e.g. seals, o-rings, gaskets, fuses and couplings. Moreover, wherever special tools are needed, they will be included as well.

All these parts shall be shipped together with the pilot plant and enable client to use these parts during installation and acceptance tests for replacement in case of damage or malfunctioning.

Furthermore, a detailed list of spare parts necessary during operation stage shall be provided by the Vendor.

8. DESIGN AND MANUFACTURING CODES AND STANDARDS

All documentation, project communication and implementation shall be in the English language. Units will be in accordance with SI. With respect to manufacturer operating manuals, Vendor will ask to suppliers to provide an Italian documentation. The design, manufacturing and documentation will be in accordance with the European regulations, such as PED 97/23/CE and ATEX 94/9/CE. A EC declaration of conformity shall be delivered and the related CE marking shall be installed on the pilot plant.

The Hazardous electrical area classification of the new pilot unit is the Zone 2 IIC T1.

9. SCOPE OF SUPPLY

The Vendor scope of supply shall be:

- Extended basic design engineering of the hydrogenation pilot plant, including as minimum:

- Process and instrumentation diagram

- Basic process frame lay-out
- Equipment specifications and drawings
- Battery limit and utility list
- Instrumentation and signals list with identification of the battery limits
- between Vendor and client
- Analyzers specifications

- Electrical diagrams and identification of the battery limits between
- Vendor and client
- HAZOP/SIL analysis
- Execution schedule

- Detailed engineering and procurement (to be carried out on the client's final approval on the extended basic design engineering documents)
- Construction and assembly of the hydrogenation pilot unit at Vendor's premises
- Documentation for the hydrogenation pilot unit operating and safety manual

  Documentation for the hydrogenation pilot unit laboratory manual
- Manufacturer manual and documentation for maintenance and installation of the equipment, instrumentation, analyzers, GC and detectors.
- Transportation to client's premises
- Hydrogenation pilot unit re-assembling to client's premises
- Assistance for training, assistance to start-up and execution of acceptance test.

10. UTILITIES

The following utilities will be made available at pilot plant battery limits:

- Electric power

50 Hz / 380 V for motor and heater

50 Hz / 280 V for control and interlocking purposes

24VDC for instrumentation

- Cooling water inlet temp.: HOLD °C max outlet temp.: HOLD °C
- Instrument air
- Plant air
- Nitrogen
- Demi water: Min/Max pressure: HOLD °C

The Vendor shall indicate with its technical proposal the requirement needed for each utility at BL condition (norm/max flow-rate/consumption of the new circulating riser pilot unit.

11. ASSESSMENT PARAMETERS OF TECHNICAL OFFER

The Technical Value of the offer will be assessed by taking into account the following aspects:

A) Technical details of the supply and quality of design documentation (score: max 40);

B) Turnover (score: max 10);

C) Experience (score: max 10);

D) Human resources (score: max 5);

E) Professional skills (score: max 5);

The technical score will be awarded on the basis of the following criteria:

A) Technical details of the supply and quality of design documentation (max score: 40)

The economic operator must provide a design documentation with at least the following information:

- General description of the supply;
- Process scheme with mass/heat balances;
- Process and instrument diagram;
- Equipment specifications and drawings;
- Battery limit and utility list;
- Electrical diagrams and identification of the battery limits
- List of instruments and electrical signals;
- List of suppliers of the main electrical, mechanical and control devices
- Technical and improvement considerations;
- Construction materials;
- Control system;
- Execution schedule

B) Turnover (maximum score: 10)

The economic operator must declare the economic turnover (expressed in €) concerning executive designs/manufacture/fabbrication/commissioning of process plants (pilot and/or industrial scale) carried out in the 2015-2019 five years, by filling the following table:

Turnover of executive design (€)					
2015	*2016*	*2017*	*2018*	*2019*	*Total*

Calculation formula: (F/Fmax)*10

where:

F= turnover in the 2015-19 five year concerning process plants (pilot and/or industrial scale) of the economic operator;

Fmax= maximum turnover in the 2015-19 five year concerning process plants (pilot and/or industrial scale) among all the economic operators participating to the procedure.

For instance:

Economic operator	*Turnover (€)*						*Score*
	2015	*2016*	*2017*	*2018*	*2019*	*Total*	
EO1	*100.000*	*200.000*	*5.000*	*300.000*	*15.000*	*620.000*	*1,6*
EO2	*800.000*	*60.000*	*100.000*	*1.000.000*	*20.000*	*1.980.000*	*5,0*
EO3	*200.000*	*50.000*	*700.000*	*50.000*	*100.000*	*1.100.000*	*2,8*

C) Experience (max score: 10)

C.1-Experience in executive design (max score: 5)

The economic operator must declare a list of executive design projects process plants (pilot and/or industrial scale) carried out in the 2015-2020. For each project, the scope, a technical description and the customer shall be indicated as reported below.

N.	***Project Overview***
1	*Scope: ……* *Description: ……* *Customer: ……*
2	*Scope: ……* *Description: ……* *Customer: ……*
…	

Calculation criterion:

- A score of 0.5 for each executive design projects of hydrogenation plants (pilot and/or industrial scale);
- A score of 0.25 for each other executive design projects

An example is reported below:

N.	***Project Overview***	***Assigned score***
1	*Scope: Hydrogenation pilot plant* *Description: executive design of a continuous hydrogenation pilot plant able to perform hydrogenation reaction of hydrocarbon oligomers contain double bonds in order to obtain a product with low iodine*	*0.5*

	number. Capacity: 15 kg/h of liquid flow rate and 5 STDm3/h of hydrogen with sepration/recycling system for both liquid and gas phase; operating conditions: up to 300 °C and 60 barg; ; WHSV: 0.2-0.5 h-1, … *Customer: ENEA – Italy*	
2	*Scope: Batch distillation pilot plant* *Description: executive design of a batch distillation pilot plant able to distillate a C9-C18 olefin mixture in order to obtain C10 olefin cut at high purity. Capacity: 15 kg/h of distillate and 500 kg of feed per batch. Technical aspects: 30 theoretical plates; operating pressure: 0.2 bara; maximum temperature: 260 °C; pot duty: 20 kW;…* *Customer: ENEA – Italy*	*0.25*
…		

C.2 - Experience in engineering/manufacture/commissioning (max score: 5)

The economic operator must declare a list of engineering/manufacture/fabrication/commissioning/testing projects of process plants (pilot and/or industrial scale) carried out in the 2014-2020. For each project, the scope, a technical description and the customer shall be indicated as reported below.

N.	***Project Overview***
1	*Scope: ……* *Description: ……* *Customer: ……*
2	*Scope: ……* *Description: ……* *Customer: ……*
…	

Calculation criterion:

- A score of 0.5 for engineering, manufacture, fabrication, commissioning of hydrogenation plants (pilot and/or industrial scale);
- A score of 0.25 for engineering, manufacture, fabrication, commissioning of other projects

An example is reported below:

N.	*Project Overview*	Assigned score
1	*Scope: Hydrogenation pilot plant* *Description: engineering and fabrication of a continuous hydrogenation pilot plant able to perform hydrogenation reaction of hydrocarbon oligomers contain double bonds in order to obtain a product with low iodine number. Capacity: 15 kg/h of liquid flow rate and 5 STDm3/h of hydrogen with sepration/recycling system for both liquid and gas phase; operating conditions: up to 300 °C and 60 barg; WHSV: 0.2-0.5 h-1, …* *Customer: ENEA – Italy*	0.5
2	*Scope: Batch distillation pilot plant* *Description: fabrication and commissioning of a batch distillation pilot plant able to distillate a C9-C18 olefin mixture in order to obtain C10 olefin cut at high purity. Capacity: 15 kg/h of distillate and 500 kg of feed per batch. Technical aspects: 30 theoretical plates; operating pressure: 0.2 bara; maximum temperature: 260 °C; pot duty: 20 kW;…* *Customer: ENEA – Italy*	0.25
…		

D) Human resources (max score: 5)

Organization chart and number of permanent and not permanent employees (at the date of application) involved in the activities of design, engineering, manufacture, fabrication, assembly, and commissioning of process plants (pilot and/or industrial scale).

An example is below reported:

Activity	*Permanent employees (no.)*	*Not permanent employees (no.)*
Design *Manufacture/Fabrication* *Assembly* *Commissioning*	……..	……

Calculation formula: (Nind+Ndet/2)/ (Nind+Ndet/2)max*5

where:

Nind: number of permanent employees

Ndet: number of not-permanent employees

(Nind+Ndet/2)max: maximum value among all the economic operators participating to the procedure.

For instance:

Economic operator	*Permanent employees (no.)*	*Not permanent employees (no.)*	*Assigned score*
EO1	*20*	*10*	*4.2*
EO2	*30*	*0*	*5.0*
EO3	*25*	*5*	*4.6*

E) Professional skills (max score: 5)

Permanent employees (at the date of application) with professional skills

and experiences able to perform the contract with a suitable quality standard, as reported in the following table:

Professional resources	**Yes**	**No**
• Project manager, with master degree in engineering science and at least three years of experience in the management of projects with economic value higher or equals to the opening bid.		
• Project engineer with master degree in Chemical Engineering and with at least three years of experience in process engineering;		
• Structural engineer with master degree in mechanical or nuclear engineering or equivalent and with at least three years of experience in mechanical design of high-pressure equipments.		
• Process control engineer with master degree in Chemical Engineering or Electric/Electronic engineering or similar, with at least three years of experience in design and tuning of system controls.		
• Electronic or Mechanical Experts with at least three-years of experience in maintenance of electrical and mechanical devices		

Calculation criterion: A score of 1 for each professional resource available in the society.