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**Italian National Agency for New Technologies, Energy and Sustainable
Economic Development**

Energy Technologies Department and Renewable Sources

Bioenergy, Biorefinery and Green Chemistry Division

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**TECHNICAL SPECIFICATIONS FOR THE SUPPLYING OF A BATCH
DISTILLATION PILOT PLANT**

Centro Ricerche ENEA di Trisaia

ROTONDELLA (MT)

October 2020

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REV.	DESCRIZIONE	DATA	REDAZIONE	CONVALIDA	APPROVAZIONE

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1. INTRODUCTION

A new batch distillation unit will be installed in ENEA research center of Trisaia in Rotondella (Matera), Italy. The aim of the plant is to distillate a C9-C18 olefin mixture in order to obtain C10 olefin cut at high purity.

2. SCOPE OF THE PROJECT

The scope of this document is 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 batch distillation unit 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:

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	UOM	C10+ olefins product specification		Typical value
Carbon number C9 and lower	% wt	-	max 1.8	0.5%
Carbon number C10	% wt	min 28	max 40	28.9%
Carbon number C12-C14	% wt	min 42	max 54	50.6%
Carbon Number C11	ppm wt	-	max 500	115
Carbon number C15-C18	% wt	min 12	max 18.5	17.7%
TAG,MAG,DAG	% wt	-	max 1.2	1.01%
Polyolefins C12-C14	% wt	-	max 4.5	4.07%
Polyolefins C15-C18	% wt	-	max 4.5	3.86%
Paraffins C10	ppm wt	-	max 250	Nil
Paraffins C12-C14	ppm wt	-	max 450	Nil
Paraffins C15-C18	ppm wt	-	max 150	Nil
Color	APHA	-	max 10	
Total Free fatty acids (Acid Value)	mg KOH/g			3.3
C10 free fatty acid	% wt			0.26
C12 free fatty acid	% wt			0.20
C16 free fatty acid	% wt			0.85

The feed will be feed to the skid at ambient temperature and in liquid phase. The new batch distillation unit shall be designed in order to distillate the following olefin cuts:

CUT	% Recovery	Spec limit	Spec limit
1st cut – C9 OLEFINS	-	-	-
2nd cut – C10 OELFINS	Min Recovery: 80%	Max 1000 ppm C9 carbon	Max 500 ppm C12 carbon and higher
3rd cut – C12-C14 OLEFINS	-	Max 1% C11 carbon and lower	Max 0.5% C15 carbon and higher
4th cut – C15-C8 OLEFINS	-	Max 1% C13 carbon and lower	Max 2% C19 and higher
5th cut - RESIDUE	-	-	-

3.2. PROCESS SCHEME and OPERATING CONDITION

The scheme of the process (to be confirmed by Vendor) is reported in Figure 1

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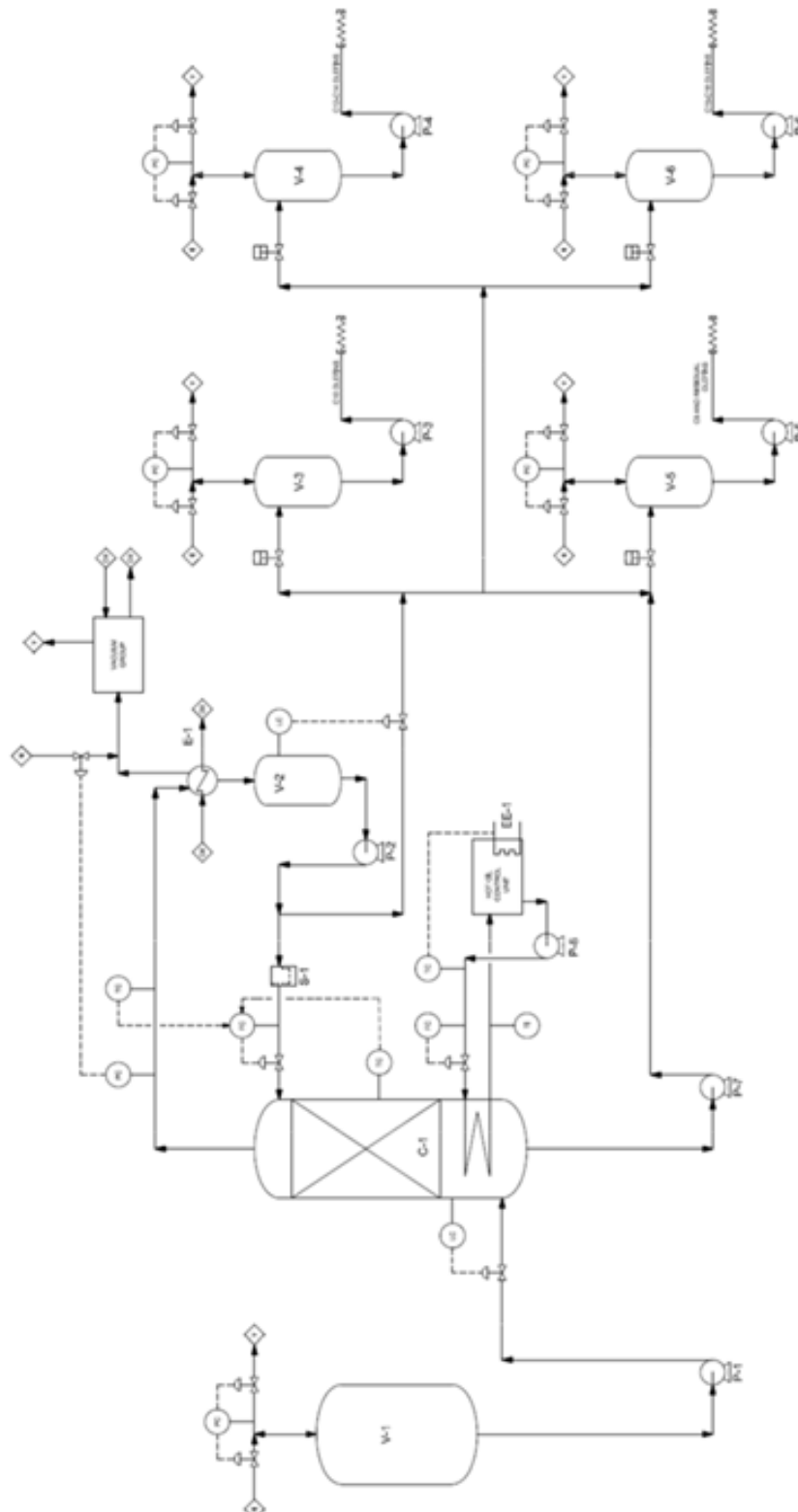


Figure 1 – Scheme of the process

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The skid unit shall have, as minimum, the following requirements:

- The distillation column should have **30** theoretical stages and a pot heating capacity of 20 kW (to be confirmed by Vendor) in order to distillate the C10 olefins cut with an average flowrate of 15 kg/h;
- The pot of the column should be designed in order to distillate around 500 kg of mixture per batch
- The skid should have n.4 distillate storage for the following distillate cuts: (1) C10 olefins, (2) C12-C14 olefins, (3) C15-C18 olefins and (4) C9 olefins + residual.
- Operating pressure: norm 0.2 bara
- Operating pot temperature: starting temperature: around 130 °C, final temperature: around 260 °C.
- The vacuum group should be designed in order to reach a minimum pressure of 50 mbar.

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. The skid should have a maximum height of **7** meters.

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

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Swagelok will be applied in accordance with Swagelok 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 pilot plant (including the storage tanks) 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.

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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 operation for replacement in case of damage or malfunctioning.

Some spare parts for replacement during operation (e.g. moving parts, filter elements, etc.) shall also be listed with the technical proposal and included in the Vendors' scope of supply.

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 IIA T3.

9. SCOPE OF SUPPLY

The Vendor scope of supply shall be:

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- Extended basic design engineering of the batch distillation 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 batch distillation unit at Vendor's premises
- Documentation for the batch distillation unit operating and safety manual
- Documentation for the batch distillation unit laboratory manual
- Manufacturer manual and documentation for maintenance and installation of the equipment, instrumentation, analyzers, GC and detectors.
- Transportation to client's premises
- Batch distillation unit re-assembling to client's premises

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- 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);

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- 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
(maximum 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;

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- Execution schedule

B) Turnover (maximum score: 10)

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

<i>Turnover of executive design (€)</i>					
<i>2015</i>	<i>2016</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>Total</i>

Calculation formula: $(F/F_{max}) \cdot 10$

where:

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

F_{max}= 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:

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

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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 distillation 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: Batch distillation pilot plant Description: executive design of a batch distillation pilot plant able to	0.5

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	<i>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</i>	
2	<i>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 number. Capacity: 15 kg/h of liquid flow rate and 5 STDm3/h of hydrogen with separation/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</i>	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 2015-2020. For each project, the scope, a technical description and the customer shall be indicated as reported below.

N.	Project Overview
1	Scope:

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	<i>Description:</i> <i>Customer:</i>
2	<i>Scope:</i> <i>Description:</i> <i>Customer:</i>
...	

Calculation criterion:

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

An example is reported below:

An example is reported below:

N.	Project Overview	Assigned score
1	<i>Scope: Batch distillation pilot plant</i> <i>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;...</i> <i>Customer: ENEA – Italy</i>	0.5
2	<i>Scope: Hydrogenation pilot plant</i> <i>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 separation/recycling system for both liquid and gas phase; operating</i>	0.25

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	<i>conditions: up to 300 °C and 60 barg; WHSV: 0.2-0.5 h-1, ...</i> <i>Customer: ENEA – Italy</i>	
...		

D) Human resources (maximum 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 here reported:

<i>Activity</i>	<i>Permanent employees (no.)</i>	<i>Not permanent employees (no.)</i>
<i>Design</i>		
<i>Manufacture/Fabrication</i>
<i>Assembly</i>		
<i>Commissioning</i>		

Calculation formula: $(N_{ind} + N_{det} / 2) / (N_{ind} + N_{det} / 2)_{max} * 5$

where:

N_{ind} : number of permanent employees

N_{det} : number of not-permanent employees

$(N_{ind} + N_{det} / 2)_{max}$: maximum value among all the economic operators participating to the procedure.

For instance:

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

E) Professional skills (maximum 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		

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