Annex B
of Appendix 1 – Terms of Reference

Group II:
Beneficiary Companies (5-23)

Specification of
foaming machine for using pre-blended
polyurethane and n-Pentane

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Investment Items for water blown foam system
Part 1

Specification of foaming machine for using pre-blended polyurethane and n-Pentane
1. Specification of foaming machine for using pre-blended polyurethane and n-Pentane

1.1 High Pressure Foaming Machines with Mixing Head and Boom

Technical requirement for the offered foaming machine:

The High-Pressure Polyurethane dosing unit has to be designed to leverage the advantages linked to the high-pressure mixing technology by impingement. The machine is to be designed for the use of pre-blended Hydrocarbons/PU formulations. Foreseen pentane concentration in the polyol is up to 12w-% of polyol pre-blend.

The machine is to be designed for implementing small production lines for molded PU foam items (e.g. panels, portable coolers, water boilers).

- The high-pressure piston pumps used on the machine, are expected to provide precise output of chemicals to ensure a better formulation and foaming quality.
- It is expected that the mechanics and electronics applied to the design of PU machinery ensures the highest performances in terms of control of the main process parameters.
- The offered dosing unit should be completely constructed in a single welded steel frame, provided with:
  - Open box and containments on POL+C$_5$ side,
  - Lifting safety devices.

Configuration

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Pressure Axial Piston Pumps</strong></td>
<td>30 cm$^3$/rev for Polyol – 30 cm$^3$/rev for Isocyanate</td>
</tr>
<tr>
<td>Nominal Output Range Ratio 1:1 (g/s) (*)</td>
<td>330 - 1650</td>
</tr>
<tr>
<td>Nominal Output Range Ratio 2:1 (g/s) (*)</td>
<td>500 - 1240</td>
</tr>
<tr>
<td>Output Adjustment</td>
<td>Speed regulation by frequency inverters</td>
</tr>
<tr>
<td>Number of Poles</td>
<td>4</td>
</tr>
<tr>
<td>Machine Tanks Capacity</td>
<td>2 carbon steel tanks, min. 100 l capacity, pressurized at 2 bars (For Evans manufacturing industry Co. the capacity of tanks should be 300 lit)</td>
</tr>
<tr>
<td>Tanks Certification</td>
<td>PED European Standards</td>
</tr>
<tr>
<td>Temperature Control</td>
<td>2 heat exchangers of 2.0 m$^3$ and 2 heating elements</td>
</tr>
<tr>
<td>Control Panel</td>
<td>PLC Controller (Siemens S7 or equivalent)</td>
</tr>
<tr>
<td>Air Consumption (6 bar) per Shot</td>
<td>80 l</td>
</tr>
<tr>
<td>Expected Max Absorbed Power (**)</td>
<td>46 kW</td>
</tr>
<tr>
<td>Max Working Pressure</td>
<td>160 bar</td>
</tr>
<tr>
<td>Max Viscosity</td>
<td>1,500 cps</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
</tbody>
</table>

(*) The specific gravity to 1.23 kg/l for Isocyanate and 1.0 kg/l for Polyol the output being calculated at 10-60 Hz.

(**) The absorbed power is calculated at 200 bar considering all the electrical devices installed (pump motor, hydraulic unit, stirrer, resistances, ancillary circuits, etc.)

1.2 Tanks Group

The tanks group:
- 2 carbon steel tanks of 100 l capacity each (just for Evans manufacturing industry it is 300 l), pressurized and certified up to 2 bar to PED regulations. Each vessel is equipped with the following items:
  - 1 over-pressure safety valve;
  - 1 manual valve to drain the tank;
  - 1 visual magnetic level with Min and Max sensors;
  - 1 PT 100 temperature transducers on the heat exchanger;
  - 1 heat exchanger (2 m²);
  - Dry air pressurization circuit with pressure gauge (on ISO tank only);
  - Nitrogen pressurization circuit with relevant EX pressure gauge installed on polyol tank;
  - 1 agitator (on POL+C5 tank only);
  - 1 safety pressure gauge with visual level (on POL+C5 heat exchanger only);
  - 1 electrical heating resistance (1.5 kW) with thermostatic control;
  - 1 floating level on water circuit;
  - 1 pneumatic ATEX loading pump from drum (on POL+C5 side only);
  - 1 pneumatic loading pump from drum (on ISO side);
  - 1 drip-stop basin.

Additional Equipment to Polyol tank for pentane handling:
- Electrical barriers for PT 100 temperature sensors;
- 1 super-max level with Ex electrical barriers;
- 1 kit to monitor the level of the liquid barrier on polyol agitator seal;
- 1 non-return valve type ADR and 1 two-ways manual drain valve complete with plug installed on the polyol return line instead of the three-ways manual valve;
- 1 high pressure on/off valve (stream distributor DN16) installed on the Polyol/C5 blend loading line and complete with actuator, limit switch, high pressure seal and mechanical seal control;
- 1 additional safety thermostatic control calibrated on 60°C on water circuit.

1.3 Dosing Group

Metering group for a precise dosing, incorporated with the tanks in a single framework:
1 integrated wiring into the steel frame;
2 AC motors;
2 mechanical joints protected by aluminum cases;
2 high pressure piston pumps (30 cc/rev);
1 liquid level monitoring for POL+C5 pump;
1 liquid level monitoring for POL+C5 stream distributor;
2 overpressure safety valves;
2 cartridge filter;
2 high pressure manometers;
2 by-pass stream distributors with common control;
1 “Fire-Safe” valve (on POL+C5 line only);
1 low pressure digital gauge (on POL+C5 line only).

1.4 Control Panel
The on-board control panel should include:

- Motor power relays;
- Power relays for heating elements;
- PLC controller (Siemens S7 or equivalent);
- Controls suitable for 1 mixing head;
- Pouring programs: 99 (19 pouring programs on mixing head selector);
- Color touch screen operator panel;
- Inverters for motor speed adjustment;
- Safety relay;
- Emergency push button connected to the safety relay;
- Anti-locking cycle for mixing head;
- Calibration program (hardware and software to calibrate the components through the mixing head);
- Week-end cycle (software to periodically run low and high pressure recycles during the “not-working” periods);
- Alarm history at operator panel;
- Modem for remote assistance;
- Signals diagnostic;
- Electrical barriers;
- Grounding system for the complete metering unit.
1.5 One Magnetic Coupling (30 CC/Rev Pump) For Iso

One magnetic coupling between motor and 30 cc/rev pump. The magnetic coupling should be composed of three parts:

- one inner rotor installed on the pump shaft
- one static intermediate can
- one outer rotor connected to the motor shaft

Magnetic coupling configuration:

- The external surface of the inner rotor is to be covered with magnets with alternate polarities.
- The pump shaft is to be mechanically fixed to the inner rotor via a feather-key.
- Being the pump shaft without any internal gaskets the metered liquid fills the volume inside the intermediate can and wets the inner rotor.
- The static intermediate can is fixed to the pump external body.
- The sealing should be with a series of Viton seals.
- The outer rotor is to be connected to the electric motor.
- The internal surface of the rotor is to be covered with magnets with alternate polarities and opposed to the inner rotor polarities.

1.6 Free-Standing Boom

Rotating boom, to be installed on the floor, to support the mixing head. The boom is to be complete with a handling device.

<table>
<thead>
<tr>
<th>Main Technical Features</th>
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</thead>
<tbody>
<tr>
<td>Working Radius</td>
</tr>
<tr>
<td>Working Angle</td>
</tr>
<tr>
<td>Max Height from the floor</td>
</tr>
<tr>
<td>Vertical Stroke</td>
</tr>
<tr>
<td>Head Nose Neutral Position</td>
</tr>
</tbody>
</table>

1.7 Ratio optimizer

Device, which enhances the control level of the foaming machine. The machine is to be completed with two volumetric flow transducers mounted along the delivery line of each stream and the output control of each stream is to be in closed loop (*). This unit is to be integrated into the machine PLC. The following information are to be displayed on the operator panel:

- total output
- type of ratio
- polyol output
- isocyanate output
- poured weight

(*) Detailed description of closed-loop system:
- the real output of each component is to be measured by the relevant flow-transducer
- the flow-transducer should send the signal back to the PLC
- the PLC compares the real output with the set value it has in the memory
- in case of deviation between the 2 values, the PLC automatically re-adjust the feeding frequency of the inverter (i.e. the motor speed) in order to bring back the discrepancy to zero.

1.8 Gas Detection and Alarm Systems
Safety and Ventilation System Configuration:
- Alarm detection in every critical point of the process (i.e.: liquid leakage, ventilation flow, gas monitoring, dosing unit std. alarm, etc.).
- Fully integrated alarm and safeties control panel, which runs and controls all the alarms that eventually occurs.
- The panel controls and operates the different safety conditions.
- Training for plant maintenance and running in safe conditions.

Safety Equipment
The scope of supply should include as a minimum the following items for the control of the production lines:
- 1 Safety Control Panel
- 2 yellow Emergency Push Buttons
- 4 Catalytic Gas Sensors
- One Double ventilator of 3.500 + 3.500 m³/h for both wet and dry part

1.9 Specification for Local Works and Local Installation Assistance
The offer should cover the following items:
- Complete sets of electrical drawings
- Electrical lay-out
- Advice on ventilation systems including calculation of ventilation requirements (dimensioning of the ventilation ducts; construction drawings of the ventilation ducts and ventilation ducts are excluded)
- List of precautions to be undertaken by the operator working inside the classified area
• Maintenance manual and electrical diagram (English language)
• Check list to verify the suitability and the performance of the plant in term of safeties of the installation.
• Detailed scope of CUSTOMER obligations and responsibility.
• White book

1.10 Installation, Commissioning and Operator Training

It is expected that the equipment supplier will provide:
• one mechanical and one electrical technician for a total of 5 days for installation
• 2 days for training
1.11 List of preparatory works and items needed for start-up

1- Fence and shelter for c-pentane feeding system:
A separate room with the specified extract ventilation to be provided by the Beneficiary.

2- Electrical power supply
Power supply to the electrical cabinet of the equipment according to the scope of the supply.
The power supply is three-phase, PE, ground, five-wire input, 380V / 50Hz, 100kW.
The power supply cables to the cabinets will be provided by the Beneficiary.

3- Grounding
The Contractor will provide all the necessary information for grounding. The grounding of the fixtures, presses and other plant equipment is done by Contractor. Grounding points will be provided by the Beneficiary near the equipment, grounding hole should be less than 3 ohm, measuring report by certified organization should be provided by the Beneficiary.

4- Civil works
Civil works for preparation of the site, underground cable channels, supply of resources water/oil/compressed air etc. are to be provided by the Beneficiary. The ventilation design is to be provided the Contractor. The ventilators including the ventilation ducts from the exhaust fans to the exterior (e.g. roof surface) and further ducts after the roof surface are to be provided locally.

• Grounding and floor levelling, construction works.
• Support for placing ventilation fans
• Support for duct, pipe line and cabling

5- Utility requirement
• Electricity Power: 380 V, 3 phases, 50 HZ, approximately 130 kW (for the Beneficiary with PU machine, they have to provide 100 kW of electricity power)
• Compressed air: 7 bar oil free
• N2 supply from N2 drum or N2 generator, at minimum 7 bar.
• Earth connection less than 3 ohm close to the equipment will be provided by the Beneficiary

6- Material for start-up (responsibility of Beneficiary)
• Material such as polyol, ISO and Cyclo-pentane, at least 2 drums of each for start-up (Polyol system is to be formulated to be used with pentane)
• 200 liters dioctylphthalate (DOP) for test of PU machine in the Beneficiary plant
• 100 liters water for chiller unit
• 100 liters hydraulic oil for start-up of PU machine

1.12 General notes:
• When the order is placed, the Contractor will provide technical layout and utility requirements; however, it is the Beneficiary’s responsibility to provide electricity power, water connection, compressed air, N₂, and earth connection as defined in the Contractor’s technical layout and utility requirements.
• It is the Beneficiary’s responsibility to supply raw material for testing in the Beneficiary’s plant.
• It is the Beneficiary’s responsibility to provide appropriated crane or lift to unload the equipment from the truck and placing the machinery in the required position based on the layout.
• Smooth and on-schedule progress of the assembly work is only possible with unrestricted access to the site.
• The floor of the workshop where the equipment is installed must be leveled and dirt-free.
• Concrete for the floor should be at least of a quality conforming to B25¹.
• On the floor, minimum drilling depth is 200 mm, for accommodating M20² grouting-/rag-bolts.
• It is the Beneficiary’s responsibility to provide firefighting equipment for hazardous material, Ex-light for the production area if needed.
• The Contractor reserves the right to improve the technical specification of the services, goods and equipment to be provided by the Beneficiary as required ensuring the optimal installation and operation of the foam system.

¹ One of the Concrete classes according to compressive strength
² Anchor size
1.13 Terms & conditions of technical assistance during guarantee period
(Will be provided by Contractor)

An example

Once equipment is set up & in production, in case the Beneficiary needs technical assistance the procedure will be as following:

Basic Helpline services (tel.:----------): Contractor’s technicians will try in first step to solve the issue via phone by guiding the personnel who have received training during start up.

Replacing of faulty spare parts: In case a 'warranty replacement part' is agreed; the Contractor/Contractor’s local service provider will arrange for replacing the defective parts by sending new ones in the first available time and free of charge, within the guarantee period.

Repair service(s): If a problem was not solved on phone or the part replacement should only be done by the Contractor/Contractor’s local service provider, a technician will be sent to customer site not later than 24 hours after receiving the first phone call, followed by a written fax/email describing the issue. During guarantee period, this visit (labor, transportation and accommodation) will be free of charge in case the fault would be from the Contractor side but if the damage is due to improper handling or not trained operators using the equipment, the Contractor will charge the Beneficiary by the daily rate of ---- IRR plus transportation & accommodation (if needed). Parts under guarantee are freely replaced while those of wear & tear should be paid by Beneficiary.

Service agreement/health check services: In case of a need to a routine periodical visit, the Beneficiary can enter a service agreement with the Contractor/Contractor’s local service provider for a specified time and within a certain amount of cost. Regular monitoring & maintenance by a Contractor/Contractor’s local service provider technician will reduce the risk of an unforeseen breakdown in production.
1.14 Terms of training

Training is an essential part securing the optimum use of the equipment which will be performed in below steps:

**Initial training during start up but before delivery:** This is the best time for the Beneficiary company’s maintenance personnel to be involved with real problems happening during commissioning & start up, so it is advised to the Beneficiary company to have one mechanical & one electrical expert (preferably with Programmable Logic Controller software knowledge) to be available in the last days before final start up. Knowledge gained in this period will help them to better understand the later advanced trainings.

**Training after start up:** There will be two separate trainings, one for operators & one for maintenance department (mechanical & electrical) in Farsi language. At the end of each training sessions, there will be a form to be signed by all trainees, where the syllabus of training is clearly described. In this way we will make sure that all topics are addressed. It is important not to relocate the trainees to other departments before being sure that there are still trained operators/maintenance to take care of the plant. Any improper handling of equipment by untrained staff will void the guarantee.

**Post contract training:** To be provided by the Contractor.
Part 2

Specification of investment items for water blown or other alternatives foam system
1. Specification of investment items for water blown or other alternatives foam system

2.1 Invest items for the water-blown or other alternatives foam selectors.

- Improved mold temperature control providing improved adhesion and foam density control. this can include:
  - Heating cables
  - Heating elements
  - Improved boiler in case of liquid heat control
  - Digital control unit

- Improved ventilation, to remove -NCO from the occupational health reasons
  - Ventilation control
  - Exhaust ventilation unit
  - Exhaust ventilation ducting
  - Blower

- Foaming machine upgrade in order to improve mixing control of foam higher viscosity chemical blend
  - New hoses
  - Volumetric of mass flow measurement for chemical flow
  - Mixing head improvement or even mixing head replacement
  - Day-tank temperature control improvement or overhaul
  - New high- or low-pressure pump units