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EQUIPMENT SPECIFICATIONS DOCUMENT

Climatic chambers for PV mini-module ageing tests

EOTP	A-MSYPV-G0-6B-DD
Platform	MODSYST

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1. PURPOSE

This specification document defines the supply, on behalf of the CEA, of an equipment designated as climatic chambers for PV modules. The equipment must be installed at the site INES, Le Bourget du Lac, France in the building Lynx2.

The installation work for the equipment will be subject to analysis following the selection of the equipment.

If the technical specifications or requested documents cannot be met, the supplier must clearly specify this in their commercial offer by at least filling out the comment section of Appendix 1 of this specification document.

2. DEFINITION

In this document, the contractor is referred to as “the supplier”.

The instructing party is referred to as “CEA”.

3. GLOSSARY

- LITEN : Laboratoire d’Innovation pour les Technologies des Energies Nouvelles et les nanomatériaux
- PMAD: Prise en Main A Distance (Remote control access)
- INES: Institut National de l’Energie Solaire (Bourget du Lac site)
- MTBF: Mean Time Between Failure
- MTTR: Mean Time To Repair
- MTBI: Mean Time Between Interrupts
- FAT: Factory Acceptance Tests
- SAT: Site Acceptances Tests
- PV: Photovoltaic
- TC: Thermal cycling
- HF: Humidity freeze
- DH: Damp heat

4. APPLICABLE DOCUMENTS

The supplier shall comply with the documents and all procedures in force at CEA/GRENOBLE. Below is a non-exhaustive list:

- EQ/CS23-10: Règles applicables aux entreprises extérieures (French version)
- EQ/CS23-11: Applicable rules for outside companies (English version)

These documents shall be available for consultation upon request by the supplier.

PUBLIC**5. INTERFACE CLIENT – PRESTATAIRE**

The technical contacts for the basic and additional services are:

Mr Lionel SICOT

Tel : +33 (0)4 79 79 22 23

Email : lionel.sicot@cea.fr

6. CONFIDENTIALITY

The supplier undertakes to keep confidential and shall refrain from disclosing to any third party, without written approval from CEA, the whole or part of information and/or knowledge belonging to CEA or any third party, that it may obtain or may have obtained during the service performed on behalf of CEA.

7. TECHNICAL SPECIFICATIONS**7.1. Description of the main function**

The purchase is for 3 climatic chambers, whose two are optional, that will be used to assess the reliability of photovoltaic modules submitted to three kinds of accelerated ageing tests (see Table 1 and details in paragraph 7.3). Climatic chambers are able to run the three tests.

An option concerning a holder for 12 modules, compatible with the test conditions, is also included.

In case the holder is not provided by the supplier, holder design with specifications about material, maximum weight and the space between modules to reach temperature and humidity homogeneities will be described.

PV modules' maximum dimensions are 500 mm x 500 mm x 10 mm with a weight of about 4.5 kg per PV module. The volume of a climatic chamber can welcome a minimum of 12 modules with the holder, including a space between the modules large enough to assure temperature and humidity homogeneity in the chamber.

Table 1: Ranges of temperature and humidity and tolerances for the three ageing tests with 12 modules in the chamber

Test	Temperature range	Temperature tolerance	Humidity range	Humidity tolerance
Thermal cycling	-60 °C / + 105 °C	+/- 2 °C		
Humidity freeze	-60 °C / +95 °C	+/- 2 °C	85 % RH @ 95 °C	+/- 5 %
Damp heat	+ 95 °C	+/- 2 °C	85 % RH @ 95 °C	+/- 5 %

Proposal and quotations can be divided as follows:

1. Climatic chamber 1
2. Optional climatic chamber 2
3. Optional climatic chamber 3
4. Optional PV modules holder

PUBLIC**7.2. Sub-functions of the equipment**

TC and HF tests require current circulation in the modules to control the continuity of the current flow and the absence of voltage drop. The climatic chambers should include at least one cable feed-through, large enough for 24 MC4 4mm² cables.

The climatic chambers have a user interface to program and store the test profiles. The progress of the test is visible on the equipment and also remotely by PC via an ethernet connection.

It is possible to choose and run a test from a pre-saved list.

Data during the tests can be saved and exported in files (.csv, .txt or excel compatible)

Audible and visual alarms are emitted in case of malfunction.

7.3. Expected performances

Requirements for the ageing tests below are adapted from IEC 61215 tests taking into account extended temperature and humidity ranges. Each chamber is able to run all the tests.

- Thermal cycling
 - 200 cycles
 - Requirement for the duration of 1 cycle: between 3h40 and 6h20
 - Temperature ramp
 - Min: 0.73 °C/min for a 6h20 cycle.
 - Max: 1.66 °C/min
 - Minimum dwell time at -60 °C and +105 °C: 10 min
 - Current flow (PV modules in short-circuit configuration)
 - 10 A when temperature increases from -60 °C to + 105 °C
 - 0.1 A otherwise
- Humidity-freeze
 - 10 cycles
 - Temperature ramp
 - Range 0 °C / +95 °C: max 1.66 °C/min
 - Range -60 °C / 0 °C: max 3.33 °C/min
 - Minimum dwell time at 95 °C and 85 % RH: 20 h
 - Minimum dwell time at -60 °C: 30 min
 - Maximum time for the part +95 °C / -60 °C / +95 °C with a dwell time of 30 min at -60 °C: 4h50
- Damp heat
 - 1000 h
 - Temperature: 95 °C
 - Humidity: 85 % RH

PUBLIC**7.4. Specifications**

The equipment shall fulfil the following requirements with the indicated flexibility degree:

- **F0** = mandatory minimum requirement, must be quoted in the main offer, not negotiable;
- **F0*** = mandatory, must be quoted in the main offer, can be negotiated during the negotiation phase;
- **F1** = Mandatory type of Option: The supplier must obligatorily include an offer with the specified option, otherwise the offer will be considered irregular and eliminated. The CEA reserves the right to decide whether to exercise this option or not, but the price of the option must be clearly stated in the offer. The price of mandatory options will be included in the overall budget for the comparison of offers.
- **F2** = Non-Mandatory type of Option: The supplier has the discretion to propose or not propose the specified option. If the option is not proposed, the supplier will not necessarily be disqualified. The CEA reserves the right to decide whether to exercise the option or not.

Table 2: Requirements

Function	Criterion / Measurement	Flexibility
Climatic chambers configuration	a) Climatic chambers must allow the homogeneous temperature and humidity for at least 12 modules (dimensions: 500 mm x 500 mm x 10 mm, weight: about 4.5 kg per module) and a holder, with measurement of temperature and humidity at chamber level.	F0
	b) The heating rate must allow linear ramp up to 2 °C/min with 65 kg of materials inside.	F0
	c) The heating rate should allow linear ramp up to 3 °C/min with 65 kg of materials inside.	F0*
	d) The cooling rate must allow linear ramp up to -2 °C/min with 65 kg of materials inside.	F0
	e) The cooling rate should allow linear ramp up to -3 °C/min with 65 kg of materials inside.	F0*
	f) The minimum temperature to reach with 65 kg of materials inside is -60 °C	F0
	g) The maximum temperature to reach with 65 kg of materials inside is 150 °C	F0
	h) The maximum humidity must be 85% relative humidity at 95°C.	F0
Holder	a) Optional: Supply of a holder compatible with mini-module's dimensions and that allows homogeneous temperature and humidity in the chambers	F2
	b) Design description for the holder, if holder not supplied	F0
Current injection	a) Openings for cables must allow the connection of 12 modules to allow the injection of current during TC and HF tests.	F0
	b) Caps must be provided to avoid/limit the leakage of humidity and heat through the openings	F0
	c) At least two controllable relays to trig current injection from an independent current supply test bench (provided by CEA)	F0

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Function	Criterion / Measurement	Flexibility
Sensors	a) The humidity sensor must measure the humidity in the chamber during the run.	F0
	b) Humidity is measured with a resistive sensor	F0*
	c) Tolerance for the humidity sensor: +/- 5 % or less	F0
	d) Humidity sensor provided with a report on uncertainties, repeatability, and calibration certificate	F0
	e) At least, one temperature sensor in the chamber	F0
	f) Tolerance for the temperature sensor: +/- 2 °C or less	F0
	g) Temperature sensor provided with a report on uncertainties, repeatability, and calibration certificate	F0
Cooling system	a) Water cooling system	F0*
Measurement	a) Full recording of raw data, temperature and humidity sensors for each run.	F0
	b) Data analysis on temperature rates indicating the quality of the linearity of the heating and cooling ramps and alerts when discrepancies appear.	F2
Maintenance	a) Operating maintenance directives.	F0
	b) Indications and delivery of spare parts for easy maintenance.	F0
	c) Included for 3 years	F1
	d) Training to, at least, 3 CEA persons should be provided at the delivery of the equipment.	F0
Safety	a) The device will be fitted as standard with a safety system designed to prevent overheating.	F0
	b) Emergency stop switch and temperature safety shutdown.	F0
	c) User and safety training	F0

7.4.1. Hardware and equipment specifications

Hardware and equipment should match requirements described in 7.3.

In case the holder is not provided, the supplier will include design recommendations in the description.

The durations of the ageing tests are about 40 days for thermal cycling and damp heat tests, and about 12 days for the humidity freeze test. Due to the lab activities in the reliability field, climatic chambers almost run all year long, day and night.

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Table 3: Specifications and tests conditions for the equipment

	SPECIFICATIONS			PROPOSED TEST CONDITIONS				
TEST #	Acceptance Criteria	Equipement Expected Target	Equipment Target Tolerance	Test Condition	Sample Type/Format (Specify who provide them)	Number of Test Samples	FAT ou SAT	Test medium (specify who provides it)
E-1	Temperature	Temperature settings	+/- 2 °C	• 1 time-adapted humidity freeze test	modules 500 mmx500 mm (CEA)	12	SAT	1 temperature sensor (Supplier)
E-1	Humidity	Humidity settings	+/- 5 %	• 1 time-adapted humidity freeze test	modules 500 mmx500 mm (CEA)	12	SAT	1 humidity sensor (Supplier)
E-1	Temperature ramp	Ramp settings	+/- 0.1 °C/min	• 1 time-adapted humidity freeze test	modules 500 mmx500 mm (CEA)	12	SAT	
E-1	Time	Dwell time	+/- 1 min	• 1 time-adapted humidity freeze test	modules 500 mmx500 mm (CEA)	12	SAT	
E-1	Relay switching	Relay status	On/Off	• 1 time-adapted humidity freeze test	modules 500 mmx500 mm (CEA)	12	SAT	Current injection (Test bench provided by CEA)

PUBLIC**7.4.2. Process specifications**

The E1 test sequence and acceptance criteria are described below.

Test E1 – Time-adapted humidity-freeze test

- Samples: 12 PV modules (500 mm x 500 mm) provided by CEA
- Test sequence
 - Step 1: Ambient temperature and humidity to 85°C / 95°C with a temperature ramp of 2 °C/min, relay in configuration to block current injection
 - Step 2: Dwell time of 1 h at 85 °C / 95 °C, relay in configuration to block current injection
 - Step 3: From 95 °C to -60 °C with a temperature ramp of -2 °C/min, no humidity settings, relay in configuration for injection current (0.08 A) from CEA test bench
 - Step 4: Dwell time of 30 min at -60 °C, relay in configuration for injection current (0.08 A) from CEA test bench
 - Step 5: From -60 °C to 25 °C with a temperature ramp of 2 °C/min, no humidity settings, relay in configuration for injection current (8 A) from CEA test bench
- SAT acceptance :
 - Compliance of chamber's temperature with the settings (+/- 2 °C)
 - Compliance of modules' temperatures with the settings (+/- 2 °C)
 - Homogeneity of modules' temperatures based on the 3 temperature sensors located between PV modules (+/- 2 °C)
 - Compliance of chamber's humidity with the settings (+/- 5 %)
 - Homogeneity of humidity in the chamber based on the humidity sensor located between PV modules (+/- 5 %)
 - Compliance with the temperature ramp settings (+/- 0.1 °C/min)
 - Relays switching to allow current injection (8 A or 0.08 A according to the test steps) or not

7.4.3. Maintenance specifications

See maintenance specifications in the table paragraph 0, "Maintenance" rows in the "Function" column.

7.5. Computer specifications**7.5.1. Computer Control**

The equipment is controlled from a computer workstation, preferably running the Windows operating system.

PUBLIC**7.5.2. Network Connection**

The equipment is connected to the CEA network through this PC via a dedicated Ethernet connection. The equipment supplier must ensure that an additional network card is installed in the workstation in case the equipment is connected to the sole available network port.

7.5.3. Instrumentation network cloud

The equipment is connected to a dedicated instrumentation IP network cloud. It follows the principle showed in the following figure:

Main Characteristics of the instrumentation network cloud:

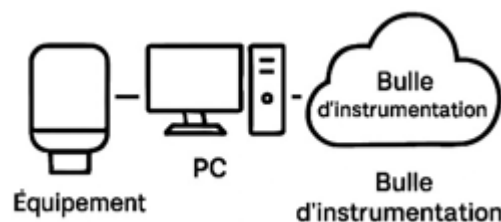


Figure 1 – CEA network connection diagram

- For IT security reasons, there is no internet access or email functionality.
- User session authentication is handled through a CEA Active Directory domain controller.
- Data is uploaded to a shared network storage system.
- Remote access is restricted to CEA's internal IT management service only.

7.5.4. Connection prerequisites

Prior to network connection, CEA requests that the equipment supplier evaluate the feasibility of:

- Installing CEA's specified antivirus software on the PC (reference available upon request).
- Implementing a process for regular Windows updates with two options:
 - Complete system updates (including all updates).
 - Security-only updates (critical security patches only).

7.5.5. Documentation and procedure

The equipment supplier must document the IT configuration of the equipment for its connection to the CEA network (network interface configuration, protocols to be implemented, ports to be opened, data types, architecture diagram, etc.). The supplier will provide a network connection procedure.

7.5.6. Equipment Supplier IT Contact Availability

Availability of an IT contact from the equipment supplier is requested both prior to and during the network connection process.

PUBLIC**7.5.7. Data Export**

During operation, if the equipment serves as a data source, data should preferably be exported in flat file formats (TXT, CSV) or office document formats (XLSX, PDF) for deposit in the designated network storage (CEA infrastructure).

7.5.8. User Session Management

- Nominal phase:

The user session is either individual (named) or generic and authenticated through the CEA Active Directory domain controller.

- Maintenance phase:

The user session is local, has administrative privileges, and is named with the Equipment manager ID.

7.5.9. Hard Disk Drive Image

Subject to technical feasibility, CEA will create a disk image of the PC and store it on a network resource. In all cases, the equipment supplier must provide a complete system reinstallation procedure and all necessary source files or binary files (removable media, official download links, software licenses, etc.).

7.5.10. Administrator password

If the PC is running Windows, CEA requests that the equipment supplier provide the password for the ADMINISTRATOR account. This password will subsequently be managed by the IT service provider under CEA's outsourcing contract.

7.5.11. Remote maintenance

If requested by the equipment supplier and subject to technical feasibility, an external remote maintenance solution may be implemented based on CEA's service offering. For IT security reasons, consumer-grade remote maintenance software is not permitted. Remote maintenance sessions are scheduled and conducted under continuous supervision by CEA personnel. During these sessions, the equipment is physically disconnected from the instrumentation network cloud.

8. WORK ENVIRONMENT, INSTALLATION LOCATION, LIMITS OF SERVICE**8.1. Limits of services**

The limits of Services between CEA and the supplier are the followings:

ITEM	CEA is responsible	Supplier is responsible
Metrology Equipments used for the SAT		X
Installation and assembly of all materials on site		X
Electrical cabinet hook-up to the CEA power lines	X	

PUBLIC**8.2. Environment, Facilities**

The characteristics of the electrical grid available in the building Lynx 2 are:

- Single-Phase: 1 Phase + Neutral + Grounding
- Tension Phase/Neutral: 230 V +/- 10%
- Three-Phase: 3 Phases + Neutral + Grounding
- Tension Phase/Phase = 400 V +/- 10 %;
- Tension Phase/Neutral = 230V + / - 10 %
- Grid frequency: 50 Hz

The **neutral grounding system** of the installation (e.g., TT, TN-S, IT) must be explicitly stated in this document. This information must be clearly and unambiguously presented to ensure equipment compatibility and compliance with electrical safety regulations. The neutral grounding system typically used at CEA INES is TN-S.

Fluid facilities in Lynx 2 building are given in Table 4.

Table 4: Specifications linked to facilities

Main fluids distribution	Specification for Building Lynx2	Note
Cooling water	Piping material: SS	Recycled cooling water in closed loop
	Inlet Pressure: 2.5 bar	
	Inlet Temperature: 18 to 23°C	
	pH: 7	
Deionized water	Point of use Filtration grade: 50 microns	
	Conductivity: 1 µS/cm	

The supplier will submit with their offer the requirements for fluids, electrical power, and all other necessary interfaces, and will complete Appendix 2 provided with this specification document. If these elements are not known at the time of offer submission as they require further study, the supplier commits to providing this information no later than submission date + 3 weeks (in accordance with “Section 9 Timeline”).

Important note:

Completing Appendix 2 will enable CEA to create Piping and Instrumentation Diagrams (PIDs) for fluids as well as the PID for electrical power supply. These PIDs will then be validated by the equipment supplier before hook-up preparation work begins. For simpler equipment, PIDs may not necessarily be required.

Communication Between Equipment and Facilities:

When the equipment relies on certain facilities (such as cooling water, ventilation, compressed air, etc.) for safe operation, the supplier must provide CEA with the following during the design phase:

The conditions required for proper equipment functioning.

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An analysis of criticality in case of parameter deviations.

This analysis may take the form of an FMECA (Failure Modes, Effects, and Criticality Analysis) or an equivalent method.

Loose of Facility Failure Analysis:

Every potential facility failure—whether isolated or combined with others—must be studied. If a risk is identified, a dedicated section must be included in the documentation.

Safety Signal Integration:

If certain facility parameters could impact:

The safety of the equipment's process,

Safe operational mode,

Overall installation safety,

The supplier must integrate the necessary signals into the safety loop or automation system to enable emergency shutdown or controlled shutdown based on temperature and humidity criticality levels.

Communication Protocol:

Finally, if the equipment's operation could significantly disrupt the installation's facilities, the supplier must propose to CEA a communication protocol to anticipate and manage these impacts.

8.3. CEA on-site intervention rules

Access to the CEA site is strictly regulated. The applicable conditions are described in documents EQ/CS23-10 (Rules applicable for outside companies) and EQ/CS23-11 (Applicable rules for outside companies), provided with the bid documents. These terms also apply to the subcontractor of the supplier that will deliver the equipment.

Prevention plan:

CEA will establish, in collaboration with the supplier and any subcontractors, a comprehensive prevention plan for the installation and commissioning of the equipment.

Safety Equipment:

As CEA prohibits the lending of equipment, including safety equipment, the supplier and any subcontractors must provide all necessary safety materials to prevent risks specific to their intervention (PPE, collective protective equipment, etc.). They will ensure the replacement and repair of this equipment and, if applicable, will ensure their personnel are properly trained and aware of its use in accordance with regulations. This equipment must comply with current regulations and have a certificate of conformity.

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Collective Safety Equipment:

The supplier and any subcontractors must provide all collective safety equipment aimed at preventing accidents related to the work, such as:

- Marking of work areas.
- Marking of circulation areas.
- Marking of handling areas.
- Marking and installation of barriers around pits and level differences.

They will ensure the installation and removal of this equipment as soon as the service no longer requires the presence of markings.

Specific Access for Deliveries:

Given the access constraints to the CEA site, the supplier must provide a restricted list of individuals authorized to access the CEA:

For EU residents, 10 calendar days before delivery.

For non-EU residents, 25 calendar days before delivery.

8.4. Delivery

Delivery and Installation Organization

For the proper organization of delivery and installation at CEA, a packing list must be communicated to CEA at the kick-off meeting or at least 1 month before delivery. This list should include the following information:

- The total net weight of the shipment.
- The number of packages for transporting the equipment.
- The weight and dimensions (length × width × height) of each package.
- The number of support points (legs) and the weight supported by each.
- Any need for specific tools or a forklift for installation.
- The unloading plans.

Whenever unloading requires lifting equipment (forklifts, cranes, etc.), a safety protocol supplementing the prevention plan must be established before the unloading operation.

All delivered materials must bear the order reference and the recipient's name on each item in the packing list.

Supplier Presence

The supplier must arrange for all necessary measures to unload and install the equipment (unloading plan and installation plan). **The supplier must be present during the unloading of any equipment requiring special monitoring due to its size, value, or complexity.**

PUBLIC**Installation Location**

The equipment must be installed at the INES in Le Bourget du Lac, France site in the LYNX 2 building.

Logistical Constraints

The supplier must consider logistical constraints related to equipment placement (maximum space, weight, access through doors, ramps, stairs, elevators, maximum height, etc.). These details are specified in Section 0 and in Appendix 1.

Dimensional and Load Constraints:

- Ground floor. No stairs.
- Door width: 1.34 m. Door height: 2.5 m

Packaging and Waste Disposal

The equipment and all its peripherals must be delivered clean and properly packaged. Transport platforms, pallets, and packaging crates must be suitable for the weight and volume of the items to ensure safe transport and avoid any disputes related to improper packaging.

All transport platforms, pallets, and packaging crates must be removed by the supplier (waste disposal from packaging is not handled by CEA).

Delivery Hours

Deliveries will be made between 8:00 AM and 12:00 AM from Monday to Friday.

9. TIMELINE

All the deadlines mentioned below are indicative.

Step	Deadline
Equipment delivery at CEA site	$T_0 + 12$ weeks
Training	$T_0 + 12$ weeks
Site Acceptance Test (SAT)	$T_0 + 12$ weeks

* T_0 refers to the date of order notification by CEA.

To facilitate compliance with delivery and acceptance deadlines, the supplier must promptly transmit all Appendixes required for equipment installation (fluid requirements, electrical power supply, and any other necessary interfaces (Appendix 2), hazard identification sheet (Appendix 3), equipment consumption data, etc.) or any other necessary elements.

PUBLIC**10. QUALITY**

For all its activities, the supplier must comply with the requirements of the ISO 9001 standard.

Significant and/or repeated deviations from this specification will be notified to the supplier (via email-anomaly or Improvement Sheet) for corrective action within a specified timeframe. In case of deviations or unperformed corrective actions, penalties will be applied to the supplier in accordance with the contract.

CEA Grenoble reserves the right to verify the effective operation of the system at any time through quality audits, which may be conducted at the supplier's premises and on the CEA Grenoble site.

Any measurements performed by the supplier for acceptance testing must comply with the requirements of Section 7.1.5 of ISO 9001 (Resources for Monitoring and Measurement). If the supplier subcontracts these measurements, they must be accompanied by a certificate of conformity.

11. SAFETY AND COMPLIANCE

As required in CEA's general purchasing conditions, the supplier commits to treating safety as an absolute priority in the design, preparation, and execution of the services covered by the contract.

The supplier acknowledges and applies the "rules applicable to external companies at the Grenoble center" provided with the tender dossier.

The supplier, as well as any subcontractors at any level, must comply with all applicable legislative and regulatory provisions regarding safety and environmental protection.

The equipment must comply with current regulations.

The equipment will be CE certified, bear the "CE marking," and be accompanied by a CE Declaration of Conformity (see § 13 Documentation).

11.1. Hazard identification

CEA may request the supplier to provide a description of the equipment's residual hazards, including the following information:

- Details about residual hazards for operators.
- Interactions between the equipment and its environment (gas or chemical emissions, electromagnetic fields, noise, etc....).

If hazard identification is required, CEA will make this request no later than during the market launch meeting. The supplier will base this analysis on Appendix 3 of the Technical Specification Document: Identification of Residual Hazards.

The supplier must submit this analysis to CEA during the design phase (cf. § 12.1 Documentation).

11.2. Power supply disconnection and separation device

A power supply disconnection and separation device shall be provided on the equipment, for each source of energy of the machine.

PUBLIC**11.3. Power supply lockout / tagout device**

A power supply lockout / tagout device with dissipation of the residual energy shall be provided on the equipment, for each source of energy of the machine.

11.4. Emergency stop

Emergency stop buttons shall feature protection against unintentional operation. See the example on the picture.

**11.5. "Service" nitrogen or compressed air connection**

When the equipment uses compressed air or nitrogen for controlling valves, actuators, and other systems, the machine must be equipped with a general shut-off valve.

This valve may be locked in the closed position using a padlock to allow for equipment isolation (maintenance).

There must be one or more purge devices to dissipate residual pneumatic energy stored in the machine after the main valve is closed. This dissipation must be performed without risk to exposed personnel.

11.6. Risks related to electricity**Generalities**

The equipment shall comply with the regulations in force, in particular the following Directives:

- "Electrical Equipment" 2017/35/EU;
- "Electromagnetic compatibility" 2014/30/EU;
- "Restriction of the use of certain hazardous substances in electrical and electronic equipment" (2011/65/EU).
- Standard NF EN 61010-1.
- Standard NF EN 50191.

11.7. Presence of an uninterruptible power supply (UPS)

If the whole equipment must be supplied by an uninterruptible power supply (UPS), then this power supply shall be provided by CEA.

The supplier shall give all the required information for product definition (voltage, power, battery life).

The supplier shall provide connection terminals on the equipment to connect the uninterruptible power supply.

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In the event that only a portion of the equipment is powered by an internal UPS integrated by the manufacturer, the following rules shall be observed:

- An all-pole isolating device shall be installed downstream of the UPS in order to enable maintenance operations.
- If voltage still remains after the master switch of the machine has been turned off, such presence shall be indicated close to the switch.
- All circuits that remain live after switch off shall be marked in orange colour in accordance with standard 60-204.

11.8. Risks related to fire

The detectors integrated into the equipment will not be connected to the building's fire protection system by default, and will only act on the affected equipment and its associated peripherals, if applicable.

If the supplier deems it necessary to connect their fire protection system with the building's fire safety system, they must first consult with CEA to ensure the compatibility of the entire system.

11.9. Risks related to explosion

The equipment shall comply with the regulations in force, especially the "ATEX" Directive 2014/34/EU.

Whenever the equipment is likely to generate an explosive atmosphere, the supplier shall perform an ATEX risk assessment and substantiate the choice of the selected ATEX equipment. The ATEX zoning plan as well as the certificates of conformity of the ATEX items of equipment shall be supplied to CEA.

11.10. Risks related to Chemicals

When the equipment uses chemical products that pose health and safety risks to operators, the supplier must detail in the risk analysis the protective measures implemented during normal, degraded, or maintenance work phases.

- When chemical products (solid, gaseous, or liquid) are supplied by the supplier, they must provide the complete list of products, along with Material Safety Data Sheets in French (MSDS) for each product. CEA will be particularly vigilant about the content, pictograms, and classification used, as well as the provision of a version written in French.
- All equipment containing liquid chemicals must be organized to form a retention system to prevent the spread of these products outside the equipment without intentional action. These retention systems will be equipped with leak detectors reporting information to the equipment's control panel. The activation of a detector will interrupt the automatic power supply to the machine and the circulation of chemical fluids. The detectors will be tested before the equipment is put into operation.
- The operation of the equipment must be controlled by the proper functioning of the extraction system. The extraction level will be continuously monitored by one or more extraction controllers, which will trigger a visual alarm at the workstation (on the equipment, and if necessary on the affected peripherals).

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- Note: For automated equipment, this "extraction" alarm may be combined with other types of alarms on the equipment's control panels. The following must be placed under extraction: trays, work surfaces, and generally any location where a leak could occur: presence of fittings, valves, pumps, storage capacities (even closed), canisters, etc.
- The chemical product trays on the benches must be equipped with an automatic drain system with adjustable timing, so that solutions can be automatically directed to the drains in case of prolonged extraction failure.
- For certain process requirements, chemical products may need to be heated. At the end of the operation, these baths are drained to dedicated drains. For temperatures above 60°C and for discharges into the "solvents" drain, a study must be conducted to define the best solution: PVDF material, dilution module, heat exchanger, etc.
- If the solution chosen by the supplier involves the installation of a buffer tank to allow cooling of these effluents, it must be under retention and equipped with an adjustable timing drain system, as mentioned above.
- For equipment with process chambers, the supplier must provide the list of expected by-products in case of chamber opening, to facilitate maintenance operations.
- The supplier will provide CEA with the technical data sheets and SDS for the thermal insulators used, prioritizing the least hazardous thermal insulating products (non-CMR). The use of CMR Category 1a and 1b is PROHIBITED. The use of thermal insulating products classified as CMR Category 2 must be justified by the supplier and validated by CEA in advance.
- The supplier will provide CEA with the list of refrigerants used in the equipment and the associated SDS.
- If the equipment is likely to contain materials subject to regulations related to perfluoroalkyl and polyfluoroalkyl substances (Decree of June 20, 2023) and "Substances of Very High Concern" (SVHC) (under Regulation (EC) No 1907/2006), the supplier will inform CEA during the design phase.

11.11. Risks related to handling

For those parts of the equipment requiring handling (pumping units, chamber lids, covers, etc.), in particular during maintenance or installation operations, suitable lifting means shall be provided and described in the safety instructions of the equipment.

Systems integrated into the equipment shall be given preference over removable systems.

11.12. Risks related to pressure vessels

The equipment must comply with current regulations, including:

- Pressure Equipment Directive 2014/68/EU.
- The contract holder will provide the following elements with the supplied pressure equipment, at a minimum:
- The pressure equipment conformity declaration;
- The presence of a CE conformity plate on the affected equipment;
- The service instruction manual;

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- The maximum allowable pressure (PS) value;
- The maximum allowable temperature (TS) value;
- The useful volume for tanks;
- The diameters of the sections for pipelines, if applicable;
- The calibration certificates and safety accessories certificates.

11.13. Risks related to work at height

In the event that use, maintenance or installation operation of the equipment require access at height, the supplier shall give priority to the installation of collective protective equipment (e.g.: built-in work platform with handrail complying with the standards in force) or, failing that, provide personal protective equipment (e.g.: anchoring points or lifelines complying with the standards in force). In the latter case, the technical documents shall very clearly refer thereto, so that the associated regulatory checks can be implemented.

Where necessary, the associated personal protections may be required.

These shall have been validated by CEA.

11.14. Risks related to artificial optical radiation

These include visible, infrared, and ultraviolet radiation, whether coherent (such as lasers) or incoherent.

The design, implementation, and labeling of the affected equipment must comply with current regulations and standards.

The supplier must provide CEA with information about the artificial optical radiation used in the equipment during the design phase, particularly regarding the risks to users.

11.15. Risks related to noise

If the equipment falls under the definition of a machine, it must comply with current regulations, including Regulation EU 2023/1230.

11.16. Risks related to temperatures

If the equipment falls under the definition of a machine, it must comply with current regulations, including Regulation EU 2023/1230.

11.17. Signalling

If the equipment falls under the definition of a machine, it must comply with current regulations, including Regulation EU 2023/1230.

Residual risks shall be indicated on the machine by means of regulatory hazard pictograms (triangles with yellow background), accompanied by additional text when applicable. In this case, this text shall be written in French.

PUBLIC**11.18. Regulatory Inspection**

CEA shall have the necessary regulatory inspections carried out by an authorized organization of its choice, in order to verify that the supplied equipment complies with the regulations.

The Supplier shall remedy any non-conformity in the shortest time possible without being able to claim any compensation. Depending on the severity of the detected anomalies, CEA may decide to suspend the commissioning operations until the problems have been solved (refer to Article 30 of chapter 11 of the General Purchasing Conditions).

11.19. Regulatory electrical inspection

CEA is attentive to the proper sizing of electrical supplies for equipment connected to its electrical network.

To facilitate proper sizing of the power supply, the supplier must provide CEA with all electrical information for the equipment, including cumulative power ratings determined by calculation (e.g., using the ELIE BT tool).

Once the equipment is installed on-site, CEA will arrange for a regulatory electrical inspection before first commissioning by an accredited certification body of its choice.

12. ENVIRONMENTAL CLAUSES**12.1. Energy Performance/Standby Mode**

The Contract Holder commits to implementing all the provisions described in their environmental proposal, which is an integral part of the contract.

In this context, and in accordance with these commitments, the Contract Holder implements all or part of the following environmental measures during the contract execution:

- To communicate data related to the energy performance of the equipment under normal operating conditions (electricity consumption, water consumption, etc.);
- To propose equipment with a standby mode or equivalent device to limit energy consumption when the equipment is not in use or turned off;
- To propose equipment compliant with temperature range (see requirements f) and g) in Table 2) and using gas with Global Warming Potential (GWP) as low as possible;
- To propose equipment with an alert system to signal excessive energy consumption;
- To provide recommendations for the least energy-consuming modes of operation;
- To propose training on the use of the Equipment in line with the implementation of the clause.

The Contract Holder remains free to submit any alternative solution within the scope of this clause.

The Contract Holder must transmit recommendations to promote more sustainable use of the Equipment based on the usage data communicated during the contract execution by CEA.

PUBLIC**12.2. Material Durability/Facilitating Equipment Maintainability**

The Contract Holder commits to implementing all the provisions described in their environmental proposal, which is an integral part of the contract.

In this context, and in accordance with these commitments, the Contract Holder implements all or part of the following environmental measures during the contract execution:

- To design equipment with robust materials and extended lifespan;
- To propose equipment offering scalability or adaptability (e.g., by adding frames);
- To ensure that the components of the equipment are easily disassembled and repairable;
- To propose training on the use of the Equipment in line with the implementation of the clause.

The Contract Holder remains free to submit any alternative solution within the scope of this clause.

The Contract Holder commits to providing recommendations to extend the lifespan of the Equipment during the contract execution.

12.3. Waste Management

The Contract Holder commits to implementing all the provisions described in their environmental proposal, which is an integral part of the contract.

In this context, and in accordance with these commitments, the Contract Holder implements all or part of the following environmental measures during the contract execution:

- To limit the production of waste and packaging;
- To prioritize packaging that is precisely sized and reusable or recyclable solutions;
- To prioritize, where possible, the consolidation of deliveries to reduce the carbon footprint associated with transportation;
- To prioritize optimized transport design to reduce the volume transported.

The Contract Holder remains free to submit any alternative solution within the scope of this clause.

The Contract Holder must provide all their practices regarding waste management during the contract execution.

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13. EQUIPMENT DOCUMENTATION

The equipment supplier commits to providing, no later than before the Site Acceptance Test (SAT), all technical and administrative documentation related to the equipment (non-exhaustive list).

This documentation will include at least:

- The instruction manual written in French including the CE Declaration of Conformity (in accordance with Regulation EU 2023/1230).
- Identification of hazard sources (see Appendix 3) and safety instructions. These documents will enable the development of a risk analysis for the equipment, co-constructed between CEA and the equipment supplier (no later than before the SAT) (see § 11.1).
- If applicable, technical and installation manuals for all commercial devices, accompanied by their calibration certificates, particularly for measurement sensors.
- The list of spare parts and consumables for routine maintenance, with costs and procurement lead times.

If applicable to the type of machine considered (prototype or custom-built with more or less CEA Intellectual Property), the supplier must provide:

- Process plans and diagrams (assembly, piping, and instrumentation).
- The final design file of the equipment.
- Sources of automation and supervision programs, documented and unprotected.
- The diagram of the IT architecture.
- The nomenclature of inputs/outputs (with tag numbers reported on electrical diagrams).
- The manufacturer's file, TQC (Piping, Quality, Control) plans, as well as the electrical and control-command file (including functional analysis and plans).
- If applicable, the ATEX zoning plan of the equipment as well as the conformity certificates of ATEX materials.
- Any other documents required by applicable regulations.

14. ACCEPTANCE CONDITIONS

14.1. Acceptance breakdown

Reception consists of a single phase:

- Site Acceptance Test (SAT)

A factory control and testing (FAT) is not required but the supplier will submit a report presenting the results of its internal verification protocol.

PUBLIC**14.1.1. SAT Phase - Controls and Testing on CEA Site**

The tests to be carried out on the CEA site must be defined by CEA and validated by the supplier.

The acceptance tests must cover all the specifications of paragraph § 0.

Each requirement must be evaluated (compliant/non-compliant/partially compliant), and the results must be recorded.

Before pronouncing the reception, the supplier must submit all the test and control reports carried out during the SAT.

14.2. Acceptance criteria

Acceptance will be granted if:

- The equipment complies with regulatory requirements (see § 11.18).
- The equipment meets all contractual technical requirements (see § 7).

When verification of an acceptance criterion requires measurement, the means used must be control, measurement, and test equipment (ECME), as defined by ISO 9001.

The supplier provides the measurement equipment and:

- Measurements must be performed using compliant ECME.
- The supplier must provide calibration certificates with COFRAC accreditation or equivalent.

14.3. Final Acceptance Pronouncement on Site

Final acceptance is pronounced when:

- The equipment has been delivered in full.
- Installation, commissioning and start-up are completed.
- Qualification controls and tests have been successfully passed.
- Regulatory compliance has been approved. If applicable, machine compliance according to EU 2023/1230, as per a report issued by a CEA-accredited body, with no non-conformities.
- If applicable, compliance with specific risks (ATEX, pressure equipment, etc.) validated by an accredited body (see § 11.9).
- The complete equipment documentation has been delivered (see §13).

A proceedings record following CEA's formalism is then drawn up and signed by both parties. This proceedings record allows the acceptance of the control file and, if necessary, the listing of reservations.

PUBLIC**15. TRAINING**

The supplier commits to provide the following training sessions. A training certificate will be issued by the supplier, listing the trained personnel and their level of intervention.

15.1. Equipment Operation Training

The supplier commits to provide training on the use of the Equipment for three people. The supplier will indicate in their offer the number of training days required.

This training will cover, among other topics, equipment operation, automation, and control system handling.

15.2. First-Level Maintenance Training

The supplier commits to providing first-level maintenance training for two people. The supplier will indicate in their offer the number of training days required.

15.3. Advanced Maintenance Training

The Advanced Maintenance Training will be quoted as an option.

The supplier commits to providing first-level maintenance training for two people. The supplier will indicate in their offer the number of training days required.

16. WARRANTY

The equipment is contractually guaranteed for 2 years from the date of acceptance against any defects in material, manufacturing, assembly, and operation, in compliance with the technical specifications of the tender document.

This warranty covers parts (excluding consumables), labor, transportation, and travel.

During the warranty period, the supplier commits to intervening for repairs within 48 hours following receipt of an email request for intervention from CEA. These services are performed every day from Monday to Friday, 8 AM to 5 PM.

In case of unavailability, the warranty period is extended by an equivalent duration to the equipment's downtime.

17. MAINTENANCE

At the end of the warranty period, CEA will have the option to subscribe to a maintenance contract.

In their pricing offer, for informational purposes, the supplier will provide as a non-Mandatory type of Option a preventive maintenance service quote which includes:

- Parts and labor for preventive maintenance,
- Corrective maintenance on demand (at hourly rates) with adherence to intervention and repair deadlines.

Following adjustments to CEA's maintenance needs, the maintenance contract may be established after the warranty period through negotiations.

PUBLIC**18. ELEMENTS TO PROVIDE IN RESPONSE TO THE CONSULTATION**

- Comments from the Equipment Supplier on the Equipment Specification Document (named Appendix 1: "FOR_533_Annexe_1.xlsx").
- Completed characteristics of fluid requirements, electrical power supply, and all other necessary interfaces (named Appendix 2: "FOR_534_Annexe2.xlsx").
- Hazard identification sheet (see § 11.1 and Appendix 3: "FOR_535_Annexe_3.xlsx").
- The cost of preventive maintenance service must be specified
- Duration and descriptions of planned training sessions.
- Separated Mandatory and non-Mandatory Option quotes

Mandatory and non-Mandatory Options:

- **Mandatory Option:** The supplier must obligatorily include an offer with the option, otherwise the offer will be considered irregular. CEA reserves the right to decide whether to exercise this option or not, but the price of the option must be clearly stated in the offer.
- **Non mandatory type Option:** The supplier has the choice to propose or not propose the option. If the option is not proposed, the supplier will not necessarily be disqualified. CEA reserves the right to decide whether to exercise the option or not.

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APPENDIXES

FOR 533_Annexe_1.xlsx : Supplier's feedback on specifications document

FOR534_Annexe_2.xlsx : Specification Datasheet (GB spreadsheet) for tool installation

FOR535_Annexe_3.xlsx : Hazard Identification Sheet (GB Spreadsheet)