

**IAEA GREENHOUSES
SEIBERSDORF**

TECHNICAL SPECIFICATIONS



FEBRUARY 2023

TABLE OF CONTENTS

| | | |
|------|---|----|
| 1. | TECHNICAL SPECIFICATION GREENHOUSE STRUCTURE | 5 |
| 1.1 | General | 5 |
| 1.2 | Overall dimensions complex | 8 |
| 1.3 | Regulations and requirements | 9 |
| 1.4 | Levels | 10 |
| 1.5 | Electricity and connections | 10 |
| 1.6 | Concrete works | 10 |
| 1.7 | Main-supporting steel structure..... | 11 |
| 1.8 | Gable sides, gable ends, separations and expansions | 14 |
| 1.9 | Roof construction 4.00 m Venlo | 15 |
| 1.10 | Rain and condense water discharge | 17 |
| 1.11 | Roof and gable coverings | 18 |
| 1.12 | Head house covering | 20 |
| 1.13 | Doors & Ante-rooms | 21 |
| 1.14 | Exhaust Air Ovens | 22 |
| 2. | TECHNICAL SPECIFICATION SHADING INSTALLATION | 23 |
| 2.1 | Regulations and requirements | 23 |
| 2.2 | Electricity and connections | 23 |
| 2.3 | Horizontal installations | 23 |
| 2.4 | Gable screens | 25 |
| 2.5 | Alternative systems | 26 |
| 2.6 | Construction drawings | 26 |
| 3. | SPECIFICATION HEATING INSTALLATION..... | 27 |
| 3.1 | Regulations and requirement..... | 27 |
| 3.2 | Heating design data | 28 |
| 3.3 | Hot water circuit | 28 |
| 3.4 | Mixing groups greenhouse heating..... | 30 |
| 3.5 | Head-house..... | 31 |
| 3.6 | Insulation activities | 32 |
| 3.7 | Painting activities | 32 |
| 3.8 | Filling of the installation and water treatment | 33 |
| 3.9 | Materials..... | 33 |
| 3.10 | Defects Liability Period | 33 |
| 3.11 | Instruction / maintenance | 33 |
| 3.12 | Spare parts installation | 33 |
| 3.13 | Material make..... | 33 |
| 3.14 | Design, materials and workmanship | 33 |
| 4. | SPECIFICATION COOLING INSTALLATION | 34 |
| 4.1 | Regulations and requirement..... | 34 |
| 4.2 | Cooling design data | 35 |
| 4.3 | Water chiller | 35 |
| 4.4 | Chilled water circuit..... | 36 |
| 4.5 | Air Handling Unit high containment greenhouse rooms | 38 |
| 4.6 | AHU for general greenhouse rooms | 41 |
| 4.7 | Fancoil units | 41 |

| | | |
|------|---|----|
| 4.8 | Exhaust fans | 43 |
| 4.9 | Insulation activities | 43 |
| 4.10 | Painting work..... | 43 |
| 4.11 | Filling of the installation and water treatment | 43 |
| 4.12 | Materials | 43 |
| 4.13 | Defects Liability Period | 44 |
| 4.14 | Instruction / maintenance | 44 |
| 4.15 | Spare parts installation | 44 |
| 4.16 | Material make..... | 44 |
| 4.17 | Design, materials and workmanship | 44 |
| 5. | TECHNICAL SPECIFICATION TABLE SYSTEM..... | 45 |
| 5.1 | Regulations and requirements | 45 |
| 5.2 | Benches | 45 |
| 5.3 | Alternative systems | 46 |
| 5.4 | Construction drawings | 46 |
| 5.5 | Defects Liability Period | 46 |
| 6. | WATER TECHNICAL INSTALLATION | 47 |
| 6.1 | General | 47 |
| 6.2 | Electricity and connections | 47 |
| 6.3 | Ground-work | 47 |
| 6.4 | City water connection for irrigation..... | 47 |
| 6.5 | Water treatment and storage system..... | 49 |
| 6.6 | Rain water storage and treatment system | 49 |
| 6.7 | Hydrophore pumpunit | 50 |
| 6.8 | Hydrophore pump unit | 50 |
| 6.9 | Irrigation piping system | 51 |
| 6.10 | Overhead irrigation | 51 |
| 6.11 | Drip irrigation installation..... | 52 |
| 6.12 | Ebb/flood system..... | 53 |
| 6.13 | Summary..... | 53 |
| 6.14 | Fertiliser dosing..... | 54 |
| 6.15 | Air humidifier | 54 |
| 6.16 | General | 55 |
| 7. | SPECIFICATION ELECTRICAL INSTALLATION | 56 |
| 7.1 | General | 56 |
| 7.2 | Regulations and requirements | 58 |
| 7.3 | Earthing system | 60 |
| 7.4 | Main distribution panel | 61 |
| 7.5 | Distributor | 63 |
| 7.6 | Overvoltage protection..... | 65 |
| 7.7 | Energy distribution in buildings | 65 |
| 7.8 | Cable tray system | 66 |
| 7.9 | Electrical installation greenhouse and head-house | 66 |
| 7.10 | Technical room..... | 68 |
| 7.11 | Cabling of the control panels | 69 |
| 7.12 | Sulphur evaporators..... | 69 |
| 7.13 | Alarm installation..... | 69 |

| | | |
|------|--|----|
| 7.14 | Grow Light installation..... | 70 |
| 7.15 | Emergency Lighting | 71 |
| 7.16 | Fire alarm system..... | 71 |
| 7.17 | Telecommunication and information technology equipment | 72 |
| 7.18 | Loudspeaker system | 72 |
| 7.19 | WINGUARD system..... | 73 |
| 7.20 | Technical ring..... | 73 |
| 7.21 | Structured cabling IT | 73 |
| 7.22 | Security Technology | 74 |
| 7.23 | Defects Liability Period | 74 |
| 7.24 | Instruction / maintenance | 74 |
| 8. | SPECIFICATION CLIMATE COMPUTER | 75 |
| 8.1 | Electricity and connections | 75 |
| 8.2 | Environmental computer | 75 |
| 8.3 | Computer connections | 78 |
| 8.4 | AHU control unit..... | 79 |
| 8.5 | Technical room..... | 79 |
| 8.6 | Cabling | 79 |
| 8.7 | Control computer and data storage | 79 |
| 8.8 | Instruction and maintenance agreement | 80 |
| 8.9 | Service climate computer installation..... | 80 |

1. TECHNICAL SPECIFICATION GREENHOUSE STRUCTURE

1.1 General

This technical specification describes the supply, construction and delivery in good working order of a greenhouse in Seibersdorf, Austria. It consists of a research greenhouse, entirely as stated hereafter.

Despite prescribed use of certain items in this specification, contractor remains ultimately responsible for design, detail-engineering, calculation of strengths and capacities, selection of components and materials, adjusting and good working of the installations and processes described. This is an indicative description of the problem definition and the minimum required in necessary solution, design, standard, tax, duty, material, labour, calculation, document and drawing to be executed until physical completion and final acceptance by the client, entirely to the satisfaction of governmental authorities.

Integral part of the work is adherence to local codes and regulations and the supply of necessary English language documentation to approving authorities and organisations until they are satisfied and required permits are provided. This applies a.o. to labour unions, HACCP, Fire Protection, H&S, etcetera.

Contractor must be aware of the state of the site, the accessibility and the position of underground pipes and cables at the day the contract is signed. The state of the site is given by the owner at request.

Furthermore, greenhouses and systems inside supplied by the Dutch greenhouse industry have to comply at least with execution quality demands stated in the ISSO handbooks in their latest valid issue.

All parts have to be UV-resistant. UV-resistance under glass must be provided in kilo-Langly per year.

Technical description in this report is based on following drawing numbers:

| Drawing List IAEA Greenhouse | | | | | |
|-------------------------------------|------------------------------|-----------------|-------------|---------------------|--|
| Sheet | Title | Revision | Date | Modification | |
| S01 | Situation | 1 | 5-10-2021 | | |
| K01 | Total plan | 9 | 5-10-2021 | | |
| K02 | Sections | 8 | 5-10-2021 | | |
| K03 | Views | 7 | 5-10-2021 | | |
| K04 | Doors | 9 | 5-10-2021 | | |
| K05 | Tables | 4 | 1-10-2021 | | |
| K06 | roof view | 2 | 29-9-2021 | | |
| K07 | Walls | 3 | 5-10-2021 | | |
| K08 | Screens | 3 | 5-10-2021 | | |
| K10 | Sections | 3 | 5-10-2021 | | |
| K11 | Concrete Overview | 1 | 5-10-2021 | | |
| K12 | Concrete Details 1/2 | 0 | 21-9-2021 | | |
| K13 | Details 2/2 | 0 | 21-9-2021 | | |
| K14 | 1st Floor | 0 | 5-10-2021 | | |
| PID01 | PID cooling | 0 | 5-10-2021 | | |
| PID02 | PID heating | 0 | 5-10-2021 | | |
| PID03 | PID irrigation | 0 | 5-10-2021 | | |
| PID04 | PID AHU and fan coils | 0 | 5-10-2021 | | |
| T01 | Principal AHU & technic room | 0 | 5-10-2021 | | |
| W01 | Plan irrigation | 0 | 5-10-2021 | | |
| H01 | Top heating & radiators | 0 | 5-10-2021 | | |
| H02 | AHU heating | 0 | 5-10-2021 | | |
| C01 | Plan cooling | 0 | 5-10-2021 | | |
| DR01 | Drain | 0 | 5-10-2021 | | |
| | | | | | |
| R01 | 3D Renderings | 0 | 5-10-2021 | | |
| EL ++ | Electrical | | 1-02-2023 | | |

1.1.1 Design requirement

In addition to normal greenhouse rooms, there are 2 specific greenhouse rooms requiring high containment & quarantine:

- Radioisotope greenhouse & pathology greenhouse are high containment greenhouse rooms, where negative pressure is maintained.

Remaining rooms have positive pressure, with netted exhaust-roof-ventilation windows.

Air flows and contact between rooms or with the outside is to be prevented since it can cause contamination.

Therefore, each room must be sealed against insect penetration, pollen and condensate, by means of sealed glazing, sealed gutters, sealed doors, ante-rooms, rubber sleeved pipe and cable conduits and siphoned floor drains. All roof vents will be executed with insect screens.

Testing tightness of separation walls will be executed in the owner's presence who signs off per room, and will be done by means of a smoke generator in a room at positive pressure, as well as hosing down gables towards adjacent rooms.

Inside the facility, UV spectrum of sunlight is beneficial. Therefore UV permeable laminated glass is preferred as a standard in the containment area, although UV-blocking polycarbonate is not ruled out as an alternative.

The facility steel structure has to be built on a flat foundation floor with a sloping perimeter knee-wall poured on top. Inner posts may either stand directly on the floor or on poured sloping concrete separations.

1.1.2 Demarcations, limitations, qualifications

1.1.2.1 Boundary limits

Boundary limits are defined as follows:

- Excluded is removal of underground obstacles from the construction site (in case position of obstacles is indicated, this has to be taken into account);
- Excluded is levelling and compacting the construction site in layers;
- Excluded is all utility infrastructure connection, the points are shown in the drawing:
 - *Process water connection, at required capacity;*
 - *Drinking water connection, at required capacity;*
 - *Possible CO₂ connection;*
 - *Earth rods for main divider and construction, will be provided at required capacity;*
 - *Lightning protection;*
 - *Sewage connection will be placed outside the building, at required capacity;*
- Excluded is miscellaneous :
 - *Remote access to systems for updates / maintenance (manufacturer only);*
 - *Active IT components such as WIFI transmitters;*
 - *All active telephone communication system;*

1.1.2.2 Belonging to the work

The execution of the work consists of the following:

- a. design according to local law, regulations and requirements;
- b. satisfying and on time delivered complete engineering package for customer and consultant to review and approve before manufacturing, drawings, structural and other calculations and instruction papers to:
 - *get approval by local authorities;*
 - *produce (by the contractor);*
 - *install/erect (by the contractor or a third party);*
 - *repair/maintain (by the owner or user or on behalf of them);*
- c. effective communication on the construction site in the English language;
- d. delivery of the required materials to the construction site;
- e. expert knowhow and supervision over construction crews (or a third party construction crew);
- f. all specific labour as prescribed;
- g. any specialized tools required for the execution;
- h. acceptance of all obligations that are involved in the successful execution of the work;
- i. authorized and qualified representation at meetings;
- j. commissioning of all technical systems supplied;
- k. presenting a contingency plan to accommodate working in a high ambient temperature $\geq 40^{\circ}\text{C}$ inside the glazed greenhouse with shade, drinking water, forced ventilation, shifted work hours etc.

1.1.3 Documents at delivery

Apart from tests and checks that take place in order to deliver, contractor must present all required delivery and commissioning documents in the English language on a flash drive subdivided in a directory structure easy to search per subject. These documents must be sent two weeks in advance of delivery.

All necessary documents have to be provided minimum 1 week before commissioning, such as:

- As-built drawings of all systems;
- Approved structural drawings and calculations of the greenhouse and systems;
- Operation/repair/maintenance manuals for machinery, pumps, motors, valves, cables, etc.;
- Specification sheets of machinery, pumps, motors, valves, cables, etc.;
- Quality- & CE-certificates of machinery, pumps, motors, valves, cables, etc.*;
- Test-certificates after on-site installation in advance of delivery, signifying test runs signed off by the owner's representative for items such as air-vents, cooling, heating, electrical, computer, etc.;
- Spare parts.

* With CE manufacturer certifies that a product meets the requirements of EC directives for the EEA.

1.2 Overall dimensions complex

| | |
|-----------------|--|
| Greenhouse type | : Venlo, a 4,000 mm roof structure, 4,000 mm truss distance (4,000 x 4,000 grid) |
| Manufacturer | : Alcomij, Boal, Excellent, Havecon or a worthy equivalent |
| Gable end width | : 4,000 mm x 12 = C.T.C. 48,000 mm |
| Truss distance | : 4,000 mm x 11 + 5,000 = C.T.C. 49,000 mm |
| Column height | : 6,000 mm (top foundation to underside gutter (with foundation it is 6,300 mm)) |
| Surface ctc | : 1,856 m ² |

1.3 Regulations and requirements

Austrian standards, regulations and requirements for works as issued by the Austrian Building Code: ÖNORM/EN13031-1:2020-02-01, Gewächshäuser Bemessung Konstruktion Teil 1, in its latest issue (please check again before design). Design Data to be used for the location Seibersdorf, Austria.

The calculations of the required strength of the superstructure and gables are made initially with the TNO strength calculation program CASTA in its latest version and are based on the following standard:

- ÖNORM EN 1990:2013 03 15 Eurocode - Grundlagen der Tragwerksplanung
- EN 13031-1, 2001 Greenhouse design and Construction
- ASCE/SEI 7 Minimum Design Loads For Buildings and Other Structures and Load Combinations

Snow according EN 1991-1-3, snow at ground level : $s_k = 1,10 \text{ kN/m}^2$

Wind according EN 1991-1-4, : $V_{b0} = 25,70 \text{ m/s}$, $Q_{b0} = 0,40 \text{ kN/m}^2$

Minimum loads to be added to the greenhouse (principally in conjunction with manufacturer / supplier of the particular system (figures have to be reviewed separately / independently before the calculation):

Loads on greenhouse structure:

- a. 1,000 N/m¹ point load on gutter (person inspecting)
- b. 150 N/m² installations (surface of the greenhouse)
- c. Two screen-installations against the lower and upper-beam of the trusses. Loads from a double pull-wire screening system according to the BRL 2007 method
- d. 5,500 N/m² roof-washer with wheelbase 1,500 mm divided over 4 wheels (greenhouse surface)
- e. 250 N/m¹ at gable-end and -sides for heating-distribution-line as shown in drawing.

Quality of materials and services to be at least according to ÖNORM EN 1990:2013 03 15 Eurocode - Grundlagen der Tragwerksplanung Edition standard and certification approval mark. This counts for quality of steel, steel profiles, steel tubes, steel wires, quality of galvanising steel, aluminium, extruded aluminium profiles, stainless steel, building profiles of rubber, cement, concrete, re-enforcement steel/sheets, quality of concrete works, quality of PVC tubes, quality of GH float glass, etc.

In addition to above requirement also according to Dutch greenhouse glazing related standards:

- Glass according to NEN 3256
- Determining light transmission of greenhouse glass NEN 2675

Standards to be applied according to their latest issue. Structural calculations to be provided within 3 weeks of acceptance of the order. The structure must be reviewed and cleared by a local government accredited certified structural engineer. Reports of all parts of the construction are to be supplied.

a. Steel construction

Contractor must hand in a construction plan. The construction has to be built by sufficiently qualified personnel. Only work according to authority approved drawings with the delivery and mounting of the steel structure as well as the fixation of parts. All main- and profile sizes must be stated in the drawings.

b. Drawings and calculations

Drawings, shop drawings, structural calculations, and all necessary details are to be presented to the client for review and for the client's structural engineer to approve the structural calculations as part of the engineering package before manufacturing. Furthermore, drawings & calculations are subject to government approval. These drawings and calculations must all be according to the relevant construction standards.

c. Anchoring/securing

Since the foundations and concrete floor are executed by a third party, it is in the greenhouse contractor's scope to provide sufficient details how the foundation and anchoring must be executed. This is part of the engineering package and structural calculations.

d. Mounting at the building site

Fixation points may only be welded or drilled in factory before galvanising. Only bolting is allowed at the site to fasten construction parts. Roof and gables are to be installed according to TNO rapport BI-91-097. Bolted dynamic loads fixations must be fastened with securing rings or nuts with nylon against loosening.

e. Surface finish steel

Steel construction must be hot dipped galvanized according ISO1461 and optional spray painted white RAL9010.

1.4 Levels

In this project levels for knee-walls roof-gutter and everything hanging from the steel structure slope down with 2,5 mm per 1,000 mm from the highest point at axis 13 to the lowest point in axis 1. Floor is level (with the exception draining per room towards a floor gutter) with reference point set at FF = finished floor = 0 mm left of axis 13 inside the connecting building.

1.5 Electricity and connections

Electricity from the grid comes in three-phase with neutral conductor and PE (protective earth). Single-phase voltage 230 V, three-phase voltage 400 V and frequency 50 Hz. Motors to be IP55 rated and designed for use in 50°C ambient conditions with 95% RH. The installation must comply with the country's ruling standards, regulations & requirements, and the power company's directions. After contracting, before sourcing equipment, the above must be checked for abnormalities, to investigate possible implications for the equipment and adjust / adapt the equipment accordingly.

1.6 Concrete works

All necessary concrete work is executed by a local third party. Integral part of contractor's job is to aid and facilitate the preparation, the groundwork, the execution of the foundation floor, the perimeter-knee-walls on top of the floor, its drains and discharges towards their connection point, by means of a detailed principle drawings from greenhouse contractor.

1.6.1 Design of third party executed foundation floor

Although the foundation floor is executed by a local party, the design and the necessary indication of the occurring structural loads are the responsibility of the contractor. The site is levelled. Integral part of the work is that contractor supplies sufficiently detailed drawings of the footprint, loads per footplate and anchoring and necessary principle drawings with cross-sections of the floor as well as all perimeter-knee-walls needed.

Despite the probability that local standards may state otherwise, getting the required slope with a 5 mm tolerance in the knee-wall is extremely important (+/- deviation from the apex line within 2.5 mm). All floors must be draining towards the floor drains and all structures on the sloping knee walls be adjusted.

1.6.2 Supervision

Integral part of the job is supervising over coordination and execution of the floor, connection details, such as position of doors, anchors for steel construction, how much the perimeter foundation is outside C.T.C., where the rainwater discharge line downspouts are, etc.

1.6.3 Execution details

The foundation floor is flat and level. The perimeter foundation / knee-wall poured on top is sloping with 2,5 mm/m towards the lower end. Principle dimensions and qualities as stated in the tender design drawings must be cross checked with the requirement before execution. And although the surface is flat, additional necessary strengths must be realized by making the floor thicker below floor level, and adding reinforcement steel.

Floors inside the complex are at the surrounding ground level, and all details concerning the connections between floor, knee-walls and separations must be according to the manufacturer's details and must be absolutely water-tight, involving all the necessary connection profiles, kit and expanding rubbers, etc. If one chooses for an alternative way of connecting between the floor and the walls, all necessary details must be provided. Floors have to be provided with drain gutter and discharge.

Floor has to be finished with hardened top-layer, and in the radioisotope greenhouse & pathology greenhouse with epoxy coating, the epoxy coating is also executed by the local third party.

1.7 Main-supporting steel structure

Structural calculations of constructions must be done by a qualified structural engineer accepted by the governmental authorities. The main structure must be carried out according to approved drawings only.

The structure must be fastened to the foundation with chemical anchors or anchor strips.

The construction of the greenhouse shall be designed in such a way that the installation of the cable trays can be mounted on the structure.

1.7.1 Materials hot dipped galvanized & option white powder coating

All steel parts must be hot dipped galvanised according the valid regulations and requirement. Treatment and strengthening of all aluminium parts of the structure (often only the gutters) must be fully explained, we think of the alloy and the heat treatment of the extruded items.

As an optional price to be offered in the specification the steel structure powder coated white RAL 9010.

1.7.2 Columns

Columns are box profiles with calculated size / strength based on the needs in designated locations:

- Next to a path, corridor, cross-bracing, outer- & inner-gable;
- Chemical anchor bolt fixation in the foundation;
- Fixations for purlin, bracing, screen, heating strips and consoles to be welded before galvanizing;
- Gable end columns must absorb the tensile strengths of the screen's wire bed;
- At gable sides intermediate columns between the standard ones prevent gutter torque;
- Inner wall columns to be placed between the glass separations, (meaning purlines and aluminium bars between the columns) so that help steel can be attached from 2 side of the wall for screens, heating, raining installation, lights etc. without breaching the gable sealing;
- Drilled oversized gable heating pipe holes in outer gable-side column (compensate strength);



- In case of a twin-roll screen at an inner gable a secondary gable-end column to be used to attach systems. To be mounted in axis line A-D 4, A-D 6, A-D 9, E-H 3, E-H 9;
- E-H5 and E-H 6 will have the glass side of the wall inside the room for easy cleaning and the twin-roll screen will be on the outside as well as the columns. Same for the walls E3-E4-F5 and E6-E9
- Where posts are omitted under a gutter in the packhouse, those remaining need to be strengthened;

1.7.3 Trusses

There will be several lengths of trusses necessary, the standard to support the Venlo roof, and where posts are omitted under a gutter, as is specifically the case in the head house where all columns in space 14, 17, 18 and 20 will have no internal columns and at axis E5.

Trusses lengths of 4,00 m, 8,00 m, 12,00 m (no posts inside rooms or corridors). Trusses must be constructed with sufficient holes to accommodate hot dipped galvanising. The width of the truss must be at all times the same as the column width.

The trusses gable side connection must be bolted to the column with a contra plate to prevent deformation of the column.

The trusses shall be able to carry the weight of the required electrical installations (cable trays, etc.).

1.7.3.1 Mounted to the truss

Following systems and installations must be mounted to the truss in various combinations.

- Inner screen opening and closing against the upper beam of the truss;
- Inner screen opening and closing against the lower beam of the truss;
- Air-vent axle incorporated in the upper beam of the truss;
- Suspension lashes / straps under the lowest beam of trusses in order to suspend:
 - o Cooling equipment where needed (welded straps needed);
 - o Upper heating pipes where needed (welded straps needed);
 - o Assimilation lights where needed (welded straps needed);
 - o Overhead irrigation pipe (welded straps needed);
 - o Fogging system;
 - o Cable gutters;
 - o Crop wires where needed (welded straps needed).

1.7.4 Bracings

Bracing of the structure must be adjustable and mounted slightly stressed. Braces connected to inner structure must not obstruct in any way.

1.7.4.1 Inner bracing in line with gutter

Braces connected to inner structure columns must not obstruct screen installations in any way.

Help steel : upper and a lower compression beams/bars

Number of pairs : to be calculated

1.7.4.2 Gable end bracings

Braces connected to gable end columns must not obstruct screen installations in any way.

Number of pairs : to be calculated

1.7.4.3 Gable side bracings

Braces connected to gable side columns must not obstruct screen installations in any way.

Number of pairs : to be calculated

1.7.4.4 Roof wind bracings

Braces must be mounted in a way that the horizontal screen and ventilation system are not obstructed.

Number of pairs : to be calculated

1.7.5 Structural function of gutters

Roof gutters are a structural element made of extruded aluminium box profiles that support the structure incorporating several functions, that are further described under “rain & condense water discharge”.

1.7.6 Several construction sub-parts and system connections**1.7.6.1 Outer gable end and side purlins**

Gable ends as well as the sides must be fitted with U-type gable purlins. Purlins must be mounted straight, parallel to the perimeter foundation, and at equal distances to accommodate a gable screen installation. One must apply flat rounded bolts and nuts pointing to the outside of the profile for the same reason, so that the total space between columns and aluminium bars will be completely empty.

Type of purlin : U type, open side down

1.7.6.2 Inner gable end and side purlins

The inner gable width must be preferably ≥ 200 mm, for which all necessary extras are integral part of the delivery, and therefore the inner gable ends and sides must be fitted with U-type gable purlins in between the columns. All purlins must be mounted straight, parallel to the foundation.

Please be aware that inner gable-end columns are in between the glass gables, so that help steel can be attached for the screens, raining installation and lights without breaching the gable's sealing.

Type of purlin : U, open side down (twice)

Mounting height : the upper purlin at level of the upper beam of the truss

1.7.6.3 Screen installation mounting straps at gable ends columns

Screen installation mounting straps must be welded to each gable-end column at the level of the truss's upper and lower beam. Straps must have sufficient strength to accommodate a horizontal screen. In co-operation with the screen installation discipline, holes sizes, distances, and forces must be defined, as well as a provision (strengthened extension) to get through the “glass-side” of the gable:

- a. For a gable end corner column 2 pc straps
- b. For a gable end inner column 4 pc straps

1.7.6.4 Means of system suspension at gables

To make insertion of a system possible an extra means of mounting must be welded to each column at a height to be determined (between 100 and 150 mm below the lower truss beam).

Type and strength depends on what installations need these supports and must be calculated in the structural calculation according to ISSO. Supports in corners at the gable ends must be mounted at an angle of 45°. Supports at "glass-side" of a gable need a strengthened extension to get through:

- a. For a gable end corner column 1 pc support mounted diagonal;
- b. For a gable end inner column 1 pc support;
- c. System mounting beams and brackets according to the below required systems need to be engineered and approved by the consultant and the client in order to suspend the systems such as heating and cooling piping, high-pressure fogging and electrical cable gutters and growlights
- d. Corridor IPE 120 mounting beams for system transport lines above the central path every 4.00 m at a to be determined height in conjunction with the suppliers and installers of the systems.

1.7.7 Service rails & maintenance platform

The greenhouse structure must be adapted for a movable service & maintenance platform along axis 1, order to inspect, service and clean the greenhouse roof. In the present design and because of the small scale of the project, no automatic roof washer device is requested in this tender specification. However for future possibilities we require roof gutters to be able to carry a 500 kg roof-washer. For flawless operation of the machinery, no objects may protrude through roof or gable-end. Platform's parking position is at axis A-B1. All necessary provisions to be delivered and mounted, consisting of supports at each gutter-end, the foundation as well as both rails. Platform should include all necessary safety provisions incl. an extendable caged ladder, collapsible railings etc. and have all the necessary extras to facilitate a rented or later owned roof washer that can clean the roof from the platform.

1.8 Gable sides, gable ends, separations and expansions

1.8.1 General gables

Greenhouse outer-gable ends and -sides must be covered in polycarbonate, as shown on the drawings.

Please state with the offer type & dimensions of:

- Aluminium mounting bar;
- Aluminium gutter connection bar;
- Aluminium roof angle bar (to be fixed rigidly at the gutter);
- Aluminium foundation connection bar;
- Aluminium glazing bars covered on the outside with white HPVC.

Aluminium profiles to be fastened with stainless steel bolts and lock nuts. No clips or other types of fasteners allowed. All conduits through glass gables and sides between greenhouse's compartments, (pipes & cables, etc.), must be closed and sealed with rubber sleeves in PVC or polycarbonate sheets.

1.8.2 Inner separations

Inner separations as shown on the drawings. To minimize the separation's width and to have the inner steel columns available on 2 sides of the wall we require the aluminium between the columns. There are 2 high containment rooms, requiring extra attention because these must be completely air tight.

1.9 Roof construction 4.00 m Venlo

Part of the facility is designed for containment and quarantine trails. This has resulted in a greenhouse roof with 2 types of cladding with either a choice for tempered glass and laminated glass or tempered glass and polycarbonate.

Standard to be offered:

- De-ironized, tempered, 4 mm float-glass above the facility in axis field A1-E1-E12-A12;
- Laminated, 6 mm float-glass in axis field E1-H12, provided UV permeable laminating foil is used;

As an alternative to the laminated glass to be offered:

- Multiwall Polycarbonate 16 mm;

The roof system must be of such design that is leak- and condense-proof from the ridge up to and including the gutter, with an aluminium gutter, torsion free hollow aluminium glazing profiles, a lowered ridge profile and a thin vent sill. Vents profiles must have integrated profiles to accommodate pleated netting. All connections screwed with stainless steel lock nuts. The roof angle is between $>21^\circ$ and $<24^\circ$. Glazing profile's construction distance in the roof to be as big as allowed by the safety regulations and structural calculations under the ruling standard with the chosen roof cover package.

Required minimum distance is 4 x 1.000 mm sheets per 4,000 mm truss distance, over a gutter's length. The cover to be fitted with thermal insulating rubber on four sides on both sides. Distance between bars to have a pre-set SST screw & clamp fixation to ridge and gutter.

Please state with the offer:

- Type/size aluminium hollow glazing profiles;
- Type/size/material screwed glass covers over hollow glazing profiles;
- Type/size aluminium ridge profile (ridge must be insulated);
- Type/size/material screwed glass covers over ridge profile (ridge must be insulated);
- Type/size of all other necessary roof construction parts (e.g. storm protection);
- Any other necessary unmentioned part;
- Roof angle.

1.9.1 Storm protection

All profiles must have the same designed and approved attachments to the gutter and the ridge. The distance of the glazing profiles in the corners and gable ends must be smaller than the normal size, according to the latest issue of the EN 13.031-1.

1.9.2 Ventilation system

Below we describe the ventilation system inside the greenhouse rooms, and the system inside the corridors. Of both we describe the preferred system but alternatives are welcome, as long as they are described clearly, are described as an alternative, and can be calculated according to the EN 13.031-1 with the CASTA program and references can be provided and visited.

1.9.2.1 Ridge vents inside greenhouse rooms

Inside the rooms and corridor according to drawing K06 ridge ventilation window installations must open and close on the luff and lee sides separately until an angle of 50° . System brand preferably Lock or Ridder equivalent.

Please state with the offer:

- Window sizes : as shown in the drawing with depth approx. 1,000 to 1,250 mm
- Type of installation : rack & pinion at luff and lee side
- Motor brand / drive : Lock or Ridder / 3-phase; 0.4 to 0.6 kW
- Number of motors : 1 pc per roof vent

Calculations on window weights, torsion in the mechanism (as a motor choice base), to be provided.

Please state with the offer:

- Opening angle;
- Type, size, brand of drive-axle;
- Type, size, brand of tooth-rack & pinion;
- Type, size, brand of bearing plates;
- Type size motor.

1.9.2.2 Roof vents inside the head house

The 5 pcs 2x 1.000 = 2.000 mm windows must open and close by a so called swing-wing mechanism, being able to open at an angle of 50°. System brand preferably Lock or Ridder equivalent.

Please state with the offer:

- Window sizes : as shown in the drawing depth approx. 1,250 mm
- Amount of installations : 1 see drawing
- Type of installation : swing-wing
- Motor brand / drive : Lock or Ridder / 3-phase; 0.4 to 0.6 kW
- Number of motors : 1 pc per compartment (lee side) / 1 pc per compartment (lee side)

Calculations on window weights, torsion in the mechanism (as a motor choice base), to be provided.

Please state with the offer:

- Opening angle;
- Type, size, brand of swing-axle;
- Type, size, brand of drive-axle;
- Type, size, brand of tooth-rack & pinion;
- Type, size, brand of bearing plates;
- Type size motor.

Headhouse air-vents and outer gables are to be covered in 16 mm polycarbonate sheets. A structural calculation should prove that the snow load can be borne by the sheet laid in aluminium profiles. Channels have to taped according to manufacturer's recommendations. When sheets /panels are cut, the cutting edges have to be taped.

1.9.2.3 Roof vents inside visitors area

Inside the Visitors area 2x 1.000 = 2.000 mm windows must open and close on the luff and lee sides by a so called swing-wing mechanism, until an angle of 50°. System brand preferably Lock or Ridder.

Please state with the offer:

- Window sizes : as shown in the drawing depth approx. 1,250 mm
- Amount of installations : 1 see drawing
- Type of installation : swing-wing
- Motor brand / drive : Lock or Ridder / 3-phase; 0.4 to 0.6 kW
- Number of motors : 2 pc per compartment (lee side) / 1 pc per compartment

Calculations on window weights, torsion in the mechanism (as a motor choice base), to be provided.

Please state with the offer:

- Opening angle;
- Type, size, brand of swing-axle;
- Type, size, brand of drive-axle;
- Type, size, brand of tooth-rack & pinion;
- Type, size, brand of bearing plates;
- Type size motor.

Glass type : de-ironized tempered float glass that must comply with the applicable standards.

1.9.2.4 Motors

The ventilation motors must be mounted on galvanized steel motor plates and steel bridges, applied with emergency switches and sensors to keep track of how much the air vent is opened. All motors must be equipped with chain couplings at the connection with the drive shaft. All motors are three-phase.

Please state with the offer: brand, type, code and capacity. The vent's motor must have a feed-back pot-meter installed for computer control.

After before ordering the equipment, above specs must be checked for abnormalities / deviations, to investigate possible implications for the equipment and adjust or adapt the equipment accordingly.

1.9.3 Insect netting for roof with extended cleaning nozzle

All roof vents, must be equipped with integrated UV stabilised insect netting with a life expectancy of $\geq 1,000$ kly. The netting must have a pleated structure for increased airflow capacity, make Holland-Gaas / Ludvig Svensson or equal. Mesh size US 40 mesh with an opening of .165 inch or 400 μm .

Part of the delivery is a device to clean the netting by means of an extended shapeable beam on a 20 feet hose with a special nozzle for high pressure water cleaning that can be mounted on a standard available high pressure water cleaning system. The beam includes a pressure regulating valve. Make Holland-Gaas / Kärcher or equal. Link: <http://www.hollandgaas.nl/746/Cleaning>

1.10 Rain and condense water discharge

1.10.1 Gutters

Discharge gutters according to the offered brand / system, with a preference for extruded aluminium, double or triple chambered, watertight, vertically slim gutters that incorporate a lowered dirt collection gully on the outside. Preferably Alcoa or BOAL, Excellent or technically equivalent.

The gutter must be able to fully separate the rainwater outside from the condense water inside.

Besides the construction characteristics, the gutters must have more main functions:

1. Rainwater discharge; the roof-gutter connection system must be absolutely completely sealed;
2. Condense water collection from the roof's inner side to be led into the gutter's lower section;
3. Support a 100 kg person inspecting the gutter;
4. Support a 500 kg roof washer (on 2 gutters 4 wheels, wheelbase 1,30 m).
5. Contamination prevention between compartments (close off all connections or split vertical in two).

State: brand / type / code / references / means of protection of contamination

Gutters at gable sides must have an extra strip to avoid flooding to the side.

Any alternative gutter systems offered will have to have been built earlier and have references.

1.10.2 Rain water discharges

The rain water drains from the highest point of the gutter to the lower gable end side, the drainage from the roof must be such that the roof gutter connection is entirely sealed and that the drainage system is calculated to the applicable local standard.

The whole PVC piping in the ground to be executed. The detail engineering of layout and pipe diameters is an integral part of the work of the greenhouse contractor, who is responsible for a correct working rainwater discharge system. The collection tanks 3 pcs are next to the greenhouse at location A1 -A4. The rainwater must be lead into the tanks and an installation is required to keep the piping empty after rain (by a floater operated submersible pump).

The water discharge from the roof must have a separate discharge of rain- and condense water.

The rain water discharge from the gutter must be located outside the gable ends. The connection from the gutter must be Ø 125 mm, with a white PVC pipe and must run to a sub soil rainwater collection system, also designed to the local regulations & standard. All PVC within the delivery scope of the contractor has to be KOMO 41 / SN 4. See drawing the foundation / ground plan.

1.10.3 Condensate discharge

1.10.3.1 General

Condensation water must be discharged per greenhouse room, to a siphoned drain in the concrete floor. The concrete floor drains will collect to a drain pit. The delivery of the floor drains, the underground PVC piping, and the pits is integral part in this scope, and the work of the contractor.

1.10.3.2 Radioisotope greenhouse & Pathology greenhouse

Condensation water must be discharged per greenhouse chamber into a wheeled vessel below table level. The concrete floor drains will only have a collection pit with a same sized bucket for easy discharge to the wheeled vessel. The delivery of the floor drains, the PVC piping, and the pits is integral part in this scope, and the work of the contractor.

1.11 Roof and gable coverings

1.11.1 Summary

| | § 1.12.2 | § 1.12.3 | § 1.12.4 & 1.13.2 | § 1.13.1 & 1.13.3 |
|---------------------|---|--|---|-------------------------------|
| | ≥ 6 mm de-ironised, tempered, UV-permeable, laminated glass | 4 mm, de-ironised, tempered float-glass | 16 mm Makrolon polycarbonate stegdoppel-sheets | PIR/PUR sandwich panelling |
| GH roof containment | standard | | alternative 2099 | |
| GH roof | | standard | alternative 2099 | |
| GH separations | | standard | | 40 mm lowest 0.8 m |
| GH perimeter | | | clear 2099 | |
| HH vents | | | white 1146 | |
| HH-GH separation | | | | 40 mm |
| HH perimeter | | | | 60 mm |
| HH separations | | | | 40 mm |
| HH roof | | | | 60 mm |

1.11.2 Standard roof cover

1.11.2.1 De-ironized tempered 4 mm glass

Glass must comply with the applicable local standards, but also especially produced for greenhouses (comparable with standards EN 572 and NEN 2675 of the Dutch greenhouse glass standards). All sheets to be of one single production lot. Sheets must be factory cut to size “dimensionally stable” at a “system design size tolerance” of 0.10 mm. Minimum required glass specification:

| | | |
|----------------------------|---|------------------------------|
| Type | : | de-ironized, tempered, float |
| Thickness | : | 4 mm |
| Direct light transmittance | : | 90%+ |
| Hemispheric transmittance | : | 84%+ |

The greenhouse rooms are used for trials that require quarantine and containment by law and in order to guarantee room integrity with hail storms the roof glass must be laminated.

1.11.2.2 Laminated glass package ≥ 6 mm

Same glass quality as the 4 mm glass, but laminating foil must be UV permeable. Package for instance:

- Inside / below 3.0 mm de-ironized tempered float-glass;
- In between 0.4 to 0.6 mm UV-permeable foil for laminating;
- Outside / on top 2.8 mm de-ironized float-glass;

Laminated glass transmission specs is uncharted territory but we aim for a light transmittance of ≥ 87 %

1.11.3 Alternative roof cover with polycarbonate sheets

Roof to be covered in 16 mm polycarbonate sheets brand Makrolon or similar multi UV 2/16-30, no drop, clear 2099, CTC 1,000 mm or an equivalent alternative brand. Channels must be taped according to manufacturer's recommendations. When panels are cut, the cutting edge to be taped as well. Fire rating (2) Europe clear 2099 B-s1-d0 (EN 13501-1). Light transmittance 80 %. Energy transmission 70 %. To be glazed in alu profiles, secured with clips covered with a HDPE white strip at all sides of each sheet.

1.11.4 Gable claddings greenhouse perimeter

Outer gables to be covered in 16 mm polycarbonate sheets:

- lower part up to first purlin brand Makrolon, colour white, LTA 0%, multi UV 3/16-??, no drop, opal / grey 691, standard width 980 mm or a worthy alternative;
- Upper part from first purlin brand Makrolon colour transparent LTA 75%, multi UV 3/16-??, no drop, standard width 980 mm or a worthy alternative;

Channels must be taped according to manufacturer's recommendations. When panels are cut, the cutting edge to be taped as well. Fire rating (2) Europe B-s1-d0 (EN 13501-1). Light transmittance 74 %. Energy transmission 70 %. Outer gables glazed in alu profiles, secured with clips covered with a HDPE white strip at all sides of each sheet.

1.11.4.1 Active ventilation units through gable-end

Multiple active ventilation & cooling units are to penetrate the gable-end, in order to feed the conditioned air hose sleeves suspended under the benches, as shown in the drawing. It is part of this specification that contractor is aware of this and the walls are pre-engineered in a way that these units can be placed.

1.11.5 Inner gable separations

Inner separations between the greenhouse compartments, as well as the corridor's gables must be glazed with the same de-ironized clear tempered glass, but the lower 0.8 m is sandwich panelling, or alternative with 16 mm non transparent polycarbonate sheets. At inner separations between rooms sandwich panelling up to 0.8 m high as a "knee-wall". Requirement is flat 40 mm width, painted steel plates, foam PIR = polyisocyanurate in between. Make Hoesch, Kingspan, SAB or an alternative equivalent, in the required relief, colour, strength and fire-resistance. All applied according to the manufacturer's directions for use. Colours standard white RAL9010.

1.11.5.1 Dimensions and transportation handling

Glass sheets must be of one single production lot and must be factory cut to size "dimensionally stable" at a "system design size tolerance" of 0.10 mm. Non-tempered "cut" glass is allowed for the top sheets in the sides and the gable-end. Glass thickness between 6.00-6.40 mm. Width and length tolerance according to EU code is +/- 1.00 mm. The square-ness tolerance is defined as the difference in length between the two diagonals ≤ 1.00 mm. Surface tolerance is defined as "pane must be completely straight" (optical waving non-existent). An optical wave is a sign that the glass is dangerous to handle. Cutting line must be edged and completely straight. Packing must be in wooden crates, for easy transportation from the factory to the storage of the glass, from the storage to exact location inside the greenhouse. The storage must be dry, to nullify the chance on weathering.

1.11.5.2 Glazing

Glazing profile's construction distance in the roof to be as big as allowed by the safety regulations and structural calculations under the ruling standard with the laminated tempered de-ironized glass package. Required minimum distance is 4 x 1.000 mm sheets per 4,000 mm column distance, over a gutter's length. The glass to be fitted with thermal insulating rubber on four sides on both sides. Distance between bars to have a pre-set SST screw & clamp fixation to ridge and gutter.

Glazing of the roof must be done by an experienced crew. The glass to be fitted with thermal insulating rubber on four sides on both sides. Distance between bars to have a pre-set SST screw & clamp fixation to ridge and gutter. The glazing must be executed according to the standards and manufacturer's instructions. Roof glass sheets must be placed on neoprene strips into the aluminium gutter edge. Contractor is held fully responsible for the quality of the glazing and must glaze with a glazing machine.

1.12 Head house covering

1.12.1 'Knik-dek' on head-house

Head-house roof to be cladded with a Venlo style integrated sandwich panelling 'knik-dek' system that fits the greenhouse steel-structure base and gutters. Requirement is flat insulated 60 mm sandwich panels (if 60mm is insufficient to comply with the local building code, it must be thicker), $R_c = 2.5 \text{ m}^2 \cdot \text{K/W}$, painted steel plates on both sides, and foam choice PIR or PUR depends on building fire requirement.

The roof to be mounted with identical height and roof angle as the adjacent greenhouse.

Make Hoesch, Kingspan, SAB or an alternative equivalent, in the required relief, colour, strength, thermal insulation as well as fire-resistance. All applied according to state of the art manufacturer's directions for use, and drawing. Panel colours RAL7016 dark-grey outside. Panel colour inside must be the respective standard white (RAL9010). Chosen colours must be approved by client before ordering.



1.12.2 Headhouse air-vents

Headhouse air-vents and outer gables to be covered in 16 mm polycarbonate sheets brand Makrolon® multi UV 3/16-16, no drop, white 1146. A structural calculation should prove that the snow load can be borne by the sheet laid in aluminium profiles. Channels have to be taped according to manufacturer's recommendations. When sheets / panels are cut, the cutting edges have to be taped.

Fire rating (2) Europe white 1146 B-s1-d0 (EN 13501-1).

1.12.3 Gable claddings head-house and tech rooms

Gable cladded with flat insulated sandwich panelling fitting the greenhouse steel-structure base towards the gutters. Outside wall requirement is 60 mm thick, with $R_c = 2.5 \text{ m}^2 \cdot \text{K/W}$, internal wall may be 40 mm panels. Between both panel sides foam choice PIR or PUR depends on building fire requirement.

Make Hoesch, Kingspan, SAB or an alternative equivalent, in the required relief, colour, strength, thermal insulation as well as fire-resistance. All applied according to state of the art manufacturer's directions for use, and drawing. Panel colours RAL7016 dark-grey outside. Panel colour inside must be the respective standard white (RAL9010). Chosen colours must be approved by client before ordering.

1.13 Doors & Ante-rooms

1.13.1 Anterooms

For this project there are 2 anterooms:

- Insect netting anteroom GH-0-01 SWMCL, width x depth x height = 2,200 x 1,000 x 2,600 mm;
- Glass & alum anteroom GH-0-09, width x depth x height = 4,000 x 3,000 x 2,600 mm;
- Air lock, glass & alum GH-0-06, width x depth x height = 4,000 x 4,000 x 2,600 mm.

1.13.2 Doors

All greenhouse doors must be supplied and mounted according to drawing. On the drawing, amount, types, sizes, materials, colour / transparency, access limitation, burglary-resistance can be recognized.

Doors must be delivered with various sized window sections. Windows and doors should not be placed in front of a part of the steel construction (bracings). Doors must be made according to the applicable regulations, requirement and technical information of the particular suppliers.

| | |
|--------------------|---|
| Lock | : for a cylinder lock system to client's requirement (DOM, ASSA, equivalent) |
| Hardware | : door handles at both sides, doorknob at the inside and a key at the outside |
| Door window | : tempered clear glass, or polycarbonate |
| Draught-brush | : Mennoclean resistant |
| Draught-brush side | : long-hole for adjustment to wear |

Automatic doors must have a release for manual control, so in case of power failure the doors can be opened manually. Automatic doors must have an adequate means of crash protection with either a pneumatic gasket at the closing edge or a light cell and reflectors against objects left in the doorway.

Doors in evacuation routes must open in the direction of the evacuation-route and should be equipped with exit panic devices. Doors with exit panic devices function so that the latch bolt and the dead bolts always unlock by operating the door handle or the horizontal push bar from the inside. The opening direction must be in line with the evacuation routes and should follow local fire regulations. They must be adequately indicated in the detailed engineering package and reconfirmed by the client.

The necessary devices for a "safe door" shall be designed (cable transition door frame to door leave, magnetic contacts, empty piping in the door frame in accordance with the specifications of the contractor safety technology).

1.13.3 Fireproof Doors

The two doors (internal and external) of the ovenroom (built by a local contractor) shall be supplied and mounted according to 1.13.2, but with a fire resistance class EI₂₃₀-C.

1.13.4 Access controlled Doors

The doors marked with access control shall be equipped with a lock system enabling the G4S campus standard electronic access control system.

1.14 Exhaust Air Ovens

Two EI90 fireproof exhaust air pipes to be installed for the two ovens in the oven room and 100cm above the roof including sealing of the roof penetration.

2. TECHNICAL SPECIFICATION SHADING INSTALLATION

2.1 Regulations and requirements

The quality of the materials used must be according to the US standards as well as the hereafter following DIN-EU equivalents of the following standards:

| | |
|--|-------------------|
| Hot dipped galvanized coatings on fabricated iron and steel articles | : DIN EN ISO 1461 |
| Sherardizing – Zinc diffusion coatings on ferrous products | : DIN EN 13811 |
| Fasteners – Electroplated coatings | : DIN-EN 4042 |
| Thermoplastic preformed gaskets used in buildings | : DIN-ISO 3934 |
| Stainless steel | : DIN-EU 88 |

2.2 Electricity and connections

Electricity from the grid comes in three-phase with neutral conductor and PE (protective earth). Single-phase voltage 230 V, three-phase voltage 400 V and frequency 50 Hz. Motors to be IP67 rated and designed for use in 60 °C ambient conditions with 98% RH. The installation must comply with the country's ruling standards, regulations & requirements, and the power company's directions. After contracting, before sourcing equipment, the above must be checked for abnormalities, to investigate possible implications for the equipment and adjust / adapt the equipment accordingly.

2.3 Horizontal installations

2.3.1 General

2.3.1.1 Driving force

For movement of the installations driving units of the brand Lock or Ridder must be mounted in a torque free position. Motors must be shored to the greenhouse construction rigidly by means of a mounting plate. The amount of motors must be chosen according to the manufacturer's design specs.

Motors to be supplied with built-in end-switches, emergency switch-off, and a means of synchronizing movement of installations. The needed time for opening / closing an installation to be stated in the offer.

2.3.1.2 Transmission

Transmission of motion over the width of a compartment from a motor into horizontal movement of the screen, first through the drive axle by means of cross- or chain couplings, mounted in a stress free position. The drive axle must be hot dipped galvanized steel and should be sized/chosen according to calculated design specifications. The drive axle should be supported at regular intervals, by means of a bearing plate which incorporates dustproof bearings. Axle to be mounted under the screen installation and shored to the construction by means of stainless steel wire.

Transmission motion over the length of a compartment from the drive shaft to the aluminium screen closing-profile is done either by means of a push-pull shaft driven by the drive axle by means of a tooth rack & pinion or a semi wire, or a full wire system without a push-pull shaft. The expansion and contraction difference of a roof gutter's on top of a compartment to be shaded determines the how wide a split becomes at the outer edges of a shading screen, and thus indirectly determines per brand/make

which type of transmission is used. Flawless closing against the trusses despite occurring splits in the longer compartments must be overcome with the various “slip systems” available in the market. Strength of an aluminium screen closing-profile must be in line with the amount of transmissions chosen in the width of a bay for even and parallel closing against a truss.

Pull-wires to be wound around a drive-axle as many times as necessary for sufficient friction and to be applied with the same pre-stress amount of kg inn weight. Tie-knots of any wiring to be enveloped as protection against damaging the screens. Transmission at the sides to be applied with adjustable mechanical delays in order to realise an even & compact shading package over the width when open.

2.3.1.3 Purlins

In order to suspend wires at the gable end a profile must be chosen, mounted and integrated into the gable end construction, so that in the end the closed shading installation will not leak any air at the sides. Draught wires have to be attached by means of screw eyes or a comparable means of attachment.

2.3.1.4 Suspension wires & draught wires

For supporting the screen, nylon-wires (or equivalent) must be tightened to the shading purlins. These wires should be supported by means of stainless steel clips to the greenhouse truss. Support wires at 0,40 m distances under the screen, draught wires to be mounted at 0,80 m distances over the screen.

2.3.1.5 Closing profile

The shading installation must be supplied with an aluminium closing profile which is provided with a soft black or transparent closure strap. The make of it should be "HV-hollow clip profile in thin shape", provided with stainless steel wire leaders. The profiles must be mounted in such a way that shrinking and expansion has no influence on the operation of the installations.

Closing profiles should only be applied in standard lengths plus the shortage in one piece. The maximum distance between a connection of two closing profiles and a pull wire attachment is 40 cm.

For the pull wire attachment to the profile, a “slip system” should be offered as an alternative.

2.3.1.6 Screen's sealing energy tight

The screen installation, there where it runs along a gable or screen side, has to be sealed energy tight on the under-side of the screen. This U-formed sealing should be executed with of LS-10-ultra or any stated alternative. The seal must be executed by means of fixing the material to the gable, or fixing it to a wire (made for the purpose). This sealing-U must be starting at 5 cm under the screen, 6 cm wide at the lower side and with a depth corresponding with length of the hanging screen part (at least to the truss-beam). Staples used for fixing must be SST. Hooking staples to a moving screen to be prevented.

2.3.1.7 Mounting the screen cloth

The horizontal screens should be fixed by stainless steel clips to the closing profile every 40cm. At the other end the screen must be fixed to the truss by stainless steel truss clamps. After mounting the screen material it should be left for at least 24 hours before fixing it to the installation to minimise the risk of shrinking. On the sides of the installation the material has to be fixed by screen hooks to the side hang wire, which is provided with a plastic mantle. The percentage of hanging over the sides, must be calculated with the manufacturer's expected shrinking of the screen so that blowing up by draught or curling up of the sides cannot occur. If necessary weights should be applied to the sides.

2.3.1.8 Screen clamps

Sufficient clamps and pincers to be calculated for screen damage prevention when blown upwards.

2.3.2 Horizontal installations with shading screens

| | |
|-------------------------------|--|
| Required type of installation | : pull-wire system |
| Mounted in compartment | : all compartments, corridor and visitors, 10 in all |
| Surface installation | : see drawing in all mentioned greenhouse compartments |
| Drive | : system dependent, preferably “slip-skid-wire-operated” |
| Motor per installation | : 1 per compartment, 10 in all |
| Direction closing | : trellis' to trellis |
| To be mounted on | : truss' upper beam |
| Screen type | : Harmony 3647 FR |

2.3.3 Horizontal installations with black-out screens

| | |
|-------------------------------|--|
| Required type of installation | : pull-wire system |
| Mounted in compartment | : G0-01, 0-02, 0-03, 0-04, 0-05, 0-08, 0-010, 0-011 |
| Surface installation | : see drawing in all mentioned greenhouse compartments |
| Drive | : system dependent, preferably “slip-skid-wire-operated” |
| Motors per installation | : 1 per compartment, 8 in all |
| Direction closing | : trellis' to trellis |
| To be mounted on | : truss' lower beam |
| Screen type | : OBSCURA 9950 FR W |

2.4 Gable screens

2.4.1 Roll gable screens in gable end and side

In the perimeter gable ends and sides, rolling screens (see drawing) have to be installed between the purlins from purlin to purlin etc. until foundation level, in each field separate installations with a tube motor unit. In closed position they have to close energy tight to the purlins and to the sides behind the column or with a closing profile. The remaining gap at the sides may only be as wide as the 100°C expansion – contraction difference of aluminium tube minus 2 x 50 mm & construction width needed for installing tube-motor. Greenhouse contractor must adjust the position of the purlins entirely straight. The whole outside gable installation should be operated room by room.

Twin-roll gables to be delivered in the compartments where Black-Out screens are necessary, these are locations where inside gable the gable the room is not available, or where a second gable screen is needed (shading and black-out), or where it is used as a temporary separation.

Driving force of these types installations must be an CE listed tube motor make Ridder, Lock or Somfy or an alternative equivalent. Motors to be applied with an electronic device to prevent a “brown-out”. 4-cored cables of sufficient length right to the connection point per motor. Per motor to be delivered, low-voltage-current switch-relays for the opened and closed position including the synthetic connection housings. All groups per group to be interconnected in UV and splash-water (electrical parts) resistant housings. Motors to be connected through a maintenance-work power-switch. To prevent wear, apply cable-leading-chains with all cables moving with the motor.

All cable connecting for the high power and low steering voltages to be UV and splash-water (electrical parts) resistant, connections to be brought together per steering group at first purlin's height so that the electrical as well as climate contractor can connect power and steering groups without problem.

All not described necessary extras must be included in the offer; Delivery in working order!

2.5 Alternative systems

If the contractor feels he has a better system than the one described, he is free to present in his offer as an alternative with the price implication.

2.6 Construction drawings

Drawings of the structure, details, and all other drawings needed for maintenance, should be handed in at 1 month after acquiring of the order. If changes were made while building, revised drawings should be given to the principal at delivery.

3. SPECIFICATION HEATING INSTALLATION

3.1 Regulations and requirement

The heating installation to be carried out according to Austrian regulations standards and acts by law.

All relevant EU directives (and their Austrian equivalents), CE markings, certifications, standards legally in force in Austria at the time of tendering for described installations are valid and must be complied to.

3.1.1 Execution

- The "burning in" of welding sparks in gables is not tolerated; gable sheets must be changed;
- Vertical pipes perpendicular, horizontal pipes horizontal or to a slope if necessary;
- All mounting material (bolts & nuts included) have to be hot dipped galvanized;
- Pump & valves to be applied with bolted flanges to accommodate revision activities;
- The installation includes delivery and mounting of described electro- & servomotors;
- For the electrical connections see chapter on electrical installation;
- The tubes must be mounted straight, so that they can expand & contract freely;
- All mounting & support material must be of sufficient strength;
- The contractor should check the actual slope of the construction before starting the work;
- When mixing groups are used with screwed connections, then one should use butterfly nuts;
- The installation is including delivery and mounting of the described electro motors, servo motors, but exclusive their electrical connections and switch panels;
- If any cooling- or transport lines run through walls or gables, the holes should be made sufficiently "oversized" to let the line expand and contract freely. After insulating, the hole should be closed off in a sufficient manner. If a line runs through a fire wall, all necessary measures should be taken in order to maintain the ability of the wall to contain the fire.

3.1.2 Sufficiency of tender

Contractor must convince himself that the tender is correct and sufficient and that he will do all necessary for the proper execution and completion of the work and the solving of any defects therein. Meaning that in practice contractor conforms himself to the design and he fulfils all his obligations under the contract.

3.1.3 Electricity and connections

The electricity from the grid supplies three-phases, 0 and earth. Single phase 230 V; three phase voltage 400 V, and a frequency of 50Hz. The complete installation must be carried out according to the CE standard regulations and Austrian equivalent/adaptations.

After contracting, before ordering the equipment, the above specifications should be checked for abnormalities/deviations, to investigate possible implications for the equipment and adjust/adapt the equipment accordingly.

3.1.4 Testing, adjusting and final delivery

The heating installation must be tested and 'fine-tuned' according to the requirement of inside and outside climate conditions, ideally when they occur (often not possible). The installation must be adjusted further within the defects liability period mentioned in the tender specification, or when climate conditions prevented from doing so in the first place at the time of delivery.

3.2 Heating design data

Design is based on following climate data:

| | |
|----------------------|--|
| U-factor glazing | : 5.8 W/m ² .K |
| U-factor side wall | : 5.8 W/m ² .K |
| Ventilation | : 0.2 1/h |
| Room volume | : 5.5 m ³ /m ² |
| Outside temperature | : -14 °C (DIN Norm Aussentemperatur) |
| Greenhouse peak-load | : -20 °C / +16 °C, with energy-screen closed |
| Heating demand | : 150 W/m ² |
| Outside walls | : 35% |
| Normal operation | : 280 kW + 10% added = 300 kW |
| Extension | : + 50% |
| Heat-capacity | : 300 kW (first stage) |
| Pipe-heating | : 450 kW |
| Flow / return | : 90 °C / 70 °C |

3.3 Hot water circuit

3.3.1 Hot water connection

The hot water connection for the heating installation will be installed in the technical room. The greenhouse heating system will have to be separated from the hot water supply by a heat exchanger.

3.3.2 Heat exchanger

| | |
|------------------------|---|
| Capacity | : 450 kW |
| No of heat exchangers | : 1 pc |
| Supply temperatures | : 90 / 70 °C |
| Primary water pressure | : up to |
| Primary flow | : 20 m ³ /h |
| Secondary temperatures | : 85 / 70 °C |
| Secondary flow | : 25 m ³ /hr |
| Water pressure | : up to 3 Bar |
| Testing code | : 10 Bar / 120 °C (According to the European pressure vessel directive PED) |
| Valves: | : 4x DN 80 mm |
| Motor valve | : 1x DN 80 mm |
| Filter | : 1 pc screen filter DN 80 mm |

3.3.3 Heat exchanger pump

Each water chiller must be provided with an individual pump unit, to install in the technical room:

| | |
|--------------------|--|
| Code | : HP1 & HP2 |
| Main lines | : Ø 95 mm; 2x Ø 76 mm |
| Pump Valves | : 4 pc. DN 65 mm |
| Pump | : approx. 2x 15 m ³ /h with VFD drive |
| Power | : 2x ± kW |
| Frequency inverter | : 2 pc |

Non-return valve : 2 pc
 Safety valve : 1 pc
 Filling and drain valve : 1 pc

3.3.4 Pressure expansion system

1 pc : compressor expansion automat
 Expansion vessel : 1 pc, approx. 800 ltr.
 Dimensions : Ø 800 x 1800 mm
 System setup : air compressor with butyl-rubber membrane
 Pressure control : within 0.2 Bar
 Control panel : included
 Vessel code : Produced in accordance with the Pressure Equipment Directive 2014/68/EU
 Machine code : and the Machinery Directive 2006/42/EC
 Alarms : pressure alarm (min / max)
 Safety valve : 1 pc
 Filling and drain valve : 1 pc

3.3.5 Heating manifold with mixing groups

The hot water supply piping must be connected to the heating manifold. On the manifold the mixing groups will be installed. The mixing groups have to be carried out with valves, 3 way mixing valves with servomotor and manual operating device. The mixing groups must be provided with drain- and filling valves, air vents, thermometers, welding socks for temperature controllers.

Heating manifold : Ø 160 mm
 Type : floor standing
 Safety valve : 1 pc
 Filling and drain valve : 1 pc

Mixing groups :

| Mixing groups | AHU 1 | AHU 2 | GH AHU | Head house | GH top heating |
|------------------|----------------|----------------|----------------|----------------|----------------|
| Code | MG 1 | MG 2 | MG 3 | MG 4 | MG 5 |
| Rooms GH 0-0- | 08 | 10 | 1 – 5 + 11 +13 | 18 - 20 | 1 - 12 |
| Peak flow demand | ≥ 50 °C | ≥ 50 °C | ≥ 40 °C | ≥ 80 °C | ≥ 85 °C |
| Return temp | 40 °C | 40 °C | 30 °C | 65 °C | 70 °C |
| Main line | Ø 45 mm | Ø 51 mm | Ø 70 mm | Ø 45 mm | Ø 76 mm |
| Main valves | 40 mm | 50 mm | 65 mm | 40 mm | 65 mm |
| Emergency valve | 40 mm | 50 mm | 65 mm | 40 mm | 65 mm |
| Mixing group | | | | | |
| Code | MV 1 | MV 2 | MV 3 | MV 4 | MV 5 |
| Size | DN 40 mm | DN 50 mm | DN 65 mm | DN 40 mm | DN 65 mm |
| Circulation pump | 1 pc. pump | 1 pc. pump | 2 pc. pump | 1 pc. pump | 2 pc. pump |
| Code | CP 1 | CP 2 | CP 3 | CP 4 | CP 5a & CP 5b |
| Capacity | 2 m³/h | 4 m³/h | 5 - 16 m³/h | 2 m³/h | 5 - 16 m³/h |
| Delivery head | 3.5mWK (35kPa) | 3.5mWK (35kPa) | 5.5mWK (55kPa) | 3.5mWK (35kPa) | 5.5mWK (55kPa) |
| Frequency inv. | -- | -- | 1 pc. | -- | 1 pc. |
| Nominal power | 0.6 kWe | 0.8 kWe | 2x 1 kWe | 0.6 kWe | 2x 1.5 kWe |

Material specification**Mixing valves**

- valve type : plug type
- servo motor : 24 V
- make : Honeywell V5015 or similar

Butterfly valves : Tyco / Econosto

Circulation pumps

- pump type : in-line pump with dry motor
- RPM : 1450 rpm
- voltage : 3-phase 400 V
- make : Grundfoss / Johnson control

3.4 Mixing groups greenhouse heating

The hot water is distributed to the greenhouse sections by a transport line. For all the heated zones a mixing group will have to be installed. The mixing groups have to be carried out with valves, 3 way mixing valves with servomotor and manual operating device. The mixing groups must be provided with drain- and filling valves, air vents, thermometers, welding socks for temperature controllers. The heating connection of the greenhouse AHU consists of a motorised 2-way valve without a pump.

| Description Mixing groups | Top heating Type 1 | Top heating type 2 | Valves GH AHU |
|---------------------------------------|-------------------------------|---|---|
| Code | MG5.2/5.5/5.8 | MG5.1/3/4/10/11/12 | V3.1/2/3/4/5/11/13 |
| | 64 - 96 m ² | 144 m ² | 96 – 144 m ² |
| Greenhouse rooms | GH-0-02 GH-0-05 GH-0-08 | GH-0-01 GH-0-03 GH-0-04 GH-0-10 GH-0-11 GH-0-12 + 13 | GH-0-01 GH-0-02 GH-0-03 GH-0-04 GH-0-05 GH-0-11 GH-0-13 |
| Flow temperature (min) Peak demand | 85 °C | 85 °C | 40 °C |
| Return temperature | 70 °C | 70 °C | 30 °C |
| Main line | Ø 32 mm | Ø 38 mm | Ø 38 mm |
| Main valves | 32 mm | 40 mm | 40 mm |
| Mixing group | | | |
| Code | MV | MV | V |
| Size | DN 40 mm | DN 40 mm | DN 40 mm |
| Circulation pump | 1 pc. pump | 1 pc. pump | |
| Code | CP | CP | |
| Capacity | 1.1 m ³ /h | 2 m ³ /h | |
| Delivery head | 3.2 mWK (32 kPa) | 3.2 mWK (32 kPa) | |
| Nominal power | 2x 1.5 kWe | 2x 1.5 kWe | |

3.4.1 Greenhouse heating

The heating system to be carried out with a top heating system as shown in the drawings. The heating system must be finished with air release valves, filling and draining cocks etc. All the mounting material must be hot dipped galvanized.

3.4.2 Top-heating

The top heating to be carried out with hot water heating tubes, mounted on the steel structure of the greenhouse with pipe hooks.

Heating system per bay of 4m:

| | |
|------------------------------|-------------------------|
| Top heating: | 6 heating tubes Ø 51 mm |
| Pipe hooks | monorail type |
| Distribution lines | at end walls |
| Max. Flow/return temperature | 90 – 70 °C (maximum) |

3.4.3 Gable heating

At all the outside walls of the greenhouse to install 6 pipes Ø 51 mm x 2,25 m for heating the gable. Pipes to be connected to the top heating system with valves for regulating the capacity, and rubber tubes to compensate for expansion differences.

The heating pipes to be installed through the holes in the side wall columns!

3.4.4 Consoles

For the mounting of the distribution lines at the gable-end, consoles are available (see greenhouse description) The distribution lines have to be mounted with rings & chains.

3.4.5 Other installation details

For the course and diameters of the heating lines, please see the relevant drawings and drawing details. The whole installation must be finished with the necessary air cocks, drain taps, etc.

3.5 Head-house

3.5.1 General

For the heating of the head house a hot water heating has to be delivered and installed.

3.5.2 Fan coil air heater

The air heater has to be connected to the main transport line with a motor valve in the hot water line connection.

Specification:

| | |
|---------------------|--|
| Room size | : 260 m ² |
| Room volume | : 1600 m ³ |
| Capacity | : 15 kW |
| Room temperature | : +18 °C |
| Water temperatures: | : 80 – 60 °C |
| Fan capacity | : 2000 / 1000 m ³ /hr (2 speed) |
| Control box: | : 2-speed |
| Thermostat | : controlled by climate computer |

Motor valve : 240 V (valves opens when fan in operation)

3.5.3 Radiator heating work rooms

In the following rooms a radiator heating system has to be delivered and installed, connected to the transport line of the headhouse heating installation. The radiator has to be provided with a thermostatic valve, isolation valves, vents, etc. In the main connection a strainer has to be installed.

| | | |
|---------|----------------|----------------------|
| GH-0-14 | Technical room | 1 pc radiator 2000 W |
| GH-0-15 | Control room | 1 pc radiator 1000 W |
| GH-0-17 | Growth chamber | 1 pc radiator 2000 W |
| GH-0-19 | Oven room | 1 pc radiator 2000 W |
| GH-0-20 | Potting room | 2 pc radiator 2000 W |

3.6 Insulation activities

The transport lines (those after the mixing groups, and above soil) to be insulated with 30 mm Rockwool, and covered with a 0.6 mm smooth aluminium sheet.

3.6.1 Technical room

- 1 hot water connection
- flow and return line;
- distributor with mixing groups.

3.6.2 Main transport

The transport lines must be insulated from the technical room to the end of the main corridor.

- 2x 60 m Ø 76 - 50 mm (top heating)
- 2x 60 m Ø 70 - 50 mm (AHU heating)

3.6.3 Mixing groups

Insulation of the mixing groups on the transport line. Complete mixing group up to the pump valves. Insulation with 30 mm Rockwool, covered by a smooth aluminium sheet.

- 9 mixing groups.

3.7 Painting activities

All metal pipes must be cleaned and painted in red primer before insulation.

After installing, cleaning & priming the welded connections, the pipes must be painted in white, heat resistant paint. The to be insulated parts of the installation must not be painted white. All cleaning- and painting materials must be included in the price.

3.8 Filling of the installation and water treatment

The filling and putting under pressure of the total installation must be executed by the contractor.

A water treatment unit (a softener) will be installed by another party. Contractor is responsible for the quality of the water with which the installation is filled. Contractor must analyse the selected water before it is used, and treat it if necessary (pH, iron, chalk, etc.). Analysis and treatment must be presented to the principal for approval.

3.9 Materials

All tools needed for installing the installation as well as parts like flanges, small tubes, rubber tubes, air vents, drain cocks, thermometers, sockets etc., valves, pumps, mixing valves, insulation material must be delivered by the tenderer.

3.10 Defects Liability Period

The defects liability period is 12 months from the date of successful completion of the job.

3.11 Instruction / maintenance

The installation supplier shall give an instruction- and a maintenance handbook in the English language after final delivery.

3.12 Spare parts installation

Below a description of spare parts to be delivered as a part of this contract volume. Not included in the list are materials which are normally taken in as extra for the installation of the project. The underneath mentioned spare parts must be presented after final delivery. A service set for the installation contains approximately 5% of the materials listed in the chapter regarding air vents, drain cocks, small valves, thermometers, sockets etc.;

3.13 Material make

All the to use materials shall be of reputed makes. In case of maintenance the equipment must be serviced locally, an exception can be for special parts not available locally. The makes The offered makes shall require approval of the principal.

3.14 Design, materials and workmanship

The successful tenderer shall assume full responsibility for co-ordination and adequate design. All materials and equipment shall be of the appropriate class well finished and of approved design and make. All ferrous parts including bolts & nuts etc. used must be hot dipped galvanized. Special attention shall be paid to the tropical treatment of the materials, as it will be subject to extremely severe exposure, to atmospheric moisture and to long period of high ambient temperature.

4. SPECIFICATION COOLING INSTALLATION

4.1 Regulations and requirement

The heating installation to be carried out according to Austrian regulations standards and acts by law.

All relevant EU directives (and their Austrian equivalents), CE markings, certifications, standards legally in force in Austria at the time of tendering for described installations are valid and must be complied to.

4.1.1 Execution

- The "burning in" of welding sparks in gables is not tolerated; gable sheets must be changed;
- Vertical pipes perpendicular, horizontal pipes horizontal or to a slope if necessary;
- All mounting material (bolts & nuts included) have to be hot dipped galvanized;
- Pump & valves to be applied with bolted flanges to accommodate revision activities;
- The installation includes delivery and mounting of described electro- & servomotors;
- For the electrical connections see chapter on electrical installation;
- The tubes must be mounted straight, so that they can expand & contract freely;
- All mounting & support material must be of sufficient strength;
- The contractor should check the actual slope of the construction before starting the work;
- When mixing groups are used with screwed connections, then one should use butterfly nuts;
- The installation is including delivery and mounting of the described electro motors, servo motors, but exclusive their electrical connections and switch panels;
- If any cooling- or transport lines run through walls or gables, the holes should be made sufficiently "oversized" to let the line expand and contract freely. After insulating, the hole should be closed off in a sufficient manner. If a line runs through a fire wall, all necessary measures should be taken in order to maintain the ability of the wall to contain the fire.

4.1.2 Sufficiency of tender

Contractor must convince himself that the tender is correct and sufficient and that he will do all necessary for the proper execution and completion of the work and the solving of any defects therein. Meaning that in practice contractor conforms himself to the design and he fulfils all his obligations under the contract.

4.1.3 Electricity and connections

The electricity from the grid supplies three-phases, 0 and earth. Single phase 230 V; three phase voltage 400 V, and a frequency of 50Hz. The complete installation must be carried out according to the CE standard regulations and German equivalent/adaptations.

After contracting, before ordering the equipment, the above specifications should be checked for abnormalities/deviations, to investigate possible implications for the equipment and adjust/adapt the equipment accordingly.

4.1.4 Testing, adjusting and final delivery

Air handling unit must be tested and 'fine-tuned' according to the demanded inside and outside climate conditions. The installation has to be adjusted further within the defects liability period mentioned in the specification, or when climate conditions prevent from doing so in the first place at time of delivery.

4.1.5 Connection, testing, operation, inspection

The contracted volume contains all concerning-, and including the costs of:

- testing of the equipment
- putting into operation
- inspections by the approving authorities.

4.2 Cooling design data

Design is based on following climate data:

| | |
|------------------------|---|
| U-factor glazing | : 5.8 W/m ² .K |
| U-factor side wall | : 2.8 W/m ² .K |
| Ventilation | : 6 – 10 1/h |
| Room volume | : 6 m ³ /m ² |
| Outside temperature | : 35 °C |
| Outside humidity | : 40% RH |
| Solar radiation | : 900 W/m ² |
| Shading screen | : 40% shading, 35% solar heat reduction |
| Greenhouse temperature | : 26 °C |
| Room humidity | : 60 – 80% RH |
| Fogging system | : 0.4 ltr/m ² /hr |
| Cooling demand | |
| Standard rooms | : 280 W/m ² |
| Containment rooms | : 600 W/m ² |
| Headhouse | : 60 W/m ² |
| Total cooling load | : 372 kW |

4.3 Water chiller

General description

In order to cool a part of the greenhouse complex, 2 pc. of air cooled chillers have to be delivered and installed. For reliability and maintenance reasons the water chiller has to be a double unit with twice 70% of the needed cooling power.

| | |
|---------------------|-----------------------------------|
| Type | : air-cooled water chiller |
| Location | : outside, next to the head house |
| Number | : 2 pc. |
| Cooling power | : 2x 260 kW |
| Max Air temperature | : 40 °C |
| Min temperature | : -20 °C |
| Electrical power | : 2x 80 kWe |
| Water temp. | : 12 / 6 °C |
| Sound pressure | : max. 65 dB(A) at 10 m |
| Make | : Carrier, Daikin or similar |

| | |
|------------------|--|
| Number | : 2 units |
| Refrigerant | : Ozon-friendly R410A or similar |
| Frost protection | : Electrical condenser heater |
| Steering | : Integrated controlling unit per cooling unit |
| Master-slave | : Master-slave operation with time equalisation and failure takeover |
| Control unit | : A steering and control unit with digital connection (Modbus) for remote control by the climate computer has to be delivered and installed. |

4.4 Chilled water circuit

4.4.1 Chiller Pump unit

Each water chiller must be provided with an individual pump unit, to install in the technical room:

| | |
|-------------------------|--|
| Main lines | : 2x Ø 95 mm |
| Mounting | : subsoil |
| Frost prevention | : electric heat cable between insulation and pipe for outside connection |
| Code | : CP1 & CP2 |
| Valves | : 3 pc. 80 mm |
| Pump | : approx. 30 m³/h |
| Mixing valve | : 1 pc DN 80 mm with servo motor 24 V |
| Non-return valve | : 1 pc |
| Safety valve | : 1 pc |
| Filling and drain valve | : 1 pc |
| Screen filter | : 1 pc |

4.4.2 Buffer tank

To lower the number of starts and stops of the water chiller and to smoothen operation, a buffer tank must be delivered and installed. The volume must be according to chiller manufacturer's specification.

| | |
|---------------|--------------------------------|
| Tank volume | : > 5 m³ |
| Type | : vertical |
| Size | : Ø 1.6 m |
| Height | : 2.9 m |
| Coating | : rust preventing primer |
| Insulation | : 20 mm closed cell insulation |
| Color | : PVC blue |
| Valves | : 2 pc DN 100 mm |
| Tank pressure | : max. 2 bar |

4.4.3 Pressure expansion system

| | |
|------------------|---|
| 1 pc | : compressor expansion automat |
| Expansion vessel | : 1 pc, approx. 800 ltr. |
| Dimensions | : Ø 800 x 1900 mm |
| System setup | : air compressor with butyl-rubber membran |
| Pressure control | : within 0.2 Bar |
| Control panel | : included |
| Vessel code | : Produced in accordance with the Pressure Equipment Directive 2014/68/EU |
| Machine code | : and the Machinery Directive 2006/42/EC |

Alarms : pressure alarm (min / max)
 Safety valve : 1 pc
 Filling and drain valve : 1 pc

4.4.4 Cooling manifold with mixing groups

The heat exchanger for cooling shall be connected to the cooling manifold. On the cooling manifold the mixing groups will be installed. The mixing groups have to be carried out with valves, 3 way mixing valves with servomotor and manual operating device. The mixing groups must be provided with drain- and filling valves, air vents, thermometers, welding socks for temperature controllers.

Cooling manifold : Ø 200 mm
 Type : floor standing
 Safety valve : 1 pc
 Filling and drain valve : 1 pc

Mixing groups :

| Mixing groups | AHU type 1 | AHU type 2 | AHU type 3 |
|---------------------------|---------------------|---------------------|--------------------------|
| Code | CG 1 | CG 2 | CG 3 |
| Peak demand min flow temp | 6 °C | 6 °C | 6 °C |
| Return temperature | 12 °C | 12 °C | 12 °C |
| Main line | Ø 57 mm | Ø 76 mm | Ø 108 mm |
| Main valves | 50 mm | 65 mm | 100 mm |
| Emergency valve | 50 mm | 65 mm | 80 mm |
| Mixing group | | | |
| Code | MV 1 | MV 1 | MV 1 |
| Size | DN 50 mm | DN 50 mm | DN 100 mm |
| Circulation pump | 1 pc. pump | 1 pc. pump | 2 pc. pump |
| Code | CP 2 | CP 2 | CP 1a & CP 1b |
| Capacity | 6 m ³ /h | 6 m ³ /h | 5 - 30 m ³ /h |
| Delivery head | 5.5mWK (55 kPa) | 5.5mWK (55 kPa) | 5.5mWK (55 kPa) |
| Frequency inverter | -- | -- | 1 pc. |
| Nominal power | 0.6 kWe | 0.8 kWe | 2x 1.5 kWe |

Pump units AHU win coil system

| Description Twincoil groups | AHU type 1 | AHU type 2 |
|-----------------------------|-----------------------|-----------------------|
| Heat capacity | 33 kW | 66 kW |
| Medium | 30% glycol | 30% glycol |
| Return temperature | -16 °C / 30 °C | -16 °C / 30 C |
| Main line | Ø 32 mm | Ø 45 mm |
| Main valves | 25 mm | 32 mm |
| Expansion vessel | 1 pc | 1 pc |
| Circulation pump | 1 pc. pump | 1 pc. pump |
| Code | CP 2 | CP 2 |
| Capacity | 1,6 m ³ /h | 3,4 m ³ /h |
| Delivery head | 5.5 mWK (55 kPa) | 5.5 mWK (55 kPa) |
| Nominal power | 0.6 kWe | 0.8 kWe |

Material specification

Mixing valves

- valve type : plug type
- servo motor : 24 V
- make : Honeywell V5015 or similar

Butterfly valves : Tyco / Econosto

Circulation pumps

- pump type : in-line pump with dry motor
- RPM : 1450 rpm
- voltage : 3-phase 400 V
- make : Grundfoss / Johnson control

4.4.5 Main chilled water lines greenhouse

The pre-mixed chilled will be transported to the greenhouse rooms by a transport line. The transport line has to be installed overhead in the corridor. On this transport line the 6 greenhouse rooms will be connected, with a valve set and a two-way control valve.

- Valve size : 50 mm
- Valve type : Honeywell V5011
- Servo motor : 24 V

4.5 Air Handling Unit high containment greenhouse rooms**4.5.1 General**

Two greenhouse rooms 08 and 10 are designed for containment, these rooms will be more or less air tight, the entrance is through an air lock with negative pressure. Room pressure will be maintained at a negative pressure of 0.125 mBar per individual room (air lock – 0.125 mBar, room – 0.25 mBar).

An Air Handling Unit (AHU) consists of an air supply unit and an exhaust. The AHU is designed for direct exhaust of air, no recirculation. The exhaust must be ≥ 8 m away from the air intake grille. The AHU are dedicated units per individual room. Ductwork must be short to minimize contamination by leaks in ducts.

4.5.2 AHU design

- Ventilation capacity : 10 – 12 1/hr (air exchanges per hour)
- Fans : double fans with EC motors (variable speed)
- Fan redundancy : 2x 60%
- Room pressure : -0.25 mBar
- Air lock room pressure : - 0.125 mBar

Air supply unit

- Fan unit : double fan unit with VFD
- Redundancy : 2x 60% capacity (fans and filters)
- Filtration : M5 – F7 class (efficiency > 95%)
- Dampers : air tight dampers on both sides of the filters
- Heat exchanger, pre-heating : twin coil system (glycol circuit)

| | |
|------------|--|
| Heating | : 1 pc heating coil section |
| Cooling | : 1 pc cooling coil section |
| Condense | : 1 pc condense collection, syphon and drain |
| Air intake | : wall air grill |

Exhaust unit:

| | |
|----------------|--|
| Fan unit | : double fan unit with variable speed motor |
| Redundancy | : 2x 60% capacity (fan and filters) |
| Filter type | : double bag-in bag-out system |
| Pre filtration | : F7 – F9 class (efficiency> 95%) |
| HEPA filter | : H13 class (efficiency> 99.95%) |
| Dampers | : air tight dampers on both sides of the filters |
| Heat exchanger | : twin coil system (glycol circuit) |
| Exhaust | : air duct through the roof |
| Make | : Wolf / Novenco / Al-Ko or similar |
| Control unit | : Per individual AHU a steering and control unit with digital connection (Modbus) for remote control by the climate computer |

4.5.3 Design data Radioisotope greenhouse

| | |
|-------------|----------------------|
| Room code | : GH-0-08 |
| Room size | : 64 m ² |
| Room volume | : 350 m ³ |
| AHU type | : Type 1 |

Air supply unit

| | |
|--------------|----------------------------------|
| Fan capacity | : 1000 – 4300 m ³ /hr |
| Filtration | : M5 class |
| Twin-coil | : 15 kW |
| Heating coil | : 20 kW |
| Cooling coil | : 40 kW |

Exhaust unit:

| | |
|----------------|-----------------------------------|
| Fan capacity | : 1000 – 4300 m ³ /hr |
| Filter type | : double bag-in bag-out system |
| Pre filtration | : F7 – F9 class (efficiency> 95%) |
| HEPA filter | : H13 class (efficiency> 99.95%) |

4.5.4 Design data Pathology greenhouse

| | |
|-------------|----------------------|
| Room code | : GH-0-10 |
| Room size | : 144 m ² |
| Room volume | : 800 m ³ |
| AHU type | : Type 2 |

Air supply unit

| | |
|--------------|----------------------------------|
| Fan capacity | : 2000 – 8600 m ³ /hr |
| Filtration | : M5 class |
| Twin-coil | : 20 kW |
| Heating coil | : 30 kW |
| Cooling coil | : 80 kW |

Exhaust unit:

| | |
|----------------|-----------------------------------|
| Fan capacity | : 2000 – 8600 m ³ /hr |
| Filter type | : double bag-in bag-out system |
| Pre filtration | : F7 – F9 class (efficiency> 95%) |
| HEPA filter | : H13 class (efficiency> 99.95%) |

4.5.5 Differential pressure sensors

The room pressure in the greenhouse can be visually checked / controlled by magnehelic or digital pressure sensors. The recommended pressure difference for a greenhouse room is maximally 20 Pa.

The sensor will also be monitored by the climate computer.

**4.5.6 Air distribution**

For above described AHU's, air supply and return ducts will have to be delivered and installed:

Air supply:

Air supply ducting to be installed from the wall of the head house to the air intake connection of the AHU. In the wall of the head house a grille has to be installed with bird proof mesh. The air duct to be thermally insulated to prevent condense inside the head house.

From the AHU to the greenhouse an air supply duct to be installed at floor level of the room. The supply air to be distributed over the total width of the greenhouse room. From this distribution duct, perforated air hoses have to be connected to distribute the air equally under the benches. Ductwork penetrating greenhouse walls to be air tight. Ductwork penetrating the head house walls to be rain water tight.

Specification:

- Air intake grill
- Insulated supply air duct
- Greenhouse ductwork
- Perforated air hoses under the benches
- Air supply and return duct for the air lock room

Exhaust air:

A return air duct must be installed and connected to the AHU, high in the greenhouse room under the lower energy screen. From the Exhaust AHU, an exhaust duct has to be installed with a roof penetration.

- The distance between the air intake and exhaust has to be at least 8 m.
- The penetration of the ductwork through the greenhouse walls has to be air tight.
- The penetration of the ductwork through the head house walls has to be rain water tight.

Specification:

- Return air duct to AHU
- Exhaust air duct
- Roof penetration

4.6 AHU for general greenhouse rooms

All greenhouse rooms must be equipped with an AHU (a compact mechanical ventilation system with a cooling and a heating coil), that's installed in the room's back walls. From the AHU a duct divides the air inside the room to connection points under the tables where perforated air hoses distribute air. The system is used for ventilation with outside air, recirculation of air, cooling, heating or any mix of those. The AHU must be provided in line with first a cooling coil for additional cooling in the summer, and then a heating coil for use in the winter, so that the unit is able to manipulate humidity inside the room.

| | |
|------------------------------|---|
| Greenhouse rooms | : GH-0-01 / 02/ 03 /04 /05 /11 |
| Number of AHU units | : 6 pc |
| AHU type | : Type 3 |
| Ventilation capacity | : up to 10 times per hour up to 7200 m ³ /hr |
| Heating capacity per room: | : > 23 kW |
| - water temperatures | : 40 / 30 °C |
| Cooling capacity per room: | : > 40 kW |
| - cooling water temperatures | : 6 / 12 °C |
| Servo motor by-pass valve | : 1 pc |
| Main fan motor | : 2 kWe (variable flow Ec motor) |
| Control box | : 1 pc control box with Modbus connection protocol |
| Make | : VanDijk Heating or similar |
| Air hose | : distribution piping & 2 to 6 pc air hose, mounted under the tables. |

4.7 Fancoil units

4.7.1 General

Several rooms in the greenhouse & head house have to be provided with a fan coil unit. Room temperature must be controlled per individual room. Air cooler is connected to the chilled water system.

4.7.2 Specification potting room:

| | |
|-------------------|-------------------------------------|
| Room | : Potting room |
| Room code | : GH-0-20 |
| Floor area | : 75 m ² |
| Room volume | : 450 m ³ |
| Unit type | : fancoil unit heating & cooling |
| Mounting position | : Ceiling model |
| Fans speed | : 3 settings: low – medium – high |
| Room temperature | : individual room control |
| Controller | : integrated |
| Connection | : 4-pipe system (heating & cooling) |
| Heating capacity | : 5 kW |
| Cooling capacity | : 4 kW |
| Connection | : 2x 2 pc valves |
| Motor valve | : integrated in unit |
| Room controller | : 1 pc |

4.7.3 Specification control room

| | |
|------|----------------|
| Room | : Control room |
|------|----------------|

| | |
|-------------------|-------------------------------------|
| Floor area | : 16 m ² |
| Room volume | : 50 m ³ |
| Unit type | : fancoil unit heating & cooling |
| Mounting position | : Ceiling model |
| Fans speed | : 3 settings: low – medium – high |
| Room temperature | : individual room control |
| Controller | : integrated |
| Connection | : 4-pipe system (heating & cooling) |
| Heating capacity | : 1.2 kW |
| Cooling capacity | : 1.2 kW |
| Connection | : 2x 2 pc valves |
| Motor valve | : integrated in unit |
| Room controller | : 1 pc |

4.7.4 Specification Visitors room

| | |
|-------------------|-------------------------------------|
| Room | : Visitors room |
| Room code | : GH-0-13 |
| Floor area | : 60 m ² |
| Room volume | : 360 m ³ |
| Unit type | : fancoil unit heating & cooling |
| Mounting position | : Ceiling model |
| Fans speed | : 3 settings: low – medium – high |
| Room temperature | : individual room control |
| Controller | : integrated |
| Connection | : 4-pipe system (heating & cooling) |
| Heating capacity | : 5 kW |
| Cooling capacity | : 5 kW |
| Connection | : 2x 2 pc valves |
| Motor valve | : integrated in unit |
| Room controller | : 1 pc |

4.7.5 Specification Corridor

| | |
|-------------------|-----------------------------------|
| Room | : Greenhouse corridor |
| Room code | : GH-0-12 |
| Floor area | : 208 m ² |
| Room volume | : 1250 m ³ |
| Unit type | : fancoil unit heating |
| Mounting position | : Hanging type |
| Air distribution | : perforated air hose 42 m length |
| Fans speed | : 3 settings: low – medium – high |
| Room temperature | : by climate computer |
| Connection | : 2-pipe system (cooling) |
| Cooling capacity | : 10 kW |
| Connection | : 2 pc valves |
| Motor valve | : 1 pc (24 V) |

4.8 Exhaust fans

The following rooms have to be provided with an exhaust fan complete with grill, shutter and wall penetration. The wall penetration has to be provided with a leak free seal. The exhaust fan has to be controlled by manual 3-speed controls.

An air intake grill with damper must be installed at a low level in the wall.

| Room no | Description | Room size | Room volume | Fan capacity | Wall shutter |
|---------|-----------------|-------------------|--------------------|------------------------|--------------|
| GH-0-14 | Technical room | 63 m ³ | 300 m ³ | 600 m ³ /h | 1 pc |
| GH-0-16 | Pest regulation | 16 m ² | 45 m ³ | 160 m ³ /hr | 1 pc roof |
| GH-0-19 | Oven room | 32 m ² | 180 m ³ | 900 m ³ /hr | 1 pc |
| GH-0-20 | Potting room | 75 m ² | 450 m ³ | 900 m ³ /hr | 1 pc |

4.9 Insulation activities

The chilled water circuit with pipes, pumps, control valves, valves, buffer tanks etc. must be insulated with vapour proof closed cell insulation and covered with a 0.6 mm smooth aluminium sheet.

4.9.1 Water chiller connection

- Main piping to water chillers;
- Pipe frost protection outside with electrical heating cable between insulation and pipe.

4.9.2 Technical room

- Distributor with mixing groups;
- Buffer tank;
- Mixing groups with mixing valves and pumps;
- All chilled water piping.

4.9.3 Piping to AHU and cooling units

All piping in the head house and greenhouse, up to the AHU and cooling units.

4.10 Painting work

- All insulated metal pipes and flanges must be cleaned and painted in red primer before insulation.
- Non-insulated pipes and welded connections must be cleaned and painted with primer, and then painted in white heat resistant paint.
- All cleaning- and painting materials must be included in the price.

4.11 Filling of the installation and water treatment

The filling and putting under pressure of the total installation must be executed by the contractor.

A water treatment unit (a softener) will be installed by a third party. Contractor is responsible for the water quality with which the installation is filled. Contractor must analyse the water before use, and treat it if necessary (pH, iron, chalk, etc.). Analysis and treatment to be presented to the principal for approval.

4.12 Materials

Contractor must deliver all necessary tools and parts for the job, such as flanges, small tubes, rubber tubes, air vents, drain cocks, thermometers, sockets, valves, pumps, mixing valves, insulation, etc.

4.13 Defects Liability Period

The defects liability period is 12 months from the date of successful completion of the job.

4.14 Instruction / maintenance

Supplier gives an instruction- and a maintenance handbook in the English language after final delivery.

4.15 Spare parts installation

Spare parts to be delivered as a part of this contract volume. Not included in the list are materials which are normally taken in as extra for the installation of the project. The underneath mentioned spare parts must be presented after final delivery. A service set for the installation contains approximately 5% of the materials listed in the chapter regarding air vents, drain cocks, small valves, thermometers, sockets etc.;

4.16 Material make

All the materials to be used shall be of reputed makes. In case of maintenance the equipment must be serviced locally, an exception can be for special parts not available locally. The offered makes shall require approval of the principal.

4.17 Design, materials and workmanship

The successful tenderer shall assume full responsibility for co-ordination and adequate design. All materials and equipment shall be of the appropriate class well finished and of approved design and make. All ferrous parts including bolts & nuts etc. used must be hot dipped galvanized. Special attention shall be paid to the tropical treatment of the materials, as it will be subject to extremely severe exposure, to atmospheric moisture and to long period of high ambient temperature.

5. TECHNICAL SPECIFICATION TABLE SYSTEM

5.1 Regulations and requirements

Quality of materials used according to the Austrian standards and the following DIN-EU equivalents:

| | |
|--|-------------------------------|
| Hot dipped galvanized coatings on fabricated iron and steel articles | : DIN EN ISO 1461 |
| Sherardizing – Zinc diffusion coatings on ferrous products | : DIN EN 13811 |
| Fasteners – Electroplated coatings | : DIN-EN 4042 |
| Thermoplastic preformed gaskets used in buildings | : DIN-ISO 3934 |
| Stainless steel | : DIN-EU 88 |
| Materials' fire resistance | : EN 13501-1 / DIN 4102-1 B1; |

Parts to be UV-resistant. UV-resistance must be provided in kLy = kilo-Langley/year;

5.1.1 Materials

All materials and equipment shall be of the appropriate class, well finished and of approved design and make, and made of non-corrosive and humidity resistant materials. All ferrous parts including bolts & nuts etc. used must be hot dip galvanized. The aluminium materials must be connected with stainless steel bolts and rivets. All plastic made of heavy duty PE. Ebb/flood bottom made of HIPS, 2 rooms with stainless steel bottoms.

5.2 Benches

5.2.1 Benches / tables fixed supports

Benches to be constructed with aluminium profiles and supports:

- supports to be adjustable to level the bench or make a slight slope;
- supports have to be anchored to the concrete floor;
- between supports diagonal bracing has to be installed;
- supports have to be installed 10 cm inside the bench extremity to prevent stumbling;
- bench ebb/flood bottom plastic made of heavy duty HIPS;
- adapt support structure for suspending air-handling hose sleeves of Ø 450 mm under the tables

The sides of the table to be constructed of aluminium with a side profile of 150 mm high. The inner table floor must be made with a closed bottom, preferably out of a single sheet, with enough stiffness and resilience that pot plants of up to 7 kg will not topple nor lean if distributed unevenly. Used pot sizes:

| | |
|--------|--|
| Height | : ~ 800 mm (to be decided later, height 650 to 800 mm) |
| Load | : 150 kg/m ² |

| | |
|------------------------|---|
| Bottom | : closed bottom |
| <i>Bottom option 1</i> | : <i>HIPS bottom, with drain channels</i> |
| <i>Bottom option 2</i> | : <i>smooth aluminium or (preferred) stainless steel bottom</i> |

| GH room | No | size | Bottom type | No of basins |
|---------|------|------------|--------------|----------------|
| GH 0-01 | 6 pc | 10 x 1,2 m | HIPS | 3 pc per bench |
| GH 0-03 | 6 pc | 10 x 1,2 m | HIPS | 3 pc per bench |
| GH 0-04 | 6 pc | 10 x 1,2 m | HIPS | 3 pc per bench |
| GH 0-05 | 4 pc | 10 x 1,2 m | HIPS | 3 pc per bench |
| GH 0-08 | 4 pc | 6 x 1,2 m | Smooth metal | 1 pc |
| GH 0-10 | 3 pc | 6 x 1,2 m | Smooth metal | 1 pc |
| | 3 pc | 10 x 1,2 m | | |
| GH 0-11 | 6 pc | 10 x 1,2 m | HIPS | 3 pc per bench |

5.3 Alternative systems

If the contractor feels he has a better system than the one described, he is free to also offer the alternative with the price implication in comparison with the standard.

5.4 Construction drawings

Drawings of the structure, details and all other drawings needed for maintenance, should be handed in 1 month after acquiring of the order. If changes were made while building, revised drawings should be given to the principal at delivery.

5.5 Defects Liability Period

The defects liability period is 24 months from the date of successful completion of the job.

6. WATER TECHNICAL INSTALLATION

6.1 General

All installation works on the drinking water part of the installation to be carried out under supervision of a company with local approved/certified installer certificate of the local drinking water company.

6.2 Electricity and connections

Electricity from the grid comes in three-phase with neutral conductor and PE (protective earth). Single-phase voltage 230 V, three-phase voltage 400 V and frequency 50 Hz. Motors to be IP67 rated and designed for use in 60 °C ambient conditions with 98% RH. The installation must comply with the country's ruling standards, regulations & requirements, and the power company's directions. After contracting, before sourcing equipment, the above must be checked for abnormalities, to investigate possible implications for the equipment and adjust / adapt the equipment accordingly.

6.3 Ground-work

All groundwork digging, hacking for laying sub-soil pipework of installations, is integral part of the job.

6.4 City water connection for irrigation

In the head-house a city water connection will be made available by a third party in GH-0-14. The drinking water will be used for irrigation. The irrigation water must be connected to this point by means of a waterworks company approved backflow preventer (Rohrtrenner) according to DIN EN 1717, followed by a closing valve, so that no cross contamination can take place.

After the backflow preventer an adjustable pressure reducing valve (Druckminderer) to be installed to reduce water pressure to about 2.5 Bar (installation design pressure).

From this connection all further necessary piping to be installed to the different rooms and systems.

All the installation works on the drinking- & process water installation has to be carried out by a company licensed by the local drinking water company, and entirely according to their rules and regulations.

Specification for a capacity of 10 m³/hr

- 1 pc stop valve
- 1 pc backflow preventer (Rohrtrenner) according to DIN EN 1717
- 1 pc reducing valve (Druckminderer)
- 1 pc water filter (200 micron)
- 1 pc water meter with pulse flow output (for process computer)
- 1 pc stop valve
- 1 pc *option: water heater*

6.4.1 Main lines

From the main connection, drinking water piping has to be installed to the several water users. From the main connection in the head-house a fresh water line to be installed in the corridor. Main lines have to be installed overhead through axis 5-6 and D-E. Room's water connection from a riser-pipe in the floor.

Piping type: Wavin PE-Xc/Al/PE piping or similar. Above soil PVC tubes (10 Bar) to be executed in white (WZW-tube - black inside layer as light blocker)

Capacity main piping: 4.5 m³/hr

6.4.2 Hand-valves

In the corridor and head house, hand-valves has to be installed, neat the water sinks.

Per connection point:

- 1 pc hand-valve (10 l/min)
- 1 pc high capacity hand-valve with hose connection (25 l/min)

| | |
|--------------------------------|--|
| Valve sets greenhouse corridor | : 6 pc |
| Greenhouse containment rooms | : 2 pc (GH-0-08 & GH-0-10) |
| Headhouse potting room | : 1 pc (near axis M8) |
| High capacity hand-valves: | |
| Headhouse | : 1 pc (near axis L5) |
| Technical room | : 1 pc (near axis I5) |
| GH corridor | : 1 pc near axis D1, water supply roof washer) |

6.4.3 Water sinks

In the central corridor stainless steel sinks have to be delivered and installed. Above every sink a water tap to be installed. The sink to be provided with a siphoned downpipe to the sewage under the concrete floor. The end of the main line to be provide with a controlled flush valve to automate flushing of the line. For two contaminated rooms (GH-0-08 & GH-0-10) collection tanks shall be implemented to collect the contaminated waste water. The waste water containers shall be meet the requirements of the existing water treatment system on the IEAE campus. Additionally, two sump pits including pumps, which empty the pits into the containers, shall be installed.

Single sinks:

| | |
|----------------------|---|
| Corridor | : 6 pc. |
| Containment rooms | : 2 pc. (GH-0-098/10) |
| Potting room | : 1 pc |
| Specification sinks: | |
| Make | : Blanco Professional or similar |
| Model | : ES 14 |
| Material | : Stainless steel |
| 9 pc: | : Industrial sinks on frame with frame and bottom sheet |
| Size: | : ± 1400 x 700 x 850 mm (wxbxh) |
| Sink drain | : connected to floor drain or collection tank |

6.5 Water treatment and storage system

6.5.1 General

City water has to be treated before this can be used for irrigation and process water. The water will be demineralised by a Reverse Osmosis (RO) system. The treated water will be stored in a day tank. The water will be supplied to the greenhouse by a hydrophore installation. The water will be stored in one of the day tanks (hand selection valves), 1 tank is reserved for RO water, 1 tank for treated rain water.

6.5.2 Reverse osmosis installation (RO)

Reverse osmosis installation: 1 pc

| | |
|--------------|---|
| Supply water | : $\pm 1,8 \text{ m}^3/\text{hr}$ |
| Capacity | : $1 \text{ m}^3/\text{hr}$ |
| Flush | : to floor drain |
| Size | : $\pm 1.3 \times 0,6 \times 2 \text{ m}$ (w x d x h) |

| | |
|-----------------|---|
| Water meter: | : 1 pc, suited for the water quality. |
| Preferred brand | : Lubron or similar |
| Connection | : to both buffer tanks with hand valves |
| Pump start/stop | : on tank level |

6.5.3 Buffer-tanks

| | |
|-----------------|--|
| Buffer tank | : 7 m^3 |
| No of tanks | : 2 pc |
| Size | : diam. $\varnothing 1.8 \times 3 \text{ m}$ |
| Tank material: | : HDPE, PE 100 |
| Cover | : top cover with manhole |
| Level indicator | : mechanical level indicator |
| Overflow | : to drain pit |



6.6 Rain water storage and treatment system

The rain water of the roof will be collected in a storage tank next to the greenhouse. Overflow of rain water will be drained to a nearby ditch. The rain water will be used for irrigation of the greenhouse.

6.6.1 Tank specification

| | |
|---------------|--|
| Tank material | : corrugated galvanized steel, thickness based on calculations |
| Coating | : two-sided plastisol coating |
| Tank liner | : Ex foil |
| Cover | : depending on tank type: |
| - Span Cover | : anti-algae span cover (woven polypropylene) (tanks up to $\varnothing 8 \text{ m}$) |
| Bottom slope | : flat tank bottom |
| Foundation | : Concrete tiles on a stabilized sand bed (exterior tanks) |

| | |
|----------------------|---|
| Suction line | : subsoil, with closing valve |
| Overflow | : subsoil to nearby ditch |
| Retention overflow | : subsoil with closing valve, at a height of about 70% of the tank height |
| Tank no | : Tank 1 to 3 |
| Water type | : rain water |
| Size | : Ø 3,64 x 4.64 m |
| Dug in | : 0,8 m |
| Capacity day storage | : 48 m ³ |
| No. of storage tanks | : 3 pc |
| Top cover | : anti-algae cover |

6.6.2 UV disinfection unit

| | |
|--|--|
| No. of units | : 1 pc |
| Disinfection method | : UV disinfection |
| Lamp power | : ±3.6 kW |
| Supply pump | : 1 pc (connected to the rain water storage tanks) |
| Capacity | : 1.5 m ³ /h |
| Filtration unit | : 25 micron, automatic flush to the drain gutter outside |
| Dosing capacity | : 250 mJ/cm ² |
| T10 | : 90% |
| Acid dosing | : integrated |
| <i>H₂O₂ dosing</i> | : <i>integrated</i> |
| Capacity | : 1.5 m ³ /hr |
| Pump unit | : 1 pc |
| Frequency inverter | : 1 pc; |
| Connection to | : to both buffertanks with handvalves |
| Dimensions | : ± 1.5 x 0.6 x 1.1 m (w x d x h) |

6.7 Hydrophore pumpunit

| | |
|-------------|------------------------|
| Capacity | : 3 m ³ /hr |
| No of units | : 2 pc |

6.8 Hydrophore pump unit

For the irrigation of the greenhouse, a hydrohore pump has to be delivered and installed. Both buffertanks will have a dedicated pump unit.

| | |
|--------------------|------------------------------|
| Pump unit | : 2 pc |
| Pump housing | : Stainless steel (INOX) |
| Capacity | : 0.6 – 6 m ³ /hr |
| Power | : ± 1.5 kW |
| Frequency inverter | : 1 pc; |
| Filtration unit | : 80 micron |
| Pressure control | : 1 pc pressure sensor |
| Buffertank | : 1 pc pressure tank |

6.9 Irrigation piping system

6.9.1 General

From the pump unit in the technical room, the irrigation piping has to be installed into the greenhouse corridor. For both pump units an individual piping have to be installed, with selection valves at the greenhouse room for selection of the preferred water source.

6.9.2 Greenhouse piping

| | |
|------------------------|--|
| Main piping greenhouse | : PVC diam 63 mm (10 Bar); |
| No of pipings | : 2 pc |
| Water source | : Rain water and RO water |
| Piping material | : PVC (10 Bar), |
| Colour: | : white (wzw - with black layer for light blocking) |
| Mounting | : overhead in the greenhouse corridor |

6.9.3 Hand watering

For hand watering and cleaning purposes a hand water piping with hand valves must be designed, delivered and installed. The piping must be installed on the hydrophore pump unit in the technical room.

| | |
|------------------------|---|
| Hand-valves | : ball valve with Geka coupling (fastened / connected to steel structure) |
| Technical room | : 1 pc |
| Greenhouse rooms | : 1 pc per greenhouse room |
| Headhouse potting room | : 2 pc |
| Growth chambers | : 4 pc |
| Headhouse general | : 2 pc |
| Roof washing unit | : 1pc (outside GH, with extra hand-valve in greenhouse (frost protection) |

6.9.4 Hose reels

For hand watering (clean water) a hose reel has to be delivered and installed. The hose reels in rooms have to be equipped with selection valve and a connection to the fertilizer injector. Hose reel to be mounted, with length sufficient to reach every plant on the benches.

| | |
|----------------------------|--|
| No. of hose reels | : 1 pc per Gh chamber, total 8 pc. |
| Hose reel type | : wall mounted, automatic roll-up |
| Hose | : at least 24 mtr, 13 mm (1/2") hose with spray nozzle. |
| Fertilizer injector option | : double valve set |

6.10 Overhead irrigation

6.10.1 General

In the greenhouse rooms, an overhead irrigation system has to be delivered and installed. The installation consist of PVC piping with sprinklers and valve sets. The above soil piping has to be installed in white PVC piping with a black core, to prevent the build-up of algae.

6.10.2 Overhead irrigation installation

| | |
|-----------------------|--|
| No of rooms | : 6 |
| Room code | : GH-0-01, GH-0-02, GH-0-03, GH-0-04, GH-0-05, GH-0-11 |
| Total valve sets | : 16 pc |
| Crop | : several crops |
| Sprinkler piping | : c.t.c. 2 m (one per bench) |
| Nozzle distance | : c.t.c. 0.5 m |
| Mounting height | : about 3 m above floor level |
| Uniformity | : over 80% |
| Nozzle capacity | : 40 ltr/hr (3 Bar) |
| Nozzle type (example) | : DAN-7955-360° with LPD, or similar |
| Shut off valve | : 1 pc per irrigation piping |
| Capacity valve set | : 50 ltr/m ² /hr |
| Nozzle type | : bridgeless rotating micro sprinkler, DAN or similar |
| Non-drip valve | : 1 pc LPD per sprinkler |
| Suspended stands | : 1 pc with stabilizer |
| Valve set | : 1 pc per 2 lines |
| Capacity valve set | : ± 2.4 m ³ /hr |
| Valve sets | : near central corridor |

6.11 Drip irrigation installation**6.11.1 General**

The system in the rooms consists of pressure compensated drippers with needle peckers on benches.

6.11.2 Specification pot drippers

| | |
|---------------------|--|
| No of rooms | : 5 |
| Room codes | : GH-0-01, GH-0-03, GH-0-04, GH-0-05, GH-0-11 |
| Crop | : several crops |
| Cultivation method | : in pots on benches |
| Plant distance | : 200 mm |
| Bench width | : 1.200 mm |
| Bench length | : 10.000 mm |
| Pots per bench | : 6 x 50 = 300 pots |
| No of benches | : 28 see drawing |
| Drip-tube | : 3 tube sections per bench (10 mtr), easy to disconnect with quick coupling |
| Dripper capacity | : 2 ltr/hr |
| Dripper type | : pressure compensated |
| Solenoid valves | : 28, 1 per bench (2 mtr) |
| Valve drip capacity | : ± 600 ltr/hr |
| No of valves | : 28, 1 per bench |

6.11.3 Specification in line drippers

| | |
|-------------|-----|
| No of rooms | : 1 |
|-------------|-----|

| | |
|---------------------|---|
| Room codes | : GH-0-02 |
| Crop | : - |
| Cultivation method | : In soil (room GH-0-02) |
| Plant distance | : 500 mm |
| Drip-tube | : inline drip tube (10 mtr), easy to disconnect with quick coupling |
| Dripper capacity | : 1,6 – 2,3 ltr/hr |
| Driper distance | : 20 cm |
| Drip line distance | : 1.6 m |
| No of drip lines | : 6 pc |
| Dripper type | : pressure compensated |
| Irrigation capacity | : 5 ltr/m ² /h |
| Solenoid valves | : 3 pc , 1 per 2 drip lines (1,6 mtr) |
| Valve drip capacity | : ± 160 ltr/hr |

6.12 Ebb/flood system

For several greenhouse rooms with benches an ebb/flood system must be delivered and installed. The benches are separated in basins with a length of about 3 m. Below the benches a collection tank have to be placed with a pump unit. The collection tank will be installed per 2 benches.

The benches have an ebb/flood bottom and must have a manual valve disconnect the bench from the ebb/flood system. Valve type must be Quick-Valve with a manual shut-off valve. Draining of the flood & drain system by collecting the water in the storage tank. The storage tank can be drained to the drain gutter in the middle of the greenhouse room.

The ebb/flood system to install in greenhouse room GH-0-03; GH-0-04; GH-0-11

Specification ebb/flood system

| | |
|-----------------------|---|
| Room code | : GH-0-03; GH-0-04; GH-0-11 |
| Basin size | : about 3.6 m ² |
| Basin volume | : ± 144 ltr |
| Tank volume | : ± 480 ltr (1600 x 600 x 500 mm) |
| Position | : End of the path between the benches |
| Pump capacity | : 3x 12 l/min = 36 l/min (2,16 m ³ /h) |
| Filter | : mesh filter, 200 micron |
| Solenoid valves | : 2 pc per pump set |
| Total pump units | : 9 pc |
| Total solenoid valves | : 18 pc |

6.13 Summary

| Room no | 1 | 2 | 3 | 4 | 5 | 8 | 10 | 11 |
|---------------------|------|---------------------------|------|------|------|------|------|------|
| Hand valve | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc |
| Hose reel | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc | 1 pc |
| Overhead irrigation | 3 pc | 2 pc | 3 pc | 3 pc | 2 pc | | | 3 pc |
| Drip irrigation | 6 pc | 3 pc Inline dripper | 6 pc | 6 pc | 4 pc | 4 pc | 6 pc | 6 pc |
| Ebb/Flood system | | | 3 pc | 3 pc | | | | 3 pc |

6.14 Fertiliser dosing

Fertiliser will be pre-mixed in the potting soil. For additional supply of fertiliser, a mobile fertiliser injector will be used to add the required fertiliser to an irrigation system. The fertilizer dosing will have to be carried out by using a water powered fertiliser injector on a cart.

| | |
|--------------------|----------------------------|
| Injector | 1 pc. Dosatron |
| Pressure regulator | 1 pc. |
| Filter | 1 pc. 80 micron (200 Mesh) |
| Check valve | 1 pc |
| Hand valves | 2 pc. |
| Fertiliser tank | 2 pc., 500 ltr with cover |

No of fertiliser carts 4 pc

6.14.1 Valve sets greenhouse

In order to connect the Dosatron a valve set to be installed to each room consisting of:

| | |
|---------------------|--------|
| Main valve | : 1 pc |
| By-pass valve | : 1 pc |
| Injector connection | : 2 pc |

6.15 Air humidifier

6.15.1 General

For humidity control in the greenhouse a fog installation must be designed, delivered and installed. The installation must consist of a high pressure pump installation and high pressure lines and nozzles inside the greenhouse rooms. The water source is the reverse osmosis water.

6.15.2 Pump installation

A pump installation has to be installed in the water technical room.

| | |
|----------------------------|---|
| Water filters | : 2 pc |
| Pump installation | : water pressure above 105 Bar, double pump unit |
| Capacity pump installation | : 0.5 m ³ / hr (8 ltr / min) |
| Steering/control panel | : 1 pc |
| High pressure piping | : stainless steel |
| Valves and appendages | : stainless steel |
| Nozzles | : stainless steel |
| Noise level | : max. 76 dB(A) |
| Legionella prevention | : automated flushing the installation on a daily basis. |

6.15.3 Greenhouse installation

A high pressure main line must be installed from the pump into the greenhouse towards the nozzles.

Nozzles : average droplet size 10 micron (non-drip valves inside nozzles)

| | |
|------------------------|--|
| Distribution | : nozzles to divide over the greenhouse area, spacing about 3 x 4 m; |
| Nozzle capacity | : 5 to 6 ltr / hr; |
| Nozzles per room | : depending on the room size; |
| Piping | : 1 RVS distribution pipe per 8 m; |
| Mounting height | : about 0.5 m below the trellis girder; |
| Steering | : on a signal of the climate computer installation; |
| Solenoids | : one per greenhouse room; |
| Legionella prevention | : flush valve per greenhouse room; |
| Total greenhouse rooms | : 8 pc; |
| Room code | : GH-0-01/02/03/04/05/08/10/11 |
| Water hammer arrestor | : when needed a water hammer arrestor to deliver and install. |

6.16 General

6.16.1 Electrical connections

The pump sets, solenoid valves, etc. must connected to the greenhouse control system.

6.16.2 Defects Liability Period

The defects liability period is 24 months from the date of successful completion of the job.

6.16.3 Instruction / maintenance

Supplier shall give an instruction manual as well as a maintenance manual after final delivery. Control and approval will be done by the IAEA Site Supervisor, although responsibility is still with the tenderer.

6.16.4 Spare parts water technical installation

Spares have to be delivered and are part of this tender specification. Not included in this list of spare parts are the materials which are normally taken in as extra for the complete installation of the project.

7. SPECIFICATION ELECTRICAL INSTALLATION

7.1 General

The electrical supply is provided by the existing high voltage ring.

Transformer networks creates the following power grids

- Power Grid A – Normal Power Supply
- Power Grid B – Emergency Power Supply
- Power Grid C – Independent Power Supply

The job consists a.o. of:

- All necessary preliminary works, as design, applications for licenses, testing and commissioning (license and testing fees of local authorities are for the principal);
- Main- and sub-distributions incl. all necessary connections to the main;
- Cable gutter system;
- Electrical installation for the greenhouse;
- Lighting unit
- Low voltage main installation including cabling for BMS
- Fire alarm system
- Emergency lighting system
- Access control system
- Video camera system
- Intercom system
- Earthing and lightning protection system, potential equalization
- Low voltage system
- Loudspeaker system
- IT-network ("EDV-Netzwerk") installation of complete passive systems
- Cabling WLAN area wide
- Fire protection systems
- Folding work
- acceptances, TÜV acceptance.
- Supervision and installation, testing, setting to work and commissioning of the electrical installation.
- All panels, pumps, heating cooling installation, ventilation etc. must be connected & tested
- Critical limits general alarm on operational systems (technical alarms);
- Execute necessary contacts and integration into the Winguard system

The Contractor shall provide all components required for proper integration and/or connection to existing systems (fire, emergency, access control, IT, Intercom, video, loudspeaker, etc.).

Manufacturer's specification of mandatory systems (NO alternatives allowed):

| | |
|--------------------|------------------------|
| Emergency lighting | system Zumtobel |
| fire alarm | system Siemens |
| Loudspeaker | system Honeywell/Esser |
| Alarm/video/access | system G4S |

Leading brands (alternatives allowed):

| | |
|-----------------------|--------|
| Switches & Connectors | Gira |
| Data distributor | RITTAL |
| Copper Cabling | R&M |
| Fibre optic cabling | R&M |

The design of the electrical installation is based on a pre-selection of equipment. The installer has to check the setup of the installation and the total loads of the panels and distribution boards and hand over this information at an early stage of the detailed design process.

Protection Measures

The Contractor shall

- a. Apply the protective measure zeroing up to the low-voltage main and low-voltage sub-distribution boards.
- b. Install the main distribution board (NSHV) in a separate electrical operating room.
- c. Plan from the main distributor upwards, a TN-S network with protective measure zeroing (5-pole version with separate N and PE conductors). This will also apply to the general distribution boards (area distribution boards) and the technical distribution boards (union distribution boards) connected to the low-voltage main and low-voltage sub-distribution boards.
- d. Use the RCD protection circuit as additional protection for the plugs and sockets up to 25A.

Installation Works**Products**

The specification shall be based on products which have already been used in existing systems of the IAEA. If alternative products shall be proposed, it shall be warranted by the Contractor that the compatibility is given 100% to the existing control systems. If not, the requested products shall be installed.

Cable dimensions

The cable dimensions specified in the planning principles are minimum cross-sections. If the cable calculation results in higher values, these shall be carried out.

Installation Plan

- a. All assembly plans and detailed drawings, sections, input and execution drawings, circuit diagrams, slotted plans, recess plans, plans for plinths, niches and other construction details shall be prepared by the Contractor in a timely fashion without being requested to do so and shall be handed over to the IAEA or their authorised representative for inspection and approval before execution. The approval does not, however, release the Contractor from their responsibility for functional efficiency and acceptance of guarantee.

- b. The following drawings, documents and authorizations shall be prepared by the Contractor and submitted to the IAEA for approval. The drawings shall also be available as files on data carriers created and submitted in RVT, DWG, DXF, PLT and PDF file format.
 - I. All construction drawings, documents and data carriers are to be revised to the actual inventory after completion of the plant and handed over to the IAEA as coloured inventory documents.
 - II. In addition, the appropriate number of documents shall be brought on site.
 - III. As assembly drawings, only those drawings of the Contractor which are adapted to the latest architectural standards will be accepted.
- c. For all plans prepared by the Contractor, the Contractor's typeface shall appear above or next to the architect's title block, clearly indicating the contents of the drawing, the type of drawing (assembly drawing, detailed drawing, the company's internal numbering), and the signature of the IAEA Site Supervisor.

Test run, measurement, acceptance

In order to ensure the operational safety of the plant, the Contractor shall measure insulation resistance, loop resistance, earth contact resistance of earth electrodes (especially in lightning protection systems) and nominal currents in consumer lines as well as voltage losses in selected (critical) circuits during or after the work is carried out and the results shall be recorded.

The IAEA Site Supervisor shall be informed of the measurements and invited to participate in the measurements.

In addition, the Contractor shall confirm that all other circuits have been measured and that the required minimum and maximum values have been complied with.

Handover of the plant

The handover of the system shall take place after the trial operation has been completed and the inspection of the technical systems has been recorded in accordance with the VDI forms, all essential performance and operating data and the instruction of the IAEA Site Supervisor or operating personnel with a written handover protocol.

7.2 Regulations and requirements

Quality of materials used according to the Austrian standards and the following DIN-EU equivalents:

| | |
|--|-------------------------------|
| Hot dipped galvanized coatings on fabricated iron and steel articles | : DIN EN ISO 1461 |
| Sherardizing – Zinc diffusion coatings on ferrous products | : DIN EN 13811 |
| Fasteners – Electroplated coatings | : DIN-EN 4042 |
| Thermoplastic preformed gaskets used in buildings | : DIN-ISO 3934 |
| Stainless steel | : DIN-EU 88 |
| Materials' fire resistance | : EN 13501-1 / DIN 4102-1 B1; |

Complete work shall be carried out conform the provisions of Austrian Electricity Act and relevant Standards. After contracting, before ordering equipment, check the above for abnormalities / deviations, in order to asses possible implications for the equipment and adapt the equipment accordingly.

Contractor prepares fabrication and detailed working drawings and obtains approval of the electrical inspecting authorities. All works shall be carried out only on approved drawings. Approval of drawings does not relieve contractor of his responsibilities to meet the intents of specifications.

7.2.1 Electrical installation

All parts of the installation to be VDE/CE approved. Number-codes of all used parts to be supplied at delivery. All equipment has to meet the requirements of general machinery safety (e.g. DIN EN ISO 12100-1: Safety of machinery – General principles for design – Risk assessment, Machinery Directive 2006/42/EC). The installation includes all the connections around the facility. All leaving cables, cable conducts, thermal overload switches and connections are included in the delivery. The delivery of motors of mixing valves, circulating pumps, ventilation motors screen motors etc. are excluded, and will be delivered by the contractor of the system. Single phase wall sockets will be standard type double-outlet. For three phases they must be CEEFORM 16 amp. 3 poles + Neutral + PE. All plug sockets to be at least splash water proof (IP44), all control panels, connection boxes, control panels etc. situated in glass houses to be IP65. On the platform area IP44 shall be used.

Plug socket and power plug to be secured with Residual Current Circuit Breakers (FI-Schutz Schalter fe. DRCM-40/4/0,03-G/A). RCCB's must be installed together with the plug sockets in separate connection boxes (like AMAXX), to simplify recurring function test procedures of the RCCB by the users.

7.2.2 Operating rooms for electrical systems

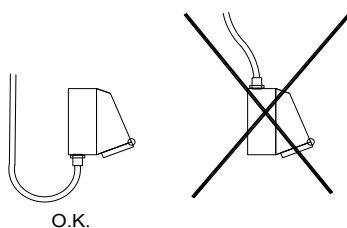
The operating rooms shall be designed according to the regulations of the building code and the regulations of OVE E 8101.

- a. For the following electrical installations, separate electrical operating rooms shall be set up:
 - b. Low voltage main distribution board;
 - c. Group battery system for safety lighting;
 - d. Low low Voltage System (fire alarm system, IT, etc.)
 - e. Electrical sub-distribution.
- f. The electrical operating rooms shall constantly and effectively be ventilated so that the heat loss during operation or the gases produced by the battery can be eliminated.
- g. The electrical operating rooms shall each be equipped with EI90 enclosure walls and an entrance door EI2-30C, which shall be self-closing and open to the outside.
- h. The ventilation of the battery room for the central unit of the emergency lighting system shall
- i. The escape be carried out in accordance with OVE EN IEC 62485-2 in the latest valid. route from the electrical operating rooms to an exit is no longer than 40m.
- j. The electrical operating rooms have a clear height of at least 2.40 m.
- k. The electrical operating rooms shall constantly and effectively be ventilated so that the heat dissipated during operation or the gases produced by the battery can be eliminated.

7.2.3 Electricity and connections

The electricity from the grid supplies three-phases, 0 and earth. Single phase 230 V; three phase voltage 400 V, and a frequency of 50Hz. The complete installation must be carried out according to the CE standard regulations and Austrian equivalent/adaptations.

7.2.4 Installation



- Vertical cables must be installed perpendicular;
- Electrical materials & connections to be splash proof;
- Connections to panels & plug sockets to be fed from below;
- All sub-soil power cables to be dug in sufficiently deep;
- English language legend at every sub-distribution panel;

7.2.5 Execution

Location of panel-, distribution-, and switch boards, light fittings, cable routes, conduit wiring routes etc. to be on site before approval of engineer in charge is obtained and before installation work is started. All connections from panels to motors to be tested by the contractor. This means the water chillers, transport pumps, the water technical units, ventilation motors and pumps in the facility, etc. All leaving cables, thermal overload switches and connections are included in the delivery. Motors of mixing valves, circulating pumps, ventilation motors and screen motors are not included in this chapter.

7.3 Earthing system

7.3.1 General

The complete electrical installation and metal structure has to be connected to an earth rod. The earthing rod and ground electrode will be installed by a local company. The Contractor shall install the grounding system and the Lightning protection as per specifications below.

For Lightning protection, the greenhouse steel structure has to be grounded. The steel columns at a raster of 20 x 20 m will have to be connected to the earth. The earthing rods and ground electrode will be installed by a local company.

7.3.2 Grounding

The grounding system of the floor slab shall be made by the general contractor of the FML2 building. It is used to connect the lightning conductors and to integrate the equipotential bonding system.

- a. The elevations shall be led into the outer wall above the groundwater level. connected to the potential equalization network and the lightning protection system.
- b. Connection lugs/nuts shall be provided by the grounding system for:
Grounding fixed points for protective grounding/protective equipotential bonding.

7.3.3 Lightning protection

- a. The lightning protection system shall be connected to the existing grounding system.
- b. According to ÖVE/ÖNORM EN 62305-3 Supplement 2:2013 (industry and commerce / office areas / storage areas / production areas), the property shall be equipped with a lightning protection system in protection class III that complies with the regulations (ÖVE/ÖNORM EN 62305). Mesh size of catching device for BK III 15x15m.
- c. The inspection interval shall be 3 years.
- d. For the required arrestors round wire galvanized with a diameter of 8 mm shall be used.
- e. Depending on the design, facade constructions are connected to the arresters or auxiliary arresters according to the regulations.
- f. Metal roof superstructures, roof surfaces and construction parts shall be integrated into the lightning protection system according to the existing regulations if necessary, otherwise they shall be protected with a safety gear.

7.3.4 Potential equalization

- The equipotential bonding in the floor slabs shall be installed according to ÖVE/ÖNORM E 8014-3 (e.g. construction steel grid mesh size max. 20x20 cm).
- An equipotential bonding system shall be installed for the entire plant in accordance with the regulations, in which all electrically conductive power plant components, such as ventilation ducts, steel structures, pipelines, etc. shall be integrated.
- Equipotential bonding rails shall be located in the immediate vicinity of the various electrical and HVAC distribution boards.
- The individual equipotential bonding lines shall be connected separately and labeled permanently and legibly and installed by the Contractor.
- The surge arresters shall be installed accordingly.

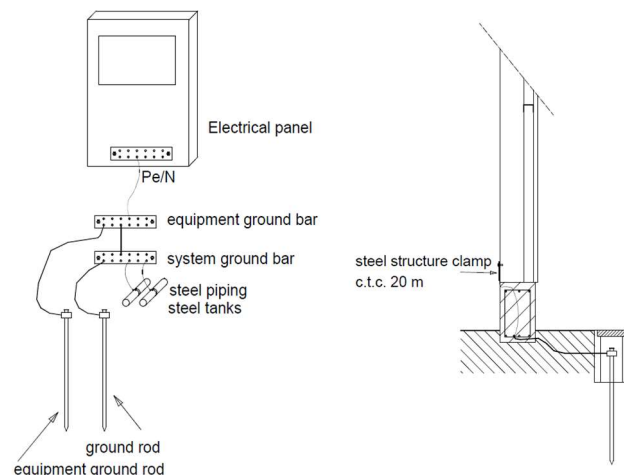
7.3.5 Earthing and bonding of equipment:

The following equipment and steel materials have to be connected to the earthing installation, directly connected to the earth or with an equipotential busbar:

- electrical panels;

Following equipment to be provided with a connection point for the earthing installation

- steel structure;
- outside water storage tanks;
- outside water chiller;
- steel piping heating installation;
- steel cable tray system;
- metal water piping;
- metal air distribution ductwork;
- all other metal piping.



7.4 Main distribution panel

General for Net A, Net B and Net C:

Installed circuit breakers shall be equipped with auxiliary contacts and connected to the existing SICAM system (incl. all required functions and suitable wiring diagrams).

The supply lines of the main distribution boards shall be indicated by means of transformer measurement and multi-function measuring device at the distribution board doors.

Various fault messages from the RCD monitoring shall reported to the existing BMS system and displayed.

In the head house the main distribution panels for net A, net B and net C are planned. This panel must have several spare groups available for extensions. The feed cable to this panel will be carried out by a local party. Next to the power cable, a power supply cable will be installed for emergency power (about 250 kVA). The emergency power is for the basic equipment, except the growlight installation, max 1 chiller, no ovens.

7.4.1 NET A (Required power: 385kW)

The Contractor shall install and connect the cables from the main low voltage distribution board Net A in FML2 building to the main distribution board Net A in the technic room on platform.

All materials and work required for this shall be provided by the contractor.

7.4.2 NET B (Required power: 253kW)

The Contractor shall install and connect the cables from the main low voltage distribution board Net B in FML2-building to the main distribution board Net B in the technic room on platform.

All materials and work required for this shall be provided by the contractor.

7.4.3 NET C (Required power: 15kW)

The Contractor shall install and connect the cables from the main low voltage distribution board Net C in FML2-building to the main distribution board Net C in the technic room on the platform

All materials and work required for this shall be provided by the contractor.

7.4.4 Main distribution panel (Net A; Net B, Net C)

| | | | |
|-----------------|---|----------|----------------------------|
| Main power rail | : | 1250 Amp | |
| Main switch: | : | 1250 Amp | 1-0 |
| Group 1 | : | 360 kWe | Feeding sub panel |
| Group 2 | : | 140 kWe | Feeding grow-lights panels |
| Group 3 | : | 80 kWe | Feeding Chiller 1 |
| Group 4 | : | 60 kWe | Feeding Headhouse panel 2 |
| Spare | : | .. | Future extension |

Sub panel

| | | | |
|--------------|---|---------|----------------------------------|
| Main switch: | : | 800 Amp | 1-0-2 (mains – 0 – generator) |
| Group 1 | : | 60 kWe | Feeding greenhouse control panel |
| Group 2 | : | 40 kWe | Feeding plug sockets greenhouse |
| Group 3 | : | 60 kWe | Feeding irrigation system |
| Group 4 | : | 30 kWe | Feeding pump panel |
| Group 5 | : | 80 kWe | Feeding Chiller 2 |
| Group 6 | : | 80 kWe | Feeding Head house panel 1 |

7.4.5 Sub divider headhouse 1 (Net A; Net B, Net C)

| | | | |
|-----------------|---|---------|--------------------------------------|
| Location | : | axis K8 | |
| Main power rail | : | 125 Amp | |
| Main switch: | : | 125 Amp | |
| Group 1 | : | 18 kWe | Feeding growth chamber panels type 1 |
| Group 2 | : | 32 kWe | Feeding growth chamber panels type 2 |
| Group 3 | : | 30 kWe | Feeding plug sockets |
| Group 4 | : | 2 kWe | Feeding fancoil (axis k6) |
| Group 5 | : | 2 kWe | Feeding overhead door (axis M6) |
| Group 6 | : | 12 kWe | Feeding fancoil (axis i7 & L9) |
| Group 7/9 | : | | single phase groups |

7.4.6 Sub divider headhouse 2 (Net A, Net B, Net C)

| | | | |
|-----------------|---|---------|-------------------------|
| Location | : | axis M5 | |
| Main power rail | : | 125 Amp | |
| Main switch: | : | 125 Amp | |
| Group 1 | : | 30 kWe | Feeding electrical oven |
| Group 2 | : | 30 kWe | Feeding electrical oven |
| Group 3 | : | 8 kWe | Feeding autoclave |

7.4.7 Sub divider irrigation (Net A, Net B, Net C)

| | | | |
|-----------------|---|---------|---------------|
| Location | : | axis I5 | |
| Main power rail | : | 125 Amp | |
| Main switch: | : | 125 Amp | |
| Group 1 | : | 8 kWe | RO unit |
| Group 2 | : | 8 kWe | UV unit |
| Group 3 | : | 16 kWe | HP fog system |
| Group 4 | : | 3 kWe | Hydrophore 1 |
| Group 5 | : | 3 kWe | Hydrophore 2 |

7.4.8 Pump panel (Net A, Net B, Net C)

The several electro motors (400 and 230 V), circulating pumps (400 V) and servo motors (24 V) must be connected to the control panels to be delivered and mounted. The electro motors must be secured with a MCB (Motor Circuit Breaker) for protection against “over” current, by thermal and magnetic detection. The electro motors and pumps mentioned above are 3-phase motors except for the servomotors of the mixing valves (24 V DC). The electromagnetic switches must be placed in the control panel as mentioned before. The environmental computer installation will control the electro motors automatically, but it must be possible to operate the system manually. For each pump a steering switch (on/off/auto.) must be included and for the mixing valves, a steering switch (open/close/off/auto) must be installed. The steered plug sockets in the greenhouse sections must be individually secured with a circuit breaker. The individual MCB relays has to be equipped with a fault contact for remote indication of a motor fault. Motor fault shall be displayed on control panel with a red signal indication lamp.

| | | | |
|-----------------|----------|----------------|---------------------------------|
| Location | : | axis H4 | |
| Group 1 | : | 8 kWe | Feeding Heating pumps |
| Group 2 | : | 8 kWe | Feeding chiller pumps |
| Group 3 | : | 1,5 kWe | Feeding pressure system heating |
| Group 4 | : | 1,5 kWe | Feeding pressure system cooling |
| Group 5 | : | 3 kWe | Feeding AHU type 1 |
| Group 6 | : | 5 kWe | Feeding AHU type 2 |

7.5 Distributor

- All distributors (light, power, BMS etc.) shall be equipped with a class 2 surge arrester (medium protection), the alarm shall be given locally acoustically and via the BMS.
- The distributors shall be designed as sheet steel standing distributors with doors according to the latest regulations and guidelines.
- Type-tested standard distribution boxes shall always be used.

- d. The distributors shall be installed in the technical rooms.
- e. When designing the distributors, the following space and power reserves shall be taken into account:
 - I. Reserve space for distributor installations: at least 20%.
 - II. Performance reserve: at least 20%.
 - III. Shunting space reserve: at least 25%.
- f. In addition to the reserve mentioned above, a device reserve of 15% shall be implemented.
- g. The distributors shall be completely wired, equipped, delivered and assembled in the factory.
- h. The distributor doors shall be equipped with swivel bolt locks (directed for DIN half profile cylinders).
- i. Only system solutions from one manufacturer shall be preferred as distributor installation devices.
- j. The distributor installation devices shall be designed for quick mounting on top-hat rails.
- k. The miniature circuit breakers are single-pole or three-pole with a disconnectable neutral conductor.
- l. The starting and inrush currents shall be taken into account for the load of the circuits, both light and sockets, and a reserve of at least 20 % of the rated current shall be maintained.
- m. When selecting the coarse fuses and switching devices (number and nominal data), the short-circuit power to be expected at the installation location and perfect selectivity with regard to overload, short-circuit or residual current (earth fault) shall be ensured.
- n. In general, the so called slow type C miniature circuit breakers shall be used due to the increased inrush currents of the LED drivers. Type B (suitable for LED lighting) shall be used for the RCDs. Using the example of miniature circuit breaker C 13A:
 - I. LED lights 10-15W max. 500W light power;
 - II. LED lights 15-30W max. 600W light power;
 - III. LED lights 33-60W max. 1000W light power;
 - IV. LED lights 60-100W max. 1100W light power.

sockets / device connections:

General sockets 9 230V 1+N / 16A / C

Cleaning sockets 12 230V 1+N / 16A / C

Office Workstations:

4 workplaces combined to 1 circuit "normal power"

4 workplaces each combined to 1 circuit "IT power"

- o. The selection of coarse fuses and switchgear (number and nominal data) shall be made taking into account the short-circuit power to be expected at the installation site and perfect selectivity with regard to overload, short-circuit or residual current (earth fault).
- p. Distributors and distributor installations shall include:
 - the complete Workshop assembly;
 - the test in the Workshop;
 - the structure for the functional acceptance;
 - the internal cable connections including wiring channels, connectors and terminals;
 - the necessary backup material for the test run and the startup;
 - the equipment of the respective control room with the devices in accordance with the regulations;
 - the complete documentation effort.

- q. Wages of distributors and distributor installations shall include:
- the transport, the toleration on the construction site;
 - the placement at the installation site;
 - the assembly of the transport units;
 - the ready-to-use connection of all internal connection cables;
 - the ready-to-use connection of all external cables and lines;
 - the commissioning;
 - the test run;
 - the training of the operating personnel.

7.6 Overvoltage protection

- a. According to OVE E 8101, the system shall be protected against overvoltage due to atmospheric discharges by means of staggered protection.
- b. The lightning current arresters (coarse protection) shall be located in the low-voltage main distribution board.
- c. In addition, medium protection surge arresters shall be provided in the low-voltage sub-distribution boards or all sub-distribution boards.

7.7 Energy distribution in buildings

- a. The distribution from the sub-distributors shall be carried out with cables type E-YY, NYY and NYM in cable trays and pipe systems.
- b. The dimensioning of the cabling shall be carried out according to the valid regulations and guidelines as well as according to economic considerations. For possible extensions of the electrical system, a power reserve of 20% shall be taken into account when sizing the main cables (distribution feeds).
- c. The conductor cross-sections shall be designed according to the current that is to be transmitted, the permissible current carrying capacity, the voltage drop, the power loss of the short-circuit resistance and the type of installation.
- d. For cable systems with functional integrity, tested installation systems (clamps, pipe systems) shall be used.
- e. All cables shall be laid in such a way that they cannot be crushed or damaged by sharp edges or moving parts. If this is not possible, suitable protective measures such as transfer pipes, etc. shall be provided.
- f. All cables shall be permanently and legibly labeled at their ends and at each inspection opening in accordance with the documentation.
- g. Cables which are laid in areas with a high risk of damage shall be reliably protected against mechanical damage by appropriate measures such as metal cover plates, metal hoses, etc. This applies especially to main cables.
- h. Cables shall be laid in cable trays, in riser shafts vertically with cable clamps on anchor rails and in pipe systems.
- i. Weak-current cables shall be separated from heavy-current cables in cable trays by means of separating webs or shall be laid in separate cable trays or pipe systems.
- j. All connection points shall be relieved of tension and thrust. This especially applies to cables and lines that are not permanently installed.
- k. Cable entries shall be uniformly designed with armored or metric threads.

7.8 Cable tray system

In the facility a cable tray system must be installed. The make of this cable tray system can be selected by the contractor. Nevertheless, the material used must be of galvanised sheet steel. The mounting of the installation must be in accordance with factory specification, and materials used for mounting have to be corrosion proof as well. Vertical parts of the tray system have to be carried out with cover plates. The approximate sizes of the cable tray system should be 400 by 60 mm minimally for the main lines and 70 by 60 mm to the several electrical motors in the greenhouse. The material thickness must be selected depending on the load and support distance in accordance with factory specification.

Separate cable trays for high and low current, suspended on the trusses designed for the expected weight.

Despite the fact that most computer cabling may be protected, all low voltage (230/400 V) and weak current cables (computer signals) to be separated inside the tray by a partition plate.

Coating: The cable tray system to coat with a white powder coating

7.9 Electrical installation greenhouse and head-house

7.9.1 General

The electrical installation in the greenhouse must be connected tested and delivered in good working order by the contractor. Orientation light and wall-sockets have to be installed in the compartments. The groups for 400 and 230 V wall sockets must be equipped with RCCB and automatic fuses.

7.9.2 Room Lights

Lights in the rooms to mount on a white coated rail. Fitting type: 36 W LED, IP 65. Per greenhouse room a light switch (IP 65) to install, large rooms to provide with additional switches

Light level:

| | | |
|---------------------|-----------|-----------------|
| Greenhouse corridor | : 200 Lux | |
| Greenhouse room | : 200 Lux | (front path) |
| Potting room | : 400 Lux | |
| Office room | : 400 Lux | |
| Headhouse general | : 300 Lux | |
| Technical room | : 200 Lux | (walking paths) |

7.9.3 Plug sockets

The to use plug sockets has to be installed in a combination housing, with plug sockets and an RCCB. According to the safety procedures, the RCCB has to be tested frequently by the end users, without opening the control panels.

| | |
|--------|---|
| Make: | : Mennekes Amaxx (alternative: Walther; http://www.walther-werke.de) |
| Model: | : Type 920001: 6x Schucko 230 V; 1x RCCB; 6x MCB |
| | : Type 920002: 3x Schucko 230 V; 1x RCCB; 3x MCB |
| | : Type 920009: 2x Schucko, 1x 400 V/ 16 Amp; 1x RCCB |

7.9.4 Greenhouse specification (Net A, Net B, Net C)

| Room | Type 920001 | Type 920003 | Type 920009 | LED 36 W | Feeding equipment |
|----------|-------------|-------------|-------------|----------|---|
| | 6x 230 V | 3x 230 V | 2x 230 V | | |
| | | | 1x 400 V | | |
| GH0-0-01 | 2x | | | 2 pc | GH AHU type 3, 2 kW |
| GH0-0-02 | 2x | | | 2 pc | Feeding drain pump (230 V) axis D6 |
| | | | | | GH AHU type 3, 2 kW |
| GH0-0-03 | 2x | | | 2 pc | GH AHU type 3, 2 kW |
| GH0-0-04 | 2x | | | 2 pc | GH AHU type 3, 2 kW |
| GH0-0-05 | 2x | | | 2 pc | GH AHU type 3, 2 kW |
| GH0-0-06 | | 1x | | 2 pc | |
| GH0-0-07 | | | 2x | 2 pc | Feeding Autoclave: 2x 10 kW plug socket |
| GH0-0-08 | 2x | | | 2 pc | |
| GH0-0-09 | | 1x | | 2 pc | |
| GH0-0-10 | 2x | | | 2 pc | |
| GH0-0-11 | 2x | | | 2 pc | GH AHU type 3, 2 kW |
| GH0-0-12 | 8x | | | 12 pc | Plug socket roof washer (axis D1) |
| | | | | | Feed speed roller (400 V), axis H6 Fancoil |
| GH0-0-13 | | 2x | | 6 pc | Fancoil |
| | | | | | |

7.9.5 Headhouse specification (Net A, Net B, Net C)

| Room | Type 920001 | Type 920003 | Type 920009 | LED 36 W | Feeding equipment |
|----------|-------------|-------------|-------------|----------|-----------------------------------|
| | 6x 230 V | 3x 230 V | 2x 230 V | | |
| | | | 1x 400 V | | |
| | | | | | |
| GH0-0-14 | | | 2x | 8 pc | See technical room Exhaust fan |
| GH0-0-15 | 2x | | | 4 pc | Fan coil |
| GH0-0-16 | | | | 2 pc | Exhaust fan |
| GH0-0-17 | | 2x | | 2 pc | 2x Growth chamber 9 kW |
| | | | | | 2x Growth chamber 16 kW |
| GH0-0-18 | | 1x | 2x | 20 pc | 1x autoclave, 8 kW |
| GH0-0-19 | | 1x | 2x | 4 pc | 2x Oven, 30 kW Exhaust fan |
| GH0-0-20 | | 1x | 2x | 16 pc | Exhaust fan Fan coil |

7.10 Technical room

7.10.1 Control panels greenhouse (Net A, Net B, Net C)

Multiple electro motors (400 / 230 V), circulating pumps (400 V) and servo motors (24 V) to be delivered, mounted, connected and tested to control panels (to be delivered). The motors to be secured with a MCB (Motor Circuit Breaker) for protection against a current “surge”, by thermal and magnetic detection. The electro motors and pumps mentioned above are 3-phase motors except for the servomotors of the mixing valves (24 V AC) and the tube screen motors (230 V). The electromagnetic switches must be placed in the control panel. The environmental computer installation will control the electro motors automatically, but it must be possible to operate the system manually. For each pump a steering switch (on/off/auto) must be included and for the mixing valves, ventilation motors and screen motors a steering switch (open/close/off/auto) must be installed. The steered plug sockets in the greenhouse sections must be individually secured with a circuit breaker. Individual MCB relays to be equipped with a fault contact for remote indication of a motor fault. The control panel to be provided with red signal indicators to display engine malfunctions.

7.10.2 Control panel greenhouse (Net A, Net B, Net C)

Location: : Axis 5F

Panel 1 : Greenhouse equipment

Panel 2 : Grow lights

| Location distributor- & power-panel, Axis | | | | | | | | | | | | | | |
|--|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| Room GH-0- | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | |
| Roof-vent | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | 1* | |
| Horizontal shading | 2 | 2 | 2 | 2 | 2 | | | 2 | | 2 | 2 | 1 | 1* | |
| Outside wall sreen | 2 | 1 | 1 | 2 | 2 | | | | | | 2 | | | |
| Twin rol screen | 2 | 1 | 2 | 1 | 1 | | | 2 | | 2 | 2 | | | |
| Mixing group top heating | 1 | 1 | 1 | 1 | 1 | | | 1 | | 1 | 1 | 1 | 1* | |
| AHU type 1 & 2 | | | | | | | | 1 | | 1 | | | | |
| Wall AHU type 3 | 1 | 1 | 1 | 1 | 1 | | | | | | 1 | | | |
| Fan coil | | | | | | | | | | | | 1 | 1 | |
| Motor valve AHU heat & cold | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | 2 | |
| Mixing group AHU heat & cold | | | | | | | | 2 | | 2 | | | | |
| Sulphur evaporator | 1 | 1 | 1 | 1 | 1 | | | | | | 1 | | | |
| HP fogging | 1 | 1 | 1 | 1 | 1 | | | 1 | | 1 | 1 | | | |
| Grow lights | 1 | 1 | 1 | 1 | 1 | | | 1 | | 1 | 1 | 1 | 1 | |
| Top irrigation | 3 | 2 | 3 | 3 | 2 | | | | | | 3 | | | |
| Drip irrigation | 6 | 3 | 6 | 6 | 4 | | | 4 | | 6 | 6 | | | |
| Ebb/flood | | | 3 | 3 | | | | | | | 3 | | | |

Control panel headhouse

- room GH0-18 : 1 pc roof vents
- room GH0-18 : 1 pc fan coil heating
- room GH0-15 : 1 pc fancoil heating + cooling
- room GH0-20 : 1 pc fancoil heating + cooling

VFD drive

The required VFD drives are specified by the heating, cooling and water installation.

7.11 Cabling of the control panels

For the control panels (Net A, Net B, Net C) in the greenhouse sections a feed cable has to be delivered and installed from the main distributor in the head house. The cabling from each individual motor, and pump as well as various messages to the control panels shall be installed.

The cable cross-section must be designed in accordance with the regulations.

7.12 Sulphur evaporators

In the greenhouse sections GH-0-01 to 05 and room 11, a computer controlled plug socket and sulphur evaporator to deliver and install.

Per greenhouse chamber

- | | |
|--------------------|--------------------------------|
| Plug socket: | 1 pc in the middle of the room |
| Sulphur evaporator | 1 pc 100 W with top cover |
| Total units | 6 pc |

7.13 Alarm installation

An alarm panel must be installed in the office building. This alarm panel must be delivered and connected by the contractor. The alarm signals from the pump panels, control panels, cooling units, computer etc. shall be connected to the central alarm panel in FML2-building and shall be integrated into the existing Winguard system.

Connections:

- Control panels greenhouse
- growth chambers
- Cooling unit
- pump panel technical room
- AHU units
- Climate computer

7.14 Grow Light installation

7.14.1 General

For the complementary lightning off crop a grow light installation must be delivered and installed. The installation must have a light uniformity of over 85%. The grow light installation must be installed in growth rooms. Light fittings to be mounted on a rail. The fittings to be connected to distribution boards.

LED fittings (Net A, Net B, Net C)

| | |
|------------------------|---|
| Light level | : 350 $\mu\text{mol}/\text{m}^2/\text{s}$ |
| Light type | : LED |
| LED spectrum | : Light spectrum for now: |
| - Red | : 80% 660 nm |
| - Blue | : 10% 460 nm |
| - White | : 10% white LED |
| Unit module type | : Top LED |
| Light efficiency | : > 2.7 $\mu\text{mol}/\text{J}$ |
| Power per module | : 300 W – 600 W per unit |
| Flux output | : > 2.8 $\mu\text{mol}/\text{J t}$ |
| Voltage | : 230 V / 400 V |
| IP Rating | : IP66 |
| Life expectancy | : > 25,000 hrs |
| Mounting | : U-profile, hot dipped galvanized steel |
| Mounting rail distance | : c.t.c. 2 m |
| Mounting position | : above benches and crop area |
| Mounting height | : about 3.5 m above floor level |

| Room number GH-0- | 01 | 02 | 03 | 04 | 05 | 08 | 10 | 11 |
|--|-------|------|------|------|------|------|------|------|
| Room length in m | 12 | 8 | 12 | 12 | 8 | 8 | 12 | 12 |
| Room width in m | 12 | 12 | 12 | 12 | 12 | 8 | 12 | 12 |
| Room surface in m^2 | 144 | 96 | 144 | 144 | 96 | 64 | 144 | 144 |
| Mounting profile type | ∩ | ∩ | ∩ | ∩ | ∩ | ∩ | ∩ | ∩ |
| Mounting height in m | ± 3.5 | ? | ? | ? | ? | ? | ? | ? |
| Rail distance in mm | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 |
| Light intensity in $\mu\text{mol}/\text{m}^2/\text{s}$ | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 |
| Power kWe | 18 | 12 | 18 | 18 | 12 | 8 | 18 | 18 |

7.14.2 White Powder coating

As an option, white powder coating of the U-profiles and cable conduct gutters shall be offered.

7.14.3 Distribution boards

The distribution boards to mount in the technical corridor. The distribution boards to complete with relay for the steering by the environmental computer installation. For each light group a steering switch (on/off/auto.) must be mounted. The main cables from the main distributor to the distribution boards to install. When subsoil cables will be used, it has to be specified in the offer.

| | |
|--------------------|---------------------------------|
| <u>Section</u> | <u>: GH-0-01 to GH-0-11</u> |
| Panel location | : :Axis F5 |
| Number of panels | : 1 pc. |
| Power | : 120 kW |
| Main switch | : 240 Amp |
| light groups | : 16 pc (2 per greenhouse room) |
| number of switches | : 16 pc (on – off – automatic) |

7.15 Emergency Lighting

7.15.1 General

The safety lighting center in the FML2 building shall be extended by 4 circuits for the Greenhouse, the stationary batteries according to OVE EN IEC 62485-2 in the latest valid shall be equipped for an operating time of 3 hours.

The extension of the safety light center in the FML2 building with all necessary plug-in units shall be included in the total price.

The Contractor shall install the safety lighting as per specifications below.

- a. The Greenhouse shall be equipped with emergency lighting according to OVE E 8101, EN 1838.
- b. Emergency exits and escape routes shall be equipped with appropriate escape route orientation lights / escape sign lights.

7.15.2 Safety Lights

- a. All safety lights shall be designed with modern LED technology.
- b. The arrangement of the floodlight fixtures for the escape routes are in accordance with TRVB E 102 and the workplace regulations.

7.15.3 Cabling

- a. The cabling shall be carried out according to OVE E 8101.
- b. Cable systems with functional integrity E30 shall be installed from the central battery system in FML2-building up to the supplied fire compartment,
- c. Within the fire compartment itself, cabling shall be carried out with plastic-insulated sheathed cables without functional integrity.

7.15.4 Escape route lighting

Appropriate circuits shall be provided in the central battery system to supply the escape route orientation lights.

7.16 Fire alarm system

The building shall be equipped with a fire alarm system according to TRVB S 123 with full protection.

The fire alarm center in the FML2 building shall be extended by 2 loops for the Greenhouse.

The extension of the fire alarm center in the FML2 building with all necessary plug-in units shall be included in the total price.

Also the integration/display in the existing hazard detection system must be established, and the connection and signaling of fault and alarm messages to the existing BMS must be taken into account in the total price.

- a. The fire department control panel shall be installed in the fire department attack path.
- b. Integration point fire alarm central + hazard alarm system: see attached diagram
- c. Heat detector cables, push-button detectors, ventilation line detectors, smoke detectors and heat detectors shall be installed.
- d. All emergency exits shall be equipped with switch detectors.
- e. The alarm in case of fire shall be triggered and set off the sirens.
- f. The fire control system controls the following system components via 2-detector dependency:
 - Central control technology;
 - Siren activation;
 - Activation of escape route orientation lighting;
 - Switching off ventilation systems;
 - Closing fire dampers;
 - Activation Smoke and heat extraction systems;
 - Release of hold-open systems for fire protection doors;
 - Intervention circuit.
- g. All messages are shown in plain text with location information on the display.
- h. The protection of all fire detectors before and after the start-up as well as for provisional or acceptance until the complete handover of the object.
- i. The scope of delivery includes all hardware and software as well as the system cabling and the fire alarm cable.
- j. The scope of delivery of the Contractor includes the cables for the power supply of the smoke exhaust distributors and the complete installation for fire smoke ventilation and fire control.
- k. For the control of the electrical drives of the smoke exhaust openings (sky dome, el. doors, gates and windows), appropriate smoke exhaust control units for fire and smoke sections shall be installed. The location of the push buttons is provided on the first and last level and at the fire control panel. The cabling is to be carried out according to OVE E 8101 (E30 or A05VV).
- l. The holding magnets and flashing lights shall be buffered for 72 hours by rechargeable batteries.
- m. The fire protection plans for the extension according to TRVB O 121.
- n. All control systems shall be designed in accordance with TRVB S 151 and shall be coordinated with the fire department and the plant management.
- o. Manual interventions as well as the fire control panel are to be coordinated in close cooperation with all responsible authorities and to be integrated or installed by the Contractor.
- p. The fire control matrix is to be created by the Contractor, all agreements and necessary coordination with authorities, Contractor/building, Contractor HVAC, etc. are to be carried out independently, unsolicited, on time and to be included in the final report.

7.17 Telecommunication and information technology equipment

The Contractor shall install the telecommunication and information technology as per specifications below.

7.18 Loudspeaker system

The loudspeaker center in the FML2 building shall be extended by 2 circles for the Greenhouse.

The extension of the loudspeaker center in the FML2 building with all necessary plug-in units shall be included in the total price.

The Contractor shall install a loudspeaker system (Honeywell/Esser)

- a. A loudspeaker system shall be installed for announcements. This shall be provided in the corridors and all rooms.
- b. The system shall be connected to and controlled via the Main Gate.

7.19 WINGUARD system

The Winguard system shall be extended for approx. 95 pcs. alarm- or fault-messages.

The extension with all necessary units shall be included in the total price. Adaptation of the visualizations shall be included in the total price accordingly.

7.20 Technical ring

The technical ring for the building shall be integrated into the existing system.

7.21 Structured cabling IT

The fibre optic transfer point is the EDV-IT cabinet in the FML2 building.

From there the contractor shall install 2 fiber optic cables 12 fibers to the IT cabinet in the Greenhouse (1 cable from the YAL switch and 1 cable from the IPCL switch).

The Contractor shall install the structured cabling it as per specifications below.

- a. A passive, structured cabling system CAT 6a according to ÖVE/ÖNORM EN 50174-1, ÖVE/ÖNORM EN 50174, ÖVE/ÖNORM EN 50288, ÖVE/ÖNORM EN 50310, IEC60603-7-5 shall be installed.
- b. It consists of network cabinets (LAN distributors), RJ45 patch panels, shielded data lines CAT 7, RJ45 data outlets and patch cables.
- c. Active components such as switches, hubs, routers etc. are supplied and installed by the IAEA.
- d. For the integration of the entire extension into the existing EDP network, a total of 1 EDP stand-alone cabinets (max. 384 connections per distributor) are provided. The cabinets can be opened from 2 sides, located in the technic room on the platform
- e. Design of the systems according to IAEA standard.
- f. The cabling to the individual double RJ-45 sockets shall be done in Cat6a standard. A CAT6a 500 MHz CAT6a cable with an AWG22 cross-section shall be used for the data cable.
- g. The fibre optic connection of the floor standing cabinets to the data center shall be carried out with the minimum number of fibres in single mode (OS2) as defined in the IAEA cabinet specification.
- h. Type LWL: 12-fibre single mode E9/125 OS2 - LC connector
- i. The fibre optic cabling shall be wired to the server rooms to the FML2-Gebäude situated on Groundfloor.
- j. The cabling of the IT and telephone system shall provide connections to the technic room, the growth chambers and the office.
- k. No redundancy shall be considered for the air conditioning. For the power supply 1 UPS circuit 16A/230V and 1 UPS Circuit 16A/400V per IT distributor should be considered.
- l. A telephone bus line, backbone cabling and DECT cabling are not necessary.

7.22 Security Technology

7.22.1 General

The final security standard of the client (G4S) shall be included in the total price.

The integration of points D.5.5.2, D.5.5.3 and D.5.5.4 is carried out via the security cabinet on the platform by means of fiber optic cable (multimode 24 fibers) and 2 multiple cables (2x 10x2x0.8) to the security cabinet in building FML2 (in the security room).

7.22.2 Magnetic contacts/Door monitoring

The Contractor shall install the magnetic contacts as per specifications below.

- a. The entrance doors or escape doors of the building skin are equipped with magnetic contacts.
- b. Doors that are equipped with an access control system shall also be fitted with magnetic contacts.

7.22.3 Access control

The access control center in the FML2 building shall be extended for the Greenhouse.

The extension of the access control center in the FML2 building with all necessary plug-in units shall be included in the total price.

The Contractor shall install the access control system as per specifications below.

Various sections of the building shall be equipped with access controls.

7.22.4 Video cameras

The video center in the FML2 building shall be extended by 2 lines for the Greenhouse.

The extension of the video center in the FML2 building with all necessary plug-in units shall be included in the total price.

The Contractor shall install the video cameras as per specifications below.

In outdoor areas, corridors and the headhouse, cameras shall be installed and integrated into the network.

7.23 Defects Liability Period

The defects liability period shall be considered according to Austrian standards.

7.24 Instruction / maintenance

The electrical installation supplier shall give an instruction manual as well as a maintenance manual after final delivery. Control and approval will be done by the IAEA Site Supervisor.

8. SPECIFICATION CLIMATE COMPUTER

8.1 Electricity and connections

The electricity from the grid (Net A, Net B, Net C) supplies three-phases, 0 and earth. Single phase 230 V; three phase voltage 400 V, and a frequency of 50Hz. The complete installation must be carried out according to the CE standard regulations and Austrian equivalent/adaptations.

After contracting, before ordering the equipment, the above specifications should be checked for abnormalities/deviations, to investigate possible implications for the equipment and adjust/adapt the equipment accordingly.

8.2 Environmental computer

8.2.1 General requirements for the environmental computer

For the control of the greenhouse climate & environmental computer have to be delivered and installed in the office (see drawing). The computer runs the climate-, water-technics-, cooling installation.

Current provisions:

| | |
|--------------------|--|
| Language | : English; |
| Measurements/calc. | : °C, m, m ² , mW/cm ² , J/cm ² |
| Visual display | : text, graphs and user interface (Visio); |
| Printer | : text, graphs and graphics; |
| Control for | : roof ventilation, AHU / heating & cooling; RH, light; screen, irrigation |
| measuring boxes | : for air temperature & humidity; height adjustable; |
| External meteo | : on temperature, wind velocity & direction, light radiation, rain. |
| Accuracy sensors | : temperature ± 0.2 °C Range -10 to + 50 °C |
| | humidity ± 3% Range 10% to 100% |
| | light sensor ± 5% |

System make:

The above mentioned system must be make, Hoogendoorn", Priva "Integro" or Hortimax "Multima" and equipped with all requirements necessary for this greenhouse and future extension.

Control system:

The climate control system should be a dedicated system, with automatic storage of the data and settings during power failure and automatic restart after a power restore. The control software should be designed with the latest developments in greenhouse control.

Meteo station

Measurement of the outside conditions must be placed outside out of the influence of chimney, no shadow of buildings and trees etc.;

- | | |
|--------------------------------|----------------------|
| - outside temp. sensor | -25 / + 60°C |
| - humidity sensor | electronic: 0 – 100% |
| - wind velocity sensor | 0 – 40 m/s |
| - wind direction sensor | 0 – 360 ° |
| - pyrano-meter ("Kipp" Solari) | 0 – 2000 W/m² |
| - rain-sensor | 0 / 1 |

The software for climate departments of the to be built greenhouse:

- greenhouse climate compartments;
- measuring boxes temp. and humidity;
- roof ventilation (windows);
- horizontal screens;
- gable screen steering;
- pipe heating
- controlling air handling unit (heating, cooling, dehumidification)
- grow light steering;
- steering sulphur evaporators
- For the future extension it must be able to extend this computerComputer connections

8.2.2 General

For the installation the following connections and materials have to be delivered and installed:

- a) Measuring box greenhouse
 - fan with dust filter;
 - temperature sensor
 - wet bulb sensor
- b) Roof ventilation:
 - Proportional steering of the roof ventilation;
 - 2 motor relays boxes ventilation (lee- and wind side);
 - interface panel for manual control (open / close / off / automatic);
 - build in potentiometers for feedback window position.
- c) Horizontal screen installations (twice, shading & blackout)
 - Proportional steering of the horizontal screen installation;
 - motor relays boxes screen motor;
 - interface panel for manual control (open / close / off / automatic);
 - built-in potentiometers for feedback window position.

- d) Gable screen installation
 - Open / close steering of the gable screen installation;
 - motor relays boxes screen motor;
 - interface panel for manual control (open / close / off / automatic);

- e) Air handling unit type 1 & 2
 - steering of the fan, with VFD drive;
 - steering of 2 air dampers.
 - steering of the heating coil (pump and mixing valve);
 - steering of the cooling coil (pump and mixing valve);
 - steering of the twin coil system;
 - 2x on/off signal for circulation pump;
 - 2x tri-state floating steering of the mixing valve;
 - interface panels for manual control pumps and mixing valves;
 - pipe temperature sensors in flow and return line;
 - temperature sensors in the AHU.

- f) Air handling unit type 3
 - steering of the fan, with VFD drive;
 - steering of 2 air dampers (recirculation and fresh air)
 - Steering of the heating coil (motor valve);
 - Steering of the cooling coil (motor valve);
 - pipe temperature sensors in flow and return line;
 - temperature sensors in the AHU;
 - steering roof vent for exhaust air vent (differential pressure sensor)

- g) Pipe heating installation
 - Steering of the heating installation;
 - on/off signal for circulation pump;
 - tri-state floating steering of the mixing valve;
 - interface panels for manual control pumps and mixing valves;
 - pipe temperature sensors in flow and return line;

- h) Sulphur evaporators
 - On / off signal or other programmable set-point;
 - relay steering of the plug socket for the electrical heater;
 - shut-off of all fans in the greenhouse chamber;

- i) Grow light installation
 - Steering of the grow lights;
 - on/off signal for the grow lights per section;
 - interface panels for manual control of switches (on / off / automatic)

- j) Irrigation
- water meter with digital reading and pulse signal for remote reading by climate computer
 - steering of the valves or the drip irrigation;
- k) Measuring and steering cable
- cabling should be low voltage cables (up to 42 V 50 Hz). It must be possible to use this unshielded cable without influences of the measurements.

8.3 Computer connections

| Room GH-0- | measuring box (temp + hum) | 2 horizontal screens | gable screen | vents (lee / wind side) | Air handling unit type 1/2 | Air handling unit type 3 | Room pressure sensor | heating mixing group | AHU motor valve | AHU mixing group | High pressure fogging | Sulphur evaporator | grow lights | Overhead irrigation | drip irrigation | Ebb flood |
|------------|----------------------------|----------------------|--------------|-------------------------|----------------------------|--------------------------|----------------------|----------------------|-----------------|------------------|-----------------------|--------------------|-------------|---------------------|-----------------|-----------|
| 1 | 1 | 2 | 4 | 2 | | 1 | 1 | 1 | 2 | | 1 | 1 | 2 | 6 | 6 | |
| 2 | 1 | 2 | 4 | 2 | | 1 | 1 | 1 | 2 | | 1 | 1 | 2 | 4 | 6 | |
| 3 | 1 | 2 | 4 | 2 | | 1 | 1 | 1 | 2 | | 1 | 1 | 2 | 6 | 4 | 6 |
| 4 | 1 | 2 | 4 | 2 | | 1 | 1 | 1 | 2 | | 1 | 1 | 2 | 6 | 6 | 6 |
| 5 | 1 | 2 | 4 | 2 | | 1 | 1 | 1 | 2 | | 1 | 1 | 2 | 4 | 4 | 6 |
| 6 | | | | | | | 1 | | | 2 | | | | | | |
| 7 | | | | | | | | | | | | | | | | |
| 8 | 1 | 2 | 4 | | 1 | | 1 | 1 | | 2 | 1 | | 2 | | | |
| 9 | | | | | | | 1 | | | 1 | | | | | | |
| 10 | 1 | 2 | 4 | | 1 | | 1 | 1 | | 1 | 1 | | 2 | | | |
| 11 | 1 | 2 | 4 | 2 | | 1 | | 1 | 2 | 1 | 1 | 1 | 2 | 6 | 6 | 6 |
| 12 | 1 | | | 2 | | | | 1 | 1 | | | | | | | |
| 13 | 1 | ? | | ? | | | | | 2 | | | | | | | |
| HH | | | | | | | | | | | | | | | | |
| 15 | 1 | | | | | | | | 2 | | | | | | | |
| 18 | 1 | | | 1 | | | | | 1 | | | | | | | |
| 20 | 1 | | | | | | | | 2 | | | | | | | |

Greenhouse rooms 1 to 5 and 11, to be ventilated by and air handling unit. The roof vents will acts as exhaust vents. The greenhouse rooms will be on a slight positive pressure. The roof vents has to be steered to maintain a slight overpressure of about 10 Pa.

Greenhouse rooms 8 and 10, to be ventilated by and AHU only. The room pressure has to maintained at a pressure of – 25 Pa

8.4 AHU control unit

The Air Handling units can be controlled directly by climate control computer, or a separate control box on a Bus system can be selected (like Hotraco Orion or similar).

8.5 Technical room

The next equipment will be installed in the technical room

- 1 pc Motor valve heat exchanger
- 1 pc heat exchanger pump
- 6 pc heating groups
- 2 pc Water chillers
- 2 pc Chiller pumps
- 4 pc Chilled water groups
- 1 pc UV unit
- 1 pc RO unit
- 2 pc Hydrophore

8.6 Cabling

8.6.1 Climate control computer

All cabling of the sensors, actuators, relays, etc. have to be installed and tested. Sensors and actuators has to be mounted.

8.6.2 Irrigation installation

Cabling of the level detectors, valves, flow counters etc. Those must connected and tested by the contractor. Cabling to the valves and drain system: see computer.

8.7 Control computer and data storage

For the operation of the climate computer a PC computer with operating software has to be delivered and installed. The software must be able to show tables and graphs of the climate and setting. All the settings, measurements, calculations etc. must be stored. For long term storage and backup a mini-NAS system has to be delivered with at least 200 GB storage capacity and software.

- event logging for equipment cycles, motor starts etc.
- logging of climate data, temperature, humidity, radiation, rain etc;
- graphical display of measured data;
- data export capability for all recorded data for use in programs like Microsoft Excel;
- soft copy of the program and required loading software to be provided.

Specification

- PC computer with 21"+ colour display
- NAS data and UPS power backup system
- Modem for remote communication
- Needed operation software for the climate operation and control

8.7.1 Modem connection

For tel. service a communication program must be installed together with a high speed modem.

8.7.2 Online control software

Online control software to operate the climate control computer with a tablet or smart phone.



8.8 Instruction and maintenance agreement

8.8.1 Instruction

For instructions of the environmental climate computer installation an English description must accompany the price specification of this description. When the complete system is delivered and mounted an instructor must be available for at least one week and four visits, to put the installation into operation and to supply an instruction manual as well as a maintenance manual; control and approval by the IAEA Site Supervisor.

8.8.2 Guarantee & maintenance

The period of guarantee of the computer system will be 12 months. It must be agreed upon that, in case of malfunctioning, a mechanic must be present. Material costs do not have to be paid for the first period of guarantee and it should be possible to operate the system manually.

With the price quotation, an offer for a maintenance agreement for the environmental computer installation must be enclosed, covering the following items:

- All-risk insurance;
- 24-hour helpline telephone support
- Yearly site visit and a complete check on the operation of the system, calibration of the total system, check of the meteo-station;
- Regular update of the climate computer programs.

8.9 Service climate computer installation

Service, maintenance must be able to be there and repair within 24 hours.