Containment Level 3 Facility for Growing Genetically Modified Plants and Plant Pathogens.

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Containment Level 3 Facility for Growing Genetically Modified Plants and Plant Pathogens.

- History
- Scientific Requirement
- Legislative Requirement
- Design and Build
- Engineering Solution

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History

- Decision to build new facility Spring 2005
- Initial OJECS Controlled Environments Summer 2005
- Cancelled December 2005
- Spring 2006 revised remit for building
- Tender revised CE summer 2006
- Revised Design Autumn 2006
- Work commenced February 2007
- Handover February 2008

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Scientific Requirement

- The development of plant virus based vectors and inoculation techniques for the analysis of plant gene function
- Studies with genetically modified plants and their interaction with plant pathogens
- Studies with genetically modified plant pathogens
- Studies with genetically modified insects
- Affordable

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Scientific Requirement

Plant Species

- Wheat and related species. (*Triticum species)*.
- Barley (*Hordeum vulgare*).
- Rice (*Oryza sativa*)
- *Brachypodium distachyon*
- Maize (*Zea mays*)
- Oilseed Rape (*Brassica napus*)
- *Brassica rapa*
- Thale Cress (*Arabadopsis thaliana)*
- Sugar Beet (*Beta Vulgaris*)

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Scientific Requirement

- Fungal Species: *Gibberella zeae* (anamorph *Fusarium graminearum*), *Fusarium culmorum, Gibberella coronicola* (anamorph *Fusarium pseudograminearum*), *Fusarium sporotrichioides, Gibberella moniliformis* (anamorph *Fusarium verticillioides*), *Gibberella fujikuroi* (anamorph *Fusarium moniliforme*), *Mycosphaerella graminicola* (anamorph *Septoria tritici*), *Claviceps purpureum* (anamorph *Sphaecelia segetum*), *Leptosphaeria maculans* (anamorph *Phoma lingam), Leptosphaeria biglobosa, Pyrenopeziza brassicae* (anamorph *Cylindrosporium concentricum*), *Oculimacula yallundae* (anamorph *Ramulispora herpotrichoides*), *Oculimacula acuformis* (anamorph *Ramulispora acuformis), Gaeumannomyces graminis* var. *graminis* (anamorph *Phialophora* sp. = *Harpophora* sp.), *Gaeumannomyces graminis* var. *tritici* (anamorph *Phialophora* sp. = *Harpophora* sp.), *Gaeumannomyces graminis* var.*avenae* (anamorph *Phialophora* sp. = *Harpophora* sp.), *Gaeumannomyces cylindrosporus* (anamorph *Harpophora radicicola* var. *graminicola*), *Magnaporthe grisea (anamorph Pyricularia grisea*)

- Virus Species: *Barley stripe mosaic virus, Soil borne wheat mosaic virus, Soil borne cereal mosaic virus, Barley mild mosaic virus, Barley yellow mosaic virus, Beet necrotic yellow vein virus*

- Virus Vectors: *Polymyxa graminis, Polymyxa betae*

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Legislative Requirement

- Proposed work covered by two sets of regulations:
- The Genetically Modified Organisms (Contained Use) Regulations 2000
- The Plant Health (England) order 2005. This implements the European Council Directive 2000/29/EC

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Legislative Requirement

- The Genetically Modified Organisms (Contained Use) Regulations 2000 specify the legislative requirements for containment of genetically modified organisms in the UK
- Enforced by the Health and Safety Executive (HSE)
- Risk from genetically modified plant pathogens defined as a category 3 risk purely on environmental grounds
- Facilities are licensed by the HSE and for a Category 3 risk facility inspections are scheduled annually

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Legislative Requirement

- The Plant Health (England) order 2005. This implements the European Council Directive 2000/29/EC Enforced by the Health and Safety Executive.
- Imported ‘scheduled’ organisms including plants and plant pathogens not permitted into the European Union have to be held under a licence issued by the PHSI (Plant Health and Seeds Inspectorate), an agency of DEFRA.
- Licences are issued, subject to an inspection by the PHSI and conditions for containment commensurate with the risk are imposed.
- Inspections are annual.

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Design and Build

Guidance:

- ACGM Guidance Notes issued by HSE.
- Existing facilities at Syngenta, Jeallotts Hill and SCRI, Dundee.
- Research staff. Kim Hammond Kosack and Martin Urban who had worked at a similar facility at Monsanto in Cambridge.
- Discussions with HSE inspectors and PHSI inspector and colleagues at CSL.
- Safety and Biological Safety officers at Rothamsted.
- SDC of Bedford, Roger Parker Associates, EPP, Unigro and Weiss Gallenkamp

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Design and Build

Constraints:

- Multipurpose building
  - Containment Level 3 33%
  - Soil Physics Laboratory 15%
  - Field Support Facilities 35%
  - Alternate computing facilities 17%
- Funding
  - Budget of £5 million ($9 million)
  - Estimated that £2 million would be spent on the Cat 3 Facility
- Affordable to run
- No Benchmark
- Location

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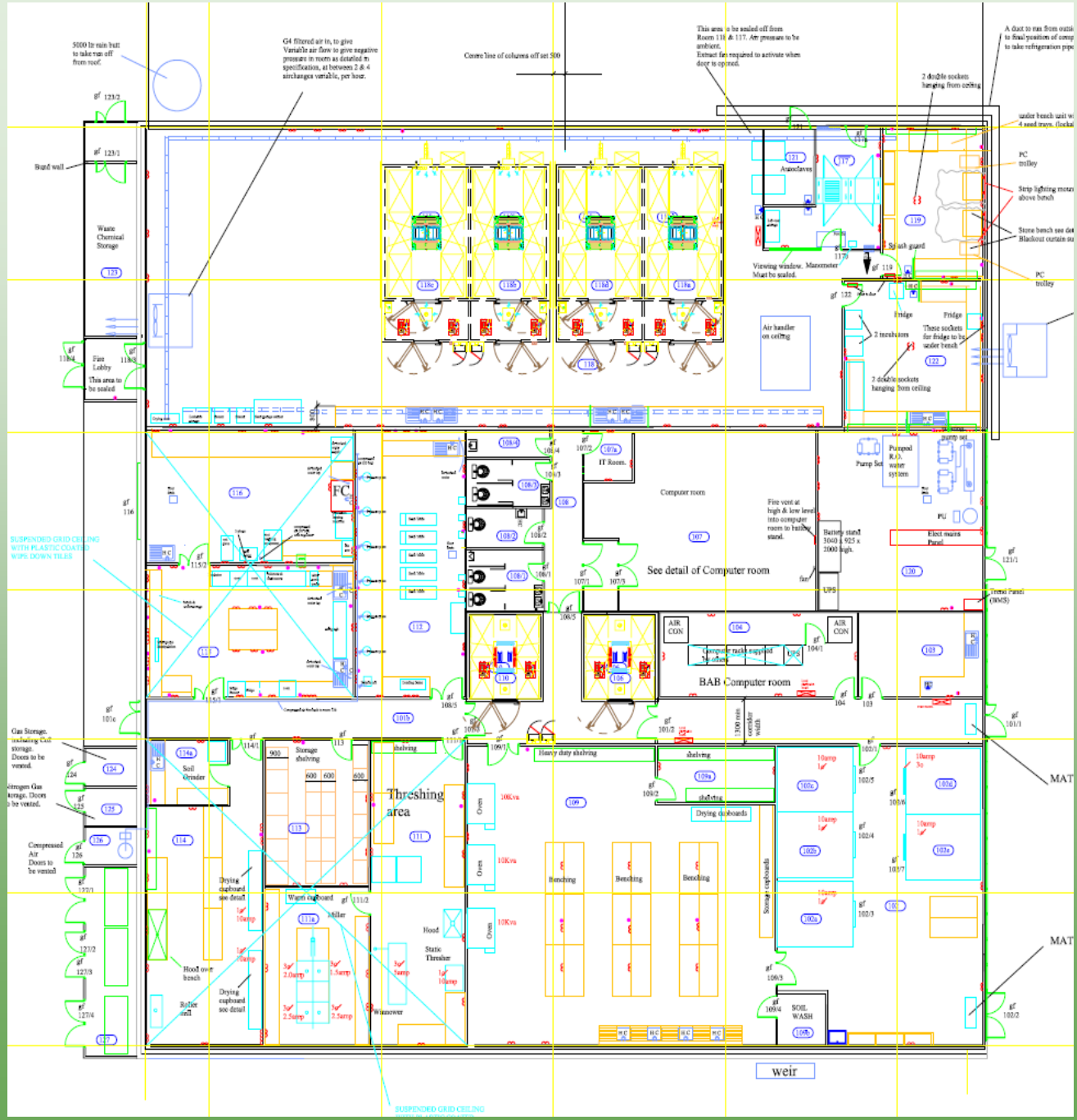
5000 ltr rain butt to take run off from roof.
G4 filtered air in, to give Variable air flow to give negative pressure in room as detailed in specification, at between 2 & 4 airchanges variable, per hour.
Centre line of columns off set 500
This area to be sealed off from Room 118 & 117. Am pressure to be ambient. Extract fan required to activate when door to opened.
A duct to run from outside to final position of compressor to take refrigeration pipe
2 double sockets hanging from ceiling
Bund wall
Waste Chemical Storage
Fire Lobby
This area to be sealed
Viewing window. Manometer Must be sealed.
Splash guard
Fridge
Fridge
These sockets for fridge to be under bench
2 double sockets hanging from ceiling
Air handler on ceiling
Pump set
Pumped R.O. water system
Computer room
See detail of Computer room
Fire vent at high & low level into computer room to battery stand.
Battery stand 3040 x 925 x 1000 high.
Elect mains Panel
UPS
AIR CON
AIR CON
BAB Computer room
SUSPENDED GRID CEILING WITH PLASTIC COATED WIPE DOWN TILES
Gas Storage.
Nitrogen Gas storage. Doors to be vented.
Compressed Air Doors to be vented
Soil Grinder
Storage shelving
Threshing area
Drying cupboard see detail
Warm cupboard
Miller
Hood over bench
Roller mill
Winnower
Hood
Static Thresher
Ovens
10Kva
Benching
Heavy duty shelving
Drying cupboards
Storage cupboards
SOIL WASH
weir
SUSPENDED GRID CEILING

Design and Build

Purpose of Containment

- Mitigation of Risk
- To contain organisms (plants and pathogens) so that they pose no risk to the environment.

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Design and Build

Containment area:

- Total area of 428 square metres.
- Large Room with four growth rooms, two tiered with 24 square metres of growing area, two with trolleys with 9.75 square metre of growing area.
- UV water treatment system.
- ‘Wet’ laboratory
- ‘Dry’ laboratory
- Autoclave room
- Entrance lobby and ‘Air Shower’

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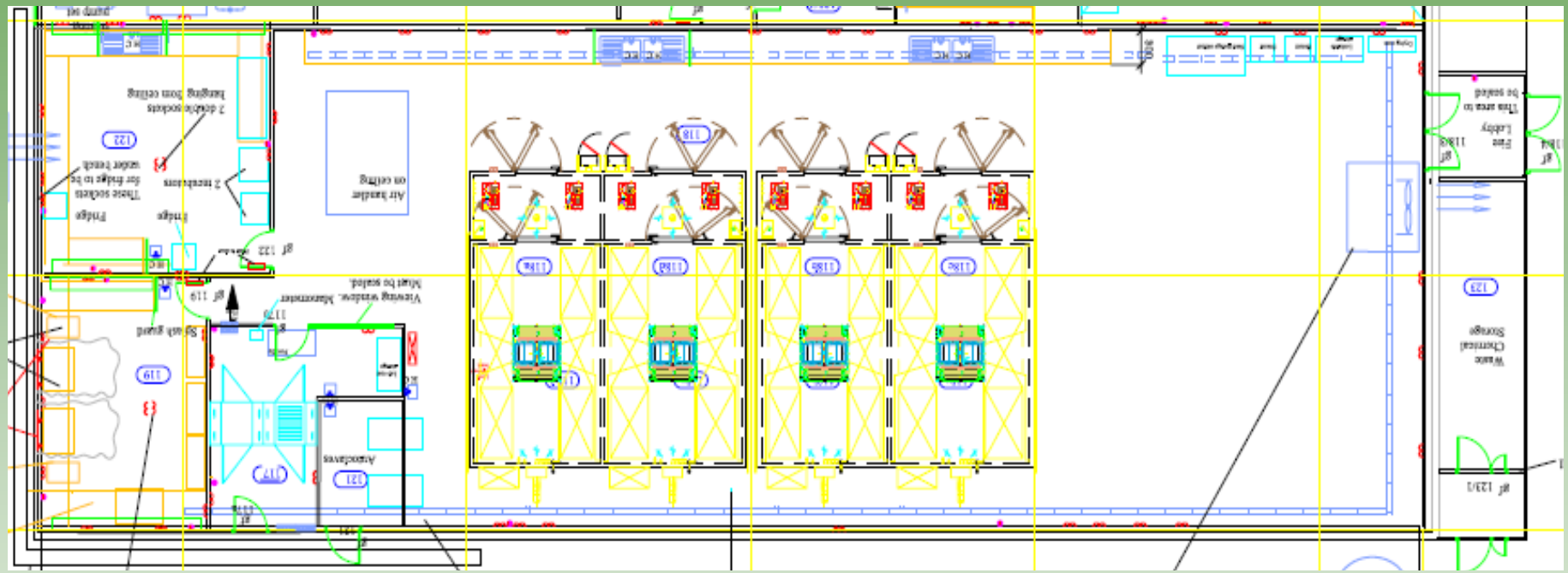

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Engineering Solution

Building Envelope

- Containment facility is part of a much larger structure but physically separate.
- All six elements of the structure have been carefully constructed to provide a hermetic solution.
  - ‘Kingspan’ roofing system for thermal and sealing purposes.
  - All plasterboard surfaces are double skinned- each skin being taped and sealed.
  - Joints/interfaces between elements are fitted with PVC coving that is mechanically fixed and mastic sealed.
  - Number of times an element has been punctured has been minimised.
  - Floor is sheet vinyl punctured only by drains of growth rooms and sump to which drains are fed

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Engineering Solution

Building Envelope

- The Containment area envelope has been pressure tested and achieved a leakage rate of 0.71 m^3/hr.
- The buried drain lines between the Growth chambers and the treatment sump have been pressure tested.
- The main Air handling units include filtration.
  - The extract system has duplex filters with G3 and F7 filters with a “safe change” housing.
  - In addition to the duplex filtration system there are duplex motors to cover motor failure.
  - Interlocks are fitted to maintain negative pressure at all times.

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Engineering Solution

Building Envelope

- Swipe carded door entry.
  - Both outer door and inner lobby door.
- Outer lobby.
  - Monitoring equipment and signing in book.
  - Coats and safe storage (lockers)
- Air shower installed.
  - Interlocked doors, timed ‘air shower’
  - Designed to remove loose particles, pollen, insects.
  - Traps inside shower to monitor insect load. SOP to monitor and fumigate if required.
  - Separate goods air shower.
- Inner lobby.
  - Held at -5 Pa relative to air shower and outer lobby.
  - Coloured lab coats, overshoes, put on.

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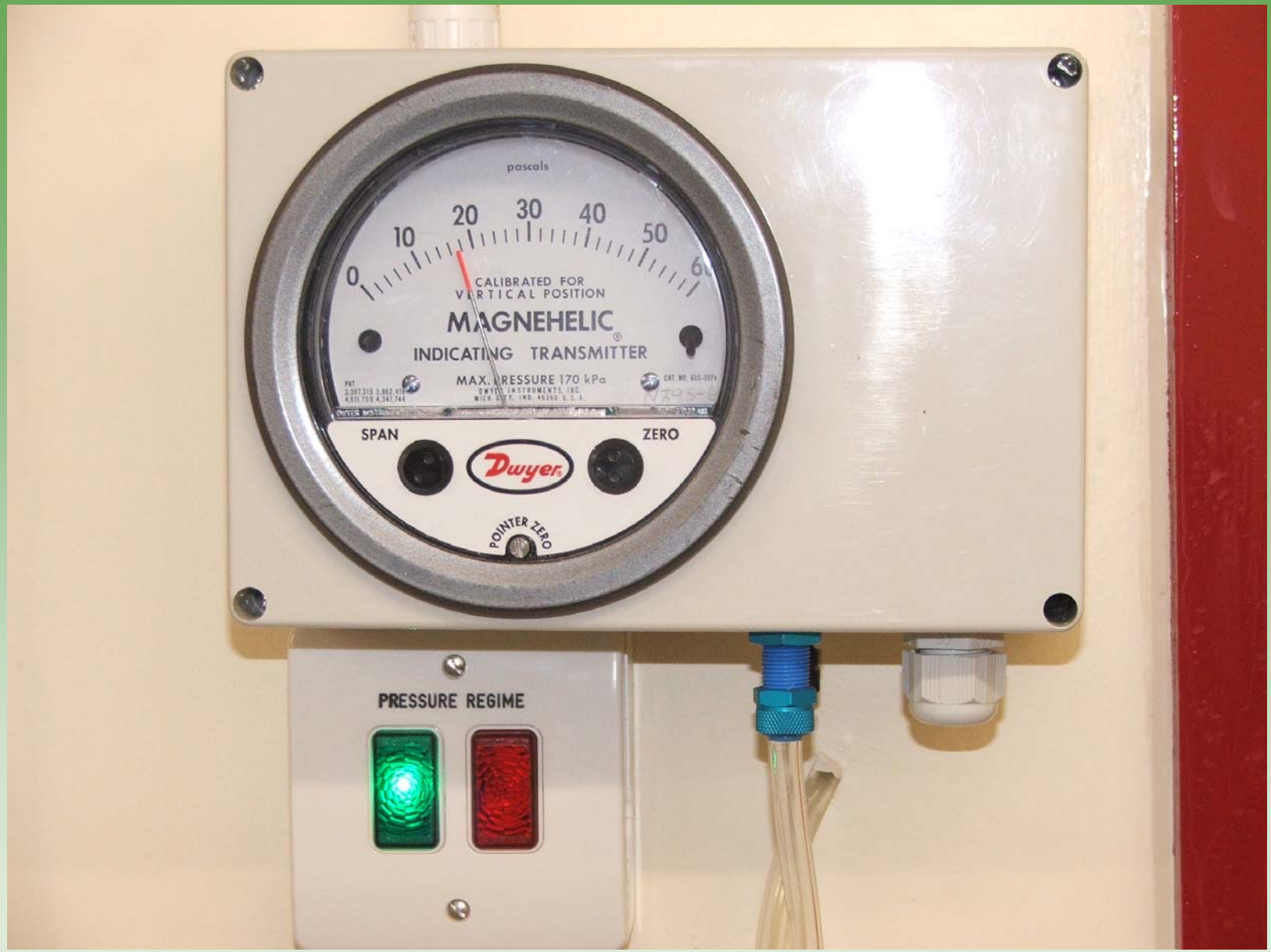

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Engineering Solution

Building Envelope

- Main area, including labs kept at -15 Pa relative to inner lobby.

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Engineering Solution

The Growth Rooms

- There are 4 growth rooms that provide the highest level of containment.
  - Integral air locks
  - mechanically sealed box with sealant gunned into the joints
  - totally pressure tight apart from the functional openings.
- The fresh air inlet.
  - Connected to an external weatherproof louvre via sealed ductwork
  - Gas tight dampers for filter maintenance and fumigation
  - EU4 filter with integral pressure sensing
  - A VAV damper to maintain room negative pressure
  - Supply fan
  - Back draught prevention damper
  - Supply air diffuser and integrated insect screen

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Engineering Solution

The Growth Rooms

- The Exhaust air outlet.
  - Connected to an external weatherproof louvre via sealed ductwork
  - Gas tight dampers for filter maintenance and fumigation
  - Filter section comprising pre filter, an H13 HEPA filter, an insect screen and integral pressure sensing.
  - Exhaust fan with speed control governed by room negative pressure.
- Negative Pressure Regime
  - Growth room lobby -15 Pa to main room
  - Growth room -15 Pa to growth room lobby (-45 Pa to outside)

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The Growth Rooms

- The Growth Room Lobby
  - Door to main growth room from lobby has face to face seals on three sides and wiper seal on bottom
  - Door to main room has face to face seals on all four edges
  - Door to growth room has EU filter
  - Door interlocked to outside main room door
  - Infra red operated tap

- Main Growth Room
  - Adjustable air flows
  - Noise levels less than 70 db
  - Temperatures adjustable in range 10 to 30°C. Uniformity ± 1°C
  - Light level achievable up to 500 µmol m^2 sec^{-1}
  - Occupancy Sensor

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Engineering Solution

Water Treatment

- All drains feed to sump
  - No linkage to outside
  - Drain pressure tested to 50 Pa.
- Ultra Violet Water Treatment
  - Dual tank/treatment system
  - Water filtered prior to UV treatment
  - Sample ports for regular check
  - Fail safe if power off
  - 12 hour treatment cycle
  - Overflow tank linked to shut off valves on all water supplies
  - Tanks bunded
  - Kill cycle validated by peer review paper.

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Engineering Solution

Waste Treatment

- Through the wall autoclaves
  - Interlocked doors
  - Dual autoclaves

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Engineering Solution

Management

- Appropriate Containment
- Standard Operating Procedures
  - Cleaning
  - Sample Handling
  - Experimental Procedures
- Protective Clothing

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Summary

- Containment Level 3 capable
- Room for Expansion
- Validated
- Inspected
- Energy Efficient

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