L390

A Low Cost, Energy Efficient, GM Mouse Breeding Facility

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4/17/13

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Course Description

A 4000m2 vivarium has been recently constructed on a green-fields site near Sydney. It has employed extensive energy saving initiatives.
The facility is exclusively used for the breeding of SPF mice for use in multiple research institutions.
The facility has an initial capacity of 17,500 cages but has been planned to be easily expandable to 33,000 cages at a low incremental cost. The facility is of simple, robust warehouse style construction and uses soft wall clean rooms as the main housing module with the warehouses. The clean rooms are added as the facility grows.
The facility design addresses the major issues of low capital and operating costs, low energy use, staff and animal welfare and ease of maintenance.

Learning Objectives

At the end of the this course, participants will be able to:

1. Consider a low cost approach to design of a large scale rodent breeding facility

2. Consider energy efficient design approaches

3. Consider a business model for the shared use of a large facility

4. Design for scalability in a large breeding facility

Presentation overview

- The birth of the facility – the brief
- Space planning principles
    - expansion
    - amenity and safety
- The business model
- Engineering planning principles
    - robust
    - efficient
- Utilities and facility performance

The need for a new facility

- A 10 year old Inner city medical research institute facility (www.garvan.org.au) was highly overcrowded

- There were no foreseeable on-site expansion opportunities

- The best solution was seen to be to move breeding services off-site

The need for a new facility

• Why build a new facility for Garvan's needs only? - Multiple research institutes and universities were facing similar space shortage and facility ageing issues

• After significant effort, a number of core founding partners committed to *use* of the facility (but not the capital cost)

The new breeding facility brief

The facility should:

- Be an SPF agistment facility with foreseeable 5-7 year capacity of 15,000+ mouse cages with 400 *plus* strains
- Allow for additional significant growth, flexibility and regeneration of space, plant and equipment (over 20+years)
- Have a “modest” construction cost (~$20 million TPC) <$4K/m2
- Be designed to minimize environmental impact and operating costs
- Be robust and appropriately manage all foreseen risks
- Be built for to high standards of staff amenity & safety

As an agistment facility, it must have:

- High client visibility and accountability

- Simple user interface with transparent ordering and accounting systems. - the “Stuart” software package was developed in conjunction with the physical facility design

Development of the business model

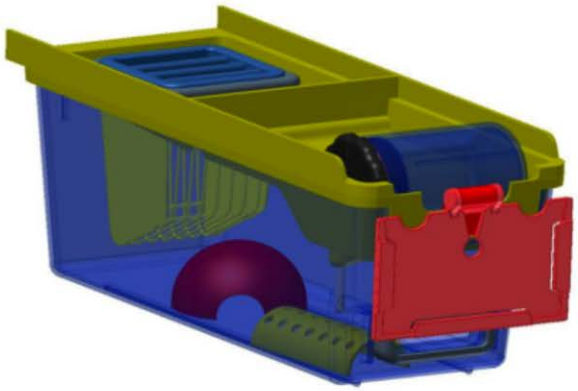
- Garvan-built, owned and operated
- Highly accountable management – with a client-representative management advisory group and regular reporting
- Full client visitation rights
- Full cost recovery – not for profit
- Monthly transparent billing and reporting

Cost-driven development of the vision

The basic space design evolved with early cost-based decisions around 4 major elements:

- Greenfields, warehouse-based (to lower construction cost and allow incremental expansion)
- IVC's powered only by house exhaust (Airlaw EVC's)
- Soft walled clean rooms (SWCR) for cleanliness and contamination control rather than discreet holding rooms (BioBUBBLE)
- Total budget was $20million - <$4000.00/m2 ($400/sq.ft) – including clean rooms

Exhaust ventilated cage

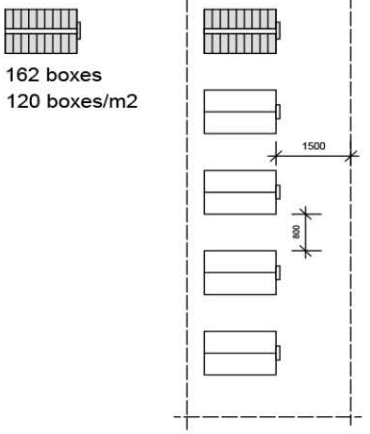


Development of the accommodation module – start with the rack

162 boxes
120 boxes/m2

The basic planning module was a double sided 162 box, high density, exhaust ventilated cage rack

Development of the accommodation module

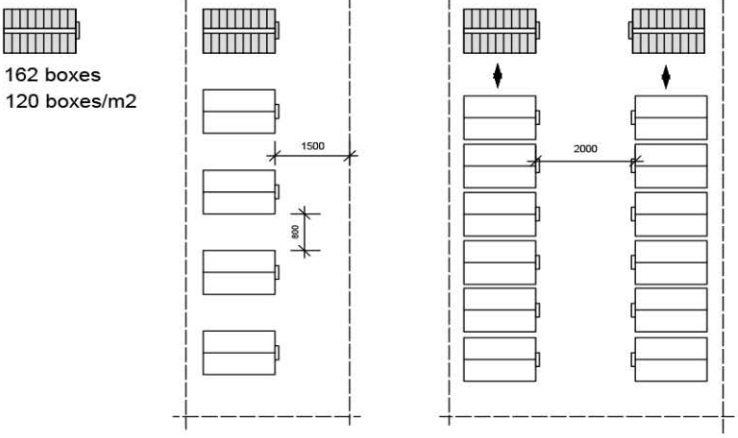


162 boxes
120 boxes/m2

31.8M2
810 boxes
25 cages /m2

Add circulation space between and beside racks

Development of the accommodation module



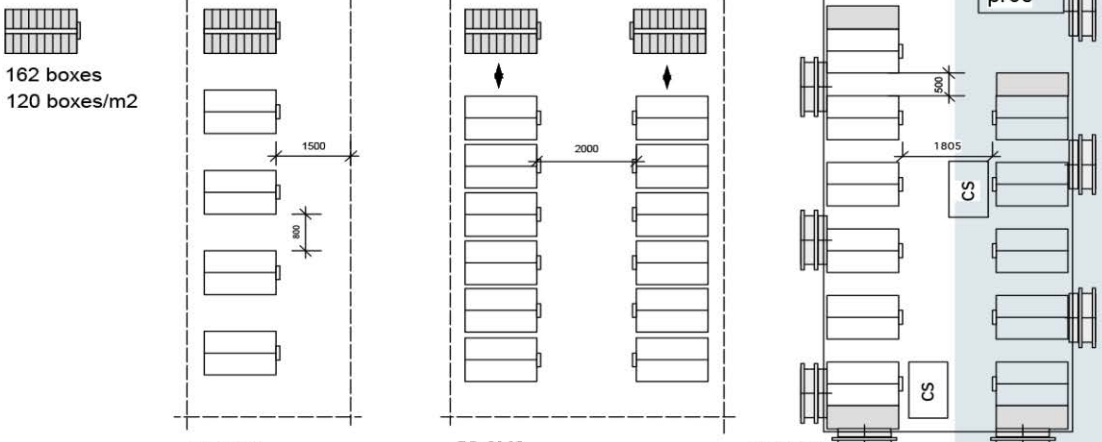
162 boxes
120 boxes/m2

31.8M2
810 boxes
25 cages /m2

52.6M2
2268 boxes
43 cages /m2

Add double loaded corridor
for efficiency

Development of the accommodation module



162 boxes
120 boxes/m2

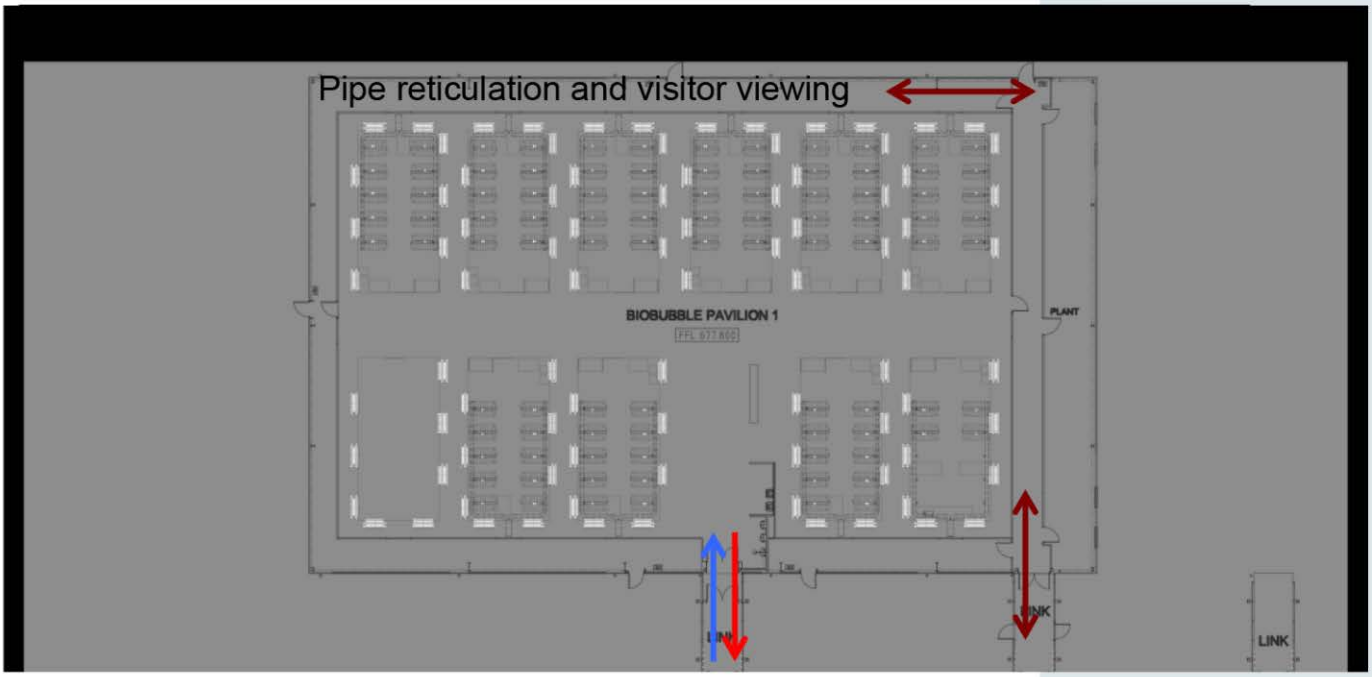
31.8M2
810 boxes
25 cages /m2

52.6M2
2268 boxes
43 cages /m2

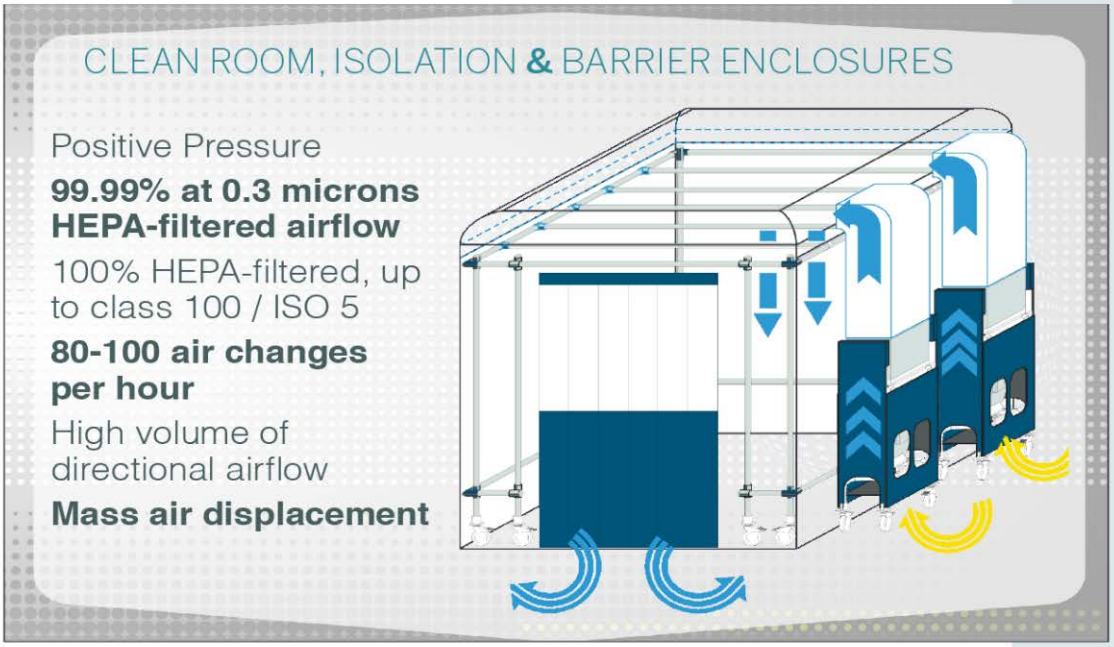
50.0M2
1782 boxes
35 cages/m2

enclose in a SWCR

House 11 x clean rooms in a breeding *pavilion*

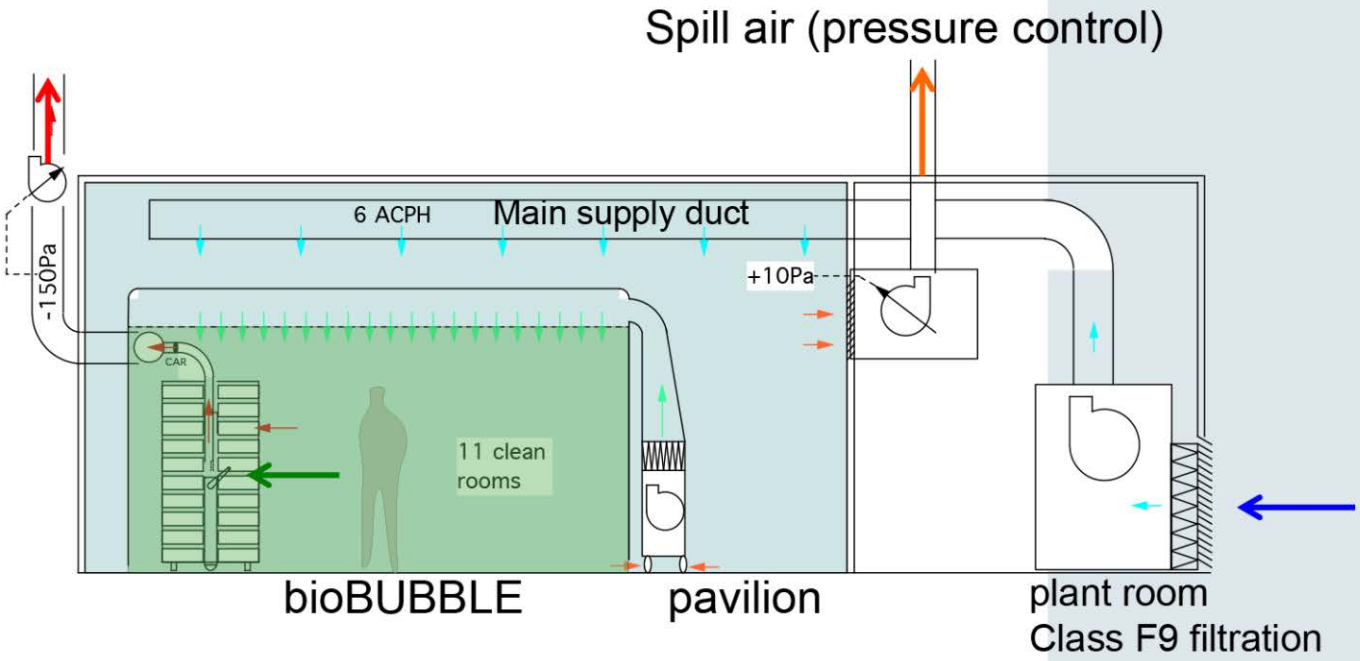


BioBUBBLE clean room operating principles



+ Add a mouse barrier at low level

Pavilion airflow schematic



Development of servicing principles

- For simplicity, a single box service corridor model was developed with campaign style servicing of clean and dirty materials movement

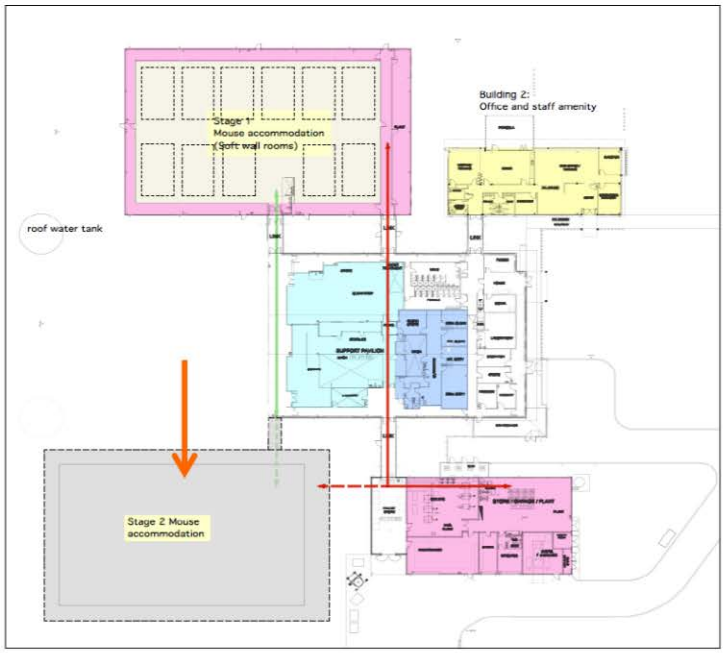
- Engineering plant and servicing separation was considered essential (peri-stitial corridor around animal pavilion)

Development of accommodation expansion principles

- While the facility was foreseen to initially have 15-20,000 cage capacity, the expansion capability should be double this

- How was this accomplished?

Allow for a second mouse pavilion

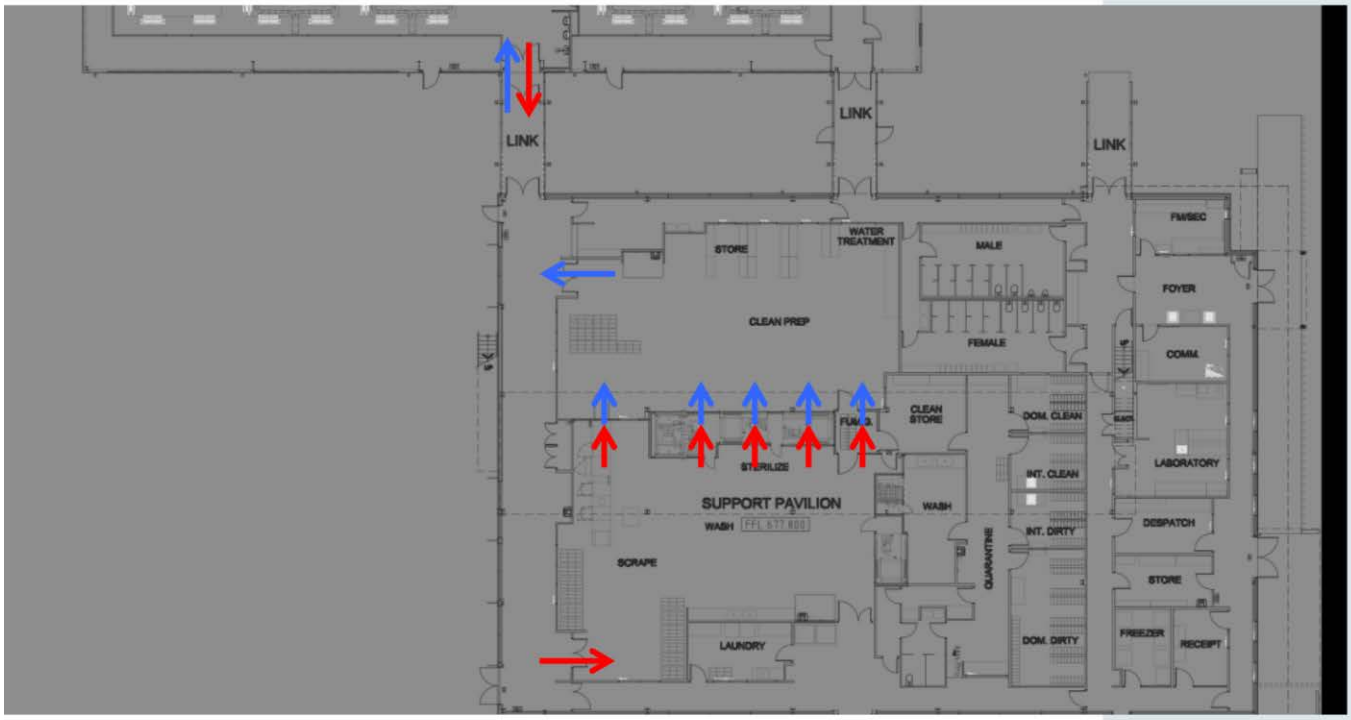


Service area durability and regeneration

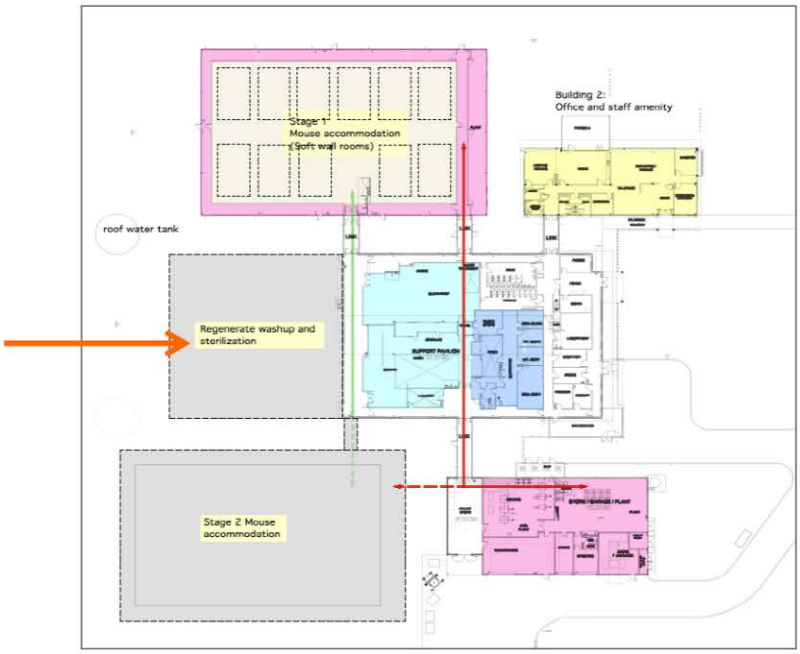
- Design to allow for expansion and / or regeneration of the main cage service area

- Allow for additional units of plant

Washup pavilion arrangement



Allow for washup expansion or regeneration



Allow for additional or replacement energy plant

- steam boilers
- hot water boilers
- chillers

In terms of

- access
- space

Design for engineering *robustness / redundancy*

- dual utility sources
  - gas and oil for boilers
  - town power and generator power
    for the whole facility

- dual air handlers and fans (run and standby)

- >1 sensors
  (4 temperature and humidity sensors in the main pavilion)

Design for energy efficiency

- Frictionless bearing chillers
- Solar panels for process hot water
- Rainwater collection for steam and toilet flushing
- Extensive metering of services for constant improvement
- LED and T5 lighting


TASMAN
TANK CO.

Design for Staff amenity (and retention)

- Encourage visibility and communication
  - windows, open plan spaces
  - transparent holding spaces
- Provide excellent break facilities
- Provide visual access to the outside world

Design for client and community engagement

- Access for visitors, clients without interrupting work or barrier
  - extensive viewing windows
  - engagement with community organisations, schools

- ”Conduit” for high speed internet to local schools


SPARTAN

Risk management overview

- Disease – SWCR and negative pressure cages
- Utilities' failure (dual sources)
- Plant failure (n+1)
- Security – 24 hr video and community engagement
- Earthquake and bushfire – appropriate construction and separation from fire fuel

Particle counts

	0.3 micron (p/m^3)	0.5 micron (p/m^3)	1.0 micron (p/m^3)	3.0 micron (p/m^3)	5.0 micron (p/m^3)	10.0 micron (p/m^3)
supply plenum	13,249,054	794,277	258,907	217,639	73,051	10,292
office	2,862,809	172,033	55,494	35,416	5,852	1,614
dirty wash	1,417,127	184,645	99,991	102,715	33,095	4,742
mouse pavilion	1,110,192	45,001	15,639	16,144	6,357	1,211
clean prep	10,273	6,329	5,962	8,439	5,045	1,192
occupied soft wall	7,063	5,953	5,449	6,054	3,431	908
empty soft wall	504	1,110	1,312	2,119	404	202

Disease containment aspirations

- High quality SPF animals (re-derived if not certified “clean”)

- Excluding over 30 pathogens, following a similar testing regime to the FELASA guidelines.

- Pathogens commonly found in mouse breeding facilities, Murine norovirus and helicobacter species are excluded from the facility.

Disease containment performance

• In early 2012 a disease outbreak occurred in the barrier area involving murine nonovirus (MNV) and minute virus of mice (MVM) that were introduced in two different imported/re-derived lines.

• In both cases the combination of IVC caging within SWCR's provided excellent containment allowing infected lines to be removed and the outbreak rapidly contained.

Utilities cost

Water	5100 kl /yr	<1c/box/week
Gas	$7.9x10^6$ MJ/yr	25c/box/.week
Electricity	$7.9x10^5$ kWhr/yr	24c/box/week

Total cost about 50c per box per week

Box charge is $9.50/box/week (~5%)jj

Further benchmarking required

Facility Tour

Extensive use of glass

The “bubble” pavilion

Inside a clean room


KIMTECH

Clean room laboratory

Expansion space


1


MILLIPORE
RIOS

Viewing and engineering corridor