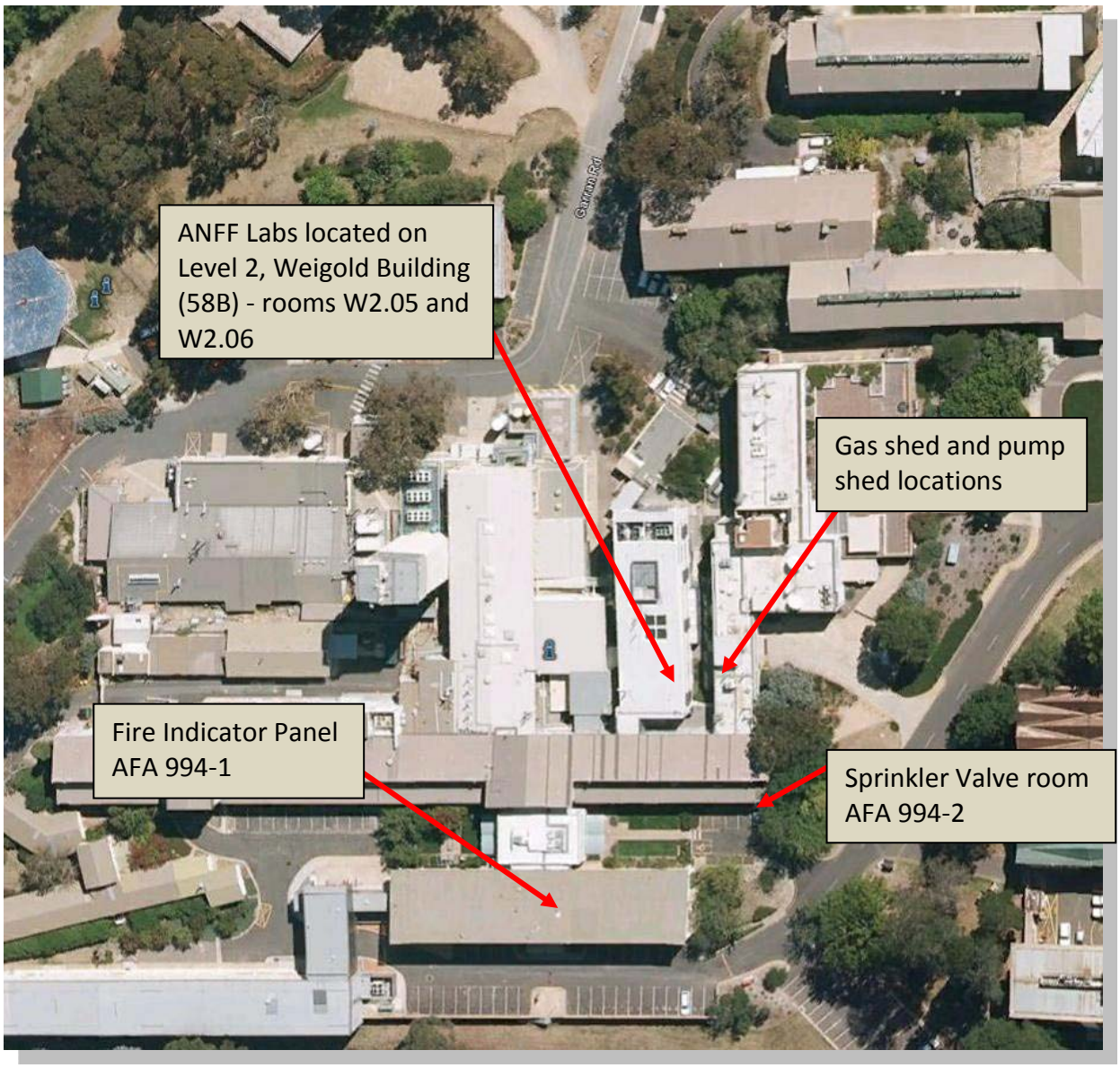
Australian National University

Australian National Fabrication Facility (ANFF)

Located in Building 58B – Erich Weigold Building
Mills Road, Acton

Smoke Detection System	AFA 994-1
Sprinkler System	AFA 994-2



The ANFF laboratory in room W-2.05 houses four (4) state-of-the-art research instruments used for processing and fabrication of microelectronic, optoelectronic and photonic devices:

- Temescal BJD 2000: an electron-beam (**e-beam**) evaporator that will be used to deposit thin films of metals (such as Ti, Au, Pt, Ge, Ni, Cr, Al, etc.) on various substrates. This machine uses a high voltage power supply to the electron-gun. Two neutral gasses are connected to this machine: N_2 for venting purpose and Ar for use with the ion-source.
- Oxford Instruments Plasma Technology System 100: a plasma-enhanced chemical vapour deposition (**PECVD**) system that will be used to deposit dielectric layers as such silicon dioxide, silicon nitride, silicon oxi-nitride and amorphous silicon. This system makes use of the following gases: SiH_4, NH_3, CF_4, O_2, N_2, He. Only the first two are hazardous. Silane is explosive/toxic and ammonia is corrosive.
- Oerlikon Versaline: an inductively coupled plasma reactive ion etching (**ICP-RIE**) machine for etching of various materials. The system uses the following gasses: Cl_2, BCl_3, CH_4, H_2, CHF_3, SF_6, O_2, Ar, He and N_2. Cl_2 and BCl_3 are corrosive, CH_4 and H_2 are flammable.
- FEI Helios: an electron microscope with an integrated focused ion beam (**FIB**) source. The system is used to fabricate nano-structures and also for various electron-beam-based characterisation of materials.

Temescal BJD 2000

Oxford Instruments Plasma Technology System 100

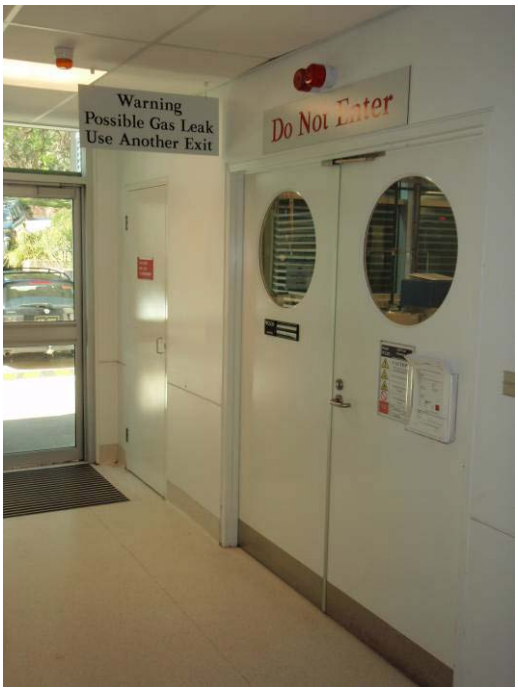
Oerlikon Versaline

FEI Helios

Various auxiliary facilities are installed in two purposely-built sheds outside the building and adjacent to the lab W-2.05. One shed (Gas Shed) contains all the gas cylinders. These cylinders are stored in extracted gas cabinets. The second shed (Pump Shed) houses a nitrogen generator (and the associated compressor and a high pressure storage vessel), two dry pumps and 2 abatement systems (one each for the PECVD and ICP-RIE system). The nitrogen is required to purge the pumps whilst they are in operation and the abatement systems are used to scrub residual Cl_2, BCl_3, SiH_4 and NH_3 gases from the process.

Gas shed

Pump shed



ANFF laboratory – room W2.05

Gas Monitoring System

A number of safety features have been built in to the ANFF laboratory to ensure safe operation of the systems. Potential hazards of the system include a toxic gas leak, flammable gas leak, and fire.

Moreover an oxygen detector is located in the room to monitor any possible O_2-depletion that may be caused by a gas leakage of a neutral gas. Conditions throughout the laboratory and the gas shed are therefore monitored by a series of gases sensors and smoke detectors. The output of all these monitors and their general operation is monitored in turn by an elaborate gas monitoring system.

The gas monitoring system is built to incorporate the outputs produced by the sensors and smoke detectors to the various inputs of the RIE and ICP-RIE systems, in addition to controlling the remote turning on/off the gases, producing messages and other alarms. When an alarm condition is activated messages are displayed on the screen of the gas alarm monitoring system accompanied by a warning beeper, by flashing lamps and/or by sirens depending on the nature or severity of the alarm condition. Not all inputs to the gas alarm monitoring system are considered critical but it will act on non-critical inputs with a beeper and on-screen messages indicating the input and any action taken.

When critical alarm conditions are activated, the RIE and ICP-RIE systems and all ancillary equipment are put into a safe state. Any deposition and etching process (which use the gases) is terminated, supplies of all gases from the gas shed are shut off via the remotely controlled valves and should therefore poses no further risk. The gas alarm monitoring system will however continue to monitor and act on the output of various detectors.

In the event of a toxic or flammable gas leak detected in the laboratory, a General Evacuation Alarm is activated in addition to the termination of deposition/etching process and the shutting off all the gases in the gas shed. A general evacuation alarm is indicated by the red flashing lights and loud sirens located at various places in the Weigold Building, including at the entrances. The ANU Security and Fire Brigade are informed.

In the event a Fire Alarm is activated (either as a result of an incident in the ANFF Lab, Pump Shed, Gas Shed or other activities within the building), the gas alarm monitoring system terminates the deposition/etching process and shuts off all gases in the gas shed. The Fire Alarm is integrated into the ANU Fire Safety System. The ANU Security and Fire Brigade are informed.

The gas monitoring system activates different signalisations and flash lights depending on the nature and cause of the alarm, ANFF staff would know if alarm is caused by a gas sensor or by a fire alarm (lab room or elsewhere in the building).

Warning signs and strobe lights

Chemicals in Gas Shed

Chemical Symbol	Chemical Name	Quantity	TLV (ppm)
SiH_4	Silane	10 kg	5
NH_3	Ammonia	22.7 kg	25
CF_4	Tetrafluoromethane	32 kg	N/A
O_2	Oxygen	10.5 m^3	N/A
N_2	Nitrogen	2x 8.4 m^3	N/A
He	Helium	2x 9.1 m^3	N/A
BCl_3	Boron trichloride	4.5 kg	5
CH_4	Methane	12.5 m^3	N/A
H_2	Hydrogen	4.1 m^3	N/A
CHF_3	Trifluoromethane	31.8 kg	N/A
SF_6	Sulfur hexafluoride	24.7 kg	N/A
Ar	Argon	10.5 m^3	N/A
Cl_2	Chlorine	10.2 m^3	1

Staff Alarm Response Procedure

Activated by a gas sensor

Working Hours

During business hours the ANFF staff is responsible to respond to any alarm and the following steps should be undertaken:

If general evacuation is activated by a gas sensor:

- ANFF staff and all lab users have to evacuate the premises.
- All gases will be shut-down by the gas monitoring system.
- The gas monitoring cabinet is positioned in such a way that one can see from outside the room the cabinet screen and identify which gas is causing the alarm and the location of the leakage/activated sensor.
- If gas level remains above TLV an action should be undertaken to shut manually the corresponding gas cylinder. This should take place by two persons in SCBA through the window of the gas cabinets with a protective gear (long sleeves and gloves) if the gas leakage is Cl_2/BCl_3.
- If gas level has dropped below TLV after shutting down all gases the alarm system can be reset; however the faulty gas will not be used until the leakage has been identified, repaired and tested.

After Hours

If general evacuation is activated by a gas sensor:

- ANFF staff and all after hours lab users (if any) have to evacuate the premises.
- All gases are or will be shut-down by the gas monitoring system.
- ANU Security is notified by Building Management System (BMS) through the Lab alarm system. The fire brigade may decide to call ANFF personnel (emergency list) requiring presence and assistance in further handling of the alarm.
- The gas monitoring cabinet is positioned in such a way that one can see from outside the room the cabinet screen and identify which gas is causing the alarm and the location of the leakage/activated sensor.
- If gas level remains above TLV an action should be undertaken to shut manually the corresponding gas cylinder. This should take place by two persons in SCBA through the window of the gas cabinets with a protective gear (long sleeves and gloves) if the gas leakage is Cl_2/BCl_3.
- If gas level has dropped below TLV after shutting down all gases the alarm system can be reset; however the faulty gas will not be used until the leakage has been identified, repaired and tested.

Staff Fire Alarm Response Procedure

Activated by a smoke detector

Working Hours

If general evacuation is activated by a fire alarm:

- ANFF staff and all lab users have to evacuate the premises.
- All gases will be shut-down by the gas monitoring system.
- ACT Fire Brigade and ANU Security are notified and ANFF staff should remain available to assist/advise ACTFB during the entire period of the fire alarm.
- The fire alarm can only be reset by ACT Fire Brigade.
- Re-enter building if ACT Fire Brigade allows it.
- Write summary report and distribute.

After Hours

If general evacuation is activated by a fire alarm:

- ANFF staff and all after hours lab users (if any) have to evacuate the premises.
- All gases are or will be shut-down by the gas monitoring system.
- ACT Fire Brigade and ANU Security are notified by fire alarms system, ANU Security calls ANFF personnel (emergency list) requiring presence and assistance in further handling of the fire alarm.
- The fire alarm can only be reset by ACTFB.
- Re-enter building if ACT Fire Brigade allows it.
- Write summary report and distribute.

ACT Fire Brigade Procedures

The following procedures have been developed to aid ACTFB officers after hours.

Fire Alarm - Zone 2 Gas leak trip

Business Hours

- ANFF staff and all lab users have to evacuate the premises.
- All gases will be shut-down by the gas monitoring system.
- The gas monitoring cabinet is positioned in such a way that one can see from outside the room the cabinet screen and identify which gas is causing the alarm and the location of the leakage/activated sensor.
- If gas level remains above TLV an action should be undertaken to shut manually the corresponding gas cylinder. This should take place by two persons in SCBA through the window of the gas cabinets with a protective gear (long sleeves and gloves) if the gas leakage is Cl_2/BCl_3.
- If gas level has dropped below TLV after shutting down all gases the alarm system can be reset; however the faulty gas will not be used until the leakage has been identified, repaired and tested.

After hours

- ANFF staff and all after hours lab users (if any) have to evacuate the premises.
- All gasses have been automatically shut off with the fire alarm.
- The gas monitoring cabinet is positioned in such a way that one can see from outside the room the cabinet screen and identify which gas is causing the alarm and the location of the leakage/activated sensor.
- If gas level remains above TLV an action should be undertaken to shut manually the corresponding gas cylinder. This should take place by two persons in SCBA through the window of the gas cabinets with a protective gear (long sleeves and gloves) if the gas leakage is Cl2/BCl3.
- If gas level has dropped below TLV after shutting down all gases the alarm system can be reset; however the faulty gas will not be used until the leakage has been identified, repaired and tested.

Fire Alarm – Zone 6 smoke detectors

Business Hours

- Assess situation and liaise with ANFF staff

After hours

- Wait for ANU Security to arrive to gain entry to the room and gas cages.
- Enter room and or gas cages and assess situation.
- All gasses have been automatically shut off with the fire alarm.
- If additional information is required then contact one of the technical staff members.
- If a fire tech is required to attend the site ask ANU Security to arrange.

Sprinkler activation

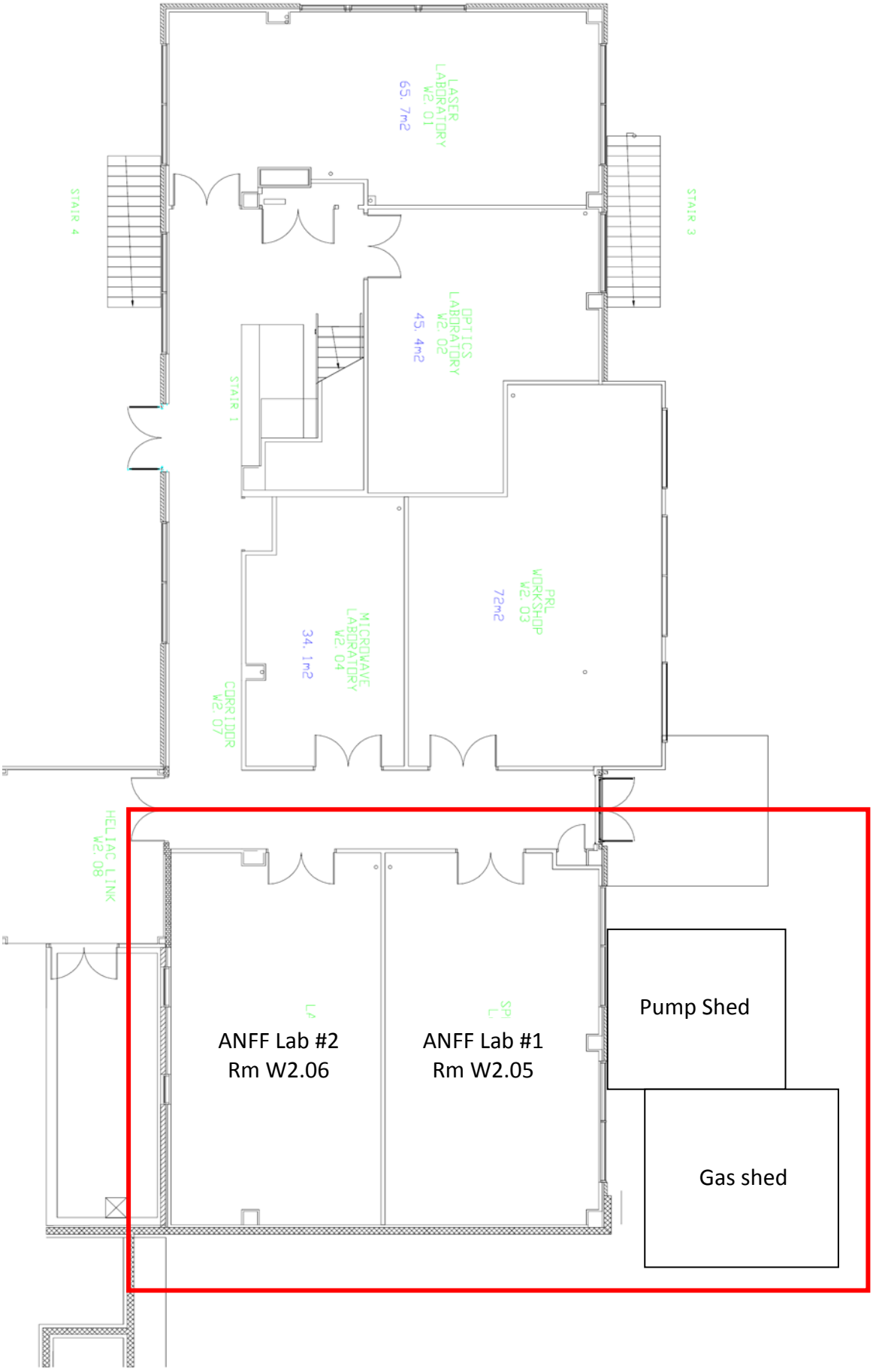
- All gasses have been automatically shut off with the fire alarm.
- Wait for ANU Security to arrive to gain entry to the room
- Enter room and assess situation.

Clean up

- The clean up of the building is the responsibility of ANU Research School of Physics & Engineering (RSPE). If the incident has occurred after hours ANU Security will call Building Manager / Custodian and RSPE technical officer to attend and start clean up procedures.

Replacing sprinkler head

- If a sprinkler head requires replacement ask ANU Security to contact the fire maintenance contractor to replace the damaged sprinkler head.


LASER LABORATORY W2.01
65.7m2
STAIR 4
STAIR 3
OPTICS LABORATORY W2.02
45.4m2
STAIR 1
PRL WORKSHOP W2.03
72m2
MICROWAVE LABORATORY W2.04
34.1m2
CORRIDOR W2.07
HELIAC LINK W2.08
ANFF Lab #2
Rm W2.06
ANFF Lab #1
Rm W2.05
Pump Shed
Gas shed