NATIONAL MARINE RESEARCH STATION

NATIONAL UNIVERSITY OF SINGAPORE

RESEARCHER HANDBOOK

Revised in November 2026

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Staff Directory

Roles and responsibilities	Name of staff/Designation	Email address	Contact No.
Registration and Access for Facilities	Mr Ahmed s/o Aliyar (Admin Manager)	tmsaha@nus.edu.sg	(65) 8418 3071
Finance and Administrative matters	Ms Joleen Chan (Assistant Manager)	jol.chan@nus.edu.sg	(65) 6601 4089
Facilities Management	Mr Razali (Facility Manager)	tmsmrd@nus.edu.sg	(65) 8126 5040
Boat transportation to NMRS	Mr Jackson Chan (Assistant Facility Manager; Aquaria Manager)	tmscks@nus.edu.sg	(65) 9695 0338
Use of aquaria			
Use of aquaria including Controlled Environment, Biosafety Level 2 (BSL2) Aquaria, Seawater Flume	Ms Syazwanee Liemhetcharat (Aquaria Manager)	wanee-09@nus.edu.sg	
Biosafety and IACUC matters	Ms Afiqah Binte Kamaruzzaman (Lab Manager)	afiqahk17@nus.edu.sg	(65) 9823 1775
Access for BSL2-certified Aquaria and Laboratory			
Access to Research Labs	Ms Lim Lay Peng (Lab Manager)	tmsllp@nus.edu.sg	(65) 9823 1775
	Ms Helen Wong (Lab Manager)	tmswpsh@nus.edu.sg	(65) 9273 8347
Organism Supply and Culture Facilities	Ms Serina Lee (Lab Manager)	tmslscs@nus.edu.sg	(65) 9273 8347
Chemical Store and Chemistry Labs	Ms NurHafizah (Lab Manager)	hafizahkatwadi@nus.edu.sg	(65) 9273 8347
R/V Galaxea and Field Support	Mr Sebastian Yeo (Field Support Officer)	tmsyjhs@nus.edu.sg	(65) 9273 8347
	Mr Syabilhan Siddiq (Field Support Officer)	syabil.s@nus.edu.sg	(65) 9273 8347
Marine Environment Sensing Network (MESN)	Ms Joleen Chan (Assistant Manager)	jol.chan@nus.edu.sg ; mesn@nus.edu.sg	(65) 6601 4089
Outreach & Education, Overnight stay in NMRS	Ms Wong Cai Lin (Executive)	wongcl97@nus.edu.sg	(65) 9224 4022
	Ms Beth Lee (Senior Executive)	beth_lee@nus.edu.sg	(65) 9224 4022

Emergency SOP & Telephone numbers

Classification of injuries:

1. Major injuries: Examples: head/spinal injuries, unconscious casualty. Please refer to the flowchart below
2. Moderate injuries: Examples: fractures. Evacuate via Singapore Island Cruise.
3. Minor injuries: Example: minor cuts. Please inform Lab Manager.

Emergency Evacuation

During a medical emergency, shout for help and inform other researchers to get help.

⇩

Get other researchers to inform the Lab, Facility and Admin mangers.

⇩

Reassure and move casualty to a safe location, if possible. Do not move casualty if spinal injury is suspected.

⇩

Perform CPR and use AED if necessary (only first aid certified personnel).

⇩

Inform SCDF ambulance (995) to arrange for evacuation of casualty. Nearest hospital: Singapore General Hospital (via Marina South Pier).

⇩

Arrange for evacuation, using stretcher and buggy, if necessary and bring the casualty to SJI jetty.

In the Event of a Fire

When the fire alarm is activated

⇩

All personnel to vacate offices/labs via the nearest exit to corridors (if alarm rings for more than 30 seconds)

⇩

Once the fire alarm is muted, wait for instructions via the PA system

⇩

If the fire alarm rings again, proceed to the Assembly Point



Assembly Point

AED, Stretcher and Buggy are located in the admin area.

Emergency Telephone Numbers:

Mr Ahmed s/o Aliyar (Administration) - 8418 3071

Mr Razali (Facility Management) - 8126 5040

Mr Jackson Chan (Facility and aquaria) - 9695 0338

Mr Raja (Maintenance) - 8445 2221

NMRS Security Guard - 9197 6841

SCDF (ambulance) - 995

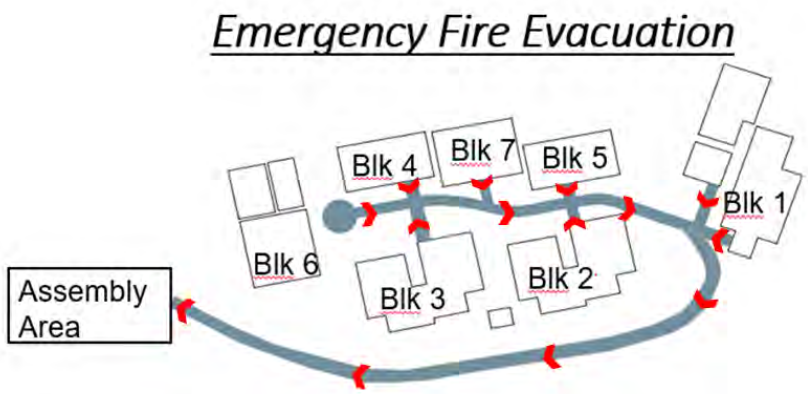
Singapore Island Cruise (24 hrs) - 9777 6111

Power Failure

a. Stay calm; do not panic.
b. Turn off all electrical appliances and equipment wherever possible.
c. Check if the power failure is confined within the laboratory or block, or if it is institute wide.
d. Contact Facility Manager.
e. Seawater supply may be interrupted if power is not supplied to the seawater pumps at Block 6; appropriate measures (e.g., activation of standby diesel generators to power aerators and refrigerators) will be activated. Please contact Facility Manager if you require assistance.

Fire

a. Shout "Fire! Fire!" and activate the fire alarm by breaking the glass panel of the fire alarm call point with a blunt object (do not use bare hands).
b. Put out the fire only if it is safe to do so, using the fire extinguisher and/or fire hose-reel.
c. Seek assistance if needed.
d. Call Facility Manager for instructions.



Medical Emergency

1. Remove casualty to safe location and render first aid to casualty where possible, except in the event of potential spinal injury.
2. Contact Facility Manager or First Aiders; prepare for evacuation from St John's Island if necessary.
3. AED and stretcher are available in Block 1.

Emergency Evacuation

Evacuation to Singapore can be carried out through a ferry operator (currently Singapore Island Cruise) or the Police Coast Guard; in the former case, arrangements must be made with the Singapore Civil Defence Force (SCDF) to have an ambulance (if needed) pick up the casualty at Marine South Pier (MSP).

If the casualty cannot be moved (e.g., due to a spinal/head injury), please contact Police Coast Guard to activate SCDF and a paramedic brought over to the island for safe evacuation.

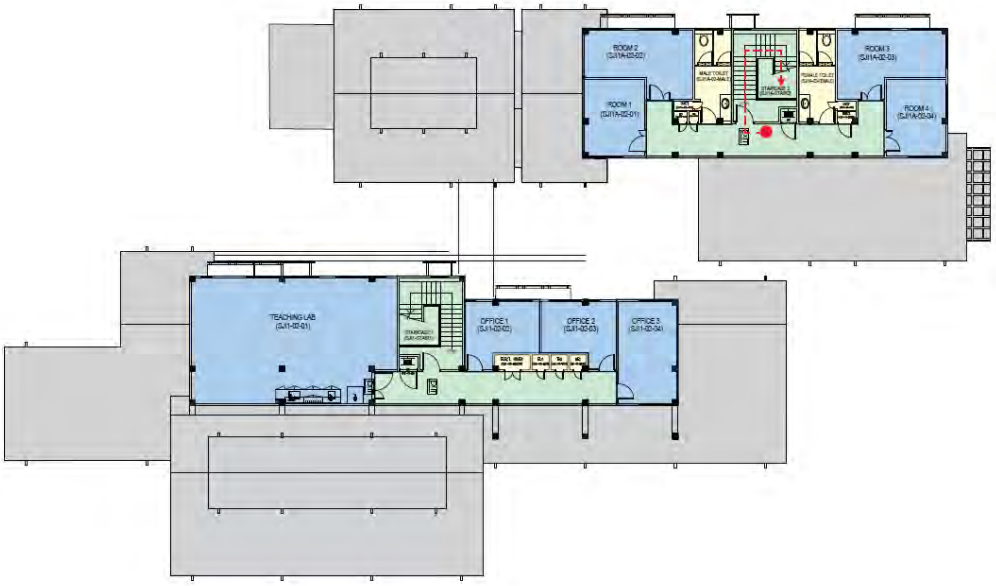
NMRS Floor Plan

Block 1

BLOCK 1 - 1st Storey Plan

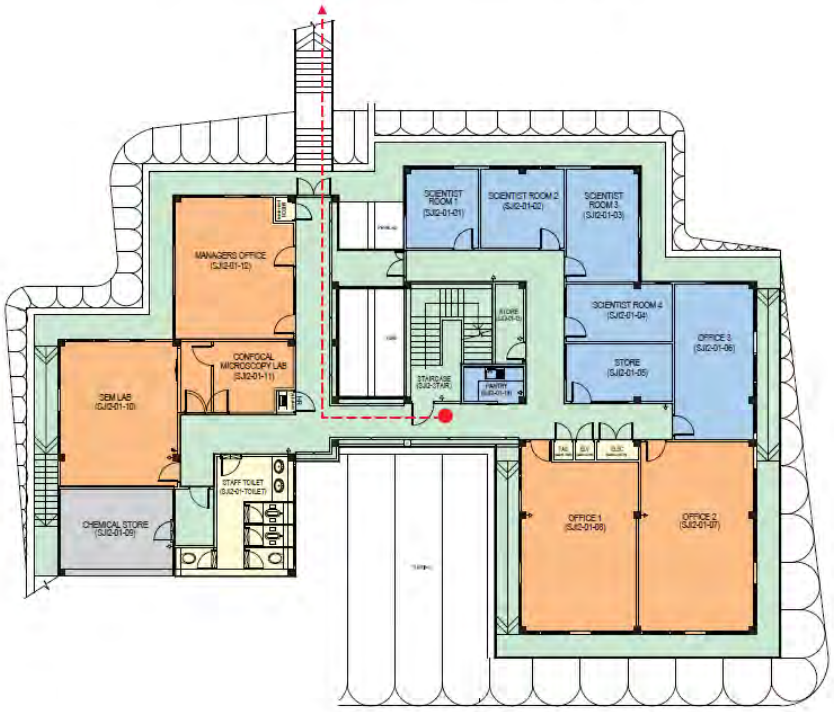


BLOCK 1 - 2nd Storey Plan

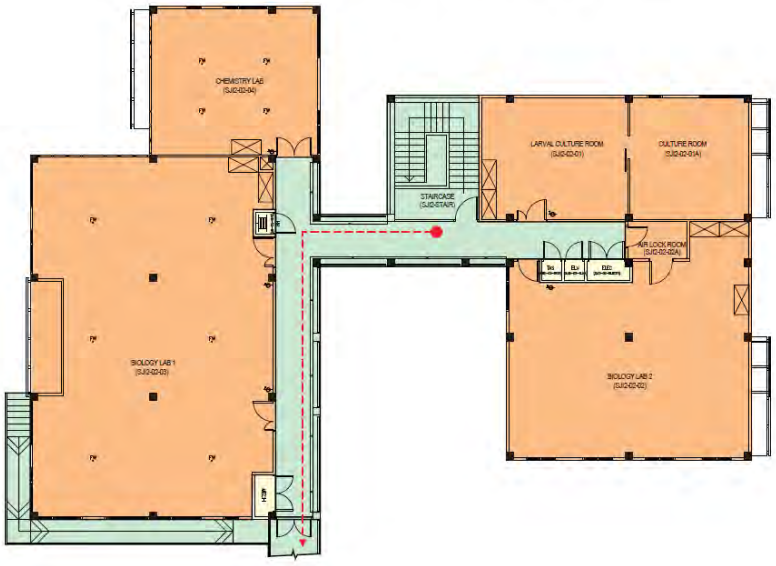


Block 2

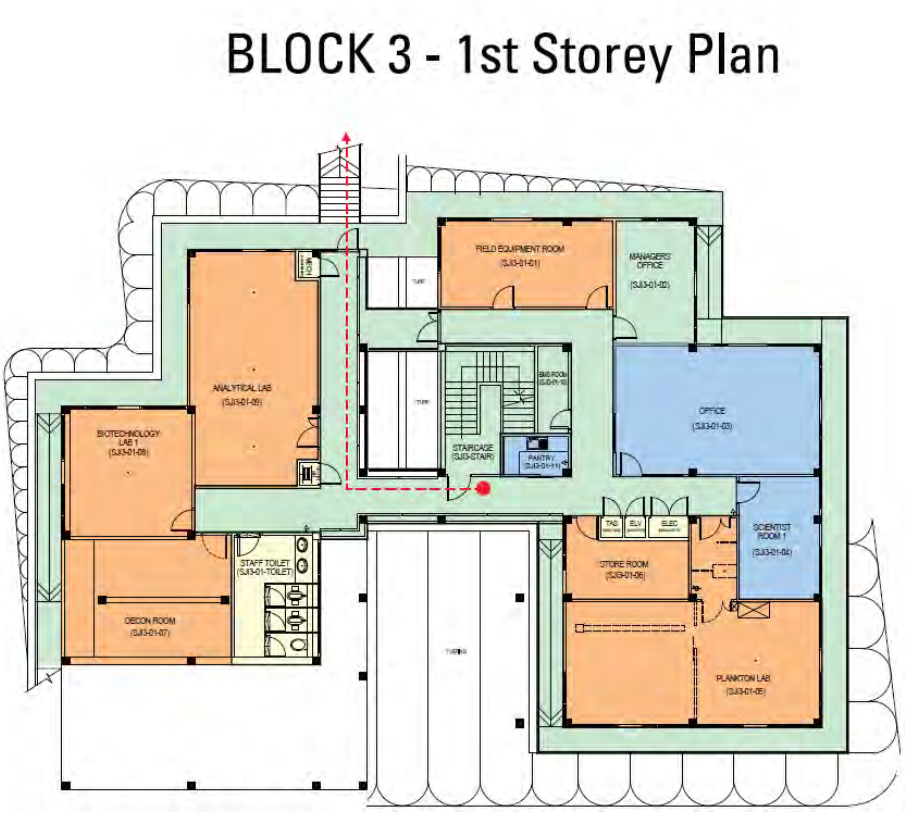
BLOCK 2 - 1st Storey Plan



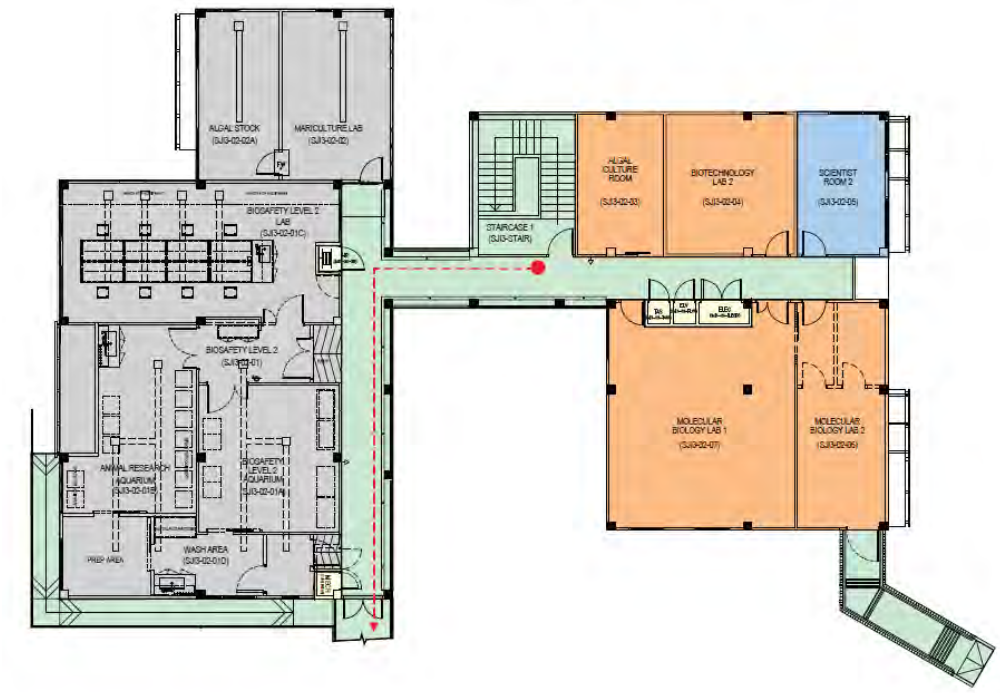
BLOCK 2 - 2nd Storey Plan



Block 3

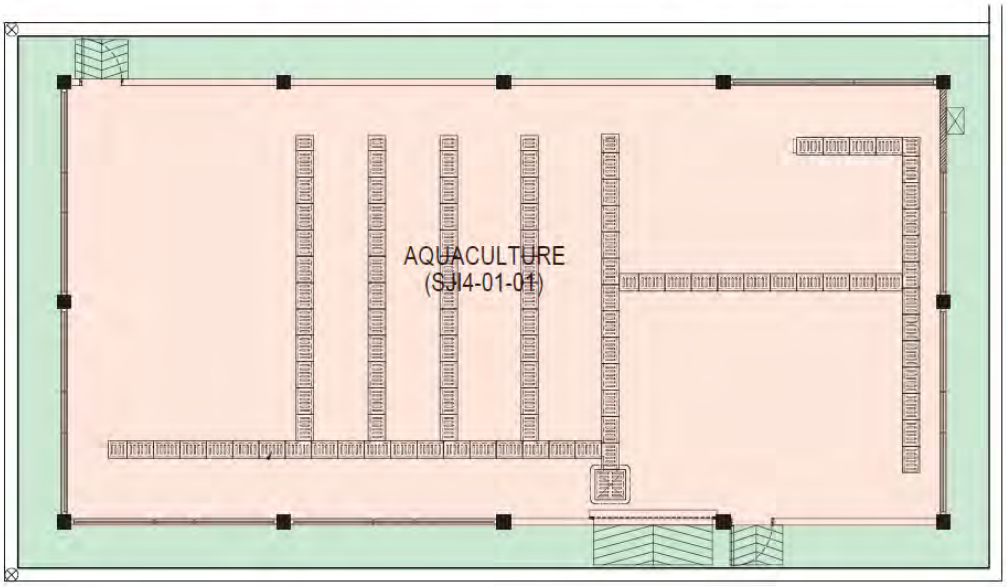

BLOCK 3 - 1st Storey Plan
FIELD EQUIPMENT ROOM
(SJI3-01-01)
MANAGERS' OFFICE
(SJI3-01-02)
ANALYTICAL LAB
(SJI3-01-05)
BIOTECHNOLOGY LAB 1
(SJI3-01-06)
STAIRCASE
(SJI3-STAIR)
PANTRY
(SJI3-01-11)
OFFICE
(SJI3-01-03)
SCIENTIST ROOM 1
(SJI3-01-04)
STORE ROOM
(SJI3-01-09)
PLANKTON LAB
(SJI3-01-08)
STAFF TOILET
(SJI3-01-TOILET)
OBCON ROOM
(SJI3-01-07)

BLOCK 3 - 2nd Storey Plan

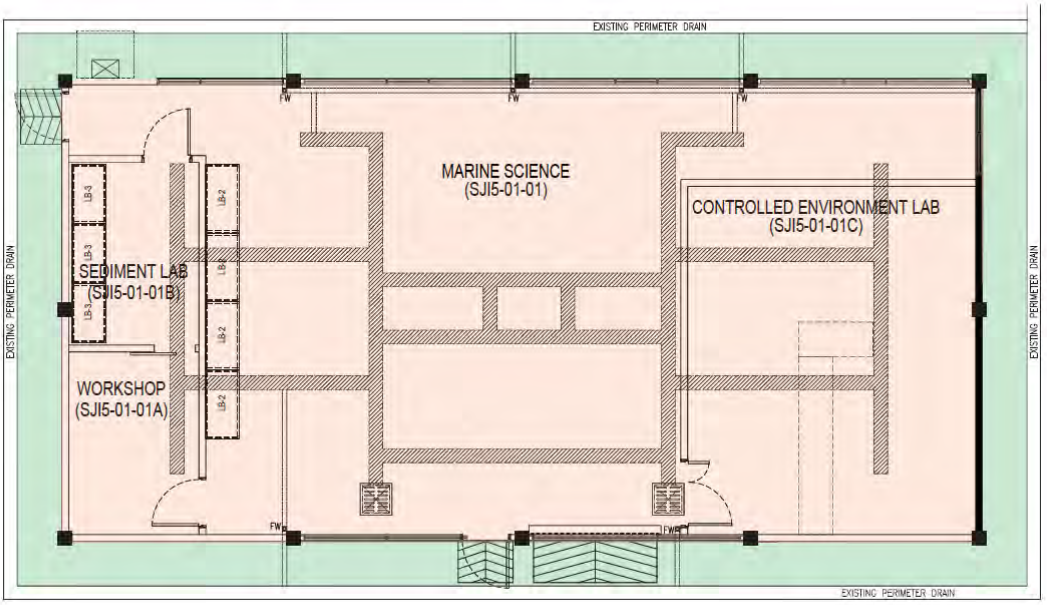


Block 4 and 5

BLOCK 4 - 1st Storey Plan



BLOCK 5 - 1st Storey Plan



National Research Foundation (NRF) National Research Infrastructure (NRI)

NRF introduced the NRI framework in April 2015 to guide the development of selected research facilities that are to be operated as a national resource. The NRI framework enables continued investment in infrastructure upgrades to enable research development in a cost-effective way, in order that researchers in Singapore have ready access to critical research infrastructure and services to conduct cutting-edge research, and sustain R&D capabilities in Singapore.

The key guiding principles for operation of NRIs are:

a) **Open Access** - NRIs, which has a host institution, must be made available to all research entities, public and private, in Singapore. The facility, including use of all equipment and technical support, should be made available for external entities to access and use on an equitable basis. The funding of NRIs is predicated on opening access to a larger researcher base and making the provision of research infrastructure services more cost-effective.
b) **Collaborative Platform** - NRIs must serve as a platform for collaborative and inter-disciplinary research among local and international, and public and private researchers. This encourages synergies from interdisciplinary and collaborative research, which can drive the development of novel approaches and new technologies.
c) **Charging Model** - Researchers of NRIs are charged depending on the degree of use and type of services required. The charges are used to cover operating costs of NRIs.

National Marine Research Station as an NRI

The National Marine Research Station (NMRS), formerly named the St John's Island National Marine Laboratory (SJINML), is operated by the Tropical Marine Science Institute of National University of Singapore (NUS), is Singapore's only offshore marine research facility. The marine station was opened on 3 October 2002 as a research facility of NUS. It is strategically located next to the Sisters' Islands Marine Park, Singapore's first marine nature reserve. The high-quality seawater aquaria at NMRS provides unique opportunities for high impact research in marine science.

Based on considerations of its strategic research value and potential researcher base, NMRS was designated a National Research Infrastructure on **28 March 2016**. Operation of NMRS as an NRI commenced on **1 June 2016**, with facilities opened to all researchers commencing **22 August 2016**.

Mission

Singapore is strategically located at the crossroads between the Pacific and Indian Ocean. Its unique position in the tropical South China Sea offers unprecedented opportunity for rapidly advancing research discovery in tropical marine science, to secure Singapore's competitiveness in the global maritime industry and strengthen Singapore's blue economy in the long term. As one of the busiest transhipment hubs in the world, Singapore is seamlessly connected to over 600 ports in 120 countries. This connectivity presents challenges for human health and marine environment management.

The mission of NMRS as an NRI is to serve as a national resource and focal point for marine science expertise, supporting marine science research that meets our strategic national needs for the future.

As an NRI, it aims to:

a) Enhance the quality of national marine science research by facilitating multi-disciplinary research interactions through provisions of quality access to research expertise, facilities and specialist training support.
b) Conduct research that supports national agencies for projects of strategic significance.
c) Increase high-impact research outputs in sustainability research.
d) Catalyse collaborations that enhance strategic national and international research programs; and
e) Implement manpower training programs to support future national needs in marine science.

Management

NUS as the host institution and facility owner is responsible for the primary management of NMRS and its facilities. NMRS is managed by TMSI on behalf of NUS Office of the Deputy President (Research and Technology).

The Facility Governing Board of NMRS, appointed by NRF, guides the strategic development and business plan of the Facility, and directs changes where necessary to ensure the Facility achieves its strategic goals. The Board has oversight of financial governance and access policies of the Facility. It will review and approve the equitable access and charging policies to foster external usage and collaboration.

Under the NRI framework, personnel present at NMRS consist of:

a) "*Programme Personnel*", referring to employees of the Host Institution who manage the operations of the NRI; and
b) "*Research Personnel*", referring to any persons who use the Facility and its Equipment to perform research including those of the Host Institution, as well as persons from other third parties.

The Facility Director is responsible for day-to-day management of NMRS. The Facility Director is supported by program personnel overseeing: Administration, Facilities Management, Laboratory Management and Research. Research Personnel form the researcher base and main body of the Facility that sustains the scientific mission and research continuity at NMRS.

A) NRI Registration and Access Policy

- ***EQUITABLE, OPEN ACCESS TO ALL RESEARCHERS***
- ***A COLLABORATIVE RESEARCH ENVIRONMENT***
- ***A SAFE WORK ENVIRONMENT***
- ***PROMOTING ENVIRONMENT SUSTAINABLE PRACTICES***

1. User Registration

- All research personnel (including students, volunteers and visiting scientists) must sign up via the website at https://nmrs.nus.edu.sg
  Kindly navigate to "What we Offer" on the header menu to locate the registration page.
- NMRS Admin will follow up with the registration. The researcher will be required to complete a Facilities Request Form and the agreement form. These forms will be reviewed by NMRS's Laboratory Managers to ascertain that NMRS has adequate facilities to support the proposed research projects and ensure that researcher has adequate training to undertake the proposed research activities at the lab in a safe manner.
- Lab and Aquarium Managers will now allocate a scheduled date and time for training and induction. Requests for training outside the allocated schedule will incur an $50 charge, additional to other training charges where relevant
- ***Medical evacuation to a hospital on mainland may take more than an hour: if you have an existing medical condition that places you at higher risk, please speak to the Admin Manager/Facility Director. We will advise if appropriate contingency measures are available to support your work on NMRS.***
- Research proposals and projects are subjected to approval based on the following criteria:
  - **Small projects** requiring basic use of NMRS facilities (*value <$10,000 per month) - approval from the Admin Manager.
  - **Mid-sized projects** involving several full-time researchers and commitment of resources (value >$100,000 per year) - approval from the Facility Director in consultation with an Advisory Panel member.
  - **Large projects** (value >$1m per year) involving several researchers and significant commitment of NMRS infrastructure require approval of NMRS Governing Board.

  * Value of project in this instance refers to the researcher's estimated expenditure for facilities use and installation of new infrastructure/equipment.

2. Terms of Use and User Agreement Forms

- For NUS research personnel: with endorsement from the relevant lab managers, NMRS admin office will proceed to send Researcher a TERMS FOR FACILITY USE Form which must be signed by the Researcher and Principal Investigator (or the authorized signatory for the relevant NUS research account). NUS researchers are expected to abide by terms and conditions set out in the NMRS Handbook, in addition to NUS' policies when they are present on NMRS premises.
- Researchers from non-NUS organizations, RESEARCH FACILITIES USE AGREEMENT Form (See Appendix A) and/or Risk Acknowledgement and Consent Form (See Appendix B) is required. Once your facilities request is approved by the lab managers, the Admin Manager will work with you to ensure that the appropriate legal agreements are in place. The forms must be completed, signed by the Researcher and authorized signatory for the Researcher's host institution before research may commence.

- The facilities request form will be attached to the above forms. Before final submission, this document should be revised as necessary after consultation with Lab Managers, to reflect accurately the facilities and activities that the researcher intends to carry out on NMRS premises.
- **All researchers are reminded of their obligation to declare research outputs that have arose from the use of NMRS facilities and/or data**: Publications of any materials (via media releases, media interviews, speeches or videos etc.) by any User of the Facility that are related to work fully or partially undertaken at the Facility and/or have made used of the NMRS MESN buoy data must include an acknowledgement of the National Research Foundation's support of NMRS substantially in the form as follows: "[The authors] would like to acknowledge the National Marine Research Station (NMRS) for providing the facility and/or marine environmental data necessary for conducting the research. The NMRS is a National Research Infrastructure under the National Research Foundation Singapore." Users shall keep NUS informed of the creation of Intellectual Property, patents and publications arising from research that is performed using equipment and data that is maintained by NMRS. All peer-reviewed publications arising from research that is performed using equipment and data that is purchased or maintained under NMRS shall be made publicly available no later than twelve (12) months after the official date of publication.

3. Safety Training Requirements

- All researchers are required to hold valid safety training certificates as determined during registration, for entry into laboratories.
- Where safety training is lacking, the research personnel will be required to complete the necessary training requirement before commencement of work.
- Research personnel are expected to submit a copy of endorsed Safety Risk Assessment form to the respective laboratory manager before commencing work.
- It is mandatory for all full-time research personnel to attend the NMRS Safety Briefing conducted by NMRS twice annually.
- Under the safety and health training harmonisation framework, chemical safety training, biological safety training and safe needle usage in research laboratories are now recognized across selected institutions of higher learning in Singapore (Refer to list here). For overseas or institutions not under the harmonized framework, lab managers will arrange for researchers to complete all other relevant safety trainings and electronic certificates will be issued from NUS.

4. Structured research skill training (SRST)

- The structured training program at NMRS aims to enhance research skills across various levels of researchers by implementing training calendar. This allows Principal Investigator (PI) to plan and ensure their researchers acquire the necessary competencies to conduct their work effectively, minimizing equipment damage and project delays. Researchers are encouraged to participate in training sessions to expand their skill set and adopt new research tools, benefiting the broader research community by elevating overall competencies. This not only fosters the advancement of science R&D but also increases the value of researchers working at NMRS.
- The SRST will consist of three tiers:
    - Tier 1 to consist of basic lab skills (cover most general equipment). This is free for all registered researchers. PIs strongly recommended to check schedules and sign up their staff for relevant modules to ensure they are competent using facilities in NMRS labs.
    - Tier 2 will cover equipment that requires additional hands-on training. Fee may be chargeable, depending on the training. For registered researchers only.

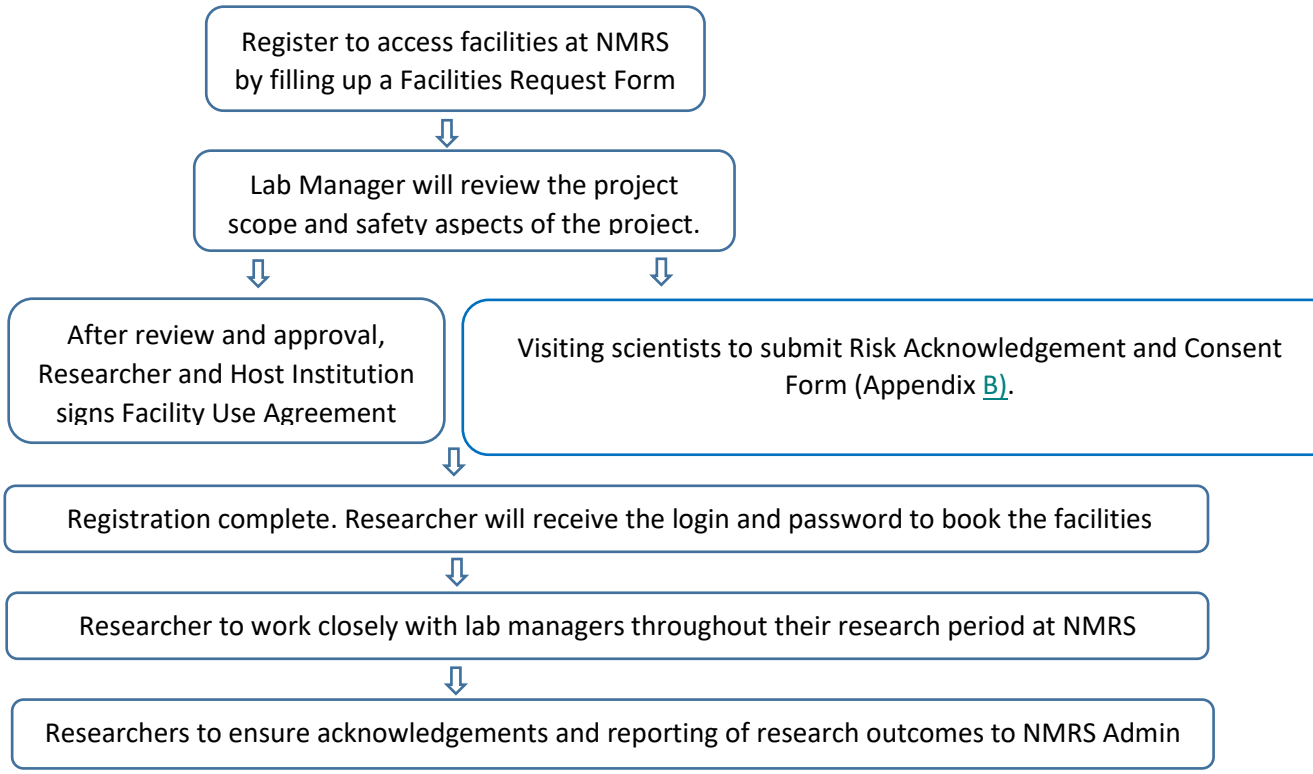
- Tier 3 covers training for specialist equipment and specialist research skills, which may include training by vendors or invited scientist. This comes with a training fee and is open to external participants.

- Researchers can visit NMRS's website and navigate to the Skill Training tab to book their training sessions.

5. Booking of Facilities

- After registration is completed, the Researcher will be able to book for access to required facilities.
- Note that charging of bench fees (*See next point*) and use of facilities will be based on what is reflected in the booking system. Thus, if a Researcher is no longer planning to use the facility, it is imperative that he/she cancels booking at least 7 working days before the actual booking date.
- Waiver for daily bench fee for volunteers can be sought from Management – with Facility Director's approval.
- Booking cancellations made ≥7 working days will incur no charge. Booking cancellations made between 3 to 7 working days will incur a 50% charge. Full charges will apply for bookings cancelled <3 working days.
- To foster a positive spirit of cooperation and resource sharing, research personnel should not block book resources consecutively for ≥7 working days. If you have special requirements, please approach the Admin Manager to assist with your requirement.

Registration Process



6. Schedule of Bench Fee Rates (Updated as of 1 June 2026)

DAILY RATES	Student	Academic	Commercial User
Basic Bench Fee *consisting of ferry transfer, hot-desk, dining amenities, use of basic lab facilities at NMRS*	$30	$60	$100
Bench Fee for researchers based at MAC *Access to basic lab facilities at NMRS only*	$30	$40	$70
Biosafety Level 2 Research *Access to Biosafety Level 2 lab and support at NMRS (in addition to basic bench fee)*	+$20	+$20	+$40
Overnight stay in dormitory	$35	$35	$35
ANNUAL SUBSCRIPTION	**Student**	**Academic**	**Commercial User**
Basic Facility Access *consisting of ferry transfer, use of basic lab facilities (BSL1) at NMRS, dining amenities and dormitory, fixed desk and storage allowance*	$1,500* (max 5 months) $2,000* (max 8 months)	$15,000	$24,000
Enhanced Facility Access *consisting of ferry transfer, use of BSL1 & BSL2 lab facilities at NMRS, dining amenities and dormitory, fixed desk and storage allowance*	$3,000*	$20,000	$35,000
GROUP MEMBERSHIP			
Basic Level Access	Up to 2 researchers on site per day - $32,000 per annum. For every additional researcher - $15,000 per annum		Not applicable
Biosafety Level 2 Access	Up to 2 researchers on site per day - $42,000 per annum. For every additional researcher - $20,000 per annum		Not applicable

*Applicable for Industry Attachment Program students only.

Lab and Aquarium Managers will now allocate a scheduled date and time for training and induction. Requests for training outside the allocated schedule will incur a $50 charge, additional to other training charges where relevant

7. Schedule of rates for specialist facilities

a) AQUARIA

Facility	Description	Cost Per Day (excludes bench fees)
Block 5 Marine Science Aquarium		
Open seawater tables, researcher to provide own tanks	Total tank volumes do not exceed $2m^3$ occupying $2m^2$ bench space	\$10 per $2m^2$ area $2m^3$ tank volume/day
	Additional requirement per $1m^3$ of seawater OR $1m^2$ area	+\$10.00
Seawater Flume (See point 3 below for cancellation charges of seawater flume)	15m seawater flume	\$60
	Compulsory Support services (First and last day of usage): manpower assistance with aquaria husbandry, aquarium set-up/cleaning	\$45/hr or \$270/day
	Optional Support services: manpower assistance with aquaria husbandry, aquarium set-up/cleaning	\$45/hr or \$270/day
UGEMS Erosion Microcosm System (GUST)	Training	\$50
	Use of system, excl. consumables	\$10/hr
Laser In-Situ Scattering and Transmissiometry (LISST)	Training	\$50
	Use of system, excl. consumables	\$5/hr
Controlled Environment Aquarium	Mandatory training for new researcher	\$100
	Shared Space – 3 racks, 3 sump tank supply, 2 large filter mixing tanks	\$70.00
	Use of whole room – 6 racks, 6 sump tank supply, 2 large filter mixing tank	\$120.00
	Post-project cleaning fee	\$400 (full), \$200 (half)
	Supply for CO_2 tanks for experiments (5 litre tanks)	\$200 for first tank, \$120 per additional tank
	Dosing pumps	\$5.00
	Support services: manpower assistance with aquaria husbandry, aquarium set-up/cleaning	\$45/hr or \$270/day
	Submersible stirrer table	\$5.00
Block 7 Open Area		
Outdoor seawater troughs	Total tank does not exceed $2m^3$ occupying $2m^2$ space	\$10 per $2m^2$ area $2m^3$ tank volume/day
	Additional requirement per $1m^3$ of seawater OR $1m^2$ area	+\$10.00
Large fibreglass tanks	25t round fibreglass tank	\$100 per week
Block 4 Aquaculture Aquarium		
Open area for custom aquaria set-ups	Per 2 m^2 area, with total tank volumes not exceeding 2 m^3	\$10 per $2m^2$ area $2m^3$ /day

	Additional requirement per 1 m^3 of seawater OR 1 m^2 area	$5 per 1$m^2$ area 1m^3 tank volume /day
	Large fibreglass tanks – 5t round fibreglass tank (existing setup of x 4 tanks)	$70.00 /week per tank
Block 3 Microbiology Lab (Biosafety Level 2)		
Biosafety Level 2 aquarium	User training (mandatory for new researchers)	$150.00
	Base price including decontamination and cleaning (inclusive of chemicals, decontamination up to 600L @5000ppm chlorine, biomonitoring) Additional decontamination up to 600L	$1,200.00 $330.00
	Consisting of 4x racks	+$150.00 per day
Animal research aquarium	Base price consisting of decontamination and cleaning (inclusive of chemicals, decontamination up to 3000L @5000ppm, biomonitoring) Additional decontamination up to 750L	$3,000.00 $330.00
	User training (mandatory for new researchers)	$150.00
	Consisting of 12 x RAS tanks	+$200.00 per day
	Veterinarian services Weekdays (up to 3 hours) Weekends/Public Holiday (up to 3 hours)	$400.00 (weekday) $600.00 (weekend)
	For animal carcass disposal post-experiment (autoclave & disposal biomonitoring) (x5 autoclave cycles)	$50.00 per 5 autoclave cycles
Technical assistance	Assistance with tank maintenance	$45/hr or $270/day
Support services	Manpower assistance with aquaria husbandry	$45/hr or $270/day
Waste management	Bio-monitoring and waste treatment	$400.00
Organism Supply Services		
Microalgae	See manager for species list.	$6.00 - $7.00/ 250ml
Barnacle (*Amphibalanus amphitrite)* larval stages	Stage 2 nauplii (2000 larvae)	$340.00
	Cyprid stage (2000 larvae)	$400.00
Brine shrimp	Freshly hatched (10,000)	$1.50
Cultured sea urchin *Salmacis sphaeroides*	A PAIR (Adult Male and female)	$50.00/PAIR
	Juveniles (2 - 3 cm, 3 - 4 months old)	$ 150 / DOZEN
0.2um filtered seawater	Per litre (bottle not included)	$8.00
F algal culture media	Per litre (bottle not included)	$12.00

b) Research Vessels Charges

Research Vessels				
Description/Cost	R/V Galaxea		Pioner Multi 3	Porta bote
Basic Fee (weekends) - academic	Academic	Non-Academic	Per 4 Hours	Per 4 Hours
Weekday	$1,400.00	$2,200.00	$300.00	$50 (Additional $50 with Engine)
Weekend / Public Holidays	$2,800.00	$4,400.00	$450.00	
Extra Fuel**	$4.50/L		$100.00/25L	$100.00/25L
Use of Winch	$200.00		NA	NA
Overtime Charges	$100/hr		NA	NA
Additional manpower	$270/day			
See 8. *Use of Research Vesses and Diving* for cancellation charges and more information				

***Booking needs to be confirmed at least 2 weeks in advance before the intended date of field work for all vessels.**

**** Extra fuel cost will be adjusted according to prevailing diesel rates. For R/V Galaxea, extra fuel is calculated if fuel usage is expected to exceed the 300L included as part of the basic fee.**

c) Field Equipment

Item	**Description**	**Cost Per day**
Beta Bottle water Sampler	Vertical, horizontal	$50
Bongo Net, with Frame and Bridle		$50
Ekman Grab		$50
Fisherbrand traceable waterproof thermometer		$50
HOBO Temp Pro V2 Loggers		$50
Manta Net	153um	$50
Plankton Nets	Mesh sizes: 10, 20, 53, 153 um	$50
Surber bottom sampler nets	243um	$50
Rectangular Dredge		$50
Pulse amplitude modulation unit (PAM)	Diving Pam II Accessories, Diving USH II Universal Sample Holder	$5/hr; $50 per day
Li-COR Light Sensor		$5/hr; $50 per day
Oxy 4 SMA	Optode dots not included.	$5/hr; $50 per day
Handheld GPS Unit		$10/day
YSI Multiparameter water quality Sonde	EXO2 Sonde	$100
	Conductivity-Temperature-Depth	$20
	pH sensor	$20
	Turbidity sensor	$30
	Fluorescent dissolved organic matter sensor	$20
	Optical Dissolved Oxygen sensor	$10

Item	Description	Cost Per day
	Total algae PE sensor	$20
	Central wiper	$10
	Handheld display (with GPS), weight kit, cables	$30
YSI ProDSS Multiparameter water quality meter	Measures temperature, pH, salinity, DO	$5/hr; $50 per day

d) Specialist Lab Equipment

Description	Cost
BioRad S3e cell sorter: droplet frequency of 37-43 kHz. Fixed 100 µm nozzle, with three cameras, three different sort collection modes.	Training: $400 per pax Training per group (up to 3 pax): $800 Equipment use: $40 per hour
Axio Observer 7 laser-free confocal microscope: Motorized inverted microscope (min. step width 10 nm); applicable for brightfield, DIC, fluorescence imaging; Apotome.2 optical sectioning	Training: $180 per pax Training per group (up to 3 pax): $400 Refresher training per pax: $110 Equipment use: $20 per hour
Zeiss Confocal laser LSM 900. With 2 MA-PMT detection channels and 4 laser lines (405, 488, 561 and 640 nm) on upright Axio Imager Z2 with motorized Z-drive and TFT touchscreen monitor	Training: $360 per pax Training per group (up to 3 pax): $800 Refresher training per pax: $200 Equipment use: $40 per hour Offline image processing workstation: $10 per day
Flowcam 8400: Continuous imaging flow cytometer and particle analyser. Particle size 2 µm – 600 µm; 1 mL sample in 6 minutes,120 frames per second.	Training: $280 per pax Training per group (up to 3 pax): $560 Equipment use: $25 per hour
HPLC: Agilent 1260 Infinity II Prime Liquid Chromatograph. Pressure ranges up to 800 bar, 5 mL/min flow. Multi-sampler stores up to 6144 samples.	Training: $200 Equipment use: $20 per hour
SMARTCHEM 450 nutrient analyzer. Fully automated high technology discrete analyser. 450 tests/hour, up to 100 samples, 72 reagents. Nitrate and ISE modules	Training: $380 per pax Training per group (up to 3 pax): $800 Equipment use: $25 per hour
OMNIS Basic automated titrator. Measures electrical conductivity, pH value, alkalinity, calcium and magnesium hardness, total hardness.	Training: $200 Equipment use: $25/hr
Unisense MicroOptode system. Microsensors not included (consumable)	Training: $150 Equipment use: $15 per hour/ $100 per day
Unisense Microprofiler system. Microsensors not included (consumable)	Training: $150 Equipment use: $15 per hour/ $100 per day
Histology – Thermo Scientific Shandon Citadel 2000 Tissue Processor (inclusive of tissue embedding; ethanol, histoclear, paraffin wax & tissue cassette)	Tissue Processing + Microtome Training: $150 Equipment use: $120 per day

Description	Cost
Histology - Leica RM2135 rotary microtome. Section thickness setting from 1-60 µm	Equipment use: $20 per hour
Histology – Staining apparatus. Includes basic chemicals such as histoclear, ethanol, hematoxylin, eosin, hydrochloric acid & mounting media	H&E Staining Training: $150 Equipment use: $20 per hour
Speedvac. Centrifugal vacuum concentrator. Cools to –4C with a heater that warms to +100C. Equipped with cold trap (-84C) and HPLC-vial compatible rotors	Equipment use: $10 per hour/ $60 per day
Buchi Rotary evaporator. Benchtop unit. Sample flask 20ml to 2L, with receiving flask up to 1L.	Equipment use: $25 per day
Freezer dryer. Benchtop unit, equipped with a 12-port vertical manifold.	Equipment use: $5 per port per day

e) Other Facilities

Description		Cost
Seminar room (60 pax)	Equipped with projector	$250 per day
Teaching Laboratory (30 pax)	Equipped with laboratory benches, overhead projector	$250 per day
	Teaching microscopes	Per piece $10 per hour/$50 per day
Accommodation	Shared dormitory rooms, airconditioned (5-8 pax per room)	$35 per person per night
	Single/Double rooms	$60 per room

Outreach & Education		Cost
	Academic (i.e., IHLs, government agencies)	Non-academic (i.e., industry/private sector/public)
Researcher or staff with bachelor's degree	$60 / hr	$100 / hr
Postdoctoral Fellow	$80 / hr	$130 / hr
Senior Researcher/ Scientist	$150 / hr	$240 / hr

(f) Schedule of rates for use of MESN buoy and data

Sampling frequency are at a minimum of 5-minute intervals. Kindly refer to NMRS MESN website for more details on sampling frequency and sensor information per parameter.

Note: The below rates apply to data collected from 01 Jun 2026 and beyond for all users, and data preceding 01 Jun 2026 for commercial users. Data preceding 01 Jun 2026 is available at no cost for academic users. Kindly contact MESN manager for data access.

Parameters	Unit	Details	Academic user	Commercial user
Free for registered users of database *Ombak*				
Sea temperature	°C	Monthly averaged QA/QC data from each buoy	Free	Free
Secchi Depth (monthly)	m	Monthly averaged data collected at St John's Island buoy	Free	Free
Air temperature, air pressure, relative humidity, solar irradiance, wind speed	°C mbar % W/m^2 m/s	Monthly averaged QA/QC data from each buoy	Free	Free
Real-time data on MESN landing page (SST, Salinity, Wind speed, Air temperature, Air pressure, Solar irradiance)	°C PSU m/s mbar Salinity W/m^2	Near real-time non-QA/QC data on MESN landing page	Free	Free
Basic set				
Sea temperature	°C	Raw QA/QC data	$80 per month @SJI buoy $100 per month @RLH buoy $100 per month @UBN buoy	$200 per month @SJI buoy $250 per month @RLH buoy $250 per month @UBN buoy
Salinity	PSU			
Dissolved oxygen	µmol/L			
Wind speed	m/s			
Relative humidity	%			
Solar irradiance	W/m^2			
Air pressure	mbar			
Air temperature	°C			
Add-ons				
Current speed & direction	m/s °	Raw QA/QC data	$100 per month	$250 per month
Wave & tidal height @SJI	m		$100 per month	$250 per month

Parameters	Unit	Details	Academic user	Commercial user
Marine noise		Refer to Ombak website for latest details	$35 per month	$100 per month
pH	pH	Raw QA/QC data; Only from St John's Island buoy	$35 per month	$100 per month
pCO2	ppm		$35 per month	$100 per month
CDOM/FDOM	ppb		$35 per month	$100 per month
Turbidity	NTU		$35 per month	$100 per month
Chl	RFU		$35 per month	$100 per month
Total suspended solids (TSS)	mg/L	From lab analysis of water samples collected monthly at St John's Island buoy	$35 per month	$100 per month
Total Alkalinity (TA)	µeq/kg		$35 per month	$100 per month
Dissolved inorganic carbon (DIC)	µmol/kg		$35 per month	$100 per month
Nitrate (NO_3)	µmol/l		$35 per month	$100 per month
Nitrite (NO_2)	µmol/l		$35 per month	$100 per month
Phosphate (PO_4)	µmol/l		$35 per month	$100 per month
Test-bedding on MESN buoy*				
Peripheral Module			$1,000 per month	$2,500 per month
Moonpool			$800 per month	$2,000 per month
API connectivity				
API connectivity		Dedicated data retrieval via MESN API per parameter	$10 per month	$25 per month

*Only space on MESN buoy and guidance are provided. Users are to procure any consumables or equipment required for the test-bed.

SJI = St John's Island, *RLH* = Raffles Lighthouse, *UBN* = Pulau Ubin

B) General Information

1. Transportation

Boat to and from St. John's Island (SJI):

All passengers are expected to be seated at least 5-10 minutes before ferry departure time. Due to the large number of passengers, we may not hold the ferry back for late arrivals. Please be punctual.

Services	**Day**	**From MSP to SJI: Ferry departs**	**From SJI to MSP: Ferry departs**
Workdays	Monday to Thursday	0815 hrs	1715 hrs
	Friday	0815 hrs	1645 hrs
Mid-day: book your seat by 10 am	Monday to Friday	*1200 hrs	*1230 hrs
Weekend/Eve of Public Holiday /Public Holiday:	Saturday, Sunday and Public Holiday	0815 hrs	* 1215 hrs
book your seat by Friday 10 am			1715 hrs

*Seats subjected to availability

As seats are limited, please ensure:

- Daily researchers must book your workday online at least one day in advance. No seat will be allocated for you if you have not made an online booking to work at NMRS.
- You must inform NMRS office if you plan to bring in visitors/contractors or volunteers at least 3 days in advance. If there are no spare seats available, you will need to secure your own transportation for the ad-hoc passengers at your own cost, to and from the island
- Annual Researchers – please inform Mr Jackson Chan if you will not be coming to NMRS for several days. This will allow us to manage the ferry seating better.
- Researchers arriving on Mid-day/Weekend/Public holiday should sign in at Maco Hut

The journey time is about 20-25 minutes.

For safety reasons, please ensure you wear proper footwear (minimally sandals with backstraps) when boarding or alighting the vessel.

In addition to the above services, public ferry services are available from Marina South Pier.

https://islandcruise.com.sg/?gad_source=1#

https://marinasouthferries.com/pages/ferry-schedule

Contact Persons for ferry arrangements and ad hoc ferry services are:

- Mr Razali: 8126 5040
- Mr Jackson: 9695 0338
- Mr Ahmed: 8418 3071

Use of buggies within SJI:

a. Electric buggies are available to transport passengers, and heavy or bulky items between the Facility and the public jetty. Paths are narrow and steep, drive slowly and carefully. Never overload the buggies. Passenger buggies can carry a maximum load of 380 kg (approx. 5 adults), while the cargo buggy has a maximum load of 500 kg.

b. Please contact the Admin Office to register. For safety and insurance reasons, only appointed research personnel with valid Class 3 driving licences are allowed to drive the buggies.

2. Access into Research Labs

a) Office keys will only be issued to operations staff and researchers who are in-residence for an extended period.
b) Office keys will not be issued to students, researchers here on daily (ad-hoc) booking, short-term visiting researchers.
c) Lab keys are not issued to researchers to keep. Lab keys may be signed out from Lab manager's office. These keys should be returned at the end of the day.
d) Researchers may not approach contractor staff to open doors. All requests to enter labs should be directed to the relevant lab managers. They will inform the security guard of your requirement.
e) Security staff will only open a lab as part of daily security inspection and in response to safety emergencies. The security staff is expected to remain at the site until situation is resolved.

<u>Working during office hours on weekdays</u>:

Each day, the security staff will open Shared Offices and General Labs in the morning, and lock these at the end of the work day. For all other rooms, researchers should approach Lab Manager for access.

Lab Manager's Office will be open between 9:00-9:30am, 1.30-2pm and 4-4.30pm. A manager will be present to attend to your requests for:

i. Midday ferry bookings
ii. Lab Access
iii. Application for overnight/weekend stay
iv. Sign out/deposit of regulated chemicals
v. Purchase of lab consumables
vi. Booking of equipment or trainings
vii. Access to Chemicals/Stores
viii. Other technical assistance

<u>Working after hours and on weekends</u>:

a) Researcher must first seek permission from his/her PI to work after office hours.
b) Researcher is required to submit a request form available from Lab manager's office indicating his/her planned activities, the rooms required and if overnight stay is involved.
c) All forms to be submitted by 10am.
d) Researchers will not be given access into any labs after hours if they did not apply for permission in advance for access.

2. Use of Research Laboratories

(See also: Section F on Laboratory Safety)

a. Please ensure you have permission from the relevant Laboratory Manager for access prior to commencement of work.

i. Relevant Laboratory Managers will be assigned to Researchers during the initial facility registration process
ii. All Researchers will have to attend introductory lab safety briefing and lab/equipment specific training with relevant Lab Managers before commencement of research in NMRS (mandatory)
iii. Lab Managers will now allocate a scheduled date and time for training and induction. Requests for training outside the allocated schedule will incur an $50 charge, additional to other training charges where relevant

b. Research requiring Biosafety Level 2 (BSL2) containment and/or animal handling facilities are subjected to approvals from regulatory bodies and NMRS management. See Section H on Biological Safety for work involving BSL2 agents.
c. Please ensure you have valid Safety Training certificates, as specified in your registration, at all times.
d. Under the framework of the Workplace Safety & Health Act, safety risk assessments (See Appendix H) for research activities must be conducted before commencement of any work. A copy of the relevant risk assessment should be filed with the Lab Manager before commencement of work.
e. Note the nearest locations of exits, fire extinguisher, fire hose-reel, fire alarm call point, eyewash, emergency shower, first aid kit and chemical spill kit.
f. No work with radioactive materials of any kind is allowed on NMRS premises.
g. If you intend to bring any regulated chemicals and biological materials to NMRS, please inform the Lab Manager at least 4-6 weeks in advance. Do note that approval is subjected to regulatory license coverage.
h. Appropriate procedures for disposal of chemical and biological wastes should be discussed with the relevant managers prior to commencement of work.
i. Please keep your workspace clean and tidy. Proper Personal Protective Equipment (PPE) should be in place. Such as Lab coat, covered shoes, safety glasses, etc.
j. Personnel are strongly advised to wash their hands before leaving the laboratory to minimize risks of transferring contaminants out of the laboratory environment.
k. Covered footwear is required to be worn in all laboratories.
l. Eating, drinking, smoking, applying cosmetics and handling contact lenses is prohibited in the laboratory working areas.
m. Storing foods or drinks anywhere in the laboratory working areas is prohibited.
n. Laboratory personnel are expected to have appropriate training in the research procedures for their projects. Junior researchers must be accompanied and supervised by a trained researcher.
o. It is recommended that researchers should not work alone after office hours.
p. Avoid running experiments unattended overnight. Where necessary and safety precautions put in place, the set up must be accompanied with a note containing information of the biological/chemical hazards involved, name of researcher and his/her contact number in case of an emergency.

3. Use of Seawater Aquaria

Block 3 (Biosafety Level 2 Aquarium and Animal Research Aquarium); Block 4 (Aquaculture); Block 5 (Marine Science and Controlled Environment Lab); Seawater Flume and Outdoor Aquarium

a. Please ensure you have permission from the Facilities Manager (Aquaria) for access prior to commencement of work.
b. Research activities requiring usage of Biosafety Level 2 containment and/or animal handling facilities (research involving fish, cephalopods and other vertebrates) will require approval from

relevant institutional regulatory bodies. Refer to Lab managers for assistance before commencement of any work.

c. Please ensure you have valid Safety Training certificate covering your activities at all times.
d. Please ensure that you familiarize yourself with the NMRS emergency response plan and aquarium system before work commencement.
e. Ensure that you have conducted relevant risk assessments for all your activities before commencement of any work.
f. A copy of the approval project risk assessment and Aquarium Use Request Form (Appendix D) should be submitted and filed with the Facilities Manager (Aquaria).
g. Toxic and/or hazardous substances should not be used in Blocks 4, 5 and Outdoor aquarium. Permission is required from aquaria manager before researchers may use any chemicals in the aquaria areas. Appropriate safety measures must be in place, including ensuring that such substances do not affect other Researchers nor cause harm to the environment. Chemicals may not be discharged into the seawater system.
h. All Researchers must label their tanks clearly indicate their name(s), affiliation, emergency contact number, title of project, number of tanks/troughs used and duration of occupancy on the side of the aquarium(s). Unlabelled tanks will be treated as not-in-use and will be assigned to other Researchers without notice.
i. Ensure your experiment setup does not pose any hazard to others i.e. tripping hazard, electrocution and electric fire hazard, as well as falling objects hazards.
j. Electrical equipment must be used with extreme care and caution in the aquariums; all electrical contacts must be protected from moisture and seawater. Dry your hands before handling any electrical contacts. Keep electrical devices away from tanks. Secure them safely so that they do not fall. Do not overload power sockets.
k. Wear appropriate covered footwear (e.g., non-slip track shoes, safety boots, sandals with back straps or booties; slippers and flip-flops are not allowed) in the aquarium. The floor may be wet and slippery, and sharp edges may be present. Injury due to slips and falls will be serious, and head injuries may occur. Be alert when working in the aquarium and exercise caution at all times.
l. Do not drain tank water onto the floor. Siphon water directly into the aquarium drainage system.
m. Do not discharge any seawater into garden areas.
n. Do not discharge sands, pebbles, stones etc. into the aquarium system as these will clog the pipes.
o. Use designated washing areas for cleaning equipment and samples.
p. Do not throw any plastics and trash into the seawater system.
q. No storage of items in the aquarium without approval from the Aquarium Facility Manager. Any items stored must be clearly labelled with the researcher's name, contact number and storage period. Unlabelled items will be treated as unwanted waste and may be disposed at the discretion of the Aquaria Facility Manager. A penalty fee will be imposed for disposal of items left behind by researchers.
r. Practice good housekeeping. Keep the surrounding areas dry and neat.
s. Do not tamper with other Researchers' tanks.
t. Do not change any aquarium settings (e.g. flow rates, aerations etc.) in the main feed without permission from the aquarium facility manager or else will be penalised.
u. Tighten the air valves in experimental tanks when not in use.
v. Never touch any marine organisms that you do not recognize. Use PPE at all times when handling living materials and when cleaning tanks. If you have been stung, alert First Aiders and seek medical treatment immediately.
w. When you have completed your work, please ensure that you leave the tank clean and dry so that it is ready for use by the next researcher. All rubbish and biological waste must be disposed of in a suitable and safe manner. An inspection will be carried out by the Aquarium Facility Manager and the researcher on the last day of usage (See Appendix B).

x. Use of BSL2 and Animal Research Aquaria are subjected to approval from relevant biosafety and aquaria manager. Researchers are required to complete relevant section of the **BSL2 facility usage form** with activity-based risk assessments upon registration. Please refer to Section H on Biological Safety for work involving BSL2 agents.
y. The maximum allowable booking duration for the seawater flume is **eight (8) weeks**. Requests exceeding this duration will be subjected to NMRS management approval
z. **Cancellation of seawater flume booking**: Once you have made a booking, you will be charged the full fee regardless if the Seawater flume is utilized on the day of the booking. As such, researchers are advised to cancel booking by emailing the Aquarium Manager as soon as possible with justification. Booking cancellation made more than 7 working days (not including booking date) before the booking date will not incur any charges. Any booking cancellation between 3 to 7 working days (not including booking date) before the booking date will incur a 50% charge. Full charges will apply for cancellation made less than 3 working days (not including booking date) prior to the booking date. There will be no penalty imposed if you are able to transfer your booking to another researcher

4. Use of Biosafety Level 2 Facilities

The highest level of containment available at NMRS is Biological Safety Level 2 (BSL2). **Work should only involve biological agents classified as Risk Group 2 and lower, as well as microbial agents contained within the Fourth schedule** of the Biological Agents and Toxins Act (BATA)**.**

Biological Safety Level 2 (BSL2) work may only be conducted in the Microbiology Lab located at Block 3, Level 2 consisting of three areas:

1. Biological Safety Level 2 Laboratory – Laboratory designed for microbiology research involving the culture of microbial agents, handling and storage of chemicals, feed and biological agents.
2. Biological Safety Level 2 Aquaria – Aquarium designed for research involving Biosafety Level 2 biological agents. Research on invertebrates can be performed here.
3. Animal Research Aquarium (ARA) – Aquarium designated for research involving marine animals (vertebrates and cephalopods) listed under IACUC and involving application of Biosafety Level 2 biological agents.

Please observe all guidelines defined in sections (2) Use of Research Laboratories and (3) Use of Seawater Aquaria. In addition, the following rules apply:

a. Prior to commencing work, a copy of the project risk assessment and BSL2 and ARA Facility Use Request Form (Appendix E) should be submitted and filed with the BSL2 Laboratory and Aquaria Manager.
b. All items in the Microbiology Laboratory must be disinfected/decontaminated before removal from the BSL2 area. Autoclave consumables, specimens, or samples before discarding into the appropriate bins within BSL2 area. Chemical waste should be stored in chemical waste containers until 70% volume. Disinfect and wipe down the containers with 70% ethanol before bringing out of the BSL2 lab.
c. BSL2 samples/specimens that are brought into the Microbiology Laboratory are not to be brought out without approval of Lab Managers.
d. Medical Surveillance may be required depending on the type of bacteria used or cultured for the project. Please approach respective lab managers for more information.
e. For the use of the Animal Research Aquarium (ARA), please refer to Lab Manager's with your proposed research plan. As the facility is small, you are advised to work closely with the managers to develop your research protocol. The Project PI will be responsible for the IACUC

application. When in doubt, the PI should seek clarification and guidance from the Lab Manager. All researchers working on vertebrates and cephalopods must have a valid RCULA/RCUF certificate and enrol in NUS Occupational Health Program.

f. Approval from NUS IACUC is required before any research involving live fish, amphibians, reptiles, birds, non-human mammals and cephalopods may commence. Application information is available: https://nus.edu.sg/research/iacuc/animal-care-use *Please note that approval of IACUC protocols may take between 3–6 months, depending on the date of application and amendments required after each review.*
g. There are medical surveillance requirements for work with vertebrates and cephalopods in the ARA. Please refer to Lab Manager for more information.
h. Depending on the experiment conducted, additional PPE is required in the Animal Research Aquarium and Biosafety Level 2 Aquarium. These include disposable gowns, hairnets, external waterproof gowns, eye protection and shoe covers. Please refer to Lab Manager for more information.
i. Movement of researchers in ARA should be unidirectional, i.e. entrance and exit from the ARA through separate doorways.

5. Use of Dormitory and Kitchen Block

Dormitories

a. Researchers intending to stay overnight must seek permission from their supervisor to conduct work after hours *before* booking the dormitory.
b. All Researchers must register to stay overnight. Bookings should be done in the NMRS Online System.
c. Bedlinen and keys to rooms are available from the Outreach and Education team. Please collect these items by 3pm on the day of your overnight stay. For stayovers on weekends or public holidays, please collect the items by 3pm on the previous workday.
d. After your stay, please bring the bedlinen to the wash area by 10am. Keys should be returned to the Outreach and Education team by 10am as well.
e. Students planning to stay overnight must be accompanied by a staff member.
f. Please leave footwear outside the rooms.
g. Do not leave valuables unattended.
h. Note the locations of exits, fire extinguisher, fire hose-reel, fire alarm call point, and first aid kit nearest to you.
i. A washing machine and dryer are available for your use, free of charge on the ground floor; please read instructions before operating the equipment. If in doubt, please contact NMRS staff.
j. Hot and cold drinking water from floor-standing dispensers are available.
k. No food and drink in the dormitories.

Toilets

a. Please do not dispose sanitary products (napkins, tampons) and paper towels into the toilet bowl.
b. After a field trip, please wash off mud and sand at the freshwater washing points available (Block 2, 3, 4, 5) before entering the buildings.

Kitchen

a. No naked flames allowed in the kitchen.
b. Please ensure you understand how to operate the kitchen equipment before using it. All induction cookers must be switched off before leaving the kitchen; DO NOT leave cooking unattended.

c. Please keep the cooking utensils clean and cooking area tidy.
d. Please wash all utensils and crockery after each use.
e. Wipe the stove clean after each use.
f. Note that we have kitchenware set aside for Muslim staff. Please observe appropriate social etiquette.
g. Please remove all foodstuff from the refrigerators before you leave the institute.
h. DO NOT remove any of the utensils and crockery for use in the laboratories.
i. Dispose of liquids into sink and not into kitchen bins.
j. Ensure that all food waste is disposed into the bin located in the kitchen.

Pantry Areas

a. No cooking is allowed in the pantry areas.
b. Please wash all utensils and crockery after each use.
c. Dispose of liquids into sink and not into pantry bins.
d. Ensure that all food waste is disposed into the bin located in the kitchen.

6. Use of Offices

a. A desk will be assigned to researcher after registration. This space is intended only for writing and computer work and may not be used for any kind of laboratory research work. Do not bring any research samples or chemicals into the offices. Do not use your desk space as storage space for laboratory consumables.
b. Lab coat and gloves should not be worn into the office.
c. Researchers should refrain from eating in the office. Please ensure the desk is kept clean. Leftover food, food waste, and food packaging must be discarded in the kitchen bins.
d. Observe good safety practices – avoid use of multi-pin plugs, and overloading power points with multiple devices. Do not leave electrical devices on when you are not in the office. Switch off all power points when you leave in the evening.
e. Hot-desking: Please ensure you remove all your belongings when you have completed your workday.
f. Researchers are advised not to leave confidential documents/valuables unsecured at your desk.
g. The research offices are intended for desk work. It is not to be used as a discussion room or recreational rest area. Researchers are reminded to be respectful of others working in the room and maintain good work decorum. See also below (10).

7. Use of Facilities in Marine Park Outreach & Education Centre (MPOEC) – Block 1

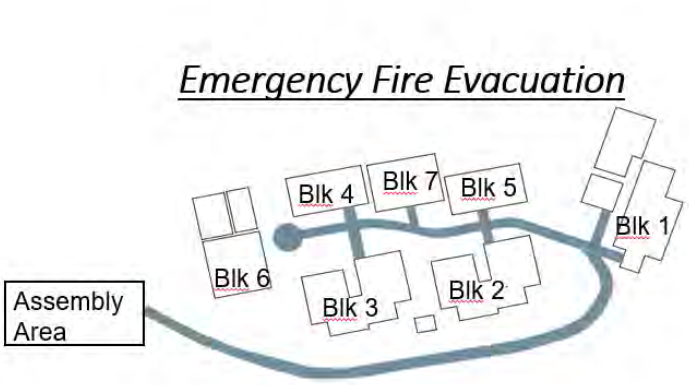
a. The Marine Park Outreach and Education Centre aims to promote awareness of marine conservation and environment sustainability through public education and outreach. The Centre was established in collaboration with the National Parks Board in 2015, with the opening of the Sisters' Islands Marine Park Public Gallery.
b. For the arrangement of visitor programmes and educational workshops, please contact the Outreach and Education team.
c. Please note that the first floor Public Gallery area is open to the public between 10am–4pm daily. Please keep your valuables secured, and ensure the rooms are locked when there is no one present.
d. The following rooms are available for booking within the MPOEC. Please contact the Outreach and Education team.
    i. Seminar Room (Level 1) – maximum capacity is 50 pax; only light refreshments allowed.

ii. Meeting Room (Level 1) – maximum capacity is 10 pax; only light refreshments allowed.
iii. Teaching Laboratory (Level 2) – maximum capacity is 30 pax; no food and drinks allowed; ensure proper PPE is worn.

e. The following areas are open to the public:
   i. Sisters Island Marine Park Gallery – maximum capacity is 30 pax; do not tamper with displays; no unauthorised use of power outlets.
   ii. Deck area and display tanks – maximum capacity is 30 pax.

f. Safety within MPOEC
   i. Please ensure that appropriate safety risk assessments have been completed. Risk Acknowledgement and Consent forms are required for all programmes.
   ii. Research activities involving the use of chemicals and hazardous material may not be conducted within MPOEC. Hazardous chemicals and equipment may not be stored in Block 1. Where workshops may require specific chemicals/equipment, please seek permission from Lab Manager.

g. Catering for events – Please inform the Outreach and Education team at least 2 weeks in advance if you intend to organise a function and/or intend to organise catering for any events to be held in NMRS premises.



8. Use of Research Vessel and Diving

Research Vessels

NMRS has 3 vessels, R/V Galaxea, Pioner Multi 3 and Pota Bote, reserved solely for research and educational activities only and STRICTLY NOT to be used for any recreational or personal activities.

a. **R/V Galaxea (SR 3049Z)** is a 12m aluminium hull workboat and installed with the Garmin_12XSV integrated navigational system. The vessel carries a maximum of 12 pax on-board, inclusive of 2 crew members, namely the steersman and engine driver/deckhand. R/V Galaxea has a cruising speed of 15 knots. It is equipped with a hydraulic A-Frame and winch that has a safe working load of 400kg and approximately 600m of steel cable.

b. **Pioner Multi 3 (SZ 20592C)** is a 5.5m powerboat, equipped with a 60HP outboard engine and with the Garmin E250 depth sounder installed. The powerboat carries a maximum of 6 pax on-board, inclusive of 2 crew, namely the steersman and engine driver/deckhand. Pioner Multi 3 has a cruising speed of 10knots. It has a shallow draft of approximately 0.3m which makes it ideal for conducting reef/shore landing and shallow water projects.

c. **Porta Bote (SZ 19878I)** is a 3.6m boat, can be equipped with optional 5HP outboard engine. The boat carries a maximum of 4 pax on board. It has a shallow draft of approximately 0.3m which makes it ideal for conducting reef/shore landing and shallow water projects.

Booking Procedures

a. All personnel boarding vessels must be registered with NMRS as a researcher, including but not limited to, and any visiting scientist. This requirement is necessary for safety and insurance compliances. Only registered personnel will be allowed to board the vessel.

b. The booking calendar for both vessels will be available in 3-month blocks. Bookings are accepted 3 months in advance. **Researchers must submit the necessary documents and confirmed their booking (refer to point e below) at least 2 weeks in advance before the intended date of field work for all vessels.**

c. Block booking is discouraged. As NMRS facilities are shared resources, we will only consider block bookings for exceptional cases. If you require consecutive booking of more than 3 days in a week, please email the Admin Manager with the justification.

d. Multiple researchers requesting the same date: NMRS has only limited resources to be shared. As such, we seek all researchers' cooperation to facilitate different activities of our marine science community. If multiple researchers require the same date for work, the Field Support Officer (FSO) will inform the relevant parties. We encourage researchers to collaborate and agree on a mutually acceptable alternative plan. If no resolution is reached within 10 days of the booking date, a ballot will be taken. The results of the ballot will be final.

e. The following documents must be submitted to the FSO to confirm their bookings.
   - Research Plan (includes planned itinerary)
   - Research Permit / Entry Permit (if applicable)
   - Risk Assessment (for both personnel and equipment)
   - Standard Operating Procedure (for both personnel and equipment)
   - Work Request Form (see Appendix C)

f. Research permits: please ensure you have all the necessary research permits for collection of marine samples. Information on research permits for collection of marine life may be found on the National Parks Board website:https://www.nparks.gov.sg/biodiversity/resources-and-research-permits.
   Note that research Permit Application may take up to 3 months for approval.

g. Entry into restricted areas: researchers are also expected to apply for the necessary permits (including names of crew) for entry into restricted areas and provide the vessel steersman a copy of the permit one day before the fieldtrip. Researchers are also to refrain from sampling at sites very close to the port limit. Maritime Port authority of Singapore (MPA) permit application website: https://www.mpa.gov.sg/port-marine-ops/marine-services/charts-tidal-info-atons-and-hydrography/conducting-hydrographic-surveys

h. Work Request Form (Appendix C): Only one representative is required to submit form and declare all personnel participating in the fieldtrip. All personnel stated in the work request form must be registered with NMRS.

i. **Cancellation (applies to all vessels)**: Once you have made a booking, you will be charged the full fee regardless if the boat is utilized on the day of the booking. As such, researchers are advised to cancel booking by emailing the FSO as soon as possible with justification. Booking cancellation made more than 7 working days (not including booking date) before the booking date will not incur any charges. Any booking cancellation between 3 to 7 working days (not including booking date) before the booking date will incur a 50% charge. Full charges will apply for cancellation less than 3 working days (not including booking date) prior to the booking date. There will be no penalty imposed if you are able to transfer your booking to another researcher.

j. If you have special requirements, please inform FSO at least 1 – 2 weeks in advance of your booking date.

Operation Hours

Please ensure that all personnel arrive at the designated vessel mooring early and be ready to set-off promptly.

a. R/V Galaxea: 0900hrs – 1700hrs
   i. Ensure all work is completed in a timely manner so that the vessel returns to the mooring on time. All personnel are expected to disembark by 1700hrs. This is to ensure that the crew have sufficient time to clean the vessel after every trip and get off work on time every day.

b. Pioner Multi 3: As Requested
   i. The operation of Pioner Multi 3 would be dependent on the nature of field work planned.

c. Porta Bote
   i. The operation of Porta Bote would be dependent on the nature of field work planned.

Vessel Mooring

a. R/V Galaxea: Republic of Singapore Yacht Club (RSYC)
b. Pioner Multi 3: St John Island
c. Porta Bote: St John Island

<u>Overtime charges apply for field work after hours</u>: For weekdays, this refers to service after 1700 hrs or before 0900 hrs, while overtime charges for weekends will apply to any service after 1600 hrs or before 0900 hrs. In due respect to the crew who have families, please ensure you plan for and complete your work on time. Note that there are strict rules regarding employment of non-academic staff after hours. As such, if you require use of R/V *Galaxea* after operation hours, please apply to FSO at least 2 weeks in advance, so appropriate staff arrangements can be made. NMRS management reserves the right to suspend any Researchers who persistently incur overtime without prior arrangement.

<u>Embarkation and Disembarkation at an alternative location</u>:
In the event that you require to embark and disembark at an alternative location besides the indicated location as above, please ensure that all the necessary arrangements have been made to host our vessel, including but not limited to the appropriate transport provisions for the crew. All expenses incurred will be borne by the project. The staff's travel to an alternate marina will be chargeable to the researchers. If you choose to embark/disembark from an alternative location, note

that the start/end time for your trip will still be based on the time of departure/arrival of R/V *Galaxea* at RSYC and Pioner Multi 3 at St John Island.

Applicable to R/V Galaxea Only: Overtime charges will apply if the crew must work outside operation hours to reach the alternate pickup point.

Bookings on weekends and public holidays are strongly discouraged, given strict NUS guidelines for employment of non-academic staff outside office hours. If you must use the vessel after operation hours, please apply at least 2 weeks in advance so that suitable arrangements can be made. Overtime charges will apply.

Important Contact Information

Boat Bookings and Enquiries
Field Support Office (FSO)
Mr Sebastian Yeo at tmsyjhs@nus.edu.sg
Mr Syabilhan Siddiq at syabil.s@nus.edu.sg

Emergency contacts
Police Coast Guard: 1800-375-0000
Maritime Port Authority: 6375 1600

Diving

a. All dive activities conducted from NMRS's vessels must comply with Singapore Standard 623 – code of practice for scientific diving (SS 623:2016). Divers intending to use either/or vessels for scientific diving must provide NMRS officers copies of relevant documentation (i.e., dive certification, medical certification) as stated in the Standards and the endorsement/approval to dive from their host institution's Dive officer, or equivalent personnel. All divers must ensure that they conform and comply with the requirements as stated in the SS 623: 2016 (Section 4.5). This is to ensure that researchers have received the appropriate training and adequately insured to conduct scientific diving.

b. The NMRS management seeks cooperation from Dive Officer of the host institution to ensure compliance of divers from their organisation. The dive officer must appoint a Dive Coordinator (or Dive Leader) to supervise the scientific diving activities from shore/vessel. It is mandatory for a dive coordinator (or Dive leader) to be present for all scientific diving activities even if not participating in the dives.

c. NMRS management reserves the right to suspend a scientific diver from activities onboard its vessels if his/her activities are not compliant with the Code or deemed in any way unsafe or inappropriate to the safe conduct of NMRS's vessel operations.

9. Application of Research Permits for Research Projects Conducted in Singapore

a. Note that St John's Island, as well as other islands in the vicinity, are gazetted as Marine Nature Areas by the National Parks Board.
b. Please refrain from indiscriminate collection of marine animals and plants.
c. Before Commencement of Work, please ensure that you have appropriate research collection permits and conduct your work in a responsible manner.
d. Information on research permits may be found on the National Parks Board website: https://www.nparks.gov.sg/biodiversity/resources-and-research-permits

e. Note that Research Permit Applications may take up to 3 months for approval.
f. Please inform the relevant Lab Manager at least 7 working days in advance, if you intend to bring in any marine organisms into the facility for research, in particular organisms governed by specific legal and health safety regulations.

10. Good Etiquette in a Shared Workspace

As our research community consist of people from different races and cultures with different social practices, we seek the cooperation of all personnel to be respectful of etiquette in common spaces

a. Respect your peers - Everybody comes from a different background and has a different level of knowledge; but everybody deserves the same level of respect and courtesy.
b. Cleanliness in the lab - when working in shared spaces, respect others by keeping the area clean and clear up messes as soon as you have finished your work. Always keep your workspace and desk space clean. Take extra care with common equipment and tools so they may remain in good condition for the next researcher. Ensure you do not infringe on others' space.
c. No pets are allowed in the NMRS facilities, office and laboratory. Avoid feeding wild animals (including stray animals) on the premises as leftover food encourages pests.
d. Switch your personal devices (computers, cell phones, radios) to silent mode when you are working in the office and lab. If you need to conduct a long conversation on your cell phone, step out of the office/lab.

11. External Contractors and Vendors

a. All contractors must report to the Admin Manager for clearance before entering the research facilities.
b. Please seek approval from Admin Office before commencement of any contract work in NMRS.
c. The contractor shall provide the particulars by filling up the Contractor Particulars Form, Contractor/visitor/Supplier Declaration Form and comply with the requirements by filling up the Contractor Acknowledgement Form. A work schedule, equipment tool list and risk assessment must be submitted for the work undertaken.
d. Formal approval is required if work involves any of the following:
    i. Hot work
    ii. Working at heights > 3m
    iii. Scaffolding Work
    iv. Lifting with Mobile Crane
    v. Confined Space
e. Contractor should not store any unnecessary materials on NMRS and should remove all material and equipment after the work has been completed.

12. Other Information

a. Smoking – in line with NUS' Smoking-free campus policy, no smoking is allowed in all buildings and enclosed areas.
b. Personal Protective Equipment (PPE) – these are expected to be provided for and maintained by the researcher's research grant and/or parent organisation.

c. Members of public and persons not registered as Research Personnel ("Casual Visitors") may not enter the research areas, but confine their visit and activities to Block 1, MPOEC only.
d. Children and minors in the workplace – No minor or child < age 13 is allowed into any research area where hazards associated with research may be present, unless the parent/guardian has obtained written permission from the Facility Director.

C) Workplace Safety

Providing a Safe Workplace for Everyone is Our First Priority

The National University of Singapore (NUS) is committed to ensuring a high standard of occupational safety and health (OSH) for our staff, students and visitors to the campus in association with its research, teaching and service activities. This commitment is demonstrated through implementation of the following policy statements.

Policy Statement

1. Legal Compliance

NUS is committed to comply with all applicable occupational safety and health legislation, guidelines and standards that it subscribes to; and other corporate policies that it adopts which are related to its OSH hazards.

2. Implementation of Occupational Safety and Health Management System and Programmes

NUS shall proactively identify, assess and control the OSH hazards associated with its activities to prevent injuries and ill health to staff, students and visitors. This shall be achieved through the implementation of an OSH management system and various OSH programmes, standards and directives at the University, faculties and departments. The specific requirements of managing OSH risks are detailed in the various NUS OSH manuals. We seek your cooperation to observe all OSH guidelines provided in this handbook to ensure a safe work environment all for Researchers of NMRS.

3. Safety Culture

NUS is committed to building a positive OSH culture and learning experience for all staff and students through the adoption of OSH best practices and systems.

4. Regular Review

The University's OSH management system shall be reviewed periodically to ensure its relevance and effectiveness to achieve improvement in its OSH performance.

Work Safety

Our staff are committed to ensure that safety system & procedures are developed and implemented to prevent injury & ill health, to protect University's properties and ensure a healthy and safe working environment at NMRS. To this end, we seek the cooperation of all researchers of the National Marine Research Station (NMRS).

a. ***Medical evacuation to a hospital on mainland may take more than an hour: if you have an existing medical condition that puts you at higher risk, please speak to the Admin Manager/Facility Director. We will advise if appropriate contingency measures are available.***
b. Remain vigilant and keep yourself informed of conditions affecting safety and health.
c. Actively participate in training programs and safety briefings, as well as regular fire drills and evacuation training.
d. Adhere to safety and health practices in the laboratory.
e. Report to the Lab Manager or Admin Manager if you observe any serious hazards in the workplace, classroom or laboratory.
f. Familiarise yourself with the attached Safety & Health information.
g. Ensure you conduct risk assessment for all work-related activities before you start work. Seek advice from our Lab Managers if you are not sure how to proceed with this.
h. It is not recommended to work alone in the facility.
i. Familiarize with the safety and health regulations applicable to your research activities.
j. Ensure you know where the nearest first aid kit and location of the Automatic External Defibrillator (AED). Only trained personnel can operate the AED.
k. Report all accidents and incidents to the Admin Manager within 24hrs.
l. Always Keep a list of the Emergency Numbers with you. (Refer to staff directory)
m. Handling of chemicals and hazardous substances should be conducted according to approved safety protocols. This includes legal compliances, its transport to NMRS and subsequent disposal. Researchers shall work closely with relevant managers to always ensure safe use of chemicals.
n. Use of regulated biological agents and Biological Safety Level 2 containment facilities are subjected to approval.
o. Use of radioactive substances is prohibited.

D) Acts and Legislations

APPLICABLE LEGISLATION

The following information describes the requirements for all researchers undertaking laboratory-based research projects.

1. Workplace Safety & Health Act

The Workplace Safety and Health Act (WSHA) stipulate the workplace safety and health obligations to be fulfilled, as well as responsibilities of every person in the workplace.

The WSH (General Provisions) Regulations stipulate provisions for statutory examination for pressure vessels, protection for working at height, lock-out procedures and safe work practices for hazardous substances. The WSH (Incident Reporting) Regulations provides requirements for notification and reporting of death, injuries, dangerous occurrences, and occupational diseases.

The WSH (First Aid) Regulations require first aid resources to be provided in the workplace. The WSH (Risk Management) Regulations specifies requirements for risk management which include the conduct of risk assessment and implementation of control measures.

Details about the WSHA and the subsidiary legislation are available at the Ministry of Manpower website. http://www.mom.gov.sg/workplace-safety-and-health/workplace-safety-and-health-act

2. Fire Safety Act

The Fire Safety Act and its subsidiary legislation specify requirements for fire protection facilities in buildings, appointment of Fire Safety Manager, and provision of fire emergency response plans for the occupants. Specifically, the transport, storage and usage of petroleum and flammable materials (PFM) are regulated under the Fire Safety (Petroleum and Flammable Materials) Regulations.

All researchers must declare to the Lab Manager all PFMs they intend to use, and comply with Lab Manager's instructions on use, storage and disposal of PFMs.

3. Environment Protection and Management Act

The Environmental Protection and Management Act (EPMA) and its subsidiary legislation govern environmental pollution: air, water, land, and boundary noise, management of hazardous substances as well as energy conservation for refrigerators and air-conditioners.

The EPM (Hazardous Substances) Regulations require application for a Hazardous Substance Permit from the National Environment Agency (NEA) to purchase, store and/or use scheduled hazardous substances (refer to Management of Hazardous Substances for more information). The EPM (Ozone Depleting Substances) Regulations prohibit the importation from and exportation of ozone depleting substances (ODS) to certain countries. The EPM (Air Impurities) Regulations control the emission of dark smoke and other air pollutants from any trade, industry, process, fuel burning equipment or specified industrial plant. The EPM (Trade Effluent) Regulations specify the limits for discharge of trade effluent into a watercourse and controlled watercourse. More details are available at: http://www.nea.gov.sg/anti-pollution-radiation-protection/chemical-safety/hazardous-substances

All researchers must declare to the Lab Manager all chemicals they intend to use at NMRS, and comply with Lab Manager's instructions on use, storage and disposal of chemicals.

4. Environmental Public Health Act

The Environmental Public Health Act (EPHA) and its subsidiary legislation govern environmental health issues. Specifically, the EPH (General Waste Collection) Regulations and EPH (Toxic Industrial Wastes) Regulations provide requirements for the storage and collection of general wastes and toxic industrial wastes. More information available at: http://www.nea.gov.sg/anti-pollution-radiation-protection/chemical-safety

All researchers must declare to the Lab Manager all chemicals they intend to use at NMRS, and comply with Lab Manager's instructions on use, storage and disposal of chemicals. Do not dispose of any chemicals in the sink or into seawater discharge.

5. Sewerage and Drainage Act

The Sewerage and Drainage Act (SDA) and its subsidiary legislation govern the installation and maintenance of the public sewer and connecting drainage. Specifically, the SD (Trade Effluent) Regulations regulate the discharge of wastewater into public sewers. More information available at: http://www.nea.gov.sg/anti-pollution-radiation-protection/water-pollution-control/allowable-limits

Do not dispose of any chemicals or waste into the sink, into seawater discharge or into the sea. More information available at: http://www.mpa.gov.sg/web/portal/home/port-of-singapore/maritime-legislation-of-singapore/prevention-of-pollution-of%20the-sea-act for the Prevention of Pollution of the Sea Act.

6. Chemical Weapons (Prohibition) Act

The Chemical Weapons (Prohibition) Act requires application of licence to use, develop, produce, acquire, stockpile, retain or transfer specified chemicals covered under the Chemical Weapons Convention (CWC). The Act also requires declaration of processing, consumption and storage of scheduled chemicals to be made annually to the Singapore Customs. The list of controlled chemicals can be found in the National Authority (Chemical Weapons Convention) website: https://www.customs.gov.sg/businesses/chemical-weapons-convention/controlled-chemicals

Please inform the Lab Manager if you intend to bring any chemicals listed under the CWC to NMRS, at least 2 months in advance.

7. Poisons Act

The Poisons Act regulates the importation, possession and sales of potent medicinal substances (poison) to prevent misuse/ illicit diversion of poisons. Application of Form A Poison Licence from the Health Science Authority (HSA) is required for the purpose of import, possess for sale, sell or offer for sale any poisons. However, Poison Licence is not required if the poisons are purchased from local vendors. For more info, click the link:

https://www.customs.gov.sg/businesses/national-single-window/tradenet/competent-authorities-requirements/hsa *Please inform the Lab Manager if you intend to bring any chemicals listed under the Poisons Act at least 1 month in advance.*

8. Arms and Explosives Act

Under the Arms and Explosives Act, application of licence from the Singapore Police Force (SPF) is required for the possession, control, import, export and manufacture or dealing with gun, arms, explosives, poisonous or noxious gas or substances, and these include explosive precursors (EP). Please refer to Arms & Explosives Licence for more details on application for licence and for the list of EP at https://www.police.gov.sg/e-Services/Police-Licences/Arms-and-Explosives-Licence

Please inform the Lab Manager if you intend to bring any chemicals listed under the Arms & Explosives Act at least 1 month in advance.

9. Misuse of Drugs Act

The Misuse of Drugs Act controls the manufacture, supply and possession of precursor chemicals necessary in the manufacture of controlled drugs as well as provides regulations on the import, export and trans-shipment of these chemicals. Under the Misuse of Drugs (Controlled Equipment, Material and Substances) Regulations, application of permit from the Central Narcotic Bureau (CNB) is required for the possession of controlled drugs and import or export of controlled equipment, materials or substances useful for manufacturing of controlled drugs. In addition, a licence from the Health Sciences Authority (HSA) is required for the import of controlled drugs.

Please inform the Lab Manager if you intend to bring any controlled substances listed under the Misuse of Drugs Act at least 2 months in advance.

10. Radiation Protection Act

The Radiation Protection Act and its subsidiary legislation regulate the manufacture, possession, use, import and export of irradiating apparatus and radioactive materials. Application of licence from the Centre for Radiation Protection and Nuclear Science (CRPNS), part of National Environment Agency, is required for lasers of certain class, ultrasound apparatus of certain power output, ionizing irradiating apparatus such as x-ray, and radioactive materials.

As of 1 September 2016, no radioactive substances may be transported into NMRS. Research with radioactive materials including radio-isotopes may be conducted on the premises.

11. Biological Agents and Toxins Act

The Biological Agents and Toxins Act (BATA) administered by the Ministry of Health (MOH) came into force on 3 January 2006 in Singapore. The BATA prohibits and otherwise regulates the possession, use, import, trans-shipment, transfer and transportation of biological agents, inactivated biological agents and toxins that are of public health concern. For more information on biosafety and list of organisms listed under BATA, please refer to: https://www.moh.gov.sg/biosafety/about-bata

Researchers intending to undertake work with any biological materials covered under BATA must first seek permission from NMRS Administration to ensure appropriate safety compliances are in place before commencing work.

12. WHO Laboratory Biosafety Manual

MOH has also adopted the Laboratory Biosafety Manual, 3rd Edition, by the World Health Organization (WHO) as the national guidelines for biosafety to supplement the BATA. The Manual provides guidance on a range of topics, including laboratory biosecurity, laboratory equipment, good microbiological techniques, biotechnology, other safety issues such as chemical, fire and electrical safety, safety organization and training, and checklist.

All research staff are required to exercise guidelines for biosafety given in the WHO Lab Biosafety Manual. https://www.who.int/publications/i/item/9789240011311

13. Singapore Genetic Modification and Advisory Committee

For projects which involve genetic manipulation or research on genetically modified organisms (GMOs), the guidelines - "The Singapore Biosafety Guidelines for Research on Genetically Modified Organisms (GMOs)" from the Genetic Modification and Advisory Committee (GMAC) are to be adhered to. The Guidelines cover experiments that involve the construction and/or propagation of all

biological entities (cells, organisms, prions, viroids or viruses, plants and animals) which have been made by genetic manipulation and are of a novel genotype and which are unlikely to occur naturally or which could cause public health or environmental hazards. The Guidelines also have provisions for the importation of GMOs and/or GMO-derived products for research purposes.

Please refer to Singapore Biosafety Guidelines for Research on GMOs for full set of guidelines. https://www.gmac.sg/Index_Singapore_Biosafety_Guidelines_for_Research_on_GMOs.html *Please inform the Lab Manager if your research is likely to involve the use of GMOs. GMOs for use in research should not be transported to NMRS without prior permission.*

14. Infectious Disease Act

The Infectious Disease Act (IDA) is the principal legislation for the control of outbreaks and prevention of infectious diseases in Singapore. The IDA and Infectious Disease (Notification of Infectious Disease) Regulations stipulate requirements for person(s) who know, or has reason to suspect, the existence of an infectious disease to notify the authority and take measures to prevent the exposure of other persons to the risk of infection.

15. IATA Dangerous Goods Regulations

The International Air Transportation Association (IATA) Dangerous Goods Regulations specify requirements for classification, marking, packing, labelling and documenting dangerous goods for air shipments.

E) Fire Safety

The National University of Singapore is committed to a high standard of fire safety and will make all reasonable efforts to adopt best practices and compliance with the Fire Safety Act, Codes of Practice and all other current fire safety legislation and standards.

Researchers must comply with instructions given to them regarding fire safety and any other fire procedures.

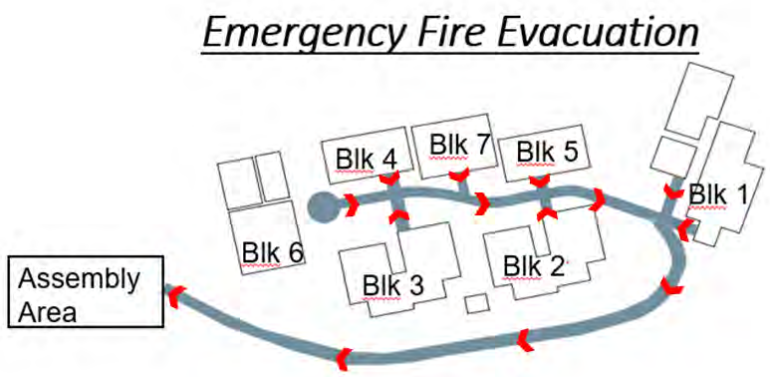
a. Know what to do in the event of a fire, including leaving equipment in a safe position
b. Familiarize yourself with the escape routes
c. Consider the risk of fire from your activities; reduce or control that risk
d. Not to interfere or abuse any equipment provided for fire safety.
e. Report any observed shortcoming in fire precautions to the Admin Manager

All Supervisors with responsibility for other staff, students, contractors or visitors have a particular role in ensuring that work is carried out safely to minimise the risk of fire.

a. Ensure those under your charge have the appropriate information, instruction and training to work safely and take the correct action in the event of a fire.
b. Include the risk of fire in risk assessment of their activities, and training needs are identified and provided for
c. Ensure control measures are implemented, Check compliances for different procedures
d. Ensure information and instruction is provided about risks and controls
e. Ensure personnel under your charge know how to respond in the event of a fire.

Fire Evacuation and Assembly Point

If evacuation is required, all researchers should move towards the empty grass patch right outside NMRS facility. See figure below. Head counting will be conducted by core staff there to account for all personnel physically present at the facility



Fire Detection and Protection Equipment

Emergency Exits

All fire exits and escape routes shall be kept clear of obstructions. A minimum 3m clearance is to be maintained from fire exit staircases.

The floor plan is available at all blocks and at the fire alarm panel board (Admin Block) to facilitate the work of emergency services in case of fire outbreak.

Good Housekeeping

Good housekeeping or maintenance of orderly cleanliness is a basic factor in fire safety. Good housekeeping practices, both indoors and outdoors, by disposal of unwanted combustibles, limitation or segregation of combustibles reduce the danger of fire.

Fire Fighting Equipment

Fire extinguishers are available in every block and level in NMRS. Please refer to the chart below on the Class Type and the extinguishing agents.

FIRE SAFETY GUIDELINES

a. Do not use cardboard boxes, wooden crates or other receptacles that are made of combustible material as makeshift rubbish bins at your workplace. Use proper rubbish bins, preferably those made of non-combustible material, like metal. Conduct frequent rubbish and waste disposal.
b. Do not accumulate unwanted items. Dispose of unwanted items at regular intervals to ensure good housekeeping at your workplace. All packing materials should be neatly stacked in a separate storage area and not in passageways or aisles. In storage areas, aisles shall be maintained for unobstructed access and egress. These aisles should correspond as much as possible to the width of the room's entry/exit points.
c. Keep corridors, walkways and passageways free of obstructions. Do not use corridors, walkways or passageways that form part of the emergency route at your workplace for storage. Do not use staircases as rest areas or storage areas. Always keep staircases free of obstructions.

d. Do not remove ceiling boards or use ceiling void (i.e. space above suspended ceiling) for storage. Ensure that all ceiling boards are in place, not missing, or damaged.
e. Ensure that the detectors and sprinkler heads are not painted over or obstructed with objects.
f. There shall be a minimum clearance of 0.5m between the top of storage piles and sprinkler heads or the ceiling. This clearance space shall be 1.0m in workshops.
g. Store flammable liquids in proper, unbreakable containers and keep flammable substances in well-ventilated places and away from any ignition source. See also CHEMICAL SAFETY
h. Ensure ventilation openings are not sealed up and have defective ventilation fans repaired quickly.
i. Do not use candles or other naked flame for lighting purposes, especially during a power failure. Use battery operated portable torchlights as a back-up.
j. Do not smoke anywhere on campus building. Observe “No-smoking” rule strictly in your premises.
k. Do not leave electrical appliances or equipment switched on when they are not in use, especially after office/working hours. Switch off at the mains for all electrical appliances or equipment that are not in use, especially after office/working hours.
l. Ensure that electrical socket, electrical switchboards and the enclosures of electrical components are kept clear of flammable or combustibles substances and liquids. All electrical boxes should be closed to prevent the possibility of contact with combustible materials.
m. All fixtures, switches and sockets should be well maintained. Do not use electrical equipment with frayed cables and loose connections. Repairs should only be carried out promptly by licensed electrician. Do not overload the electrical circuit by drawing current from one power outlet to multiple electrical appliances or equipment simultaneously. Use one power outlet for one electrical equipment or appliance, whenever possible. The use of multiple plugs drawing power from one socket is not recommended.
n. Do not use electrical closets or compartments that house dry riser inlets/outlets, hose-reel, telecom riser ducts etc. for storage. Ensure that the closets and compartments are always clean and free of obstructions.
o. Do not burn joss sticks, oil, incense fragrance sticks, incense paper and other offerings used in religious ceremonies in the premises. Use joss sticks, lamps and candles that are electrical, or battery operated. Do not wedge open any fire door or exit staircase. Ensure fire doors are kept closed but always unlocked.
p. Do not obstruct the access to a fire hose-reel or fire extinguisher.
q. Hot works, welding: please seek assistance from Facility Management for any hot works or welding.
r. Do not tamper with gas cylinders. Seek assistance from Laboratory Managers.
s. Based on safety considerations, activities which require the use of open flame, explosive, are not allowed in all buildings of NUS.
t. Flammable liquids, gases or substances are allowed in labs for research work only.
u. Attend Fire Safety Training and ensure your certificates are updated regularly.

F) Laboratory Safety

There is an increasing trend of research laboratories being designed in an "open" concept, instead of individual laboratory suites. This layout provides greater opportunities for collaboration and for monitoring of safety practices. As there might be different research groups in these laboratories, there is a need for each group to communicate their hazards and risks to the other research groups.

All staff and research personnel must comply with policies laid out in this Manual and safety instructions, standard operating procedures (SOPs), standards and guidance documents that are applicable to their area of work. All staff and students are responsible to carry out their work safely.

All researchers working in the laboratory are responsible to read and understand his/her role and responsibilities in the emergency response plans, as well as the expected actions to be carried out in the event of emergency. Everyone is required to participate in drills to familiarize themselves with the emergency response procedures.

1. Risk Management & Assessments

The principle of risk management is to identify the safety and health hazards associated with works carried out in a laboratory, assessing the risk level, prioritizing and implement measures to control the hazards and reduce the risk to acceptable level. These include:

a. Physical hazards (electrical, mechanical, noise, ergonomics, trip and fall, and etc)
b. Chemical hazards (flammable substances, compressed gas and etc)
c. Biological hazards (animals, infectious substances, biological agent and etc)
d. Radiation hazards (ionizing and non-ionizing)

Researchers must conduct risk assessments prior to the commencement of research projects, and only commence work after their risk assessments have been approved. The risk assessment should cover both routine and non-routine activities in the laboratories. Discuss with the relevant Lab Managers to ensure adequate and effective control measures are in place to control the hazards identified and reduce the risks to acceptable level. The risk assessment should be endorsed by the Principal Investigator of your project and relevant Lab Manager at NMRS. A signed copy of the Risk Assessment must be filed with your host institution and one copy filed with the relevant Lab Manager at NMRS, *before you start work*.

2. Safety Training

All researchers conducting work at NMRS must complete appropriate safety trainings before they commence work. Safety training requirements are identified during registration. Additional trainings may be stipulated if the scope of work changes.

Researchers are expected to have received adequate instruction and proper training in managing the hazards specific to his/her laboratory and the safe conduct of the experimental procedure to be used. At the minimum, all personnel working in the laboratory should be trained in the following areas prior to the start of their experiment:

a. Understanding of relevant safety training materials and laboratory manuals
b. Experimental procedures to be carried out
c. Understanding of the hazards in the laboratory
d. Proper operation of tools and equipment

e. Safety precautionary measures to be taken
f. Usage and maintenance of PPE
g. Emergency response procedures (e.g. chemical spill, fire)
h. Accident/ incident reporting procedures

3. Safety Control

a. ELIMINATION & SUBSTITUTION

Eliminate the hazard or task where it is practicable to do so. For example, use ready-mixed solutions. This eliminates the need to weigh and mix, and the associated hazards that comes with such tasks.

If elimination is not feasible, consider using substitution method. For example, substitute toxic chemicals with something less hazardous, substitute glassware with plastic ware, substitute syringes with pipettes, etc.

b. ENGINEERING CONTROL

Engineering controls can be implemented in the form of:

- Automation of the process,
- Isolating the hazard from the target(s) (including both the researcher and persons in the vicinity) by means of: - distance, physical barriers (e.g. guarding, shield, chemical storage cabinet), or containment equipment (e.g. secondary containment, fume hood, biological safety cabinet, exhaust ventilation system).

c. ADMINISTRATIVE CONTROL

Administrative controls are work procedures such as safety policies, rules, supervision, and standard operating procedures (SOP). The administrative controls commonly implemented in the University laboratories are: restricting access to laboratory and other hazardous areas, posting of signs and labelling to indicate the hazards present in the laboratory, development of SOPs on the safe handling of materials, equipment and machines, display of informative posters and guidelines and etc.

Researchers must observe all SOP and access controls posted by Lab Management.

d. PERSONAL PROTECTIVE EQUIPMENT (PPE)

The use of PPE is necessary when feasible engineering and administrative controls are unavailable or where there is a need to supplement those controls. PPE should NEVER be considered as a first priority in minimizing exposure to hazardous substances.

Researchers are expected to have available appropriate personal protective equipment (PPE) for his/her work. He/she must have been trained on the proper use, care and maintenance of the PPE. All Researchers bear the ultimate responsibility to learn and use the PPE correctly. This is to ensure the PPE provides the intended and effective protection to the researcher. Otherwise, the PPE can give a false sense of security and pose a danger to the researcher. It is the Researcher's responsibility to ensure that the PPEs are kept clean and properly maintained, and the faulty ones are replaced.

NMRS Laboratory Managers reserve the right to expel any researchers from the laboratory if they fail to use PPE correctly.

***Eye and Face Protection**

Suitable protectors shall be used when researchers are handling materials which may expose them to hazards from flying particles, molten metal, acids or caustic liquids, chemical liquids, gases, vapors, bio-aerosols, or potentially injurious light radiation. Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. For those who wear prescription lenses, eye protectors shall either incorporate the prescription in the design or fit properly over the prescription lenses.

Note that use of safety glasses is compulsory for all NMRS laboratories

***Respiratory Protection**

Researchers must undergo mask fit test and medical examination prior to using a respirator. They must also be trained in donning and maintaining the respirator properly to ensure effective protection to the Researchers. Speak to Lab managers for more information.

4. Waste Disposal

Definitions

a. General waste – paper/plastic packaging; items not contaminated with chemicals nor biological materials.
b. Broken Glass – Laboratory glassware and should not contain any hazardous material.
c. Sharps – Objects or devices capable of cutting or penetrating the skin e.g. hypodermic needles, scalpel blades and glass contaminated with chemicals, toxic or infectious materials.
d. Chemical waste – Spent chemicals and all materials/consumables tainted with chemicals.
e. Biological Waste – Biological materials of animal, plant or microbial origin. This can include infectious material, contaminated agar plates, live cultures and disposables that have been in contact with the aforementioned.
f. Cytotoxic Waste – Any materials/consumables contaminated with any residue or preparations that contain materials that are toxic, carcinogenic, toxic for reproduction or mutagenic.
g. Disposal method for mixed waste can be found under: https://www.wshc.sg/files/wshc/upload/cms/file/2014/WSH_Guidelines_on_Laboratories_Handling_Chemicals.pdf

Solid waste	Hazard	Example Waste type	Additional Action prior to disposal	Waste container
	Biological	Agar (both molten or solidified)	Allow it to solidify	Biohazard bag and bin
		Live Samples and/or Live Specimens	Decontaminate / Autoclaved (for BSL2)	Biohazard bag and bin
		Contaminated plastic tubes / vials (non-glass)	Ensure cap is secured	Biohazard bag and bin
		Contaminated, reusable glassware	If material inside the bottle is autoclavable, autoclave followed by washing	
			If material is not autoclavable and is contaminated with chemical: discard liquid into chemical waste container and disinfect bottle before washing.	Chemical waste container for liquid
		Contaminated pipette tips, gloves, paper towels	N/A	Biohazard bag and bin
	Cytotoxic	Contaminated pipette tips, gloves, paper towels	N/A	Cytotoxic bag and bin
		Contaminated agarose (molten / solidified)	Allow it to solidify	Cytotoxic bag and bin
	Chemical	Emptied bottle from supplier	Label with hazardous waste label with complete information	Contact lab manager
		Any solids / consumables contaminated with chemical (e.g. pipette tips, paper towels)	Place in separate plastic bag and seal	Laboratory waste bag and bin
		Expired chemicals	Label with hazardous waste label with complete information	Contact lab manager
		Unwanted chemicals	Label with hazardous waste label with complete information	Contact lab manager
	Broken laboratory glassware	Broken laboratory glassware		Broken glass bin
	Sharps	Glass slides, needles (see definition)		Sharps bin
	General waste	paper, plastic packaging (see definition)		General waste bin

Liquid waste	Hazard	Example Waste type	Additional Action prior to disposal	Waste container
	Biological (with no hazardous chemical)	Spent media, seawater, live culture	Decontaminate / Autoclave (For BSL2)	Sewage drain / Decontamination Room (BSL2)
	Biological (with hazardous chemical)	Spent media, seawater, live culture	Depending on chemical compatibility with decontamination procedure; contain waste in appropriate waste bottle and label with hazardous waste label with complete information	Contact lab manager
	Cytotoxic	Contaminated buffer / liquid	Contain waste in appropriate waste bottle and label with hazardous waste label with complete information	Contact lab manager
	Chemical	Liquid contaminated with chemical	Contain waste in appropriate waste bottle and label with hazardous waste label with complete information	Contact lab manager
		Expired/unwanted chemicals	Label with hazardous waste label with complete information	Contact lab manager
		Spent chemicals	Label with hazardous waste label with complete information	Contact lab manager

5. Shared Bench Spaces

As there might be researchers present in the laboratories, it is necessary to actively manage hazards and risks in a shared space.

a. Ensure you have communicated to the Lab Manager the nature of your research activities. Inform the managers if there are changes to the work scope, *before you begin work.* This is to ensure that activities within a lab are compatible.
b. Practice diligent housekeeping. Clean up your workspace as soon as possible and at the end of every workday.
c. Ensure all contents are labelled and any hazards are clearly marked so that other Researchers are aware. Always use appropriate PPE.
d. Exercise mutual respect – do not tamper with research of other Researchers in the laboratory
e. Refer to Lab Manager if you have any concerns, requirements or unsure how to operate equipment or proceed with your experiment.
f. Do not block emergency escape pathways, exit doors and emergency windows. Do not block the access to emergency response equipment (e.g. fire extinguisher, hose-reel, spill kit) and first aid kits.

6. Shared Equipment

The research equipment of NMRS are resources to be shared by the community. Researchers using NMRS facilities are expected to exercise diligence and social responsibility to ensure that the equipment are used correctly so they may continue to be available to everyone in the community. Researchers must:

a. Review the operating protocols for the equipment.
b. Attend appropriate training.
c. Researcher must file a risk assessment for the activities associated with their use of the equipment.
d. Follow the safe operating procedures for the use of the equipment.
e. Perform a risk assessment if they intend to use the equipment beyond its normal operating and performance limits. He/she must seek approval from the Lab Manager before starting work.
f. Be responsible in the use of the equipment.
g. Promptly remove samples after the use of the equipment and clean up any residual contamination from the equipment.
h. Notify the Lab Manager immediately of there has been a spill and/or damage to the equipment; and assist with the clean-up of material from the equipment.

7. Electrical Appliances

Seawater is a very good conductor of electricity and as such, it is very important to observe good practice in handling electrical devices in a marine laboratory.

Dos:

a. Use electrical equipment and apparatus that complies with local safety standards and regulations. Certified electrical equipment usually bears a 'Safety Mark'.
b. Consider the electrical loading of equipment prior to purchasing and installation.
c. Use electrical equipment and apparatus in accordance with the manufacturer's operating instructions.
d. Ensure grounding is carried out for any electrical equipment that needs to be grounded.
e. Switch off appliances when not in use. Except for those indicated by a notice that read "Do not switch off – equipment needs to be switched on all the time", all electrical equipment and apparatus are to be switched off when not in use.
f. Post warning signs whenever there is a need to alert personnel working in the laboratory about electrical hazards that may be present.

Do not handle electrical equipment with wet hands!

Electrical Plugs

a. Do not use any plug that has not been approved/ certified. Certified electrical equipment usually bears a 'Safety Mark'.
b. Make sure plug is fully inserted into socket.
c. Remove all broken or damaged plugs immediately.
d. Always switch off the electricity supply before unplugging from socket.

Electrical Sockets

a. All sockets should be firmly mounted onto the wall or mounting location.

b. Broken sockets are to be replaced immediately.
c. Do not overload any electrical socket by connecting several appliances using multiple socket accessories.

Electrical cords

a. Electrical cords should be maintained in good condition.
b. Remove all frayed cords immediately to prevent fire or electrocution risks
c. Do not run cords along floor to prevent tripping risks.
d. When connected to a plug, the electrical cord is to be firmly held by the cord gripper.
e. Do not use extension cord for heavy duty equipment and where permanent wiring should be installed.
f. No more than 4-way extension cord with 'Safety Mark' is allowed.
g. Do not plug another extension cord onto an extension cord.

Electrical wiring and fuses

a. Take note of the colour code used for electrical wiring: Live wire – brown; Neutral – blue; Earth - green / yellow
b. Do not use any undersized or oversized wire.
c. Joining of wires using adhesive tapes is not permitted – use proper connectors.
d. Select the right size fuse. Do not use a wire as an improvised fuse.

Electrical Switchboards, Distribution Panels and Faulty Equipment

a. Do not open the cover of the main electrical panels. Please refer to NMRS Facility Management for assistance
b. Do not place any item that can obstruct accessibility to the front opening of the electrical panel.
c. No one other than a licensed electrical worker is allowed to carry out any electrical installation and maintenance where there is a possibility of contacting live wiring or terminal.
d. Report any faulty electrical equipment or apparatus to the Lab Manager immediately. Do not attempt to use any equipment labelled as “FAULTY - DO NOT USE”

8. Ergonomic Risk

Many laboratory activities involve awkward and static postures, high repetition, excessive force, contact stresses, vibration, and pinch grip among others. These activities include pipetting, microscopy, cell counting, using forceps, using a cryostat and working in a glove box, biosafety cabinet or fume hood. Those who work in a laboratory are at an increased risk of repetitive stress injuries. Alternate work processes should be considered when possible. Where significant task variation is not possible, then work pauses or breaks should be taken.

Lifting Heavy Objects

a. Plan the Lift - Before lifting or moving an object, plan out the movements. Make sure there is enough room to perform the task properly and ensure that any travel path is clear of obstacles. If lifting or moving an object as a team, make sure that all in agreement with how the lift and/or move will take place.
b. Close and Centered - Whenever lifting an object, start with and keep the object close to the body. A good way to do this is to have a diagonal footing when lifting an object off the floor (one foot to the side of the object, the other foot behind the object). If lifting straight up with this footing, the object will remain close to the body. The further the person lifts and/or holds an object away

from the body, the more strain it places on the back muscles and bones. Keep the object centered in relation to the body. Keeping the object centered will help to discourage from twisting or contorting the back while lifting or holding the object. Twisting, even while lifting or carry little or no weight, can cause back injuries.

c. Use "Core Strength" - Having a strong "core" essentially means having strong upper, middle, and lower abdominal muscles. By tightening up the core muscles when lifting and moving objects, it will place the back muscles in a good position for lifting/moving and will help to prevent excessive force on the spine. Doing sit-ups and leg lifts will strengthen the abdominal muscles and will do a lot to protect from a back injury.
d. Bend the Knees, Lift with the Legs - When lifting objects from down low, bend the knees and keep the back straight when setting up the lift. While lifting the object, use the large, powerful muscles of the legs to straighten the body up (rather than the smaller, weaker, and more vulnerable muscles of the back and arms). Keep the abdominal muscles tight when lifting.
e. Look Ahead - Keep eyes looking in front of and slightly upward when lifting and moving objects – this will keep the upper back and neck in the best position for lifting. Avoid bending the head or neck downwards when lifting.
f. Don't Lift It Alone - If an object is too heavy, large, or awkward to lift or move for one person, get some help.

Helpful tips for microscopy work:

a. Do not work with elbows winged. Keep elbows close to sides, below 45-degree angle.
b. Objects that must be accessed frequently should be kept close enough to avoid having to stretch and strain, usually within 20-65 cm.
c. Make sure to work with wrists in neutral (straight) position. Avoid forearm and wrist contact pressure.
d. Ensure that feet are flat on floor or supported by footrest.
e. Avoid raising shoulders and bending neck while looking through microscope's eyepiece.
f. Ensure the microscope eyepieces have been adjusted correctly for your use.
g. Avoid repetitive movements; alter prolonged awkward postures. Take adequate small breaks, or perform other job tasks that require less repetition, rest the eyes, neck, and shoulders.
h. Reduce fatigue by taking micro-breaks, 20-180 seconds at 10-to-15-minute work. Use this time to stand and/or stretch, and allow the eyes to focus on a distance.
i. Use a fully adjustable chair or stool with built-in solid footrest.
j. Use lifters and angled microscope arm supports to relieve fatigue and strain.
k. Ensure that sufficient knee and leg space is available.

9. Accident/Incident Reporting and Investigation

An "incident" refers to any undesired safety & health-related event that resulted or could have resulted in any harm to human, property or environment. This includes:

a. Accident: Any event which has resulted to injury, ill-health or fatality.
b. Near Miss: Any event where no injury, ill-health or fatality occurs but had the potential to do so

When an incident occurs:

a. Where it is safe to do so, take appropriate immediate actions to minimize further injury/damage
b. Inform NMRS Lab Manager/Admin staff immediately
c. Ensure injured person(s) has received first aid treatment

d. Injured person(s) receives seek further medical attention at the nearest hospital if necessary
e. Ensure that the incident site is not disturbed until investigation is completed
f. Do not release any information to anyone (except NMRS staff) until investigation is completed

All safety and health-related incidents will be reported to NUS Office of Risk Management and Compliance (ORMC) within 24 hours, including those reportable to government regulators. The PI and host institution of the researcher will also be notified within 24 hours.

Incidents Reportable to Government Regulators include:

a. Ministry of Manpower (MOM): Fatality, > 24hrs hospitalization, > 3 days of MC (consecutive or otherwise), Occupational Disease, Dangerous Occurrences
b. Ministry of Health: Laboratory Acquired Infections resulting from working with Biological Agents Toxic Act (BATA) agents
c. National Environment Agency: Radiation exposure as described under Radiation Protection Act

G) Chemical Safety

All Researchers should work with lab managers to ensure that reasonably practicable control measures are implemented, measures are effective in eliminating or minimizing the risk and assist to inform any chemical hazards to other Researchers in the laboratory.

1. Legislations

There are several legislations that are applicable to chemicals which govern specific requirements for procurement, inventory record, storage, disposal and medical surveillance. These include:

- Workplace Safety and Health Act, including WSH (General Provisions) Regulations, WSH (Incident Reporting) Regulations, WSH (First Aid) Regulations, WSH (Risk Management) Regulations and WSH (Confined Space) Regulations.
- WSH (General Provisions) Regulations
- Chemical weapons (Prohibition) Act
- Fire safety (Petroleum & Flammable Materials) regulations
- Poisons Act
- Environmental Protection and Management Act (EPMA)

For detailed information on these legislations, you may refer to Section D Acts and Legislations (Page 40-43).

Type of Regulated Chemicals, Regulatory Authorities and License/Permit, Inventory & Storage Requirements.

Type	Regulatory Authority	Licence/Permit			Inventory	Live Inventory	Quantity for storage/use	Lock & Key
		Store and Use	Import	Export				
Petroleum & Flammable Materials (PFM)	Singapore Civil Defence Force (SCDF)	✓	✓		✓		Based on Maximum Allowable Quantity (MAQ)	
Hazardous Substances (HS)	National Environment Agency (NEA)	✓	✓	✓	✓		Based on Permit /Licence	
Explosive Precursors (EP)	Singapore Police Force (SPF)	✓	✓	✓	✓	✓	Based on Permit /Licence	✓
Chemical Weapons	Ministry of Home Affairs (MHA)	✓	✓	✓	✓	✓	Based on approved quantities	✓
Scheduled Poisons	Health Sciences Authority (HSA)		✓	✓	✓			✓
Controlled Drugs	Central Narcotics Bureau (CNB)	✓	✓	✓	✓	✓	Based on Permit /Licence	✓

2. PI Responsibilities

a. PIs must ensure that all researchers under their care actively avoid or minimise the generation of hazardous waste.

b. PIs are required to establish local procedures that are consistent with above guidelines and ensure that their researchers are familiar with and follow correct chemical handling procedures. In this respect, PIs must inform NMRS of any intent to use regulated chemicals at NMRS, to ensure appropriate licenses are in place before the chemical is transferred to NMRS. Note that chemical

licenses are site specific: a license to possess a chemical on campus does not automatically allow staff to transfer it to NMRS. If NMRS does not hold a license for a chemical, the researcher may be required to cover NMRS's costs for acquiring and maintaining the license. This may include costs for implementing necessary safety controls.

2.1. NUS PIs:

a. Note that researchers are required to use the NUS Laboratory Materials Purchase Requisition System (LMPRS) to purchase all laboratory materials, including regulated and non-regulated chemicals and regulated gases.
b. Laboratory materials must be registered into the Laboratory Materials Management System (LMMS), except certain exempted laboratory materials
c. NUS researchers must work closely with NMRS Lab Managers to ensure your materials follow departmental LMMS policies.

2.2. Non-NUS Researchers:

a. You must inform lab manager if you intend to use any regulated chemicals at NMRS. Appropriate arrangements will be made for its transport, inventory and disposal. These chemicals will need to be handled according to NUS' chemical safety procedures. As chemical licenses are site specific, NMRS management will be the designated license holder.

3. Administrative Requirements

3.1. **All researchers handling chemicals are expected to always hold a valid Chemical Safety Training certificate.** This is to ensure that you are equipped with the necessary knowledge, skills and techniques to handle chemicals in such a manner so as not to threaten the safety and health of yourself and others in the vicinity. PIs should ensure their students and staff received adequate instructions on the safe handling of chemicals, undergone the required training, and received the necessary medical examination. NMRS reserves the right to suspend any researcher that we feel does not have adequate training and knowledge in chemical safety, from conducting laboratory activities.

3.2. Any person wishing to work with hazardous chemicals shall first obtain permission from the lab managers. Please allow 4 – 6 weeks of processing time. The application submitted to the lab manager shall contain the following information:

a) Name of the university/institute & faculty who will be responsible for the safe use of the hazardous substances.
b) List of hazardous substances to be used, including physical form and maximum amount in possession at any one time.
c) A description of how the hazardous substances is to be used.
d) Procedures for safe removal of contaminated wastes.
e) Decontamination procedures.
f) Safety Data Sheet(s) of the hazardous substance(s)

3.3. Under the law, explosive precursors (EP), chemical weapons, scheduled poisons and controlled drugs must be kept under lock and key. The cabinet key is kept by designated lab managers, and only authorized researchers can access these licensed chemicals.

All researchers must conduct risk assessment for all activities involving chemicals in the laboratory. Your risk assessment must be reviewed once every three years and approved by the Lab manager before you begin work. The risk assessment must address:

a. Risks associated with the use of the hazardous substances
b. Potential spillage or leakage
c. Impact of an incident to the surrounding people and on the surrounding area
d. Medical or first aid requirements in the event of an exposure
e. Incompatible goods
f. Effective containment and clean up
g. Appropriate disposal of waste material

4. General guide to chemical hazards

It is important to exercise caution in the usage of chemicals as they may exist in different forms: solid, liquid and gas. They may be chemically reactive with each other and result in disastrous effect. Some are harmful to our health, and some can even cause severe injury and fatality.

In general, chemical hazards are differentiated into three building blocks:

a. Physical hazard building block
b. Health hazard building block
c. Environmental hazard building block

To identify the hazard class or hazard category of a chemical, always refer to the label affixed to the packaging/container or the Safety Data Sheet. The label should include the following information to aid Researchers in understanding the hazards and safety and health risks involved:

a. Product identifier, i.e. identify of the chemical
b. Pictogram
c. Signal words such as 'Danger' or 'Warning', indicating the relative hazard severity and alert readers to a potential hazard
d. Hazard statement(s), describing the nature as well as the degree of hazard of a chemical
e. Precautionary statement(s), describing the recommended measures that should be taken to minimise or prevent adverse effects resulting from exposure or improper storage or handling of a hazardous chemical
f. Supplier information
g. Supplementary information

4.1. Physical Hazards

There are 16 hazard classes under the physical hazard building blocks, i.e.:

1. Explosives
2. Flammable gases
3. Flammable aerosols
4. Oxidising gases
5. Gases under pressure*
6. Flammable liquids
7. Flammable solids
8. Self-reactive substances and mixtures
9. Pyrophoric liquids

10. Pyrophoric solids
11. Self-heating substances and mixtures
12. Substances and mixtures which, in contact with water, emits flammable gases
13. Oxidising liquids
14. Oxidising solids
15. Organic peroxides
16. Corrosive to metals

* The hazard categories under this hazard class include compressed gas, liquefied gas, refrigerated liquefied gas and dissolved gas.

4.2. Health Hazards

There are 10 hazard classes under the health hazard building blocks, i.e.:

1. Acute toxicity
2. Skin corrosion/ irritation
3. Serious eye damage/ eye irritation
4. Respiratory or skin sensitization
5. Germ cell mutagenicity
6. Carcinogenicity
7. Reproductive toxicity
8. Specific target organ toxicity (single exposure)
9. Specific target organ toxicity (repeated exposure)
10. Aspiration hazard

4.3. Environmental Hazards

There are two hazard classes under the environmental hazard building blocks, i.e.:

1. Hazardous to the aquatic environment – acute toxicity
2. Hazardous to the aquatic environment – chronic toxicity

Pictograms convey physical, health or environmental hazard that is assigned to a GHS hazard class and category. Please refer to the table below.

Flame	Flame over circle	Exploding bomb
 • Emits flammable gas • Flammables • Self-heating • Self-reactives • Organic peroxide • Pyrophorics	 • Oxidisers	 • Explosives • Organic peroxide • Self-reactives
Corrosion	**Skull and crossbones**	**Gas cylinder**
 • Corrosives	 • Acute toxicity (severe)	 • Gases under pressure
Health	**Environment**	**Exclamation mark**
 • Aspiration toxicity • Carcinogenicity • Germ cell mutagenicity • Target organ toxicity • Respiratory sensitiser • Reproductive toxicity	 • Environmental toxicity	 • Acute toxicity (harmful) • Irritant • Narcotic effects • Respiratory tract irritation • Skin sensitiser

5. Transportation into, out of and within NMRS

Improper transportation and transferring of chemicals can result in spills and, in some instances, chemical exposures and fire hazards. The following preventive measures shall be put in place when the chemicals are expected to be transported from one location to another via common areas such as corridors.

a. Inform lab manager at least 4-6 weeks in advance. Admin charges will apply if an additional license is required for its transport and storage in NMRS.
b. Read Safety Data Sheet (SDS) to make sure that one has understood the chemical hazards.
c. Do NOT transport incompatible chemicals together.
d. Carry the relevant spill response materials.
e. Look for any signs of leakage before handling the package.
f. Check that the container is sealed and in good condition. Do NOT transport the chemical if the packaging is damaged.
g. Use unbreakable secondary containment when transporting chemicals in public areas or within NMRS, particularly liquids and or the primary container is made of glass. Ensure that the secondary containment can hold the contents of the largest individual chemical container. Do not hold acid or solvent containers by the neck alone.
h. Use appropriate cart or trolley when necessary.
i. Do not leave chemicals unattended during transport.

j. Choose a time to minimise interaction with the public, i.e. use the mid-day boat whenever possible.

Be cautious when transporting/ transferring shock- or impact-sensitive chemicals. Consult the SDS for special precautions to be taken. When transporting and transferring cryogenic liquids, the following precautions must be observed:

a. Transportation of cryogenic liquids via ferry and buggy should be carried out in a safe manner with a buddy system.
b. Transfers or pouring of cryogenic liquids should be done very slowly to minimize boiling and splashing.
c. Transfer of liquid nitrogen should be done in a well-ventilated area and to ensure that the flasks are not completely sealed during transfer as they will result in pressure build-up.
d. Liquid hydrogen should NOT be transferred in an air atmosphere because oxygen from the air can condense in the liquid hydrogen, presenting a possible explosion risk.

6. Chemical Storage

Proper chemical storage prevents flammables from ignition, minimize the potential of exposure to hazardous materials and segregation of incompatible substances prevent the accidental mixing due to spillage or human error.

The following are the general Dos and Don'ts for chemical storage:

Dos:

a. All containers, packaging and cylinders containing chemicals (solid, liquid or gas) shall be labelled. The label must be in good condition, clear, legible and written in English. It must be affixed firmly on the container at all times and be able to withstand the expected environment it is exposed to. As a minimum, the label must contain the following information whenever available:
    i. Name of Researcher and Supervisor
b. Name of hazardous substances
c. Chemical formula/ composition
d. Chemical concentration
e. Chemical hazard pictograms/ symbol
f. Product identifier
g. Name of supplier
h. Date of purchase
i. Date of first opening (especially important for peroxide-forming chemicals)
j. Date of preparation (e.g. for solutions)
k. A valid and updated Safety Data Sheet (SDS) shall be supplied to the lab manager.
l. Researchers must work with relevant lab manager to ensure that the chemical register is updated accordingly in the LMMS.
m. Ensure storage areas are provided with adequate lighting and ventilation.
n. Segregate chemicals according to their physical and chemical properties. Store chemicals according to their chemical compatibility.
o. Licenced chemicals must be kept under lock and key with proper inventory record. The cabinet key shall be kept by laboratory manager. Only authorized Researchers can access these licensed chemicals.

p. The chemicals shall be stored in a durable, leak-proof container of compatible material to the chemicals, if it is not in its original containment.
q. Ensure that liquid chemicals are provided with a secondary containment to contain leaks and spills. Capacity of the secondary containment should be at least 20% of the total volume of chemicals stored within the containment tray. The material of the secondary containment should be compatible to the chemicals.
r. Store highly toxic chemicals (e.g. hydrofluoric acid (HF)) in compatible secondary containers prominently labelled with a description of the content.
s. Avoid using round bottom flasks for storage of chemicals. If not possible, use cork rings to secure/ support round bottom flasks.
t. Evaluate the chemicals for safe use periodically (recommended every 6 months). Chemical that is found to be safe shall be permitted to be re-dated and retained for an additional 6-month period.
u. Date peroxide formers and other chemicals that degrade over time when received and when opened. Review the label or product information for recommended shelf life and put disposal date on the container as well.
v. Store chemicals on shelves that have a raised lip along the outer edge, preferably behind glass door.
w. Always consult SDS for compatibility and reactivity information.
x. Storage of hazardous chemicals on laboratory benches should be minimized.
y. Exposure of chemicals to heat and sunlight should be avoided.
z. Periodic inventories shall be conducted, with unneeded items being discarded.

Don'ts:

a. Do not store chemical in alphabetical order except within "compatible storage group".
b. Do not store chemicals, in particular flammable substances, near heat sources (e.g. oven, direct sunlight).
c. As far as reasonably practicable, do not store chemicals on shelves above eye level, especially for liquids and corrosive chemicals.
d. Incompatible chemicals shall not be stored together. In general:
    i. Store acid separately from bases.
    ii. Store organic acid separately from inorganic acids (eg. nitric acid).
    iii. Store solvents separately from acids.
    iv. Store oxidizers, including oxidizing acids (e.g. nitric acid and perchloric acids) separately from oxidizable compounds (e.g. acetic acid).
    v. Store perchloric acid such that it cannot come into contact with organic material.
    vi. Store pyrophoric substances separately in a dry inert atmosphere (e.g. a nitrogen filled desiccator). Pyrophoric substances are chemicals that will ignite spontaneously, i.e. its auto ignition temperature is below room temperature.
    vii. Chemicals that possess two or more hazardous chemical properties (e.g. acetic acid – corrosive and flammable) shall be stored based on the highest potential threat pose to the personnel working in the lab. In the case of acetic acid, it shall be stored in a flammable safety cabinet, in a separate containment tray or an enclosed secondary container.

7. General Safety Rules for the Use of Chemicals

a. Do not smell or taste chemicals.
b. Appropriate gloves shall be worn. Inspect gloves before use. Replace them when necessary.
c. Wash hand thoroughly before leaving the laboratory.
d. Do not use mouth suction for pipetting.
e. Confine long hair or loose clothing.
f. Keep work area clean and uncluttered with chemicals
g. Appropriate eye protection shall be worn by all persons in the laboratory.
h. Use a fume-hood for operations for chemicals which might result in release of chemical vapours or dust. Keep materials stored in hoods to a minimum and do not allow them to block vents or airflow.

8. Chemical Accidents and/or Spillage Procedures

Isolate area by informing all researchers in the lab that a spill has occurred.

⇩

Close all doors and put a note on the door to prevent anyone from entering if the lab needs to be evacuated.

⇩

Inform Lab Manger immediately (Lab Manager would need to inform the SRF in-charge about the spill)

⇩

Researchers/Staff assisting in the cleaning should don PPE.

⇩

Contain spill using relevant chemical spill kit. If in doubt, please refer to the SDS.

1. Neutralize acid/bases
2. Place absorbent materials on spill from parameter towards center
3. Collect soaked absorbent materials into waste bag in the spill kit using tongs
4. Repeat steps 2 & 3 if necessary. If not, clean up remaining small amount of chemicals using paper towels and throw them into the waste bag.
5. Seal up waste bag and dispose as chemical waste.

Researchers using hazardous chemicals must be familiar with appropriate spill response procedures prior to commencing work. The SDS for a chemical should be checked for specific advice; clean-up and disposal procedures; and compatibility information.

Researchers should be trained in spill procedures so that rapid and accurate response for a minor or major spill can be undertaken. Spilled chemicals shall be cleaned up immediately and disposed as chemical waste properly. Researchers should seek assistance in the event of a major spill.

Please use the spill kit to contain any spilled chemicals and treat the victims who are involved in chemical accident.

Splashes on the skin

Remove contaminated clothing and flush with water for at least 10 minutes. Seek medical help.

Splashes in eyes

Flush the eyes with water for several minutes. Seek medical treatment immediately.

Inhalation of gases or vapours

Remove casualty to a safe area. Apply cardiac pulmonary resuscitation (CPR) if breathing has stopped. Send for medical aid immediately.

Ingestion

Wash the mouth with water. Do not induce vomiting. Seek medical treatment immediately. Be sure to inform the medical staff of the substances ingested.

All spills which are hazardous with potential to cause injury or have caused an injury must be reported.

Contact with cryogenic liquid

Warm the affected area of the body rapidly by immersion in water not to exceed 40ºC, with body heat, or by exposure to warm air. In the event of massive exposure, the emergency shower should be used to warm the body. All clothing must be removed prior to showering. Maintain the affected area of the victim at normal body temperature until medical help arrives.

Calm the victim and prevent aggravation of the injury. People with frostbitten feet should not walk on them. Do not rub or massage the affected parts of the body. Prevent infection; use a mild soap to clean the affected area. Dressings need to be applied if the skin is intact. Flush eyes, if affected, with warm water for 15 minutes.

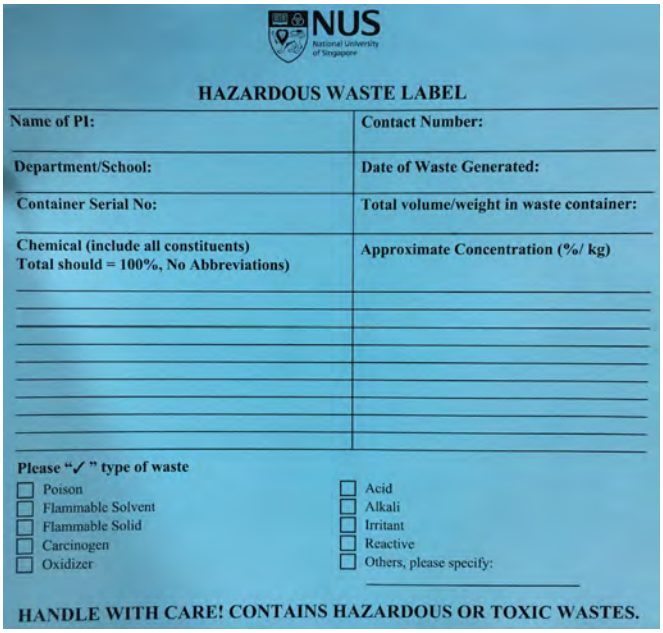
9. Chemical Waste Disposal

Chemical bottles should not be re-used for waste storage. Chemical waste containers are available upon request. Plastic containers should be used when appropriate. Please refer to chemical compatibility chart (https://share.nus.edu.sg/corporate/procedures/safety_and_health/Chemical-Safety-Procedures/EPAChemicalCompatibilityChart.pdf) for determining the compatibility of chemical mixtures. Incompatible wastes shall NOT be stored in the same container.

Containers of hazardous waste should be clearly identified, classified and labelled accordingly. Waste container shall be labelled legibly. The waste label should indicate the following information:

a. chemical name or formula of the content in container,
b. generator's name,
c. date of waste generated/collected,
d. approximate quantity/volume, and
e. affixed with the appropriate caution labels indicating the hazard classification and class of waste.

Blue hazardous waste labels (see below) can be obtained from laboratory managers.



NUS National University of Singapore

HAZARDOUS WASTE LABEL

Name of PI:	**Contact Number:**
Department/School:	**Date of Waste Generated:**
Container Serial No:	**Total volume/weight in waste container:**
Chemical (include all constituents) Total should = 100%, No Abbreviations)	**Approximate Concentration (%/ kg)**

Please "✓" type of waste

- ☐ Poison
- ☐ Flammable Solvent
- ☐ Flammable Solid
- ☐ Carcinogen
- ☐ Oxidizer
- ☐ Acid
- ☐ Alkali
- ☐ Irritant
- ☐ Reactive
- ☐ Others, please specify: _____

HANDLE WITH CARE! CONTAINS HAZARDOUS OR TOXIC WASTES.

a. Wastes shall be deposited in appropriate receptacles.
b. Chemicals that are no longer required should not be stored in the laboratory.
c. Take special care to ensure that incompatible chemical wastes are segregated to prevent risk of hazardous reactions.
d. Containers and labels for chemical waste can be obtained from lab manager. The labels are to be completed and affixed to each container.
e. Chemically contaminated consumables must be collected in strong leak proof bags and labelled as above. Chemically contaminated plastic tips must be disposed of in rigid containers and labelled as above.

10. Handover Procedures for Unused or Unwanted Chemicals

a. Researcher is responsible for disposal of unwanted chemicals and waste generated from his/her project.
b. At the completion of any research projects, all chemicals must be properly disposed.
c. In event that the PI has decided to transfer a chemical to another researcher, the Lab Manager must be informed to ensure that ownership records are amended accordingly.

H) Biological Safety

1. Legislations

There are several legislations that are applicable, which govern specific requirements for procurement, inventory record, storage, disposal and medical surveillance. These include:

a. Workplace Safety & Health Act
b. Environment Protection and Management Act
c. Environmental Public Health Act
d. Biological Agents and Toxins Act
e. WHO Laboratory Biosafety Manual
f. Singapore Genetic Modification and Advisory Committee
g. Infectious Disease Act
h. IATA Dangerous Goods Regulations

For detailed information on these legislations, you may refer to Section D Acts and Legislations (Page 34-37).

2. REQUIREMENTS FOR WORK INVOLVING BIOLOGICAL MATERIALS

Research activities in NMRS may involves use of various biological materials. Anyone working with biological materials must be aware of the potential health risks and take the necessary precautions to prevent undue exposure to these agents, resulting in consequences such as laboratory-acquired infections. In addition, Researchers dealing with cultivation / propagation of unknown environmental microbial agents should also be prepared to conduct their experiment in Biosafety Level 2 environment with proper decontamination procedures to minimize potential environmental impact.

The highest level of containment available at NMRS is Biological Safety Level 2 (BSL2). **Work should only involve biological agents classified as Risk Group 2 and lower, as well as microbial agents contained within BATA's Fourth schedule.** Risk Group 2 agents refer to pathogens that can cause human or animal disease, but the risk of infection is limited (Figure 1).

RISK GROUP	CLASSIFICATION CRITERIA
RISK GROUP 1	A microorganism that is not known to cause disease in healthy adult humans
RISK GROUP 2	A pathogen that can cause human or animal disease but the risk of spread of infection is limited. Laboratory exposures may cause serious infection.
RISK GROUP 3	A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another.
RISK GROUP 4	A pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly.

Figure 1: Risk Group Classification Levels

Administrative Requirements

For NUS researchers: Risk assessment submissions for projects must be approved by the respective Heads of Departments (HODs) / Deans and relevant Institutional Biosafety Committee before work can begin. It is recommended that PI work closely with NMRS managers to ensure appropriate safety controls and compliances are addressed in the risk assessment for work to be conducted in NMRS.

For non-NUS researchers: Approved documentations from researcher's respective institutional biosafety committee (or equivalent) and regulatory bodies (if applicable), where NMRS is included as work location, is required upon registration.

a. All researchers handling biological agents are expected to always hold a valid Biological Safety Training certificate. PIs should ensure their students and staff have adequate safety training and good practice in the handling of biological agents. NMRS reserves the right to suspend a researcher if it is deemed that the person lacks sufficient competencies to conduct research at the lab in a safe manner.
b. Researchers are required to check whether the biological agent they intend to work with at NMRS are regulated under MOH Biological Agents and Toxins Act (BATA) (Table 1 and 2), AVS (refer to AVS's selected pathogen list), and NEA (use of vectors and IDA), and NParks (Control of Plants Act) Any person wishing to work with hazardous biological agents should first obtain clearance from their host IHLs safety officer to conduct this work (see Biological Safety for work involving BSL2 agents).
c. Researchers intending to work with biological toxins (**both regulated and non-regulated)** must seek prior approval from NMRS management (see also Section on Biological toxins).
d. All researchers must conduct risk assessment for all activities involving biological agent in the laboratory. Your risk assessment must be reviewed once every three years, and whenever there is alteration to the approved risk assessments and approved by the Lab manager before you begin work. The risk assessment must address:
    i. Risks associated with the use of the hazardous substances.
    ii. Potential spillage or leakage
    iii. Impact of an incident to the surrounding people and on the surrounding area
    iv. Medical or first aid requirements in the event of an exposure
    v. Incompatible goods
    vi. Effective containment and clean up
    vii. Appropriate disposal of waste material

Table 1: Regulated Biological Agents and Toxins Act (BATA) list under MOH are classified as follows:

*NB. First Schedule is separated into Part I and Part II based on their potential to be weaponised.

Schedule Classification	Risk Group	Description of schedule
First Schedule (Part 1)	3	(1) Potential to cause serious disease which is high risk to individual (2) Need special attention in large scale production (≥10L)
First Schedule (Part 2)	3	(1) Potential to cause serious disease which is high risk to individual (2) Need special attention in large scale production (≥10L) (3) Potential to be weaponised
Second Schedule	4	(1) Can cause severe/lethal disease, high risk to individual and community (2) Prohibited for large scale production (3) Potential to be weaponised
Third Schedule	2	(1) Can infect humans (2) Need special attention in large scale production (≥10L)
Fourth Schedule	2	Can infect humans
Fifth Schedule	-	Microbial toxins with potential to be weaponised

Adapted from MOH Biosafety website, *FAQs, General information (accessed 21 Nov 2018)*

Table 2: Regulatory requirements for working with agents of various risk groups under BATA list (extracted from NUS Bio-risk Management Manual)

Requirement	First Schedule		Second Schedule	Third Schedule	Fourth Schedule	Fifth Schedule	Inactivated Agents	
	Part I	Part II					First Schedule	Second Schedule
Import Permit	√	√	√	√	√	√	√	√
Transhipment Permit	√	√	√	NA	NA	√	NA	NA
Approval to Possess	√	√	√	NA	NA	√	NA	NA
Approval to Produce	√	√	X	√	NA	NA	NA	NA
Special Approval to Handle	NA	NA	√	NA	NA	NA	NA	NA
Transfer Notification	NA	√	√	NA	NA	√	NA	NA
Certified Facility	√	√	√	NA	NA	NA	NA	NA
Protected Place	NA	√	√	NA	NA	√	NA	NA

√ - Required

X - Prohibited

NA – Not required

3. Risk Assessments

All Researchers working in the laboratories should know how to identify hazards, minimize risks and carry out their laboratory work safely. Researchers must complete and submit a project risk assessment before any new research project is implemented or when there are changes that may affect the safety and health aspects of the project or as and when required by the University.

Evaluate the risks associated with all materials to be handled. Consider:

a. the species of the source cells, the tissue or cell type origin
b. the culture type and volume
c. the intrinsic properties of the cell culture
d. subsequent properties acquired as a result of any genetic modification
e. the possibility that the cell culture may inadvertently or deliberately become contaminated
f. appropriate use, storage, decontamination, disposal, and emergency response procedures

The following flowchart (Figure 2) shows how the biosafety level can be determined for the most widely used biological agents and toxins. If animals are involved in the research, the corresponding animal biosafety levels apply.

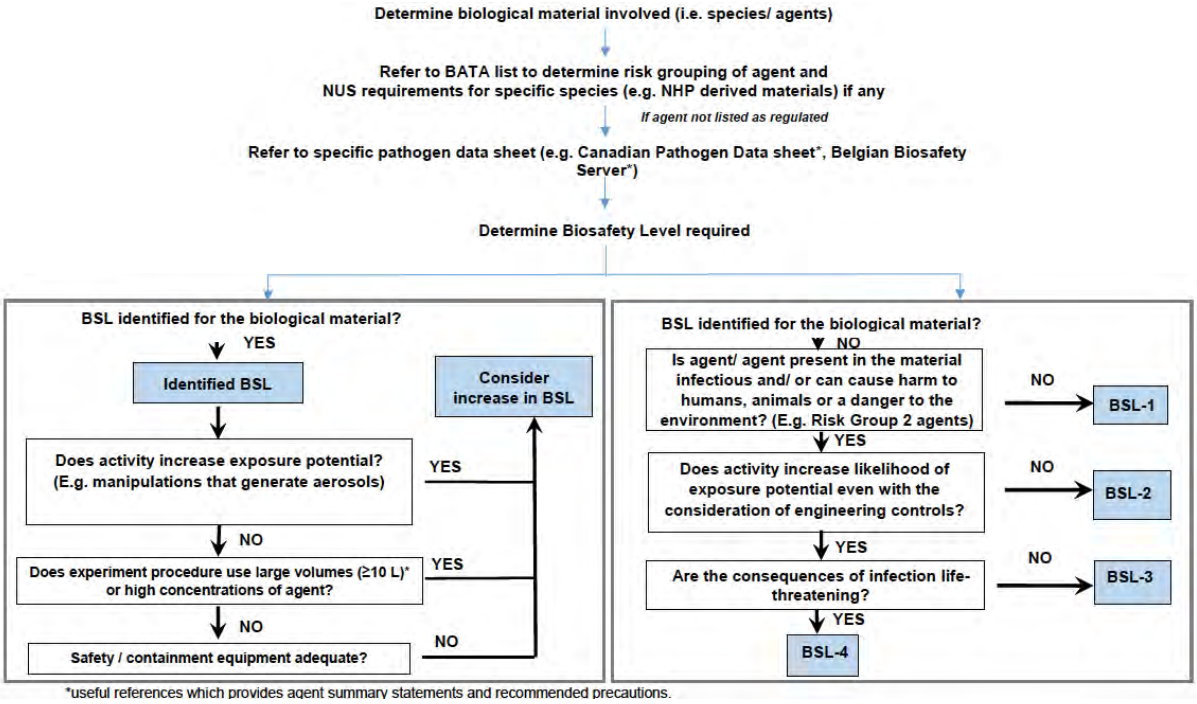


Figure 2: Flowchart on determining biosafety level. Figure adapted from NUS Biological Safety Manual

4. Safety requirements for Biological Toxins

Researchers must adhere to the following safety requirements when handling all biological toxins.

a. Disposable PPE (e.g. long-sleeved gowns) should be used during the preparation of cytotoxic drugs and toxins.
b. Toxins shall be stored under lock and key with an active inventory kept updated, where each use is recorded and accounted for.
c. Locations where toxins are handled or stored shall be labelled with appropriate hazard signs.
d. Toxins shall be always transported in leak-proof secondary containers.
e. Methods of inactivation, if performed, shall be done according to the nature of the toxin.

In addition, the following are requirements for handling of **all regulated biological toxins**:

a. Regulated toxins shall also comply with the relevant Singapore legislations.
b. Laboratory work with toxins shall be performed in dedicated rooms with controlled access and pre-determined bench area.

5. Biological Safety for work involving BSL2 agents

Biosafety Level 2 (BSL2) is applicable to work done with agents associated with human disease but is of moderate potential hazard to personnel and the environment. It is also applicable to work involving materials of human origin from both commercial and non-commercial sources and other work with biological hazards classified by the PI or IBC as Risk Group 2.

Researchers are only allowed to conduct experiments involving BSL2 agents in designated BSL2 laboratories and aquaria. Access into NMRS's BSL2 aquaria and laboratory are subjected to approval from relevant biosafety and aquaria manager. Researchers are required to make declarations of the biological agents they are dealing with and complete the BSL2 and ARA Facility Use Request Form (Appendix E) with activity-based risk assessments during registration.

a. The researcher must ensure they / their PIs update or seek new approval from their respective IBC and relevant regulatory bodies of the additional work location (NMRS) where new activities will be conducted outside their host institute.
b. For biological agents that are regulated under **MOH, AVS and NEA**, researchers must ensure their Principle Investigators (PI) have obtained approval from their institute (e.g. Institutional Biosafety Committee - IBC) and relevant regulatory agencies prior to seek approval from NMRS management.
c. If **Genetically Modified Organisms (GMOs)** are involved, the researcher must ensure they / their respective PI have a copy of the approval GMAC proposal and submit together with the application (with NMRS as additional work location).
d. The researcher or their respective PI must ensure all their staff and student has gone through **necessary medical examinations and / or vaccinations** (and submit immunization record to NMRS management) prior to commencement of work.
e. Researchers intending to work with **Risk Group 2 veterinary biologics (check AVS's selected list),** will have to seek written approval from NMRS in advance. Approval is under case-by-case review, depending on NUS-ORMC's approval. If approved, work involving RG2 veterinary biologics should only be done in BSL-2 facilities and comply with any additional requirements from AVS.
f. For institutions that do not have an IBC, please write to NMRS management to discuss possible arrangements.
g. Researchers are advised to submit their request at least 3 months prior to commencement of work to allow sufficient time to get approval. This is needed as NMRS may need to seek relevant licences / approvals and practices in place prior to transfer of material.

Research involving Vertebrates (Fish) and Cephalopods The Animal Research Aquarium at NMRS allows for work involving fish and cephalopods. Fish and cephalopod work are prohibited in all other laboratories on the island. All research activities that involve animals must adhere to:

a. the latest version of the Guidelines on the Care and Use of Animals for Scientific Purposes issued by the National Advisory Committee for Laboratory Animals Research (NACLAR); and
b. the latest version of the Guide for the Care and Use of Laboratory Animals by the National Research Council of The National Academies

Users must log in to the following websites and familiarize themselves with the applicable IACUC policies and CM SOPs as approved by the IACUC:

a. The NUS IACUC website; and
b. NUS Vet website

Before commencing any work involving animals covered under the Animals & Birds (Care and Use of Animals for Scientific Purposes) Rules, it is mandatory that IACUC approval from the NUS IACUC committee must be obtained. If you wish to carry out any research at NMRS involving animals covered under the purview of the NUS IACUC, please approach our Lab Managers at least 3-6 months in advance. They will advise you on the application process.

6. Transportation

Transportation of regulated biohazardous materials shall be done in accordance with national and international regulations or guidelines.

Local transport:

a. All biological agents and toxins as defined under BATA shall not be sent by mail or public transportation.
b. Carry a spill kit during transport. Any spill clean-up shall not be attempted without appropriate spill response material.
c. All biohazardous packages shall be opened in a biological safety cabinet.
d. New cell cultures brought to the laboratory should be quarantined to observe the growth of any contaminating pathogenic agents.
e. Any agents listed under the Fourth Schedule, shall follow NUS packaging and transportation requirements at the minimum (Figure 3). In summary:
    i. Triple containment is required.
    ii. All containers shall be leak-proof
    iii. Tertiary container shall be rigid and sturdy with a sealable lid.
    iv. External surfaces of every container shall be decontaminated during the assembly of the package, including the tertiary container.
    v. Information including quantity and type of biological material, and particulars of the transferor and transferee (including emergency contact numbers) shall be available.
f. Transportation of veterinary biologics regulated by AVS or materials containing infectious agents of animals and birds, shall follow the manual published by World Organization for Animal Health/Office of International des Epizooties (OIE). In brief:
    i. Screw-capped bottles should be used and sealed with adhesive tape / paraffin wax.
    ii. Materials shall be packed in individually identified containers and place in larger strong outer containers with adsorbent material to protect them from damage.
    iii. Veterinary biologics shall not be sent by public buses and trains. Examples of acceptable modes of transport include walking, personal vehicles, commercial carriers.
    iv. Transport of zoonotic agents shall comply with both MOH and AVS regulations.
    v. Transport of genetically modified organisms shall follow GMAC guidelines.

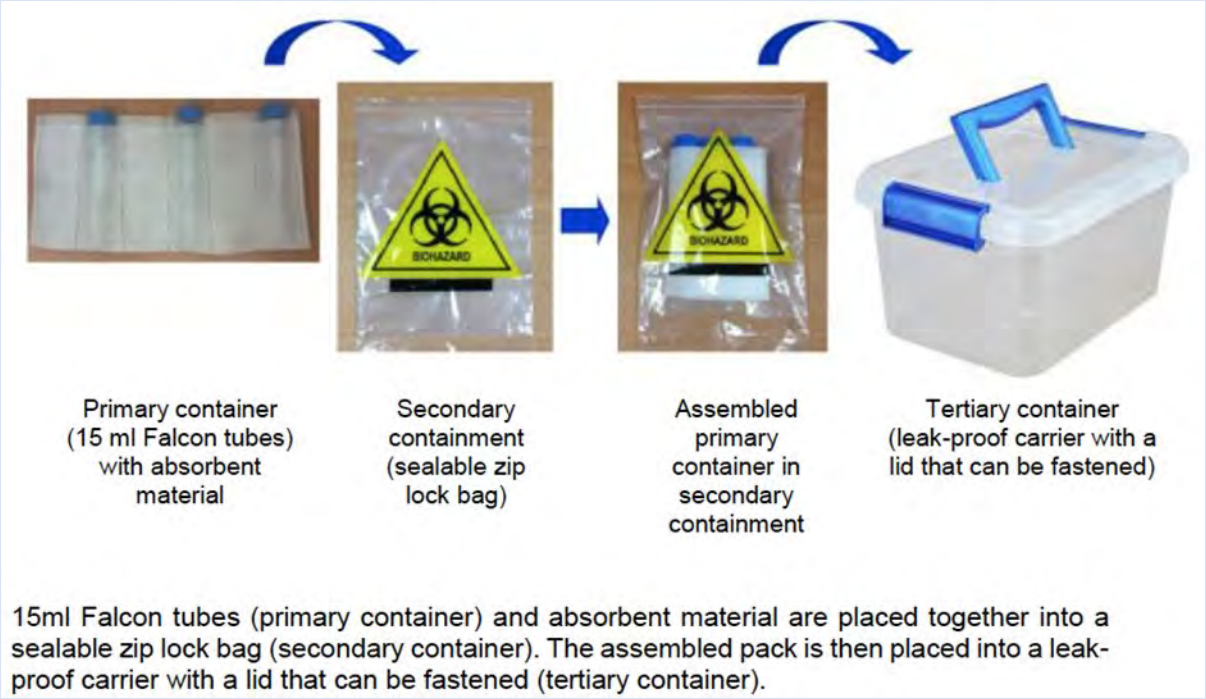


Figure 3: Example of triple packaging for biological agents

7. Storage

a. All biological materials to be stored must be clearly labelled with the scientific name, and/or descriptions, date of storage and name of person who stored them to facilitate identification.
b. Researchers are to autoclave and discard all unlabelled and obsolete biological items. Expired and other unwanted material must be decontaminated properly.
c. Storage containers must be robust and leak-proof. Visually inspect to ensure that no material remains on the outside of the container.
d. Hazard warning signs, indicating the biosafety level of the biological material being used, must be posted on laboratory doors, cold rooms, refrigerator / freezer doors and cryogenic tanks.

8. Decontamination of Biological Material and Disposal

Depending on the category, wastes containing biological agents is either sterilized and disposed as regular waste, or collected by licensed biowaste collectors.

Biohazardous waste Decontamination

Heat Sterilization

a. Steam autoclaving is the preferred method for all decontamination processes.
b. Autoclaves can sterilize all items that are heat stable. Proper autoclave treatment will inactivate all fungi, bacteria, viruses and bacterial spores, which can be quite resistant.
c. Solid surfaces are effectively sterilized when heated to 121 °C, at 15 psi for at least 15 minutes. Liquids and instruments packed in layers of cloth require a much longer time to reach a sterilizing temperature.
d. Laboratory personnel should be aware of the safe and proper operation of autoclaves.

Liquid decontaminants

Hypochlorites (bleach and Presept) are broad-spectrum disinfectants used in many laboratories. It is the main decontaminating agent for BSL2 / ARA aquaria. It is active against bacteria, fungi and viruses. At higher concentrations and extended contact times, bleach can inactivate bacteria spores as well. Domestic household bleach is typically made of 5.25% (52,500 ppm). Sodium hypochlorite can range from 3-6%. Industrial bleach solutions have a higher concentration (10-15% sodium hypochlorite). They must be diluted accordingly to obtain the working concentration. Please consult the product sheet of commercial solid chlorine-releasing disinfectants (e.g. Presept) for the equivalent availability of chlorine to add per volume of liquid.

If a chlorine-based disinfectant is used, the **minimum free chlorine concentration of 5,000ppm shall be used** for disinfecting BSL2 level potentially infectious materials UNLESS it can be demonstrated that a lower concentration is equally effective.

Other notes when using chlorine:

Many by-products of chlorine can be harmful to humans. Avoid indiscriminate use of chlorine- based disinfectants and follow safety precautions when using bleach.

a. Chlorine gas is highly toxic. Store and use bleach in a well-ventilated area.
b. Household bleach containing 5% sodium hypochlorite is an irritant. More concentrated bleaches containing 10-15% sodium hypochlorite are considered corrosive. Avoid direct contact with skin and eyes. Contact with skin can produce caustic irritation or burns. Splash goggles/face shield and protective gloves are recommended PPE when handling, diluting, etc.
c. Hypochlorite and other chlorine-releasing disinfectants may cause corrosion of metals, and this must be taken into account when decontaminating equipment. It is good practice to wipe down with water to remove residual hypochlorite on metal surfaces.
d. Products containing chlorine dioxide or other forms of chlorine can successfully and safely be used in BSCs constructed with a high quality (grade 16 or higher) of stainless steel if the chlorine residue is rinsed off with sterile water or 70% alcohol after the effective contact time.
e. Do not mix hypochlorites with other chemicals. For example, bleach mixed with acids or ammonium-containing materials rapidly generates the toxic chlorine and chloramine gas respectively. Check the incompatibility chart of bleach.
f. Do not autoclave solutions containing bleach as toxic and corrosive chlorine gas can be liberated.

9. Liquid Chemical Disinfectants

General Considerations for Selecting Chemical Disinfectants

Microorganisms exhibit a wide range of resistance to inactivating agents. Most vegetative bacteria, fungi and lipid-containing viruses are relatively susceptible to chemical decontamination whereas non-lipid containing viruses and bacteria with a waxy coating e.g. tubercle bacillus have mid-range resistance. Spores are most resistant to inactivation

No single chemical disinfectant or method is effective for decontamination in all situations. The choice of chemical disinfectants should be made after consideration of the following factors:

a. Target organism(s)
b. Highest concentration of organisms
c. Amount of extraneous organic material present
d. The material & area to be decontaminated
e. Application method, contact time possible

f. Potential toxicity of disinfectant
g. Activity of disinfectant
h. Stability, storage conditions and contact times for disinfectants are specific to each biological agent, buffer or culture media constituents and the class of disinfectants.

Most chemical disinfectants are not sterilizers and should not be relied upon to destroy all organisms on a surface or piece of equipment. Simple wiping of the surface to be decontaminated with a liquid disinfectant does not kill all the organisms present.

10. Biohazardous waste disposal

Segregation and Storage

The Principal Investigator or his designate shall ensure that all wastes are segregated (Table 3) and stored at the designated storage areas. The PI and staff shall ensure good housekeeping for all biological wastes stored in the common area under their jurisdiction.

Requirements:

a) All infectious waste containers should be properly sealed and marked with the biohazard label.
b) Biohazardous waste shall be identified and segregated according to the treatment or disposal method required.
c) Biohazardous waste shall not be disposed as general waste.
d) Solid biohazardous waste shall not be discarded into sewerage system.
e) Solid biohazardous waste shall be double bagged in yellow biohazard bags.
f) Liquid biohazard waste shall be decontaminated.
g) Biohazardous waste contaminated with chemical agents shall be discarded as chemical waste and be disposed through licensed toxic industrial waste (TIW) collectors AFTER decontamination of biological component.

Table 3: Classification of biohazardous waste based on treatment or disposal methods

	Classification	Examples
1	Sharps	Blood-drawing equipment, needles, syringes, slides, glass pipettes, capillary tubes, broken glass and scalpel blades.
2	Autoclavable wastes	All laboratory specimens or materials consisting of, containing, or contaminated with blood, plasma, serum, urine, faeces or other human or animal tissues or fluids, as well as inoculated media, cultures, contaminated paper wastes such as wrappers and towels and other potentially infectious materials
3	Wastes for incineration or cremation	Animal carcasses, solid human tissues, organs, etc.
4	Chemically contaminated wastes	Biohazardous waste contaminated with chemical agents (e.g. DMSO, EtBr or EtBR alternatives such as SyBr Green, Gel Red etc.)

11. Biological Spill Response

In the event of a biological spill, certain precautionary measures have to be taken (Figure 4).

Biological Spills in a BSL1 Laboratory

a. Notify others in the area, to prevent contamination of additional personnel and environment
b. Researchers should inform the Lab Manager immediately and Lab Managers should inform the SRF in-charge.
c. Put on gloves and a lab coat
d. Cover spill with paper towels and gently apply disinfectant
e. Leave in place for at least 30 minutes
f. Wipe down any contaminated area
g. Pick up the towels and discard into a biohazard container
h. Re-wipe the spill area with disinfectant
i. Remove gloves and thoroughly wash hands
j. Decontaminate reusable items or equipment.
k. Inform laboratory manager once the clean-up is over.

Biological Spills in BSL2 Laboratory

a. Hold your breath and leave the room immediately
b. Researchers should inform the Lab Manager immediately and Lab Managers should inform the SRF in-charge.
c. Warn others to stay out of the spill area to prevent spread of contamination
d. Post a sign on the door warning others of the spill
e. Remove any contaminated clothing and put it into a biohazard bag for autoclaving
f. Wash hands and exposed skin and inform your PI or Lab Manger about the spill

g. Put on protective clothing (lab coat / disposable gowns, double gloves, N95 respirator, eye protection / goggles, shoe covers) and assemble clean-up materials
h. Wait 30 minutes before re-entering the contaminated area to allow dissipation / settling of aerosols
i. Cover the spill with paper towels and gently apply disinfectant
j. Leave in place for at least 30 minutes
k. Use forceps, tongs, broom and dustpan to pick up any broken glass and place in a sharps container
l. Re-wipe the spill area with disinfectant
m. Remove PPE in the correct order (i.e. safety glasses first and gloves last) and dispose as biohazard waste
n. Dispose biohazardous wastes according to procedures determined after adequate risk assessment

Managing Accident / Incident

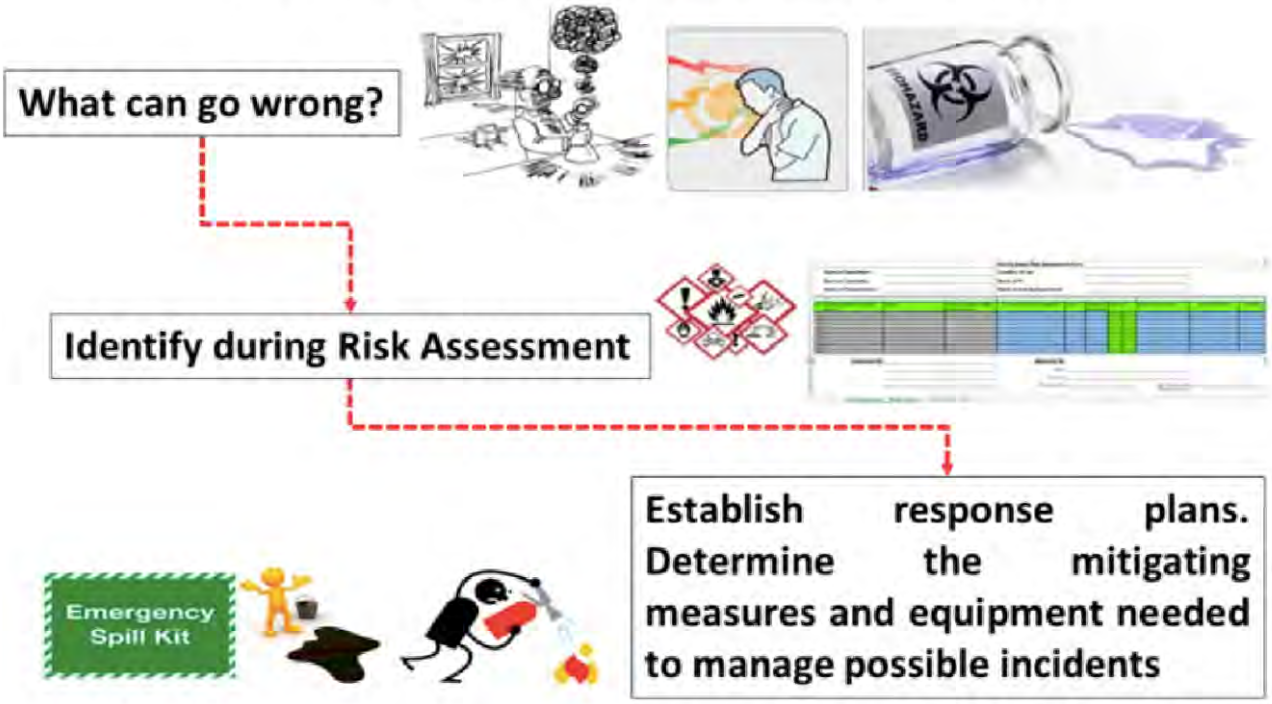


Image courtesy from ORMC OSHE

Biohazard Spill

Principal investigator should work with laboratory managers to ensure written spill clean up procedures are available in the lab

Spill kit contents and procedures should be based on **risk assessment**

Things to consider:

1) Biological agent used
2) Volume of possilble spill
3) Likely location of spill
4) Potential of release to the environment
5) Effective disinfectant
6) PPE requirements

Recommended items in biological spill kit:

- Spill clean up procedures
- Warning Signage
- Effective disinfectant
- Biological waste bags
- Absorbent material
- Tongs/forceps/brush & dustpan / sharps bin
- PPE: Disposable gown, appropriate gloves, goggles, shoe covers, N95 respirator

Biohazard Spill Response

A: Raise Alarm

1. Warn others
2. Inform laboratory manager
3. Warning signage to restrict access



B: Contain and Disinfect I

1. Leave aerosol to settle for 30 mins
2. Get spill kit
3. Wear PPE
4. Prepare disinfectant



C: Contain and Disinfect II

1. Place absorbent sheet
2. Apply disinfectant
3. Pour from outer rim towards the center



D: Dispose & Notify

1. Discard as biohazard waste
2. Notify facility management of the incident

Ensure that researchers in the lab have been trained and are familiar with the spill clean-up procedures before attempting a clean-up.

You should only clean up a spill if you are aware of the biological hazards and procedures.

Figure 4: Breakdown on how to contain a biological spill

I) Field Work Safety

A field trip is defined as any activity that occurs taking place in the outdoor environment. With respect to NMRS, this fieldwork safety policy shall be limited to activities undertaken on R/V Galaxea, Pioner Multi 3 and fieldwork on coastal shore of St John's Island and Lazarus Island by NMRS Researchers.

General Policy

Planning and preparation before embarking on the field trip is important. The organizer of the trip should plan the activities and communicate this plan to all participants. This plan should also be communicated to colleagues in the department for use in case of emergencies. The plan where applicable should include the following:

a. General description of the activities to be conducted in the field trip
b. Expected transportation routes and modes
c. Feedback/records/risk assessment of previous field trips/similar activities, etc.
d. The planned itinerary – Locations, dates of arrival and departure, lodging details, type of transportation.
e. Environmental conditions of the location – altitude, temperature, humidity, etc.
f. Applicable/relevant regulations and standards
g. List of participating personnel – organizer may need to capture information such as participant's addresses, phone numbers, passport details, blood type, medical condition and next-of-kin emergency contacts. Participants should provide relevant information about their medical background to the organizer, e.g., drug allergies. In cases of accidents, this information may be useful to emergency or rescue personnel. Designate a primary point of contact in the field who will be the person in charge (principal investigator or other on-site personnel if PI does not travel) of the field trip personnel.

Hazard and Risks Identification

General risks inherent to field trip include risk of the physical nature, posed by climatic and geographic conditions, and biological risks (for example, those arising from the presence of poisonous animals or pathogenic microorganisms). Other risk factors, such as chemical exposure, vehicular traffic, slips, trips and falls, etc should not be neglected.

Once the hazards have been defined, the next step is to qualify and quantify the risks. This is done through a procedure of risk assessment, based on:

a. Location of the field trip conducted locally (and the necessary research permit/entry permit required/or any special training required)
b. Nature of the activities conducted during the field trip (climbing, diving, handling of animals, carrying of tools/equipment)
c. Number of personnel involved in the field trip
d. Transportation arrangements (mode of transportation, hired drivers/boatmen, licenses and permits)

Once the risks are identified, the next step is to determine the appropriate type of risk controls. When determining the type of control measures, one should always consider the Hierarchy of Control:

a. Elimination,
b. Substitution/Reduction,
c. Engineering control,
d. Administrative control (including standard operating procedures) and
e. Personal Protective Equipment (PPE)

In most instances, combinations of controls are required to manage the risk effectively. In field trips, risk controls should also be considered for emergencies or scenarios.

Elimination of potential hazards will be given the priority while PPE will be the last resort in all control measures implemented in laboratories.

The following specifically describes main areas of fieldwork hazards/risks and possible measures/controls to take:

a. Weather/Climate
b. Animal Handling
c. Transportation Means

Weather/Climate related Hazards and Risk Controls

Hazard	Location	Cause	Symptoms	First Aid	Prevention
Dehydrating environment	Worldwide	Inadequate water intake	Dark urine Lethargy Constipation Light- headedness	Drink Plenty of fluids. Take frequent rest breaks. Minimize intake of beverages containing caffeine.	Drink plenty of water (at least 2 liters of water per day). Drink more if working strenuously or in a warm climate.
Sunburn	Worldwide	Excessive exposure to the sun	Irritated skin, pink to red in color, blistering in extreme cases	Apply cool water, aloe, or other cooling lotion to affected area.	Wear long sleeved clothing and a hat. Apply sun block with sun protection factor (SPF) of 30 or greater. Avoid activities during peak heat times of day.
Heat Exhaustion	Worldwide: Hot climate	Prolonged physical exertion in a hot environment	Fatigue Excessive thirst Heavy sweating Cool and clammy skin	Cool the victim, treat for shock, and slowly give water or electrolyte replacer	Acclimate to heat gradually. Drink plenty of liquids. Take plenty rest breaks. Avoid activities during peak heat times of the day.

Heat Stroke	Worldwide: Hot climate	Prolonged physical exertion in a hot environment	Exhaustion Light- headedness Change in behavior Loss of consciousness	Cool the victim at once by shower/bath/ice, replenish fluids, and seek medical attention immediately	Acclimate to heat gradually. Drink plenty of liquids. Take frequent rest breaks. Avoid activities during peak heat times of the day.

1. Animal handling related hazards and risks controls

Note that any research activities involving live fish, amphibians, reptiles, birds, non-human mammals and cephalopods require approval from NUS IACUC. Please ensure you have completed the relevant training and obtained the approvals for your research before commencing work.

2. Transportation related hazards and risk controls

Field trip activities may involve transportation across water bodies such as river channels, sea, etc. PI/Laboratory Supervisor should assess the appropriate transportation requirements and ensure that the students/ staff have received appropriate training to carry out the activity, informed about the risks involved and the safety requirements.

Improper transportation and transferring of chemicals in the field can result in spills, chemical exposures, and even fire hazards. The following guidelines can be useful while transporting chemicals in the field:

a. The Risk Assessment must be conducted for activities involving transport or transfer of chemicals.
b. Loose chemical bottles or containers shall be placed in a secured and enclosed secondary containment container before it is transported from one location to another location.
c. The chemicals should be packaged in durable, leak-proof container made of compatible material. It should be protected from external forces and secured in an appropriate cart or trolley, when necessary.
d. Carry along an emergency spill kit and the appropriate PPE, if necessary.
e. Be cautious when transporting/ transferring shock- or impact-sensitive chemicals. Consult the SDS for special precautions to be taken.
f. Special measures must be undertaken when transporting and transferring cryogenic liquids. For e.g.: transport in a well-ventilated area, transport in an unmanned lift, avoid splashing, etc.

Chemical compatibility must be taken into consideration when transporting chemicals of diverse reactivity, together at the same time.

Safety on-board

a. Under workplace safety & Health act, a risk assessment must be conducted for all research activities including fieldwork. Please submit a copy of your risk assessment to the FSO prior to commencement of work. Please ensure that you have all PPE required for use of equipment on board (e.g. safety shoes, gloves, etc.) as specified in the Risk assessment submitted.

b. The crew of either/or vessels will not be responsible for equipment loss or damage, or loss of personal valuables. Researchers are expected to take appropriate measures to safeguard equipment and personal belongings, including taking appropriate insurance for sensitive and high value equipment.

c. As Singapore waters are heavily patrolled by the coast guard, all Singaporean and Permanent Resident are advised to carry their personal identity card and non-citizens should bring their passport/FIN card when conducting fieldwork at sea.

d. Researchers are strongly encouraged to check their field equipment and materials prior to the start of the field trip so that the field trip can commence on time. No waiver of charges will be provided if the trip is called off due to problems with researcher's equipment on the day of the booking.

e. If you will be using any chemicals or hazardous for your research and will be carrying on-board either/or vessels, please seek permission from FSO at least 2 weeks before your trip. Please provide a copy of the MSDS, relevant permits and safety risk assessment. Work closely with FSO to ensure that appropriate safety controls and emergency procedures are in place before commencing trip. Researchers are responsible for supply all required chemical spill kits and PPE.

f. Any accidents, injuries or illnesses are to be immediately brought to the attention of the vessel steersman.

g. In case of any serious injury or medical emergency the vessel will immediately proceed to evacuate the casualty (casualties) to the nearest ferry point for transfer to hospital, based on host institution's emergency evacuation plan.

h. All researchers must have appropriate safety training required to complete the fieldwork planned on board, with safety risk assessments duly completed and approved by your project PI. Risk assessment should include the use of life jackets for work on the boat. Note that any research activities involving vertebrates and cephalopods are required approval from your institutional IACUC. Please ensure you have completed the relevant training and obtained the approvals for your research before commencing work.

i. Given the limitations for rapid emergency medical evacuation at sea, if you have any medical conditions which may place you at higher risk either during the field trip or during an emergency evacuation at sea, you are strongly advised to re-consider participating in the trip. Individuals are responsible for discussing known medical conditions with their

supervisor and Field Support Officer (FSO), bearing in mind the liability they pose to themselves and others in the research mission. For safety reasons, all researchers working on-board either/or vessels are expected to be able to swim.

j. For safety reasons, the winch on board R/V Galaxea should ONLY be operated by the crew of R/V Galaxea. If you have special requirements, please inform FSO at least 1-2 weeks in advance of your booking date.

k. Working on a vessel at sea is inherently dangerous. As such, every member on-board must always be safety conscious.

l. All researchers are expected to observe good work practices that minimize any harmful impact to the environment. This includes appropriate discretion in the design of your research and competent conduct of research activities at sea. Do not litter. No refuse shall be thrown overboard.

1. Dive Safety Regulations

All dive activities conducted from R/V Galaxea/Pioner Multi 3 must comply with Singapore Standards 623 – Code of practice for scientific diving (SS 623: 2016). All divers must ensure that they conform and comply with the requirements as stated in the SS 623: 2016 (Section 4.5). This is to ensure that researchers have received the appropriate training and adequately insured to conduct scientific diving.

Divers intending to use R/V Galaxea/Pioner Multi 3 for scientific diving must provide NMRS officers copies of relevant documentation (i.e. dive certification, medical certification) as stated in the Standards and the endorsement/approval to dive from their host institution's Dive Officer, or equivalent personnel.

All scientific divers must observe the following procedures:

a. Appropriate dive standards and practices (see SS623:2016);
b. Appropriate levels of dive competencies.
c. Approved Dive Plan including risk assessment for all research projects prior to diving phase of project.
d. Medically certified fit to dive.
e. Medical response plan is in place for medical emergencies.
f. Covered by relevant insurance (e.g. institution/organization insurance, or DAN insurance) for the research planned.

The following activities are NOT permitted on R/V Galaxea/Pioner Multi 3:
a. Diving to depths greater than 30 m.
b. Diving with gases other than air (21% O_2).
c. Diving with pure oxygen.
d. Decompression diving.
e. Cave diving.

Diving Activity	Minimum Certification	Minimum Experience # dives
No-decompression diving to depths < 10m	Adult Open Water Scuba Diver	20
No-decompression diving to depths 10-18m	Advanced Scuba Diver	30
No-decompression diving to depths 18-30m	Rescue Diver	50
No-decompression diving to depths 30-40m	Divemaster	100

Basic guidelines:

Risk assessment and management for any dive project is like that of any research project undertaken. All dive projects/activities must be approved by the host institution's Dive Officer. This approval should be submitted to the FSO as part of documentation before commencing work. According to SS623: 2016, all scientific divers are required to keep and maintain a permanent record of all dives undertaken for the duration of the scientific diver's research, medical certification, equipment logbook, etc. for legal and audit purposes.

The Dive Officer should additionally appoint a Dive Coordinator (or Dive Leader) to supervise the scientific diving activities from shore/vessel. It is mandatory for a Dive Coordinator (or Dive Leader) to be present for all scientific diving activities, but not participating in the dives.

Buddy System shall be practiced. Buddy diving offers a greater margin of safety, being able to provide any assistance to one another in the shortest given time and allows for better accountability for the divers working underwater. The diving pair must have a dive computer, an underwater time keeping device, a depth indicator, and a submersible tank pressure gauge.

The divers must be equipped with sufficient redundancy equipment (i.e. SPG equipped with depth gauge) to be used as a backup when a dive computer is not available or malfunctioned during the dive. Each diver is required to carry a writing slate, tank banger, a surface marker buoy and a dive whistle on each work dive. Each diver shall conduct a functional check of his diving equipment in the presence of the diving buddy. Each diver is to perform all checks as required by their training protocol – BCD, Weights, Air, Release mechanisms, Final check (BWARF).

Dives must be planned carefully and followed to ensure the number of ascents during a dive is kept to a minimum. For shallow dives, there should not be more than 2 ascents (excluding final ascent) per shallow dive. A shallow dive is defined as a maximum dive depth of 3 - 10 m. Divers performing successive multi-day repetitive dives must use the dive tables/dive computer for calculating their no decompression limits on each dive even if all dives are shallow.

The Dive Coordinator (or Dive Leader) will implement head-count procedures, which must be reflected in the dive plan and communicated to all divers. There should be no more than 6 divers to 1 Dive Coordinator (or Dive Leader). The likely quantities of gases needed for diving operations, including emergency oxygen, must be calculated when planning a diving activity. Allowances should be made for contingencies. The diving operation must cease if the quantity of gas available falls below the minimum planned for and specified in the dive plan. Gas cylinders must be clearly labelled.

Bad weather can affect diving operations in the following ways:

a. Wind speed and direction can make supervising drift divers difficult for the vessel master.
b. Rain and haze will cause a reduction in surface visibility, making it difficult to navigate the dive vessel.
c. Bad weather can make working on deck extremely hazardous for the dive team.

d. Extreme heat or cold can affect divers. Arrangements should be made to keep divers sheltered and well hydrated.
e. Electrical storms or lightning is a hazard to exposed personnel or equipment. Underwater recall procedures and drills to take cover from lightning must be included in the plan.

Underwater currents can inhibit the diver's ability to dive comfortably and safely. Tide tables for shores around Singapore provide accurate information useful for predicting the flow of prevailing currents. They should be used to assess diving conditions. The sea state can affect each stage of a diving operation as the risk of accidents are increased and recovery of divers can be difficult.

The boat captain reserves the right to cancel a dive trip in event of bad weather or rough sea condition. After the completion of a dive, each diver shall report to FSO immediately, any physical problems, symptoms of decompression sickness, or equipment malfunctions. He should also not undertake any activities that will increase the risk of decompression sickness such as strenuous exercise and heavy alcoholic intake within 24 hours after a dive, and that includes between dives.

Appendix A: Template for Facilities Use Agreement between NUS and external organisations

The following document provides a draft legal template for Facilities Use Agreement for non-NUS researchers. The Facilities Use Agreement seeks to ensure that employers and parent organisations continue to exercise appropriate responsibility for the safety of their researchers when they are working on our premises, to ensure a safe work environment for everyone. After initial registration, the Admin Manager will follow up with researcher's parent organisation to ensure appropriate legal agreement is in place.

NATIONAL MARINE RESEARCH STATION
NATIONAL UNIVERSITY OF SINGAPORE

RESEARCH FACILITIES USE AGREEMENT

This RESEARCH FACILITIES USE AGREEMENT (the "Agreement"), effective as of _____ (the "Effective Date"), is executed by and between _____ (the "User"), having a principal place of business at _____, and the National University of Singapore, having its registered office at 21 Lower Kent Ridge Road, Singapore 119077 ("NUS"), acting through its Tropical Marine Science Institute ("TMSI").

This Agreement sets out the Parties' mutual understanding regarding the use of the Facility (as defined below) by the User. "Facility" shall refer to the facilities and/or equipment at and/or operating as part of the National Marine Research Station ("NMRS") and shall include, but is not limited to, research vessels and the Marine Environment Sensing Network ("MESN") buoys (and its associated suite of sensors, peripheral modules and moon pools) located at St John's Island, Raffles Lighthouse and Pulau Ubin.

(NUS and the User may hereinafter be individually referred to as "Party" and collectively as "Parties" in this Agreement.)

1. TERM OF USE

The User's use of the Facility shall commence on _____ (the "Commencement Date") and continue through _____ (the "End Date"), unless otherwise extended or terminated as provided in Clause 15, provided the User has complied with User obligations as set forth in this Agreement.

2. PURPOSE, LICENCE AND RESTRICTIONS ON USE

a. The User's access and use of the Facility shall be for the specific purposes only. The Facility shall not be used for any other purpose(s). The use of the Facility shall not result in the generation of hazardous materials or hazardous waste, unless a written request with necessary details has been made to NUS and expressly permitted by NUS, subject to additional terms and conditions as prescribed by NUS.

b. NUS shall allocate the designated space for the User (the "Allocated Space"). Any requirement for more space at NMRS shall be subject to availability and written approval by NUS.

c. This Agreement shall not be construed as giving the User exclusive right to the occupation of the Allocated Space. The legal right to possession and control over the Allocated Space remains vested in NUS throughout the term of this Agreement. NUS retains the right to grant permission to other parties to use the Facility or any part thereof at its sole discretion.

d. The User's use of the equipment furnished by NUS is limited to the uses set out in the Equipment Standard Operating Protocols, which will be made available on-site.

e. The User's access to and use of the Facility is subject to guidelines defined in the NMRS Research User Handbook (Appendix B), and any other guidelines that may apply to the use of the specific Facility. Such guidelines will be monitored by the respective laboratory managers overseeing research facilities.

f. The User shall not commence or carry out any work involving animals covered under the Animals & Birds (Care and Use of Animals for Scientific Purposes) Rules ("animal work") unless and until the project involving such animal work has been approved by the NUS Institutional Animal Care and Use Committee ("NUS IACUC"). The User shall adhere to all applicable NUS policies, rules, guidelines, SOPs and procedures (particularly, but not limited to, those prescribed by NUS IACUC, TMSI and NUS Veterinarians), pertaining to the animal work. The Users shall also act in accordance with all instructions given by NUS IACUC, NUS Veterinarians and TMSI staff on animal welfare, care and husbandry.

g. The User's access and use of data from the NMRS Marine Environment Sensing Network (MESN) shall be for the specific purposes only. The data shall not be used for any other purpose(s) and shall be subject to the terms of use and data use policy as set out on the NMRS MESN data portal.

3. FEES AND COSTS

The fees charged to the User for use of the applicable Facility shall be as set out in the prevailing version of the Schedule of Rates (as updated from time to time)*.

a. For daily rate, User shall pay NUS on a monthly basis. NUS shall submit an invoice to User once a month (or within two (2) weeks of last date of use), and the User shall pay such invoice within thirty (30) days of the invoice date.

b. For annual fee, the User shall pay NUS in advance, within thirty (30) days of the Commencement Date.

c. Separate charges apply for use of special equipment (including Loaned Equipment), services and accommodation at NMRS. These charges shall be set out in the prevailing version of the Schedule of Rates (as updated from time to time)*, or as informed to the User by the relevant laboratory manager in charge. NUS shall submit an invoice to User once a month (or within two (2) weeks of last date of use), and User shall pay such invoice within thirty (30) days of invoice date.

d. All fee payments by User shall be made payable to the "National University of Singapore".

e.For effective notice of payment, all invoices shall be sent to:

[User to insert details]

Payments shall be sent to: [insert details]

*NUS reserves the right to adjust its fees and charges, with new rates taking into effect at the beginning of each financial year. User will be notified by 1 February of each year, of changes expected from 1 April of the new financial year.

4. CARE & MAINTENANCE

The User shall at all times ensure proper care of the Facility and keep it in good condition and good working order. The User shall also maintain the Facility in a clean and safe condition over the period of use, and upon termination of the Agreement, surrender the Facility in as good a condition as received, normal wear and tear accepted.

5. DAMAGE TO FACILITY AND INDEMNITY

a. The User shall be responsible for any damage to the Facility and any Loaned Equipment and shall be liable for all costs and expenses in rectifying the damage, or for the clean-up or waste-related expenses incurred by NUS, including without limitation, costs pertaining to disposal, shipping, damages, equipment repair and/or replacement, equipment downtime, loss of data and/or other costs or penalties incurred by NUS as a result of the use of the Facility by the User.

b. The User is fully responsible for his/her own equipment and shall maintain such equipment in safe working order.

c. The User shall indemnify and keep NUS indemnified against all losses, claims, demands, actions, proceedings, damages, costs or expenses (including all legal fees) and any other liability arising in any manner whatsoever (the "Consequences") from (i) the User's employees, agents, or students access and use of the Facility; (ii) the installation, operation or use of any of the User's equipment or material in the Facility; (iii) any animal or plant brought into the Facility by the User; (iv) any breach of the Agreement by the User and/or breach of undertakings by the User's employees, agents or students; (v) breach of law, save where the Consequences arise from and/or have arisen as a result of negligence or wilful default of NUS.

d. The User shall submit a separate damage deposit of $_____, which shall be applied towards the costs of any NUS expenses beyond reasonable wear and tear that may result from the use of the Facility by User. For the avoidance of doubt, the User's liability for damages shall not be limited or capped to the amount of its damage deposit. Any unused portion of the User's damage deposit shall be returned to User.

6. OWNERSHIP AND INTELLECTUAL PROPERTY RIGHTS

a. Intellectual property developed solely by the User or employees and/or agents of User in the Facility shall be the exclusive property of User. Intellectual Property jointly developed by the User or employees and/or agents of User and employees, agents and/or students of NUS in the Facility shall be jointly owned by User and NUS. Disposition of such jointly owned intellectual property shall be determined by the terms of a separate agreement between the Parties. Nothing in the foregoing grants any rights to NUS' share of any jointly held intellectual property to User.

b. In the case of intellectual property developed by User which constitutes an improvement or new method of use with respect to equipment within the Facility, User hereby grants to NUS a perpetual, royalty-free right and license to use such intellectual property in combination with such equipment for research purposes.

7. COMPLIANCES

a. The User, its employees, agents and personnel acting on its behalf shall comply with Singapore laws regulations, policy directives, environmental protection guidelines and other requirements in Singapore, as amended from time to time, governing the operation and use of the Facility. In addition, the User shall adhere to all applicable NUS policies, rules, guidelines and procedures, pertaining to the use of the Facility. NUS reserves the right, at its sole discretion, to determine and monitor the manner of User's compliance for any matter pertaining to use of the Facility.

b. The User shall permit unannounced access to the Facility by NUS personnel, any National Research Foundation personnel and its authorised representatives and any third party nominated by NUS. User shall promptly comply with all requests by NUS for information related to the use of the Facility as NUS deems necessary for its compliance with any regulatory policies and laws and/or any legal obligations NUS may have to any third party.

c. For avoidance of doubt. NUS' permission to the User to access and use the Facility shall not be construed as NUS' endorsement of any activities. Prior to commencing any activities in the Facility that require special permits, licenses or certifications, the User shall obtain the necessary permits, licenses or certification at its own expense and shall consult NUS on procuring such licenses permits or certifications, which may require the Facility owners acknowledgement or approval. The User shall provide NUS with copies of the relevant permits, licenses or certification.

d. User shall comply with Singapore laws and regulations controlling the export of technical data, computer software, laboratory prototypes, animals and all other export controlled commodities.

e. User may be required to attend user meeting convened and conducted by NUS to provide feedback in relation to the use of the Facility.

8. AUTHORIZED USERS

a. The User shall not permit the Facility to be accessed or used by any person who is not an employee, agent or others acting on its behalf without prior written approval by NUS. For the avoidance of doubt, under no circumstances shall the User's use rights in the Facility be extended to unrelated organisations or parties for any purpose.

b. NUS reserves the right to deny entry to the Facility or to immediately remove from the Facility, at its sole discretion, to any User personnel who NUS believes represents a safety or security risk to NUS.

9. ADDITIONS/MODIFICATIONS TO THE SPACE

a. NUS shall own all permanent modifications, alterations and additions made to the Facility, whether made by User or NUS. User may furnish non-permanent equipment, tooling, test apparatus or other materials necessary for its use of the Facility, and such items shall remain the property of User. NUS shall not be responsible for any loss or damage to such items however occasioned. The User shall be responsible for any damage to the Facility (including NUS equipment within and outside of the Facility) caused by the User's equipment or apparatus.

b. Except as specifically provided in this Agreement, the User shall not use NUS' equipment, tools, personnel or furnishings without permission. The User shall confer with relevant laboratory managers for access to equipment availability to avoid conflicts in the use of the Facility. In the event of an unavoidable conflict, NUS' uses related to research, teaching, and education shall take precedence.

9A. LOANED EQUIPMENT

a. At the User's request, NUS may, at its sole discretion and subject to availability, loan specific equipment to the User [for use in connection with the Facility]. All equipment loans shall be subject to documentation in a separate equipment inventory form/log book, signed by the User, detailing the description, condition, and loan period of each item (collectively referred to as the "Loaned Equipment").

b. All Loaned Equipment shall remain the property of NUS. The User acquires no ownership rights, title, or interest in the Loaned Equipment by virtue of possession or use under this Agreement.

c. The User shall use the Loaned Equipment solely for the purposes specified in Clause 2 of this Agreement. Any use of the Loaned Equipment outside the Facility shall be subject to specific prior approval by NUS for such use.

d. Subject to clause 2(d), the User shall exercise reasonable care in the use and handling of the Loaned Equipment, maintain the Loaned Equipment in good working condition, and immediately report any malfunction, damage, or safety concerns to the relevant laboratory manager.

e. The User shall not modify, alter, dismantle, or attempt to repair any Loaned Equipment without express written permission from NUS. The User shall not transfer or permit use of the Loaned Equipment by unauthorized third parties, or use the Loaned Equipment in any manner that violates manufacturer warranties or safety guidelines.

f. The User shall be fully responsible for any loss, theft, damage, or destruction of the Loaned Equipment (fair wear and tear excluded) during the loan period. The User shall immediately notify NUS of any such loss, theft, damage or destruction and shall reimburse NUS for the full replacement cost or repair expenses as determined by NUS.

g. Upon termination or expiration of the loan period, or upon NUS's request, the User shall return all Loaned Equipment in the same condition as received (fair wear and tear excluded), within [five (5)] business days. The Loaned Equipment shall be returned clean, properly packaged, and with all accessories, manuals, and components originally provided. If the User fails to return the Loaned Equipment within the specified timeframe, NUS may charge the User a late return fee and/or the full replacement cost of the Loaned Equipment.

10. NO TENANCY

The Parties agree and acknowledge that the User is not a tenant, and that the Parties' relationship is not a landlord-tenant relationship. As such, the User shall have no right to make any claim upon NUS for abatement of the fee, constructive eviction, rescission, or other claims to which a tenant would be entitled.

11. INSURANCE

The User [and User's parent organisation] shall at all times maintain and keep in force public liability insurance and insurance required under the Work Injury Compensation Act and other applicable legislation and for taking all other actions required as an employer for its employees utilizing the Facility.

12. REPRESENTATIONS AND LIABILITIES

a. The User shall be solely responsible for its activities while using the Facility, and agrees that it does so at its own risk. NUS makes no representations or warranties of any kind, express or implied, concerning the fitness or suitability of the Facility for any purposes.

b. NUS shall not be liable to the User or any other person for:

(i) accidents, incidents or injuries sustained in the Facility;

(ii) any loss or damage to the User's or any third party's property in the Facility; or

(iii) any interruption, disruption or cessation in the User's use of the Facility by reason of

1) any upgrading, retrofitting, necessary repair or maintenance of the Facility; or
2) any damage or destruction to the Facility;

unless it is shown to be caused by the negligence or default of NUS.

c. To the fullest extent permitted by applicable law, in no event shall NUS be liable for any consequential damages, loss of profits, loss of income, loss of anticipated savings, third party claims or any type of indirect, special, consequential or incidental damages, even if advised of their possibility.

13. PUBLICITY

Neither Party shall use the name of the other, or that of any of its trustees, officers, faculty, students, employees or agents, or any trademark owned by the other in any advertising, or other forms of publicity, without the written permission of the other Party's authorised representative.

14. PUBLICATIONS OF RESEARCH FINDINGS AND ACKNOWLEDGEMENTS

a. All publications of any materials (via media releases, media interviews, speeches or videos etc.) by any User of the Facility that are related to work fully or partially undertaken at the Facility must include an acknowledgement of the National Research Foundation's support of NMRS in such form as may be determined by the National Research Foundation.

We propose you use the following format:

"[The authors] would like to acknowledge the National Marine Research Station (NMRS) for providing the facility necessary for conducting the research. The NMRS is a National Research Infrastructure under the National Research Foundation Singapore."

b. Users shall keep NUS informed of the creation of Intellectual Property, patents and publications arising from research that is performed using equipment that is maintained by NMRS. All peer-reviewed publications arising from research that is performed using equipment that is purchased, or maintained under NMRS shall be made publicly available no later than twelve (12) months after the official date of publication.

15. TERMINATION

a. This Agreement shall terminate on the End Date set forth in Clause 1, unless it is extended for an additional period of time by written amendment signed by both Parties, or it is terminated before that date as provided in this Clause 15.

b. Either Party may terminate this Agreement at any time without cause and without further obligation except for return of all borrowed equipment/materials and confidential materials to the appropriate party and payment by User for any use charges incurred prior to the termination date. Such "without cause" termination shall be effected by the terminating Party providing at least thirty (30) days' prior written notice to the other Party's authorised representative at the address in Clause 15.

c. NUS may terminate this Agreement immediately for cause if the User:

(i) fails to make payment to NUS in accordance with the terms stated in Clause 3 above and does not remedy the non-payment within thirty (30) days' written notice from NUS;

(ii) fails to materially comply with the terms of this Agreement, provided that, at its sole discretion, NUS may allow a reasonable amount of time for User to remedy such noncompliance; or

(iii) allows its insurance coverage or safety training certificates to lapse or terminate for any length of time.

d. Upon termination by either Party for any reason, the User shall promptly pay NUS any outstanding fees owed for use of the Facility and Loaned Equipment (if applicable) up to and including the Termination date. If the User has prepaid for use of the Facility beyond the termination date, NUS shall promptly refund any such excess fees to User on a pro-rata basis subtracting any User obligations for clean-up, damage repair and/or replacement and other liabilities under Clause 5. These obligations shall extend beyond the End Date or date of termination under this Clause 15 and shall be extinguished only by written notice from NUS that such obligations have been satisfactorily met.

16. FORCE MAJEURE

a. No Party shall be liable for any failure to perform his obligations under this Agreement if the failure results from a Force Majeure Event (defined below), provided always that whenever possible the affected Party will resume that obligation as soon as the factor or event occasioning the failure ceases or abates. For purposes of this Agreement, a "Force Majeure Event" is an event that is a circumstance or event beyond the reasonable control of a Party which results in the Party being unable to observe or perform on time an obligation under this Agreement. Such circumstance or event shall include, without limitation, industrial action or labour disputes, civil unrest, war or threat of war, criminal or terrorist acts, government action or regulation, telecommunication or utility failures, fire, explosion, natural physical disasters, epidemic, quarantine restrictions, and general failure of public transport.

b. The Party prevented or delayed in the performance of its obligations under this Agreement by a Force Majeure Event, shall give written notice thereof to the other Party specifying the matters constituting the Force Majeure Event, together with such evidence as it reasonably can give and specifying the period for which it is estimated that such prevention or delay will continue.

c. If the Force Majeure Event shall continue for a period exceeding two (2) months from the date of the notice of such Force Majeure Event under Clause 16(b) above, either Party may at any time thereafter terminate this Agreement by written notice to the other Party.

17. CONFIDENTIALITY

a. Each Party agrees to hold in trust and confidence all information disclosed to it by the other Party, including, but not limited to, materials provided to it by the other Party during the course of collaborating on the Project under this Agreement, AND that is marked with the word "Confidential" or with words of similar import (collectively, the "Confidential Information").

b. The receiving Party shall not disclose all or any part of such Confidential Information to any third party or make any use of the same (except for the purpose of performing its obligations under this Agreement) without the prior written consent of the disclosing Party. The receiving Party agrees to restrict access to all such information within its institution to only such limited group of authorised employees or contractors who require such information in connection with the receiving Party's activities pursuant to this Agreement and who are contractually or otherwise obligated to keep such information confidential and are instructed to neither use nor disclose such information in a manner other than as permitted herein. This confidentiality obligation shall survive the expiration or earlier termination of this Agreement for a period of one (1) year.

c. The confidentiality obligation shall not apply to any information which:

(i) was previously known to the receiving Party without any obligation of confidentiality; or

(ii) has been properly made available by a third party to the receiving Party under conditions which do not restrict further disclosure or subject to any obligations of confidentiality; or

(iii) is or becomes part of the public domain through no fault of receiving Party or any of its employees or contractors; or

(iv) is developed by the receiving Party independently of any Confidential Information of disclosing Party, as evidenced by written records; or

(v) is required to be disclosed by court rule or governmental law or regulation, provided that the receiving Party gives the disclosing Party prompt notice of any such requirement and cooperated with the disclosing Party in attempting to limit such disclosure; or

(vi) was disclosed by the receiving Party with the disclosing Party's prior written approval.

d. The receiving Party shall, upon the request of disclosing Party, return all Confidential Information (including all copies thereof) to the disclosing Party or destroy the same on disclosing Party's instruction, within thirty (30) days after the termination or expiration of the term of this Agreement, whichever earlier.

18. WAIVERS

Failure of any Party hereto to enforce any of the provisions of this Agreement, or any right with respect therein, shall in no way be considered a waiver of such provision, right or election, or in any way affect the validity of this Agreement, unless expressly waived in writing. The failure of either Party to terminate this Agreement for breach or default shall not be deemed to be a waiver of the right to do so for any concurrent or subsequent breach or default, or for the continuing breach or default of the other Party.

19. TAXES, FEES AND DUTIES

a. Each of the Parties shall be responsible for their own corporate and personal income taxes, customs, fees, duties, fines, levies, assessments and other taxes payable under the laws of Singapore by them or their employees in carrying out their obligations under this Agreement.

b. In the event that either of the Parties is compelled by the tax authorities to pay on behalf of the other Party any of the abovementioned taxes, fees, duties, fines, levies and assessments, the Party compelled to pay shall not do so without first informing the other Party of the compulsion by the tax authorities. Upon such payment being made the other Party shall promptly fully indemnify the other Party for the payment made to the relevant tax authority.

20. ASSIGNMENT

Neither of the Parties shall transfer nor assign the Agreement or any part, share or interest therein without the prior written consent of the other Party.

21. SEVERABILITY

The Parties agree that if for any reason any provision, term or condition contained herein shall be deemed illegal, invalid, unenforceable or defective, then in any such case, that provision, term or condition shall be severable from all the other provisions of this Agreement such that this Agreement is interpreted, construed and applied as though such severed provision, term or condition did not form part thereof.

22. NO PARTNERSHIP

Nothing in this Agreement shall be so construed as to constitute either Party to be the agent of the other or operate so as to create a partnership or joint venture between the Parties.

23. GOVERNING LAW

This Agreement shall be subject to, governed by and interpreted in accordance with the laws of the Republic of Singapore for every purpose and User agrees to submit to the exclusive jurisdiction of the Singapore courts.

24. DISPUTE RESOLUTION

a. Any disputes arising under or in connection with this Agreement shall be referred by the Parties to the Director TMSI and [insert designation for User] jointly or their nominees for amicable resolution.

b. Any dispute which cannot be resolved amicably within a period of sixty (60) days from the time of being referred to each Parties' representative as aforementioned, shall be referred to and finally resolved by arbitration in Singapore in accordance with the Arbitration Rules of the Singapore International Arbitration Centre for the time being in force which rules are deemed to be incorporated by reference to this Clause. The language of the arbitration shall be English and the arbitral tribunal shall consist of one (1) arbitrator. Any award made hereunder shall be final and binding upon the Parties hereto and judgment on such award may be entered into any court or tribunal having jurisdiction thereof.

Research User Declaration: (Please tick boxes)

□ I have read the above Agreement and agree to the conditions set out in this document

IN WITNESS WHEREOF, the authorised representatives of the Parties have executed this Research Facilities Use Agreement, effective as of the date set forth above.

RESEARCH USER
Name:
Organisation:
Address:

Signature:
Date:

Authorised Representative of User's Parent Organisation: Name:
Designation:
Address:

Signature:
Date:

NATIONAL UNIVERSITY OF SINGAPORE
Name of NMRS Officer:
Designation:

Signature: Date:

Appendix B: Risk Acknowledgement and Consent Form

To: National University of Singapore

Dear Sirs,

1. I, _____ , (*NRIC / Passport No_____) of
name of participant last 3 number & Letter
_____wish to participate
participant's address
in the _____ held at _____
name of event venue
on _____ ('the Event').
date of event

2. While reasonable precaution and care will be taken by NUS to ensure participants' safety, I understand that I am taking part in the Event at my own risk. I have also been informed by the event organisers of any risks involved.

3. In consideration of NUS allowing me to participate in the Event, I,

(a) agree to comply with the rules, regulations, instructions, and directions given for the Event, will co-operate fully with NUS and conduct myself at all times in a safe and responsible manner while participating in the Event, failing which I acknowledge and agree that NUS has the right at any time to withdraw my participation in the Event;

(b) acknowledge and agree that NUS will not be held liable for any injury or death or for any property loss or damage I sustain as a result of my participation in the Event, unless caused by NUS' negligence; and

(c) give consent to NUS (including its third-party service providers) to collect, use, disclose and/or process my personal data provided to NUS for the purposes of administering my participation in the Event.

1. I represent that I am at least 18 years of age; or that, if I am under 18, my parent/ legal guardian has also signed below.

Yours faithfully

Name :_____
*NRIC/ Passport No. :_____
Last 3 number & letter
Date :_____

_____
Signature of participant

Risk Acknowledgement and Consent Form

To be completed by Parent/ Guardian

I, _____ of *NRIC / Passport No._____

name of * parent / guardian last 3 numbers & letter

of _____ am the * parent / guardian of the above-named

address

_____. I consent to the said _____

name of * child/ ward name of * child/ ward

taking part in the Event, and I agree to the terms and conditions that are set out in this document.

*Parent / Guardian's Name :_____

*Parent / Guardian's

*NRIC/ Passport No. :_____

last 3 number & letter

_____ Date :_____

Signature of Parent / Guardian

* Delete where applicable

Appendix C: R/V Galaxea Work Request Form

NAME OF PI/GROUP LEADER: _____

ORGANISATION: _____

INSTITUTE/ DEPARTMENT: _____

BRIEF PROJECT TITLE: _____

EMAIL: _____

GENERAL LOCATION(S) OF PROPOSED FIELD WORK:

_____

Expected Duration of Use		
Start Date/Days	**Start Time**	**End Time**

S/N	Name of Researcher	Organisation/Dept	Registered with NMRS (Y/N)	SPR/Foreign Passport Holder (Y/N)

*Please list all members: persons not indicated in the above manifest will not be allowed to board R/V Galaxea

Please provide a brief description on your field work (purpose; type of sampling; potential safety issues; any special permits)

_____
_____
_____
_____

- ☐ I/we will be collecting marine organisms and have the relevant permits for it
- ☐ I/we will be diving/snorkelling
- ☐ I/we will require use of the winch for:
- ☐ Our research involves the use of chemicals or hazardous materials:
- ☐ Any special sampling or safety requirements:

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Appendix D: Aquarium Use Request Form

Name: _____

Organization: _____

Proposed Start Date for Use: _____ Estimated Project End Date: _____

Emergency Contact Tel: _____ E-mail: _____

Please fill in and tick appropriate box:

Block 4 (Aquaculture)

1) Aquarium space required (minimum 5 m^2): _____m^2

2) Small flume (2.22 x 0.19 x 0.16 m)
Number of Set(s) required: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6
Equipment required: [ ] Decon system

[ ] Aquarium lights

[ ] Real-time seawater monitoring (probes not included)

[ ] Dosing pumps | No. Required: _____

[ ] Chillers | No. Required: _____

[ ] CO_2 controller (and CO_2 supply) | No. Required: _____

3) Rectangular fiberglass tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
2.50 x 0.80 x 0.30	600	4	

4) Cylindro-conical fiberglass tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
2.40 x 2.40 x 1.10	5,000	4	

5) Circular PVC tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
Dia 1.00 X 0.53	416	3	

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6) Types of water supply required: [ ] Filtered seawater

[ ] Raw seawater

[ ] Freshwater

7) Types of lighting supply required: [ ] Sunlight
[ ] Fluorescent light

[ ] Not required

8) Numbers of power points required: [ ] 1
[ ] 2

[ ] Others, please specify: _____

Block 5 (Marine Science)

Location: Controlled Environment Lab

1) Type of tank: Glass
Size: 0.50 x 0.39 x 0.35 m
Maximum Working Volume: 46 L
Per set: 6 tanks per rack
Number of Sets required: [ ] 3 [ ] 6
Equipment required: [ ] Aquarium lights

[ ] Real-time seawater monitoring (probes not included)

[ ] CO_2 controller (and CO_2 supply) | No. Required: _____

[ ] Dosing pumps | No. Required: _____

Location: Research Area

2) Big Flume (14 x 1.5 x 2.2 m)
Set required: [ ] 1

3) Rack (1.97 x 0.78 x 1 m)
Set required: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 [ ] 8

Location: Sediment lab/other equipment

4) Equipment required: [ ] LISST
[ ] GUST

[ ] Buoyant weight balances

[ ] Spectrometer

[ ] Hanna handheld multimeter

[ ] ADV

[ ] Microsensors (probes not included)

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5) Types of water supply required: [ ] Filtered seawater
[ ] Raw seawater
[ ] UV-treated seawater
[ ] Freshwater

6) Types of lighting supply required: [ ] Sunlight
[ ] Fluorescent light
[ ] Not required

7) Numbers of power points required: [ ] 1
[ ] 2
[ ] Others, please specify: _____

Block 7 (Outdoor Aquarium)

1) Rectangular fiberglass tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
0.80 x 0.80 x 0.45	288	8	
1.70 x 0.80 x 0.45	612	8	
1.70 x 0.80 x 0.70	952	6	
2.00 x 0.80 x 0.70	1,120	4	
2.50 x 0.80 x 0.30	600	4	

2) Cylindro-conical fiberglass tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
4.60 x 4.60 x 1.10	20,000	2	

3) Types of water supply required: [ ] Filtered seawater
[ ] Raw seawater
[ ] Freshwater

4) Numbers of power points required: [ ] 1
[ ] 2
[ ] Others, please specify: _____

Others available tanks and water tables

1) Square fiberglass tank stand alone

Size (m)	Volume (L)	No. of Units	No. Required
0.80 x 0.80 x 0.35	250	6	

2) Square fiberglass tank with flexi glass front stand alone

Size (m)	Volume (L)	No. of Units	No. Required
0.75 x 0.60 x 0.93	420	6	

3) Circular PVC tank stand alone

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Size (m)	Volume (L)	No. of Units	No. Required
Dia 0.55 X 0.50	118	9	

4) Water table

Size (m)	Volume (L)	No. of Units	No. Required
2.00 x 0.82 x 0.09	147	3	
2.00 x 0.69 x 0.09	124	5	

5) Types of water supply required: [ ] Filtered seawater
[ ] Raw seawater
[ ] Freshwater

6) Types of lighting supply required: [ ] Sunlight
[ ] Fluorescent light
[ ] Not required

7) Numbers of power points required: [ ] 1
[ ] 2
[ ] Others, please specify: _____

Other requirements, if any:

_____

_____

_____

_____

_____

_____

No modification of infrastructure, aeration, water and electricity supply is allowed. Please seek assistance from the Facility Manager.

Signature and Date: _____

End of Project Clearance Form

- ☐ Tanks clean and dry: _____
- ☐ Storage items: _____
- ☐ Dispose items: _____
- ☐ Remarks: _____

Researcher Name: _____ Signature: _____

Inspected By: _____ Signature: _____

Date: _____

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For Official Use

Allocated space: _____m x _____m **Allocated Area:** _____m2

Allocated Aquarium: [ ] Aquaculture [ ] Controlled Environment Lab [ ] Research Area

[ ] Outdoor [ ] Others: _____

Allocated tank: _____

Disposal of unwanted items charges: _____

Other charges, if any: _____

_____

_____

_____

Name: _____ **Signature:** _____

Date: _____

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Appendix E: ARA Facility Use Request Form

i. All researchers using the facilities falling under Biosafety level 2 (BSL2) must fill in this form.
ii. Please provide information on the following so we can assess your application.
iii. Please note our facility only allow researchers to work with Risk Group 2 agents (e.g. Schedule 4) and below.

Name of Researcher(s):

1)	
2)	
3)	
4)	
5)	

Name of Project PI: _____

Name of host institute: _____

Email: _____

Expected Start date: _____ ; End date: _____ (ddmmyy)

Section 1: General (lab + aquaria)

1. Please check which facility you're intending to use.
   ☐ BSL2 laboratory
   ☐ BSL2 aquaria
   ☐ Animal Research Aquarium (ARA)

2. List all the biological agents you are bringing into NMRS (genus and species). Please also indicate their associated risk group level.
   _____
   _____ (insert more lines if necessary)

3. Has your project been approved by your institutional IBC? ☐ Yes ☐ No (NA)

4. Please email us a copy of your approved BPN application (including the details submitted) and ensure the following information is provided: (NA)
   a. Has the biological agent known to cause disease in human and animal? ☐ Yes ☐ No
      If yes, please provide info:
      i. Target host: _____

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ii. infectivity data (route, infection dose, etc): _____
iii. Zoonotic transmission potential: ☐ Yes ☐ No

b. Maximum concentration (cells or cfu/ml) and volume (mls to L) to be used in lab / aquaria: _____
c. Is the biological agent known to be spore-forming?*: ☐Yes ☐ No
d. Any usage of antibiotics during the experiment? ☐Yes ☐ No. If yes, please state name and concentration of antibiotics: _____

5. Is the biological agent regulated under MOH / AVS / other? ☐ Yes ☐ No (NA)
https://www.moh.gov.sg/biosafety/about-bata
https://www.nparks.gov.sg/avs/pets/bringing-animals-into-singapore-and-exporting/veterinary-biologics/licence-to-possess-veterinary-biologics

   If yes, please provide approved documentation for use / possess as necessary.

6. Is the biological agent genetically modified in anyway? ☐ Yes ☐ No (NA)
   If so, please ensure the project has relevant GMAC approval and also included in your IBC approval document.

7. Please include a brief description of how the biological agent is being used in the laboratory / aquaria.

   _____
   _____ (insert more lines as necessary)

8. Will your work activities at NMRS involve the usage of sharps (e.g. needles, glass slides)? Yes / No. If yes, provide description of usage: _____ (insert as necessary)

9. Please email us approved copies of activity-based risk assessment for activities you are performing at NMRS. Risk assessment should cover, but not limited to, the following:
   a. Management of aerosols (if any)
   b. Volume biohazard liquid waste generated
   c. Spill management
   d. Biological waste management (liquid and solid)

10. Has the biological agent known to cause disease in aquatic animals? Yes / No (NA)
    If yes, we will need to notify SFA's MAC.

Section 2: Aquaria-specific

1. Number of racks to activate (BSL2: max 4, ARA: max 12): _____

2. Are you bringing in animals into the facility? Yes / No
   a. If yes, species name: _____
   b. Please provide an estimate on the number and size of animals you will be bringing in: _____
   c. Feeding regime (type of feed)
      ☐ Live feed
      - Type of organism _____

      ☐ Dry feed
      - Pellet size _____
      - Total weight of pellet _____

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☐ Others: _____

3. Are the animals collected from the wild? ☐ Yes ☐ No
    a. If yes, email approval documents from relevant authority to us

4. BSL2 only: Will you be bringing in your own tank? ☐ Yes ☐ No

5. Seawater supply:
   ☐ Sand-filtered seawater
   ☐ Raw seawater
   ☐ Freshwater
6. Water flow regime:
   ☐ Closed system (full RAS)
   ☐ Partial exchange
   ☐ Flow-through
   For partial / flow-through, please indicate intended water exchange rate (Liters exchange per day per tank): _____

7. Any fitting of your own electronics? ☐ Yes ☐ No
    a. If yes, please specify: _____

8. Can the microbial agent be killed via chlorination / ozone? ☐ Yes ☐ No (NA)
    a. If yes, state ppm hypochlorite / ozone required: _____

9. Electronic / other equipment to loan (delete as necessary)
   ☐ LED light
   ☐ Heat rod
   ☐ Chiller
   ☐ ADEX monitoring system
   ☐ SenEye monitoring system
   ☐ Filter holder: user to bring their own cartridge
   ☐ UV disinfection unit
   ☐ Protein skimmer: cleaning frequency
   ☐ Air-supply
   ☐ Masterflex dosing pump set up
   ☐ Microprofiler

10. Add-on services by aquaria manager, charges apply (refer to SOR for rates). Users are to specify details of the job and discuss protocols with aquaria managers:
    ☐ Daily monitoring
    ☐ Feeding of organisms
    ☐ Water exchange
    ☐ Filter maintenance
    ☐ Tank checks during experiment
    ☐ CO2 tank refill
    ☐ ARA only - Veterinary services

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I declare that all information provided is correct to the best of my knowledge.

S/N	Name of Researcher(s)	Signature	Date
1)			
2)			
3)			
4)			
5)			

Name of project PI

_____

Signature:

_____

Date (ddmmyy):

_____

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Section 3: Inspection for project clearance (to be completed at the end of experiment, 1 researcher and 1 manager should be present on-site for the inspection)

- ☐ Tanks cleaned and dried
- ☐ Loaned equipment returned
- ☐ Storage items
- ☐ Chemical waste incurred

Additional remarks: _____

_____

Name and initial of manager: _____; Date: _____

Researcher signature: _____

Official Use only

Section A:

Date: _____; Application approved: Yes / No

Rack IDs to activate: _____

Online safety training completed: Yes / No

- ☐ OSHBIO06: Safe needle usage in research laboratories
- ☐ OSHBIO08: Biosafety for BSL-2
- ☐ OSHCHM01: Chemical safety
- ☐ OSHGEN06: Risk Management for Laboratories

Add-on services to charge? Yes / No. (Add details to remarks)

Name of Aquaria manager in charge: _____; Initials: _____

Remarks: _____ (add more lines if necessary)

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Appendix F: Sample of a Risk Assessment Form and Risk Ranking Guide

Activity-Based Risk Assessment Form

Name of Department _____ **Location of Lab** _____

Name of Laboratory _____ **Name of PI** _____

Name of Researcher/LO _____ **Name of Activity/Experiment** _____

No	Description/Details of Steps in Activity	Hazards	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (Mitigation)	Severity	Likelihood (Probability)	Risk Level	Additional Risk Control	Person Responsible	By (Date)
1							0			
2							0			
3							0			

Conducted By _____

_____

_____

_____

Approved By

Name _____

Signature _____

Approval date _____

Next Revision date (Maximum 3 years) _____

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Severity	Likelihood: Likely	Likelihood: Possibly	Likelihood: Unlikely
Low	3	2	1
Med	6	4	2
High	9	6	3

Risk = Likelihood x Severity

RISK	DECISION PROCESS
< 3	**RISK ACCEPTABLE**
3, 4	**CONSIDER ADDITIONAL RISK CONTROL**
> 4	**ADDITIONAL RISK CONTROL REQUIRED**

Likelihood

1	**Unlikely**	Not likely to occur (has not occurred in the PI's Lab or similar Lab setup.)
2	**Possible**	Possible or known to occur (has occurred in the PI's Lab or Similar Lab setup.)
3	**Very Likely**	Common or repeating occurrence (has occurred repetitively in the PI's Lab or similar Lab setup.)

Severity

1	**Low**	(e.g. No injury, injury or ill-health requiring first aid treatment only – includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
2	**Medium**	(e.g. Injury requiring medical treatment or ill-health leading to disability – includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders)
3	**High**	(e.g. Fatal, serious injury or life-threatening occupational disease – includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning and fatal diseases)

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Severity - Consider the magnitude/severity of the consequences of the Risk Factor occurring and then list this as 3 (High), 2 (Moderate) or 1 (Low).
Severity normally will not change unless there is a physical change to the equipment or process.

Likelihood - Team should rely upon their experience and consider realistic scenarios. Listed below are examples of factors that may be considered in determining the likelihood.
- Past experience / incidents
- Complexity of the activity
- Number of personnel involved in the activity (e.g. all personnel, a limited number of trained personnel, etc)
- Frequency of use or execution
- Degree of control (involvement of contractors)
- Strength/completeness of administrative controls
- Sufficiency/formality of training
- Other....

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