

RSPHys Risk Assessment: RA_054388 – Focused Ion Beam System

- This form is used when a documented risk assessment is required in accordance with Appendix A of WHSMS Handbook Chapter 3.1.
- Original risk assessments must be provided in a convenient location accessible by all people affected by the risk assessment.
- Static risk assessments must be forwarded to local WHS Manager for inclusion in the School Static Risk Assessment Register.

Static Risk Assessment No.		Assessment Date	Reviewed by Date	Version	Top Residual Risk
RA_054388		6 Jan 2025	6 Jan 2028	1.0	Low
Name of the activity	Use of Helios 600 Dual beam SEM/FIB (Scanning Electron Microscope/Focused Ion Beam) System Hazards Assessed: Plant and Equipment, Electrical, Chemical, Radiation, Ergonomics and Manual Tasks, After Hours				
Description of the activity	Using the SEM/FIB capabilities for advanced imaging, precise material analysis, and nanofabrication				
School/ Department	Research School of Physics, EME	Location	Building 160, Room P3.51D		
Risk Assessment Team Have you completed ANU WHS Risk Management Training? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No IF NO, DO NOT PROCEED	Supervisor	Horst Punzmann	Email	horst.punzmann@anu.edu.au	Ph 02 612 50001
	Name	Li Li	Email	lily.li@anu.edu.au	Ph 02 612 50380
	Name	Huma Latif	Email	huma.latif@anu.edu.au	Ph
	Name	Rick Walsh	Email	rick.walsh@anu.edu.au	Ph 02 612 50105
	Name		Email		Ph
Who is affected by this RA?	<input checked="" type="checkbox"/> All people at the location <input type="checkbox"/> A group of people (list right) <input type="checkbox"/> A single person (list right)	People consulted on this RA. (All persons affected, or their representatives need to be consulted)			
WHS Legal and Other Requirements	Work Health and Safety Act 2011 (Cth) Work Health and Safety Regulations 2011 (Cth) ANU WHSMS Handbook Chapter 3.1: Hazard Management				
Type of RA	<input checked="" type="checkbox"/>	Static RA (long term, > 6 months)	Send a copy to WHS Manager and keep original locally near the activity/location, accessible to all people affected.		
	<input type="checkbox"/>	Dynamic RA (short term < 6 months)	Keep the original locally (electronically or physically) near the activity/location, accessible to all people affected.		

Risk Assessment Instruction

- List the hazards of the activity in the 'Hazards' column of the RA Form. Include information on when and where the hazard is present during the activity.
- Estimate inherent risk of the hazard (without any controls in place) using the Likelihood against Consequences definitions described in Table 1 and Table 2 and the ANU WHS Risk Matrix (Table 3). List them in 'Inherent Risk' column of the RA Form for each hazard.
- Develop control measures in accordance with the Hierarchy of Control Principle (Table 4) and list them in 'Control' column of the RA Form.
- Estimate the residual risk of the hazard after implementing all controls. Remember that engineering, administrative and PPE controls only reduce the likelihood of an event occurring, not the consequences.
- Identify any controls that are not in place as corrective actions and implement them before undertaking the activity.
- Obtain approval from relevant people as identified.
- Identify if this is a static risk assessment (> 6 months) or dynamic risk assessment (< 6 months).
- Send a copy of the static risk assessments to WHS Managers– Keep on file for 7 years.
- Keep originals of risk assessments in close vicinity of the activity. Dynamic risk assessments can be destroyed 1 year after the activity ceases.
- Review the static risk assessments and associated safe work procedures in accordance with Section 3.1.2.6: Step 4 of Chapter 3.1 requirements.

Risk Assessment							
Hazards Also list where and when can the hazards present?	Inherent Risk			Control Measures When designing controls, follow the Hierarchy of Controls Principle, assigning the most effective controls before less effective controls (see Table 4). <i>List the control category and the controls for each hazard below. For any controls that are not in place, fill in the Actions table on the next page.</i>	Residual Risk		
	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating
Plant and Equipment <ul style="list-style-type: none"> Entanglement and trapping parts Cables running between main unit and various electronic racks and vice versa. 	Unlikely	Major	High	Isolation <ul style="list-style-type: none"> All surface lying cables are routed below the floor or protected by covers. Engineering <ul style="list-style-type: none"> Emergency Stop in lab First Aid Equipment on site Administration <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction) Tier 2 Training: ANU Risk Management Training (WHSO03, Pulse) 	Rare	Moderate	Low

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	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating
Electrical ➤ Electrical Shock (both minor and major) ➤ Electrocutation	Possible	Catastrophic	High	Isolation <ul style="list-style-type: none"> Power supply and transformer located at level 2, plant room, Inaccessible for general workers Power supply cables routed under floor or protected by covers. Engineering <ul style="list-style-type: none"> RCDs installed on circuits Emergency Stop/ EPO (Emergency Power Off) installed in the room and Equipment Administration <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction) Test and tag of all electrical plugged into electrical sockets. 	Rare	Moderate	Low
Chemical ➤ Flammable Liquids used for cleaning (Ethanol)	Possible	Catastrophic	Extreme	Substitution <ul style="list-style-type: none"> Maximum volume of 500 ml squeeze bottle placed in the room. Administration <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction) Tier 2 training: Flammable Substances (WHSO16, Pulse) Containers labelled to GHS requirements Chemical Register (Chemwatch) Safety Showers / Eye Wash stations available in the area PPE <ul style="list-style-type: none"> Safety goggles/glasses used during cleaning. 	Rare	Minor	Low

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	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating
<p>Chemical</p> <p>Gas lines piped into the room and equipment (Nitrogen)</p>	Possible	Catastrophic	Extreme	<p>Substitution</p> <ul style="list-style-type: none"> Nitrogen supplied through ½ inch line (max flow rate limited by wall mounted pressure regulator) <p>Engineering</p> <ul style="list-style-type: none"> Oxygen depletion monitors installed in room, linked to building emergency notification systems. alarms sound if Oxygen Content reaches 19.5% Building ventilation system with alarm in case ventilation fails, link to building emergency notification systems. During Low Oxygen Event. Lab door automatically locks to prevent entry except by authorised people. <p>Administration</p> <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction) 	Rare	Minor	Low
<p>Radiation</p> <p>➤ X-ray and UV radiation.</p> <p>Radiation is produced in the chamber only when the beam is on and the sample being analysed.</p>	Possible	Moderate	High	<p>Isolation</p> <ul style="list-style-type: none"> Radiation shielding building into equipment <p>Engineering</p> <ul style="list-style-type: none"> Interlocks: the system is powered down and radiation cannot be produced when the chamber is not closed properly Regular preventative maintenance is performed by the manufacturer to make sure the instrument in a safe and in a qualified condition. <p>Administration</p> <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction). Tier 2 Training: ANU Risk Management Training (WHSO03, Pulse) User Manual ANFF prepared training and instructions Specific Equipment Training 	Rare	Moderate	Low

Risk Assessment							
Hazards Also list where and when can the hazards present?	Inherent Risk			Control Measures When designing controls, follow the Hierarchy of Controls Principle, assigning the most effective controls before less effective controls (see Table 4). <i>List the control category and the controls for each hazard below. For any controls that are not in place, fill in the Actions table on the next page.</i>	Residual Risk		
	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating
<p>Chemical</p> <ul style="list-style-type: none"> ➤ 5 different GISs (Gas Injection Systems) installed (Pt, Au, SiO₂, I₂, and XeF₂) which contain potentially corrosive byproducts. Spilled crucible materials can be hazardous. ➤ Ga⁺ ion beam hazards can occur during the system operation, vacuum failures or inadequate shielding 	Possible	Moderate	High	<p>Engineering</p> <ul style="list-style-type: none"> The GIS insertion and retraction are software-controlled, with all materials securely sealed in crucibles to prevent contamination, and the gas is evacuated from the chamber to maintain optimal system conditions Ga liquid metal ion source (LMIS) and all the GIS are sealed and only small amount into the chamber when it's used, which is vented by the exhausted system Regular preventative maintenance is performed by the manufacturer to make sure the instrument in a safe and in a qualified condition. Building ventilation system with alarm in case ventilation fails, link to building emergency notification systems. <p>Administration</p> <ul style="list-style-type: none"> Tier 3 Induction (160_L3_P3.51_2.50_CR_SF Induction). Tier 2 Training: ANU Risk Management Training (WHSO03, Pulse) User Manual ANFF prepared training and instructions Specific Equipment Training Chemical Register (Chemwatch) Signs affixed to lab door describing hazards contained within <p>PPE</p> <ul style="list-style-type: none"> Full clean room gown, face mask, gloves. 	Rare	Moderate	Low

Risk Assessment							
Hazards Also list where and when can the hazards present?	Inherent Risk			Control Measures When designing controls, follow the Hierarchy of Controls Principle, assigning the most effective controls before less effective controls (see Table 4). <i>List the control category and the controls for each hazard below. For any controls that are not in place, fill in the Actions table on the next page.</i>	Residual Risk		
	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating
Ergonomics and Manual Tasks ➤ Repetitive movements ➤ Long duration of the same posture (e.g., sitting)	Possible	Moderate	High	Engineering <ul style="list-style-type: none"> Ergonomically designed chairs available Administration <ul style="list-style-type: none"> Tier 2 Training, Setting up your workstation (WHSO20, Pulse) Rest breaks every 20 mins 	Rare	Moderate	Low
After hours working ➤ Lack of capacity to respond to emergencies	Rare	Moderate	Low	Elimination <ul style="list-style-type: none"> NO after-hours work is allowed. 	Rare	Moderate	Low

Actions			
The activity must not be commenced until all controls are in place. List below which controls are currently not in place, who will implement them and by when. Add additional rows as needed.			
List of Controls not in place	Who is to implement them?	Timeframe	Date Completed

If the level of residual risk is assessed as high or extreme,

1. Stop the activity immediately; AND
2. Tag out the plant/equipment; and/or
3. Secure any chemical; and
4. Implement, or seek advice from WHS Officer or Subject Matter Experts to implement, additional controls to reduce the residual risk further to medium [Supervisor signature required];
5. If the above is not possible, seek approval from relevant authority (High – School/Division Director/College Dean; Extreme – COO). NOTE: Approval will only be granted in exceptional circumstances after consultation with Associate Director, WEG and/or a Subject Matter Expert. See Chapter 3.1 for details.

Approval required					
Worker conducted RA			Student conducted RA		
Residual Risk Level	Authority required	Signature and date	Residual Risk Level	Authority required	Signature and date
Low	Author of RA	Li Li 06 Jan 2025	Low	Supervisor	
Medium	Supervisor		Medium	Supervisor	
High	School Director		High	School Director	
Extreme	COO		Extreme	COO	

Table 1. Likelihood Table

Ranking	Description	Probability or frequency of event happening
Almost certain	The hazard is expected to lead to an event in most circumstances at the University	A daily to monthly occurrence
Likely	The hazard could lead to an event in most circumstances at the University	Between monthly to yearly occurrence
Possible	The hazard has led to an event at some time at the University	Occurs once between 1 to 5 years
Unlikely	The hazard could lead to an event at some time	Occurs once between 5 to 20 years
Rare	The hazard may lead to an event in exceptional circumstances	Occurs once between 20+ years

Table 2. Consequences Table

Ranking	Injury, Illness or Disease	Plant, Equipment, and materials	Environment
Catastrophic	Fatality / fatalities or permanent disability. Permanently unable to work	Destroyed or cannot be reused	Long term permanent effect to ecosystems. Significant intervention required to remediate
Major	Requiring extensive medical treatment such as hospitalisation as in patient and possibly a Notifiable Incident LTI >1 week	Damage requiring repairs/rebuild and possible recertification prior to reuse, lost use for one or more days	Notification to environmental agency, ecosystem will need time to recover, intervention required to remediate
Moderate	Minor medical treatment injury, such as treated by a health professional, hospital outpatient, no potential to be a Notifiable Incident LTI < 1 week and can return to normal duties	Damage requiring a repair/service by a trade/technician within the day	Contamination event that does not impact on ecosystem. Short impact does not need intervention
Minor	Injury needing significant first aid treatment and can return to work within shift	Equipment able to be reset or gotten back into operation by the operator	Minor contained contamination ceasing when the short event is over, can remediate (e.g., spill kit)
Insignificant	Report only, no injury OR minor first aid (e.g., Band-Aid); short-term discomfort	Report only, no damage	Report only, no contamination

Table 3. ANU WHS Risk Matrix

	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium (10)	High (14)	Extreme (21)	Extreme (22)	Extreme (25)
Likely	Medium (7)	High (13)	High (16)	Extreme (20)	Extreme (24)
Possible	Low (4)	Medium (9)	High (15)	High (18)	Extreme (23)
Unlikely	Low (2)	Medium (6)	Medium (8)	High (17)	High (19)
Rare	Low (1)	Low (3)	Low (5)	Medium (11)	Medium (12)

Table 4. Hierarchy of Controls

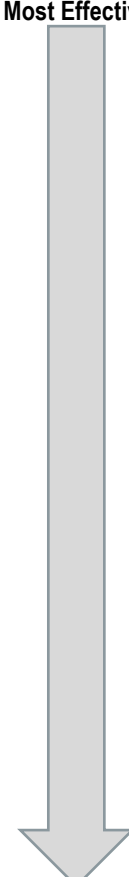
Level	Examples	Effectiveness
Elimination	<ul style="list-style-type: none"> Remove the hazards completely Cease the activity Dispose of unwanted hazardous chemicals or plant etc 	<p style="text-align: center;">Most Effective</p>  <p style="text-align: center;">Least Effective</p>
Substitution	<ul style="list-style-type: none"> Use less hazardous chemicals Use safer plant equipment Use handset instead of telephone Move smaller weight loads instead of large weight 	
Isolation	<ul style="list-style-type: none"> Physical separation from the hazard by distance or complete shielding Install guard rails around edges and holes to floors Move workers to a new room away from hazardous noise 	
Engineering Control	<ul style="list-style-type: none"> Use ventilation system Use fume cupboard when working with hazardous chemicals Install guarding around rotating and crushing parts Use trolley or hoist to lift heavy loads Use duress alarm system while doing home interview or offsite field work 	
Administrative Control	<ul style="list-style-type: none"> Use Safe Work Procedures [See section 3.1.3.1] or instructions Induction and WHS information Training [See Handbook Chapter 3.2] Contingency Planning and Testing [See section 3.1.3.2] Permit to Work system [See section 3.1.3.3] Signage 	
Personal Protective Equipment (PPE)	<ul style="list-style-type: none"> Lab coat Safety glasses/face shield Gloves/cryogenic gloves Respirators/Masks Personal hearing protectors 	

Table 5. Risk Assessment and SWP review timeframe

Use this Table to determine review timeframe and frequency for the risk assessment and any safe work procedures.

Residual Risk	Review Frequency	What to do during the review.
Extreme	6 months	<p>Stop work.</p> <p>Review the control measures and introduce additional control measures to reduce the residual risk to Medium as a maximum.</p>
High	1 Year	
Medium	2 Years	<p>Review the control measures.</p>
Low	3 Years	