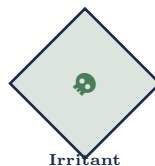
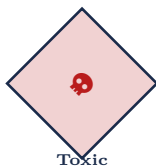


COSHH Chemical Risk Assessment

Control of Substances Hazardous to Health

Department:	Synthetic Chemistry Laboratory	Building / Room:	Science Block C, Room 214
Principal Assessor:	Dr. Sarah Whitmore	Date of Assessment:	14 March 2024
Reviewed By:	Prof. James Callahan	Next Review Date:	14 March 2025
Activity / Project:	Synthesis of organosulfur intermediates — Project NXB-OS-117		
Risk Rating (Overall):	Low After controls applied		

⚠ Important: This assessment must be read and signed by all personnel before commencing any work with the substances listed below. It supersedes all previous assessments for this activity. Any change in procedure, supplier, or scale must trigger an immediate reassessment.





Substance Inventory and Hazard Classification

The following substances are used in the synthesis of organosulfur intermediates (Project NXB-OS-117). All quantities are maximum single-session amounts. SDS documents are held in the laboratory safety cabinet (Drawer 3).

Substance	CAS No.	Quantity	State	GHS Hazards	WEL (8h)
Dimethyl sulfoxide (DMSO)	67-68-5	500 mL	Liquid	H316 – Skin irritant. Penetration enhancer; carry-through hazard for co-solvents	None est.
Thionyl chloride	7719-09-7	50 mL	Liquid	H290, H302, H314, H331, H400 – Corrosive; toxic by inhalation; reacts violently with water	1 ppm
Triethylamine (TEA)	121-44-8	100 mL	Liquid	H225, H302, H311, H331, H312 – Flammable; harmful via skin, inhalation, ingestion	1 ppm
Dichloromethane (DCM)	75-09-2	2 L	Liquid	H315, H319, H336, H351 – Suspected carcinogen; CNS narcotic; skin/eye irritant	100 ppm
Sodium hydride (60% in oil)	7646-69-7	10 g	Solid	H250, H260, H314, H290 – Pyrophoric; reacts violently with water; corrosive	N/A
Anhydrous tetrahydrofuran (THF)	109-99-9	500 mL	Liquid	H224, H302, H336, H372 – Highly flammable; STOT-RE; forms explosive peroxides	50 ppm

WEL = Workplace Exposure Limit (EH40/2005, 4th ed.). N/A = not applicable (solid, minimal vapour pressure).



Exposure Route Checklist

For each substance, the credible exposure routes have been assessed. Ticked boxes (☑) indicate routes that present a meaningful hazard.

Substance	Inhalation	Skin Contact	Eye Contact	Ingestion	Injection
DMSO	☐	☑	☑	☐	☐
Thionyl chloride	☑	☑	☑	☐	☐
Triethylamine	☑	☑	☑	☑	☐
DCM	☑	☑	☑	☐	☐
Sodium hydride	☐	☑	☑	☐	☐
THF	☑	☑	☑	☐	☐

i DMSO Carry-through Warning: DMSO rapidly penetrates intact skin and carries dissolved co-contaminants into systemic circulation. Any substance dissolved in DMSO must be treated as if dermally toxic. Nitrile gloves alone are **insufficient** — double-glove with an outer butyl rubber glove when handling DMSO-containing solutions.

 Severity–Likelihood Risk Matrix

Risk scores are the product of **Severity** (S, 1–5) and **Likelihood** (L, 1–5). Colour banding follows the standard 5-tier scheme used across Nexa Biomedical Research Ltd sites.

Likelihood (L)	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Severity (S)				

Low Risk (1–4): Acceptable. Standard laboratory procedures apply. Routine monitoring.

Medium Risk (5–9): Additional controls required. Review monthly. Supervisor awareness mandatory.

High Risk (10–14): Significant controls essential. Written permit required. Safety officer sign-off.

Critical Risk (15–25): Work must not commence without Director approval and independent audit.

 Per-Substance Risk Ratings (Before and After Controls)

Substance	Before Controls			Key Controls	After Controls		
	S	L	Score		S	L	Score
DMSO	2	3	6	Double gloving; no contaminant solutions on open bench	2	1	2
Thionyl chloride	4	3	12	Fume hood only; Schlenk line; acid-gas scrubber; face shield	4	1	4
Triethylamine	3	3	9	Fume hood; covered containers; no open use	3	1	3
DCM	3	4	12	LEV extraction; respiratory monitoring; minimise volumes	3	2	6
Sodium hydride	5	2	10	Argon atmosphere; dry glassware; metal spatulas; sand bucket at bench	5	1	5
THF (anhydrous)	3	3	9	Inhibitor check; peroxide test before use; antistatic mat; earthed vessels	3	1	3

S = Severity (1–5), L = Likelihood (1–5). Score = S×L. Colour bands: **Low** 1–4, **Med** 5–9, **High** 10–14, **Crit** ≥15.

Control Measures (Hierarchy of Control)

Controls are listed following the **COSHH hierarchy**: Elimination → Substitution → Engineering → Administrative → PPE. Higher-order controls are always preferred.

Elimination / Substitution

- Thionyl chloride: *no viable substitute* for acid chloride generation at this scale. Elimination is not feasible; minimise batch size to ≤ 50 mL.
- DCM: replace with 2-methyltetrahydrofuran (2-MeTHF) where extraction yield permits (*ongoing trial, Q2 2024*).
- TEA: consider polymer-supported base (Amberlyst A21) for scale-up reactions.

Engineering Controls

- All volatile and toxic liquid handling in **Class II fume cupboard** (face velocity ≥ 0.5 m/s, tested 2024-01-18).
- Thionyl chloride reactions on **Schlenk line** with **NaOH acid-gas scrubber** (≥ 4 M, 5 L).
- Local exhaust ventilation (LEV) at solvent evaporation workstation.
- Antistatic earthing straps on all large-volume THF vessels.
- Dedicated pyrophoric cabinet for NaH storage.

Administrative Controls

- Two-person rule: thionyl chloride and NaH operations require a second competent person present in the laboratory.
- Peroxide test strip check on THF before each use (dip strip, record in lab notebook, discard if >25 ppm).
- Maximum single-session scale limits (see inventory table).
- Monthly fume cupboard face-velocity log (Form NXB-EHS-04).
- All personnel must complete NXB COSHH induction (eLearning module #3) and sign acknowledgement sheet.
- Emergency eyewash station tested weekly; deluge shower monthly.

Personal Protective Equipment (PPE)

- ✓ **Lab coat:** cotton, knee-length, closed front
- ✓ **Gloves:** nitrile (inner, 0.3 mm) + butyl rubber (outer) for DMSO and corrosive work
- ✓ **Eye protection:** chemical-splash goggles (EN 166:2002) at all times
- ✓ **Face shield:** mandatory for thionyl chloride and NaH additions
- ✓ **Footwear:** closed-toe, impermeable; no synthetic fabrics
- **Respirator:** not routinely required (fume hood used); half-face APF 20 available for spill response

Emergency Procedures and First Aid

Incident Type	Immediate Action	Contact
Skin contact (corrosive)	Remove contaminated clothing. Irrigate skin with copious water for ≥ 20 min. Seek medical attention immediately.	Campus First Aid x4444
Eye splash	Irrigate with eyewash station for ≥ 15 min. Do not rub. Seek ophthalmologic review even if pain subsides.	A&E / NHS 111
Inhalation (thionyl chloride / TEA)	Remove to fresh air. If symptomatic (cough, chest tightness) call 999. Delayed pulmonary oedema possible — observe for 24 h.	999 / x4444
Fire (THF / TEA)	Sound alarm. Evacuate. CO ₂ extinguisher only (no water). Assemble at Car Park B.	999 / x4444
NaH water contact	Do NOT use water. Use dry sand to smother. Evacuate if fire develops.	999 / x4444
Large spill (>100 mL)	Evacuate lab. Alert building warden. Do not re-enter without specialist ERT response.	ERT x5500

 **Key Emergency Numbers:** Campus First Aid **x4444** · Emergency Response Team **x5500** · EHS Office **x3200** · External Emergency **999**

Health Surveillance and Exposure Monitoring

All personnel working with listed substances on a regular basis (≥ 4 h/week) are enrolled on the Nexa Biomedical occupational health programme administered by **Meridian Occupational Health Services Ltd**.

Substance	Monitoring Method	Frequency	Action Level
DCM	Personal air sampling (activated charcoal tube, GC-FID analysis by Synapse Analytical Services)	6-monthly	>50 ppm (8h TWA)
Triethylamine	Personal air sampling (HPLC analysis)	6-monthly	>0.5 ppm (8h TWA)
THF	Biological monitoring: urinary γ -butyrolactone (Meridian OH lab)	Annual	BEI 2 mg/g creatinine
All substances	Fume cupboard face velocity (anemometer, Form NXB-EHS-04)	Monthly	<0.5 m/s $\Rightarrow$ stop work

Surveillance Item	Detail
Pre-placement health assessment	Required before first use. Respiratory fitness, baseline spirometry recorded.
Periodic review	Annual spirometry and symptom questionnaire for DCM and THF workers.
Skin surveillance	Visual inspection of hands/forearms at 3-month intervals (thionyl chloride, TEA workers). Dermatitis referral threshold: any persistent erythema.
Incident reporting	All skin or eye contacts, near-misses, and overexposure events logged on EHS Portal (Form NXB-EHS-01) within 24 h.



Waste Disposal

All chemical waste must be disposed of in accordance with the **Environmental Protection Act 1990** and Nexa Biomedical Waste Management Procedure NXB-EHS-WMP-03.

Waste Stream	Packaging / Segregation	Collection
Halogenated solvents (DCM)	Amber glass bottle, EWC code 07 01 03* (halogenated solvents)	Vertex EHS Contractors
Non-halogenated solvents (TEA, THF)	Separate amber bottle, EWC 07 01 04*	Vertex EHS Contractors
Acid waste (thionyl chloride residues)	Quench slowly onto ice/water in fume hood; neutralise to pH 5–9; transfer to labelled inorganic acid waste bottle	Vertex EHS Contractors
Reactive metal waste (NaH)	Quench individually with dry isopropanol in fume hood (small portions); solid residue to labelled reactive metals container	Vertex EHS Contractors
Contaminated PPE	Double-bag in yellow chemical-waste bags; label with hazard class	Campus hazardous waste store



THF Peroxide Disposal: Peroxide-positive THF (>25 ppm) must **NOT** be evaporated, distilled, or stored. Contact the EHS office (x3200) immediately for specialist disposal. Do not decant into standard solvent waste.

 Review History

Version	Changes Made	Reviewed By	Date
1.0	Initial assessment. Activities limited to ≤25 mL thionyl chloride.	Dr. Sarah Whitmore	10 Sep 2022
1.1	Added NaH controls following incident near-miss on C214 (Ref. NXB-EHS-NM-0047). Pyrophoric storage procedure updated.	Dr. Sarah Whitmore / Prof. James Callahan	03 Feb 2023
2.0	Scale-up authorised to 50 mL thionyl chloride; Schlenk line engineering control added; DCM biological monitoring introduced.	Prof. James Callahan	01 Sep 2023
2.1	DMSO carry-through notice added (Sec. 2); THF peroxide disposal procedure updated per EHS circular 2024-02.	Dr. Sarah Whitmore	14 Mar 2024

 Assessor Sign-Off

By signing below, the assessor confirms that this assessment is suitable and sufficient for the activity described, that all significant hazards have been identified and adequately controlled, and that the assessment has been communicated to all persons affected.

Principal Assessor

Dr. Sarah Whitmore

Date:

Departmental Safety Officer

Mr. Oliver Crane

Date:

Head of Department

Prof. James Callahan

Date:

 Worker Acknowledgement

All personnel who have read and understood this assessment must sign below before commencing work. Completed sheets are retained by the Departmental Safety Officer for a minimum of 5 years.

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#	Full Name (Print)	Role / Job Title	Signature	Date
1	Elena Marchetti	Postdoctoral Research Associate		
2	Thomas Abara	PhD Candidate, Year 2		
3	Priya Nair	Research Technician		
4	Daniel Forsythe	Visiting MSc Student		
5				
6				
7				
8				



Regulatory References

- Health and Safety Executive. *EH40/2005 Workplace Exposure Limits*, 4th ed., 2020. [5]
- Health and Safety Executive. *COSHH Essentials: Easy Steps to Control Chemicals*, HSG193. [4]
- Health and Safety Executive. *The Control of Substances Hazardous to Health Regulations 2002 (as amended)*. SI 2002/2677. [2]
- European Chemicals Agency. *Guidance on the Application of the CLP Criteria*. Version 5.0, 2017. [3]
- Health and Safety at Work etc. Act 1974. [1]



Next Scheduled Review: 14 March 2025 (or sooner if activity, scale, or personnel change). Responsibility: Dr. Sarah Whitmore. Reminder set on NXB EHS Portal.

This document is controlled. The master copy is held on the Nexa Biomedical Research Ltd EHS Portal (Document NXB-COSHH-2024-037 v2.1). Printed copies are uncontrolled. Verify currency before use.

References

[1]

Health and Safety at Work etc. Act 1974, 1974. c.37. Her Majesty’s Stationery Office, London.

[2]

The Control of Substances Hazardous to Health Regulations 2002 (as amended), 2002. SI 2002/2677. Her Majesty’s Stationery Office, London.

[3]

European Chemicals Agency. Guidance on the Application of the CLP Criteria. Technical Report Version 5.0, ECHA, Helsinki, Finland, 2017.

[4]

Health and Safety Executive. COSHH Essentials: Easy Steps to Control Chemicals. Technical Report HSG193, HSE Books, Sudbury, UK, 2003.

[5]

Health and Safety Executive. *EH40/2005 Workplace Exposure Limits*. Sudbury, UK, 4th edition, 2020. Available from <https://www.hse.gov.uk/pubns/priced/eh40.pdf>.