1.0 OBJECTIVE

The objective of the procedure is to define when and how risk assessments should be done and the process involved in the evaluation and approval of risk assessments.

2.0 SCOPE

This SOP is applicable to all lab-based research related projects / tasks under the management of NUS. All staff undertaking lab-based research projects are required to carry out a risk assessment in compliance with the requirements of this procedure. This SOP is also applicable under the Chemical, Radiation and Biological Safety & Health programmes.

3.0 RESPONSIBILITIES

3.1 Principal Investigator

It is the responsibility of the Principal Investigators (PI) to complete the risk assessment exercise based on the risk assessment framework set at the University level before any new project or task is implemented, or when there are changes that may affect the safety and health aspects of the project / task or as and when required by the University. The PI shall ensure that the information presented during the risk assessment is as accurate as possible. If there are significant changes to the scope of the work, a new risk assessment will have to be conducted. The PI shall submit the risk assessment and all necessary supporting information to the Departmental Heads (HOD) for approval.

3.2 Head of Department

The HOD shall ensure that the PI puts in place all controls as spelt out in the risk assessment submission.

3.3 Institutional Laboratory Safety Committee (ILSC)

The ILSC shall be the highest approving authority on all risk assessment submissions that involve non-biological work. Refer to the Terms of Reference of the ILSC in Annex 3.

3.4 Institutional Biosafety Committee (IBC)

The Institutional Biosafety Committee (IBC) shall be the highest approving authority on all risk assessment submissions that involve

biological work. Refer to the Terms of Reference of the IBC in Annex 4.

3.5 Office of Safety, Health & Environment (OSHE)

The Office of Safety, Health & Environment (OSHE) shall serve as secretariat to the ILSC and IBC.

3.6 Office of Life Science

The Office of Life Sciences shall be overall coordinating body for research projects involving life sciences. OLS shall be responsible for notifying PIs to submit their risk assessments.

3.7 Office of Research

The Office of Research shall be the overall coordinating body for non-life sciences research projects. ORE shall be responsible for notifying PIs to submit their risk assessment.

4.0 DEFINITION

Risk Assessment: Risk assessment (RA) is defined as a systematic process to evaluate the likelihood and severity of hazards associated with research or teaching project / task. Risk assessment process should also evaluate the effectiveness of control measures that are planned or implemented aimed at reducing the risk posed by the research or teaching project / task.

Laboratory: a room or building for scientific experiments, which involve the making, testing, examination or analysis of materials or substances.

5.0 PROCEDURES

5.1 *Types of Projects/Tasks Requiring Risk Assessment*

a. All new laboratory based research projects / tasks undertaken by staff members from NUS faculties and research institutes must submit a duly completed Risk Assessment Form (Appendix 1) prior to commencing work i.e. those proposals submitted to granting agencies from December 2004 onwards.

b. Projects / tasks that do not require any provision of grant (e.g. teaching activities, workshop activities, dissertation projects etc.) are still required to undergo a risk assessment prior to the commencement of these projects/tasks.

c. For non laboratory based projects, a declaration form is to completed and submitted to ORE/OLS for filing. The form is available from OSHE website at: (http://www.nus.edu.sg/osh/manuals/sop.htm).

5.2 *Risk Assessment Procedures for project/task requiring grant funding*

a. PI are to familiarize themselves with the University Risk Assessments Form and consider the appropriate safety equipment, manpower and budget required for their proposal. They are to include these requirements in their project proposal.

b. ORE and OLS will inform PI accordingly when they are to submit the University Risk Assessment Form.

   a. Generally for non life sciences projects, Risk Assessment Form should only be submitted once the grant agency has approved their project.

   b. For life sciences projects, the Risk Assessment Form needs to be submitted for projects that have been short listed by the granting agency.

c. PI can only commence work only after their risk assessment has been approved.

d. PI shall submit the completed form to his/her HOD for the HOD's approval. The HOD shall evaluate the risk assessment (with the assistance of the Departmental Safety Committee, the Faculty Safety Office or other internal or external resources, if required) and ensure that the PI has taken all necessary control measures to reduce the risk to a safe level.

e. After approval by HOD, the PI should then submit the Risk Assessment Form and other supporting documents (if necessary) to OSHE who is serving as the Secretariat to the Institutional Biosafety Committee and the Institutional Laboratory Safety Committee.

f. OSHE shall conduct the preliminary review of Form RA and the form from GMAC (if applicable- Appendix 2) to determine if the project/task involves dealing with new or changed:

   - Protocol
   - Material or agent
   - Personnel
   - Facility
   - Equipment

g. OSHE on behalf of IBC or ILSC shall conduct a preliminary review of the RA. For low risk (standardized) projects OSHE will inform ORE or OLS that these projects, in principle, may commence. OSHE will update IBC or ILSC on the approval of such projects.

h. For higher risk projects or projects OSHE does not have the expertise or competency to evaluate will be forwarded to IBC, ILSC or government agencies (Ministry of Health, Ministry of Environment, etc) for approval. The IBC or ILSC may seek the opinion of non-IBC/ILSC members if required.

i. OSHE will inform the Deanery and OLS/ORE of the final decision of the risk assessment review. OLS/ORE will then trigger the release of research grant to the respective PI.

j. Risk assessment submissions that have been given preliminary review clearance from OSHE will be randomly reviewed by ILSC or IBC. The IBC or ILSC may decide that in the RA that the risk levels are unacceptable or the control measures taken are inadequate.

k. Projects/tasks may be approved with conditions (e.g. PI need to ensure that additional budget be allocated for safety etc.). These conditions will be spelt out in the communication from OSHE. PIs are assumed to have accepted the conditions when work on the project/task commences. It is the responsibility of the PI to ensure that the pre-conditions are adhered to at all times.

l. In the event of a rejection of the risk assessment, the IBC or ILSC shall furnish reasons for the rejection and may provide recommendations for risk reduction. The PI may submit a revised risk assessment to the ILSC or IBC.

m. The IBC or ILSC reserve the right to reject the project/task in its entirety from being conducted on NUS premises and/or by its staff or student(s) on non NUS premises if it deems that the risks posed by the project or task far outweigh the control measures that the PI or the university can provide.

5.3 *Risk Assessment Procedures for project/task that do not require grant funding*

a. Projects / tasks that do not require any provision of grant (e.g. teaching activities, dissertation projects) shall use the same Risk Assessment form.

b. The risk assessment has to be conducted by the person responsible for designing, coordinating and managing the project/task (e.g. Final Year Project Supervisors, Workshop Managers etc). Where no responsible person is assigned for the project or task (common support activity for the department such as workshop services, analytical services etc.), the responsibility for the conduct of the risk assessment shall lie with the HOD of the department concerned.

c. The project or task can only commence upon the completion of the risk assessment.

d. Completed risk assessment forms shall be endorsed by the HOD. The HOD shall evaluate the risk assessment (with the assistance of the Departmental Safety Committee, the Faculty Safety Office or other internal or external resources, if required) and ensure that all necessary control measures to reduce the risk to a safe level will be taken.

5.4 *Appeal Mechanism if no HOD endorsement is obtained*

In the event that the HOD does not endorse the risk assessment of the PI, the PI can launch an appeal in writing to the IBC or ILSC through OSHE. The IBC/ILSC has the right to choose whether to consider the appeal. The decision of IBC or ILSC will be final in this case.

5.5 *Resubmission of Risk Assessment Submission*

a. A new risk assessment submission should be made when there are significant changes in the protocol, practices, material, personnel or environment of the said research or teaching project / task that can increase the risk of the project / task.

b. The PI shall review his earlier risk assessment results or perform a new risk assessment and put in place necessary changes as deemed necessary from the review or the new risk assessment. The revised or new risk assessment shall be endorsed by the HOD.

c. All revised risk assessment or new risk assessment of project/task that have been previously approved by the IBC or ILSC shall be filed with OSHE. IBC/ILSC reserved the right to review the revised or new risk assessment submission.

6.0 RECORDS

Copies of all risk assessment submissions, rejection and approval communication shall be kept and maintained by:

a. Principal Investigator (PI)

b. OSHE

6.0 APPENDICES

Appendix 1: Risk Assessment Form

Appendix 2: GMAC form

Appendix 1

The Risk Assessment Form can be downloaded from:

http://www.nus.edu.sg/osh/forms.htm#form_gen

Appendix 2

GMAC Form

<Refer to OSHE website for the full version of the "Singapore Biosafety Guidelines For Research On Genetically Modified Organism (GMOs)>

PROPOSAL FORM FOR ASSESSMENT OF GENETIC MANIPULATION WORK

GMAC Ref No.: _____
(for official use only)

Name of Scientist(s) :

Name of Institution :

Type of Experimental Organisms (please tick) :

☐ Animal ☐ Plant ☐ Others, please specify:

Experiment Risk Group (please tick) :

☐ Category A ☐ Category B ☐ Category C

A. Experimental detail (attach separate sheet if necessary)

1. Project title

2. Research unit involved

3. Experimental objective

4. Rationale for the experiment

5. Duration of the experiment

B. Organism/vector (attach separate sheet if necessary)

1. Name and address of exporting user

2. Date of transfer

3. Name of organism/vector

4. Natural host

5. Requirement to ensure containment, safe handling, storage and disposal

Reviewed by

_____	_____	_____
Date received	**Name and Signature**	**Date**
IBC Chairman		

The following section is applicable for Category A and C experiments only:

For official use only:
AVA/MOH/NEA approval:

Approved ☐

Rejected ☐

_____	_____
Name and Signature Authorised Officer	Date

GMAC notification:

_____	_____
Name and Signature GMAC Secretariat	Date

SUPPLEMENTARY INFORMATION FORM :
FOR EXPERIMENTS INVOLVING WHOLE PLANTS
(Attach separate sheet if necessary)

1. Are the experimental plant noxious weeds or closely related to species which are noxious weeds?

   If 'yes', please elaborate:

2. Are the microorganisms/fungi etc. involved in this work known to be harmful to humans, animals or plants?

   If 'yes' :

   a) Give further information about the harmful agent:

   b) Detail the known and likely transmission modes (including carrier insects) for this agent:

3. Are the genetically manipulated plants to be grown?

   If 'yes' :

   a) What developmental stage will they reach?

b) Describe the techniques to be employed to contain plant materials (including pollen, seeds, spores, vegetative materials) during and at the completion of the experiments.

c) What is the proposed method of disposal of plant materials at the conclusion of the experiment?

4. a) Is soil or soil substitute to be used? (Specify.)

b) How will it be sterilised?

5. Describe the facility to be used for cultivation of the plants. Include information such as location, proximity to containment laboratory etc.:

6. Give any additional information which may be relevant to the assessment of this work:

Appendix 3

Terms of Reference of ILSC

1. Review the SOPs, Standards and Guidance Documents at university level and recommend revisions to the Director of OSHE.

2. Serve in an advisory capacity to OSHE on all chemical, radiation and physical safety related matters pertaining to laboratories.

3. Review the NUS Chemical and Radiation Programme, as well as any audit and inspection findings conducted by OSHE or other independent parties on faculties and departments.

4. Review the NUS Chemical and Radiation Policy and recommend to the NUS President on specific action items related to the Chemical and Radiation Programme.

5. To endorse risk assessments that cannot be effectively evaluated at the departmental or faculty level, including appeals by Principal Investigators.

Appendix 4

Terms of Reference of IBC

1. Review the SOPs, Standards and Guidance Documents at university level and recommend revisions to the Director of OSHE.

2. Serve in an advisory capacity to OSHE on all Biosafety related matters.

3. Establish procedures for the registration of biohazardous agents, and review the use of such agents and GMOs as required by the Genetic Modification Advisory Committee (GMAC).

4. Approve all new projects involving biohazardous agents of Risk Group 2 and above through a risk assessment framework (Refer to SOP on Risk Assessment) that must be completed by the respective Principal Investigators (PIs) before the commencement of a research project or teaching experiment, including reviewing of appeals from PIs.

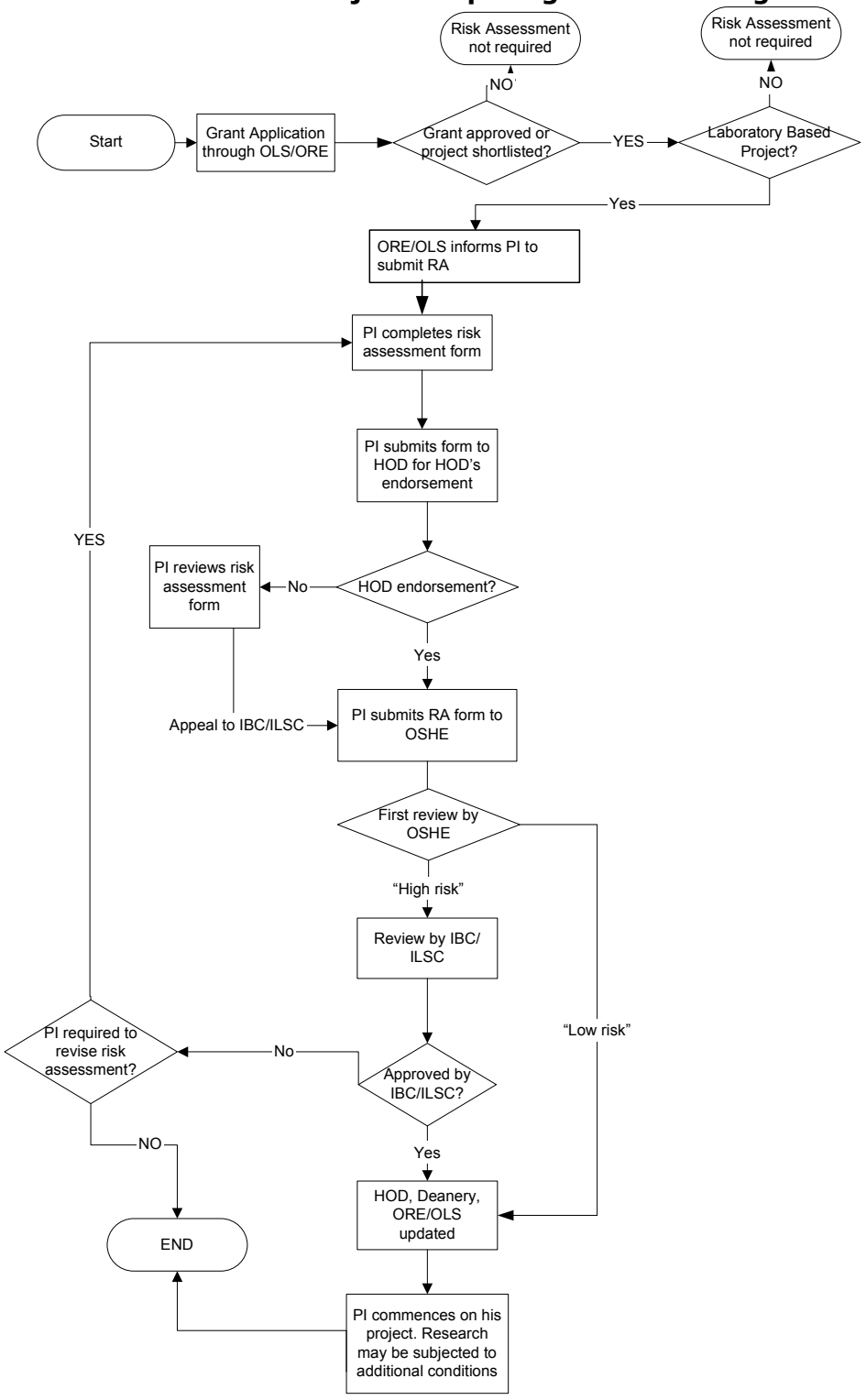
5. Review the NUS Biosafety Programme, as well as any audit and inspection findings conducted by OSHE or other independent parties on faculties and departments.

6. Review the NUS Biosafety Policy and recommend to the NUS President on specific action items related to the Biosafety Programme.

7. Perform the roles and responsibilities for Institutional Biosafety Committee stipulated in guidelines issued by the Genetic Modification Advisory Committee (GMAC) (Refer to attached page extracted from the Singapore Biosafety Guidelines for Research on GMOs).

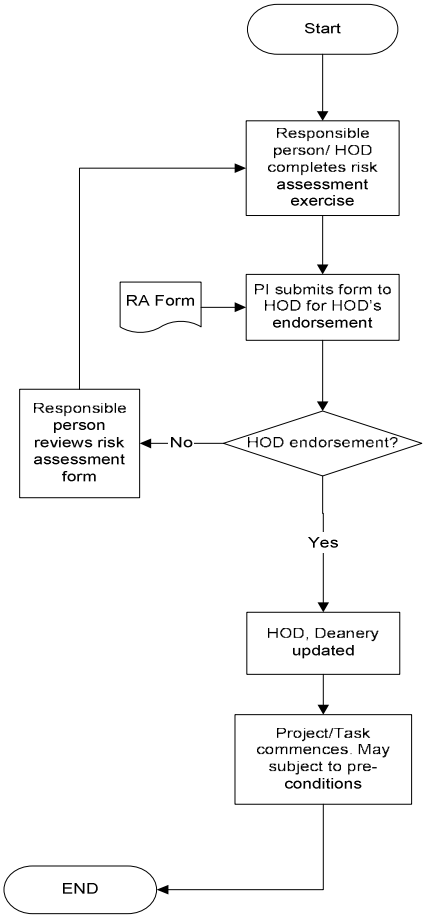
Appendix 5

A. Flow Chart of Risk Assessment Submission Procedures For Lab Based Projects requiring Grant Funding



Appendix 6

B. Flow Chart of Risk Assessment Submission Procedures for Lab Based Projects that Do Not Require Grant Application



Appendix 7

Detailed Risk Control Guidelines (for reference only)

1. Work Environment

Describe the suitability of the environment for the proposed work, including any shortcomings.

Space provided: _____

Bench & floor surfaces: _____

Traffic: _____

Temperature & ventilation: _____

Lighting: _____

Housekeeping: _____

Isolation: _____

Security of facility: _____

2. Physical Activities

	Describe activity
❑ Repetitive actions or long task duration	
❑ Physical exertion	
❑ Bending, reaching or twisting	
❑ Sustained or uncomfortable posture(s)	

3. Generic Risk Controls

The following list mirrors the hierarchy of hazard control. Tick relevant controls that will be used and add others.

			Details
Elimination	□	The benefit to be derived outweighs the risk	
Isolation	□	Secure facility with only authorized access	
	□	Designated work area within facility	
	□	Containers capped	
	□	Secondary containment for any transport outside facility	
	□	Spill tray and/or absorbent bench coat for bench work	

	□ Paperwork and computers are physically separated from wet areas	
Minimisation	□ Lowest possible volumes & concentrations	
	□ Shortest duration of task/exposure	
Engineering	□ Automated processes	
	□ Pipetting aids are used to prevent mouth pipetting	
	□ Fume cupboard or fume/dust extraction system	
	□ Proper maintenance of equipment	
Administration	□ List of authorized personnel	
	□ Safety training for project personnel	
	□ Local induction training and orientation	
	□ Records kept of project team training	
	□ Relevant permits and licenses have been obtained	
	□ Hazard signposting at entry to facility (Uni standard)	
	□ Proper labeling of containers, including decanted	
	□ Ready access to MSDS	
Procedures	□ Relevant University wide standard operating procedures will be adopted: o Biological waste disposal o Chemical waste disposal o Hazardous substance inventory o Lab sign posting and labeling o Radioactive waste disposal o Accident/Incident reporting	
	□ Adherence to MSDS instructions	
	□ Work surfaces cleaned and decontaminated after use	
	□ Spill clean-up kit and procedures	
	□ Sharps are disposed of into approved sharps containers	
	□ First aid for known exposures	
	□ Removal of lab coat & gloves before exiting facility	
	□ Hand washing before exiting facility	
	□ Work benches, under benches and passageways clear of clutter	
	□ Work conducted only during normal business hours	
	□ Procedures are implemented for after-hours work or work in isolation	

PPE	□	Laboratory coat or gown, closed at the front.	
	□	Closed footwear	
	□	Disposable, impervious gloves	
	□	Respiratory protection	
	□	Eye or face protection	
	□	Eye wash and safety shower	

Other controls: *(These should not include the risk controls listed in supplementary sections).*

4. Biological Risk Controls

			Details:
Substitution	□	A less infectious agent is not available as an alternative	
	□	A safer, non-biological methodology is not available	
Isolation	□	Secure facility with only authorized access	
	□	Designated work area within facility	
	□	Designated and secure storage for the substance	
	□	Spill tray and/or absorbent bench coat for bench work	
	□	A certified biosafety cabinet is used in accordance with correct BSC procedures	
Engineering	□	Autoclave is available	
Isolation	□	Designated and secure storage for biological agents	
Administration	□	Project personnel have attended and passed OSHE Biosafety training	
	□	Biological work only during normal business hours	
	□	Records kept of biological agent usage	
Procedures	□	Biological waste is decontaminated before disposal	
	□	Autoclave SOP is used	
	□	Spill kit includes fresh decontaminant	
	□	Needles are not re-sheathed or removed from syringes by hand	
	□	Inventories of Risk Group 2 agents and records of usage are kept	
	□	Health surveillance is undertaken	
PPE	□	Vaccinations are provided	

Other controls:

5. Assessing the chemical hazards

Legislative Requirements	Health effects	Safety effects (Hazardous reactions)	Routes of Exposure
☐ Poisons Act* (Chapter 234)	☐ Acute toxicity	☐ Explosive	☐ Inhalation
☐ Factories Act* (Chapter 104)	☐ Chronic toxicity	☐ Oxidiser	☐ Ingestion
☐ National Convention on Chemical Weapons Declaration	☐ Irritant/Sensitiser	☐ Water reactive	☐ Skin absorption
☐ Fire Safety Act* (Chapter 109A)	☐ Corrosive	☐ Flammable	☐ Eye contact
☐ Environmental Pollution Control Act*(Chapter 94 A)	☐ Carcinogen	☐ Peroxides	☐ Injection/needle stick
☐ Radiation Protection Act**	☐ Asphyxiant	☐ Others: Please specify _____	☐ Others: Please specify _____
☐ Misuse of Drugs Act* (Chapter 185)	☐ Mutagen	☐ Generates toxic / flammable gases when in contact with o Water o Acid o Others _____	
☐ Others: Please specify _____	☐ Teratogen ☐ Cytotoxic ☐ Lacrymator ☐ Others: Please specify _____		

* The links to the various piece of applicable legislation can be found on OSHE website at www.nus.edu.sg/osh/resource.htm

5.1 Chemical risk controls

		Details:
Substitution	☐ A less toxic substance is not available as an alternative	_____
Isolation	☐ Designated and secure chemical storage	_____

	☐ Segregation of incompatible chemicals	
	☐ Flammables stored in flammables cabinet	
	☐ Flammables separated from ignition sources	
	☐ Corrosives stored in corrosives cabinet	
	☐ Suitable containers and designated area are provided for chemical waste storage	
Minimisation	☐ Smallest possible volumes	
	☐ Dilution to lowest possible concentration	
Engineering	☐ Compressed gases are piped/plumbed in from outside the facility	
	☐ Gas regulators and tubing are appropriate for the gases used	
	☐ Cylinders are securely and individually chained or fixed to a solid structure	
	☐ Fume cupboard is provided and kept clear to allow proper air flow	
Administration	☐ Project personnel have attended and passed OSHE chemical safety training	
	☐ Chemical inventory and records kept of substance usage	
	☐ Chemical waste is suitable for collection by authorised waste collection agents	
Procedures	☐ Work surfaces cleaned and decontaminated after use	
	☐ Spill clean-up kit includes suitable absorbants and neutralising agents	
PPE	☐ Health surveillance is provided.	

Other controls: _____

6. Assessing the radiation hazards

Radiation source	Source Type	Health effects	Routes of Exposure
☐ Carbon-14	☐ Sealed	☐ Chronic effects	☐ Inhalation
☐ Hydrogen-3 (Tritium)	☐ Unsealed	☐ Acute effects	☐ Ingestion
☐ Sulphur-35	☐ Ionising:	☐ Burns	☐ Skin absorption
☐ Phosphorous 32	☐ Non-Ionising :	☐ Eye damage:	☐ Eye contact
☐ Phosphorous 33	☐ Others: Please specify _____	☐ Others: Please specify _____	☐ Injection/needle stick
☐ Iodine-125	☐ Others: Please specify _____	☐ Others: Please specify _____	☐ External Radiation:
☐ X-ray machine	☐ Others: Please specify _____	☐ Others: Please specify _____	☐ Others: Please specify _____
☐ Magnetic wave generators			
☐ Ultra-violet lamps			
☐ Lasers			
☐ Others: Please specify _____			

6.1 Radiation risk controls

		Details:
Substitution	☐ A less radio-toxic substance is not available as an alternative	
	☐ A safer, non-radioactive methodology is not available	
Isolation	☐ Designated and secure storage for radioactive substances	
	☐ Radioactive wastes awaiting disposal are effectively shielded	
	☐ Effective shielding of operator and facility perimeter	

Minimisation	☐ Lowest possible activity and energy levels	
Engineering	☐ Interlock between apparatus and door into facility	
	☐ Remote activation of apparatus	
	☐ Area contamination or dose rate meter	
	☐ Fume cupboard capable of handling radioactive materials	
Administration	☐ Radioactive substance inventory and records kept of radiation usage	
	☐ Radioactive waste is suitable for collection by authorised waste collection agents	
	☐ Project personnel have attended and passed OSHE radiation safety training	
Procedures	☐ Surface wipe tests are done regularly	
	☐ "Hot" waste is segregated from low-level radioactive waste	
	☐ Radioactive waste properly collected & disposed of	
PPE	☐ Personal dosimeters are worn and regularly serviced	

Other controls: _____

_____

_____

7. *Other Risk Factors*

Fill in the sub-section of each hazard ticked in Section A, Table A.
Attach separate pages if there is insufficient space provided.

E1. Electrical Hazards

Describe the electrical hazard ie, the appliances and processes involved:

_____

_____

_____

_____

Tick boxes of those that apply and add details:

- ☐ High voltage used (_____ Volts)
- ☐ High current used (_____ Amps)
- ☐ Heat producing devices used
- ☐ Insufficient power sockets provided
- ☐ Other:

_____

Electrical risk controls that are/will be put in place:

- ☐ Equipment will be grounded to earth.
- ☐ Equipment is tested and tagged.
- ☐ Residual current / earth leakage devices are used.
- ☐ Other:

Approval from Office of Estate and Development (OED) needed?

☐ Yes	☐ No

E2. Mechanical Hazards

Describe the mechanical hazard ie, the machines and processes involved:

Tick boxes of those that apply and add details:

- ☐ Crushing hazard
- ☐ Cutting hazard
- ☐ Striking hazard
- ☐ Hoist or lifting device hazard
- ☐ Other:

Mechanical risk controls that are/will be put in place *(tick those that apply):*

- ☐ Machine guarding.
- ☐ Safety interlocks.
- ☐ Safety stop buttons.
- ☐ Lock-out, tag-out procedures during service.
- ☐ Other:

E3. Noise Hazard

Describe the noise hazard ie, the sources of noise and processes involved:

Typical noise level: _____ dBA.

- Noise is sufficiently loud to cause hearing damage.
- Noise is loud enough to impact on safety eg. prevent alarms from being heard.
- Noise is not loud, but annoying or distracting.

Noise risk controls that are/will be put in place *(tick those that apply):*

- Regular maintenance of noise producing equipment.
- Baffles or noise suppression.
- Enclosing the source of noise.
- Relocating the source of noise.
- Wearing of properly fitted ear muffs or plugs.
- Other:

8. Waste Management

Type of wastes generated *(Tick those that apply and add details):*

	Chemical	***Biological***	***Radioactive***
List the wastes that are likely to be generated			
Waste treatment / disposal option			

1. The waste disposal/treatment that is proposed complies with environmental legislation?
   - YES
   - NO

3. Do you intend to reduce the amount of waste generated?
   - YES
   - NO

If you ticked YES, please write down how you intend to do so. If you ticked NO, please state the reason why waste reduction is not possible.

4. Have funds been set aside for waste disposal or treatment?
   - ☐ YES
   - ☐ NO