

# Risk Management

(NTU/OHS/SOP/04.5)

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## 1. Purpose and Scope

1.1 This procedure outlines the risk management process to address and manage the risks associated with workplace and student activities.

1.2 The procedure applies to:

a) All staff and students in NTU and NIE

b) Work and student activities undertaken:

- i) Within the University in connection with its intended business; and
- ii) Outside the University with the specific agreement of the University as part of its intended business. Intended business means, but not limited to, research work (including research work performed by FYP and graduate students), academic work, building management work and office work.

c) The following activities are excluded from this SOP:

- i) Activities managed by Contractors (including Term Contractors)
- ii) Activities managed by Tenants of NTU (including food operators)

## 2. Definitions

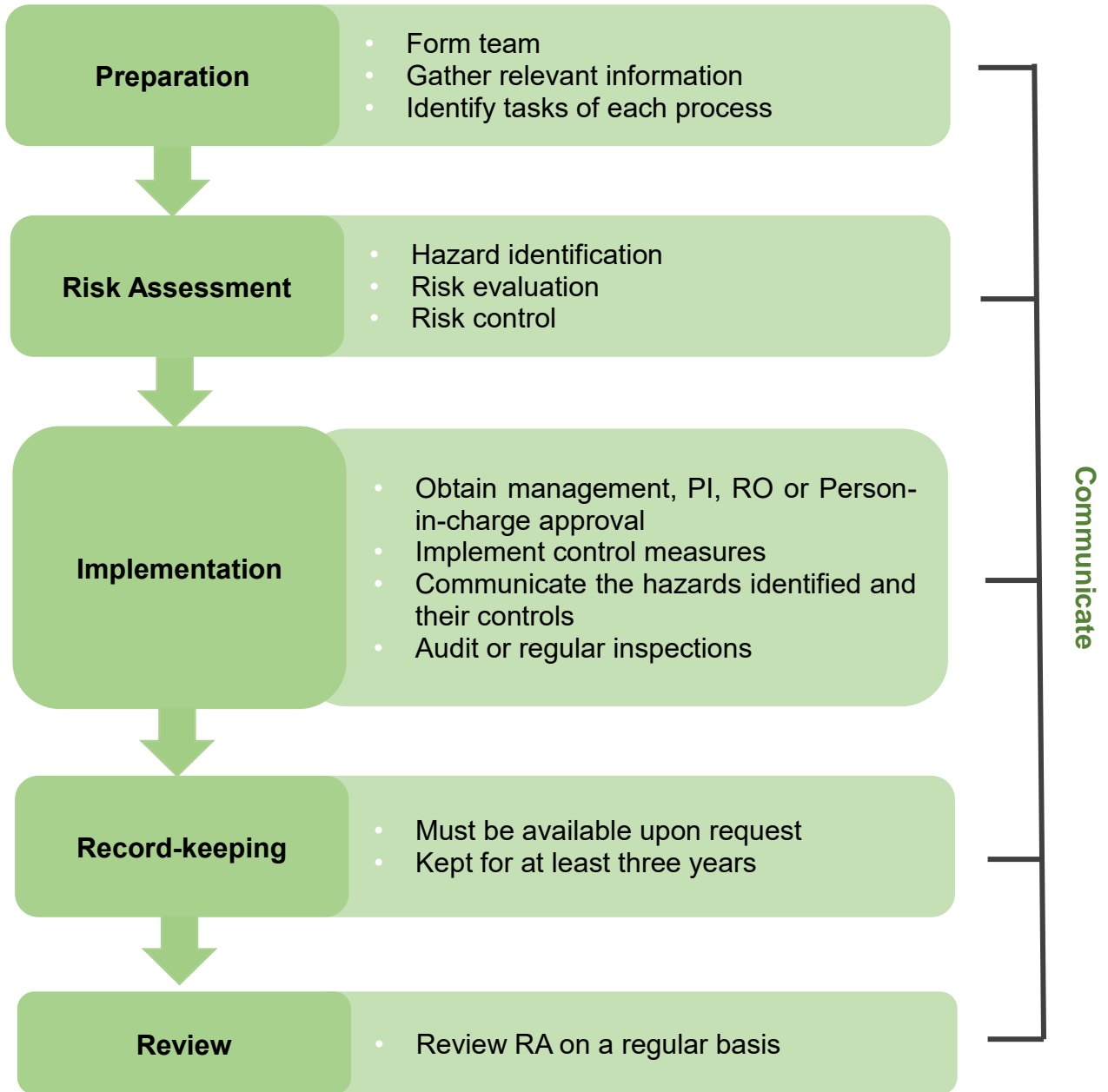
2.1 Terms used in this documents are defined as follows:

- a) **Control Measures:** refers to steps taken to effectively mitigate the risk in terms of severity and frequency.
- b) **Department Administrator (DA):** refers to the appointed WRAS administrator to manage the risk register for the School/Department.
- c) **Hazard:** refers to something that may cause harm or injury, such as handling of hazardous materials including chemicals, radiation, biological micro-organisms or carrying out activities that are potentially hazardous, e.g. working at height
- d) **Likelihood:** refers to the probability of an incident occurring.

- e) **Residual Risk:** refers to the remaining risk after appropriate control measures have been applied and one that is deemed to be as low as reasonably practicable.
- f) **Risk:** refers to the likelihood that a hazard will cause a specific harm or injury to persons or damage to property.
- g) **Risk Assessment (RA):** refers to the process of identifying safety and health hazards associated with the activity, assessing the level of risks involved, and prioritising measures to control the hazards for the purpose of reducing the risks.
- h) **Risk Assessment Team:** refers to the team responsible for conducting risk assessment.
- i) **Risk Management:** a systematic approach to manage and reduce risks in every activity
- j) **Risk Prioritization Number (RPN):** refers to the number assigned to an evaluated risk (based on the likelihood and severity).
- k) **Risk Register:** refers to the collection of risk assessments within the School/Department/Research Centre/Research Institute.
- l) **Severity:** refers to the degree or extent of an injury or harm caused by the hazard as a result of an accident. The extent of injury often varies, but it is taken as most likely to occur.
- m) **Safe Work Procedure (SWP):** refers to the procedure developed after conducting a risk assessment, for the purpose of carrying out work safely.
- n) **Workplace:** refers to any premise where a person works
- o) **Workplace Risk Assessment System (WRAS):** refers to the online risk assessment system in NTU to conduct risk assessment.

### 3. Risk Management Process

The risk management process is briefly shown in the flow diagram below:



## 4. Risk Assessment Methodology

4.1 NTU adopts a 5x5 risk matrix reflected in the WRAS. Appendix 2 shows a sample of the risk assessment form. The method is briefly described as below:

- a) Use the WRAS for the creation of any new risk assessment. The WRAS is accessible via OHSE website, **ServiceNow@NTU** or StudentLink. **ASSOC domain users do not have access to the WRAS. ASSOC users can conduct risk assessment using the RA form available on OHSE website.**
- b) The hazard identification shall be carried out systematically by recording potential hazards and sub-hazards for each activity and steps.
- c) Risk evaluation shall be carried out by assessing the severity of the potential hazards and the likelihood of occurrence of the event causing safety, ill-health or unforeseen event with current controls in place.
- d) Appropriate control measures shall be identified for all levels of risk. Where the RPN is more than 6, additional control measures will be required in the WRAS. The control of hazards and reduction of risks can be accomplished by following the hierarchy of controls.

Details of the methodology can be found in Appendix 1.

4.2 The **coverage of** risk assessment shall take into account:

- a) Routine and non-routine **office, laboratory and/or student** activities (e.g. of non-routine activities may include **relocation of office furniture, events,** temporary process modification, non-scheduled maintenance, equipment start-up/shut down, utility disruption, temporary arrangement, emergency situation);
- b) Activities of all persons having access to the workplace (including contractors and visitors);
- c) Human behaviour, capabilities and other human factor **aspects**, including medical conditions or physical disabilities;
- d) **Hazards, such as terror threat**, originating outside of the workplace capable of adversely affecting the safety and health of persons within the workplace;
- e) Hazards created in the vicinity of the workplace by work-related activities;
- f) Infrastructure, equipment and materials at the workplace;
- g) **Traffic related activities (e.g. staff driving for official business such as attending meetings, etc.);** and
- h) Changes or proposed changes in the organization, its activities or materials.

For any school or department not conducting a RA using WRAS, the school/department shall write in to OHSE requesting for a waiver and produce documentations of an alternative risk management system in place.

## 5. Documentation

All records of risk assessment conducted shall be kept and maintained using the WRAS.

## 6. Implementation and Review

RA and SWP must be conducted and completed prior to start of work, as mandated by WSH (Risk Management) Regulations.

The RA records, including but not limited to the RA forms and control measures, shall be reviewed:

- a) once in every three years;
- b) when new information on safety and health risks surfaces;
- c) whenever there are changes to the activity; and/or
- d) after any incident (accident or dangerous occurrence).

The risk assessment team shall undertake the following steps, hazard identification, risk evaluation and risk control, when conducting risk assessment review.

Office of Health, Safety and Emergency or the School/Department may conduct regular audits to ensure that risk control measures have been implemented and are functioning effectively.

## 7. Communication

7.1 Communication is essential for all stakeholders in the risk management process. This is to provide:

- a) Clarity on the risks, processes, control measures, perceptions etc.;
- b) Stakeholders information to make informed decisions; and
- c) Users knowledge of the risks faced and implement the appropriate control measures to reduce the risks.

7.2 The Person-in-Charge (PI or RO) having responsibility over the area or activity shall ensure that everyone exposed to the risks is informed of the following:

- a) The nature of risks;
- b) Any precaution, measure or SWP implemented;
- c) The means to minimize or eliminate the risks.

## **8. Roles and Responsibilities**

- 8.1 The Dean, School Chair and Head of Department (The Management) shall:
- a) Ensure risk management is done for all work activities within the workplace
  - b) Oversee the application of the control measures to minimize the risks.
  - c) Delegate the task to competent persons; the ultimate duty still rest with The Management.
- 8.2 The Principal Investigators (PI) and Reporting Officers (RO) shall:
- a) Ensure risk assessment is conducted for their work activities.
  - b) Take all reasonably practicable measures, which include reviewing submitted risk assessment and eliminating or minimizing any foreseeable risks to any person who may be affected by their activities.
  - c) Approve the risk assessment submitted by their staff/students.
  - d) Review risk assessment as needed, or when triggered by the system.
- 8.3 The **Office of Health, Safety and Emergency (OHSE)** shall:
- a) Establish the University's risk management process for workplace related activities and conduct audits at Colleges, Schools, Offices, Research Centres and Research Institutes.
  - b) Review this process as part of continual improvement.
- 8.4 The School/Department Safety Officers (SO) **and Safety Representatives** shall:
- a) Assist the staff or students on the conduct **of and improving** the risk assessment.
  - b) Assist DA on the use of WRAS.
- 8.5 The Department Administrator (DA) shall:
- a) Manage the risk register for the School/Department and housekeep the risk assessment records in the WRAS.
  - b) Assist school/department users with their RA/WRAS issues or feedbacks.
  - c) Liaise with OHSE on the use of WRAS, if necessary.
- 8.6 The Faculty, Staff and Students shall:
- a) Review the RA promptly upon receiving notification by the system or by his PI/RO.
  - b) Ensure RA is conducted for all active work **or student** activities.

- c) Use the appropriate control measures, such as use of engineering controls, personal protective equipment (PPE) and any other means as prescribed within the risk assessment.
- d) Report any likely change in the frequency and/or severity of any incident and failure in any of the control measures.

## 9. Consulted Parties

9.1 The following have been consulted in the drafting of this document:

Name	Designation	College/School/Department
OHSE safety team	Safety officers	Office of Health, Safety and Emergency
SHARP Cat 1 & Cat 2 safety committee members	Safety officers, safety representatives and safety members	NTU community

## 10. Related Legislation, Policies, Procedures and Guidelines

Type	Document Title (hyperlink to document if available)
Standard	SS 506 : Part 1 : 2009
Legislation	<a href="#">Workplace Safety and Health (Risk Management) Regulations 2016</a>

## 11. Responsible Parties and Contacts

Procedure Owner: Chief Health, Safety and Emergency Officer

Responsible Office: Office of Health, Safety and Emergency

For clarification on this procedure, please contact:

Name	Designation	Email	Telephone
Sng Ai Wen Juliana	Snr Assistant Manager	julianasngaw@ntu.edu.sg	6592 7798

## 12. Revision History

This Table below reflects the summary of changes made to the document. The full change information is indicated with yellow highlight in the document content.

Version	Approved By	Approval Date	Effective Date	Sections Modified	Details of Change
4.0	Dr Lee Kien Wah	12 Aug 2009	12 Aug 2009	N.A	Initial Release
4.1	Dr Lee Kien Wah	24 Mar 2010	24 Mar 2010	Document header	Updated document header format
4.2	Dr Lee Kien Wah	25 Jul 2011	25 Jul 2011	Document sections	Align document header title for various sections and add section on definition with enhancement

				4	Enhance roles and responsibilities section
				5	Added the risk management process flow chart
				7	Reflect the risk assessment to be approved by the PI or Reporting Officer
				RA Form	Updated the risk assessment form
4.3	Dr Lee Kien Wah	21 Feb 2013	21 Feb 2013	3.2 & 3.15	Added Department Administrator and WRAS under definition section
				4	Revise roles of responsibilities section
				5	Amend flowchart to reflect WRAS application
				6	Including WRAS, sub-hazard and requirement for additional control measures when the RPN is more than 6
				7 & Appendix 1 - A2.5	Records of RA maintained using the WRAS
				8	Specify RA to be conducted before work commencement
				9	Enhance communications to affected persons
				Appendix 1 - A2.2	Add new sub-hazard Table
				Appendix 1 - A2.3	Reflect inclusion of WRAS
				Appendix 1 - Table 5	Update the Action Table considering the WRAS
				RA Form	Add sub-hazard under column 1d
4.3a	Dr Lee Kien Wah	17 Jun 2014	17 Jun 2014	Appendix 1 - Table 2	Correct arrangement error for Severity Table. Rearranged the severity index for Environmental infectious situations.
4.4	Dr Lee Kien Wah	14 Sep 2015	14 Sep 2015	3	Standardize format and paraphrase sentence  Add 3.14 & 3:15: Definition of Shall & Should
				4	Standardize format for Responsibilities  Add/remove responsibilities for some roles
				6	Add factors to be taken into account for method(s) of risk assessment  Add information on not conducting RA using WRAS
				8	Rephrase first sentence
				9	Rephrase point (c) and next sentence



				Appendix 1 – A2.2	Add hazards and sub-hazards for biological & psychosocial
4.5	Dr Goh Chin Foo	13 Sep 2018	13 Sep 2018	Whole Document	Replaced procedure format to align to University document format from Plans Office
				Whole Document	Renamed Office of Health and Safety to Office of Health, Safety and Emergency (OHSE)
				1	Revised the purpose and scope to include student activities
				2	Revised definitions of Control measures, risk assessment, risk management and workplace  Removed definitions of Shall and Should
				3	Replaced the diagram outlining the key steps in the RM Process
				4.1	Replaced Stafflink with Service@NTU  Elaborated that ASSOC users have an alternative way (RA form on website) to conduct risk assessment
				4.2	Revised the list of activities to be taken into consideration. Added traffic related activities
				6	Specified SWP to be conducted before start of work activities.  Replaced risk register with RA records and included RA forms and control measures to be reviewed
				8.4	Included the responsibilities of Safety representatives
				A1	Replaced risk register with RA records
				A2.2	Included more hazards and sub-hazards in Table A1
				A2.3	Revamped the content in Table A2  Revised the score in Table A5

## Appendix 1 – Risk Management System

### A1 Risk Management Process

The risk management process involves:

- A1.1 Breakdown of the operation into various processes or steps.
- A1.2 Identification of the hazards associated with the materials and process. Hazards associated with waste disposal, spill and other emergency procedures should also be considered.
- A1.3 Assessment of the likelihood of occurrence and the severity of each hazard in context to the process and potential exposure.
- A1.4 Determine the risks according to the accepted risk matrix.
- A1.5 Controlling/reducing those risks to an acceptable level.
- A1.6 Communicating the risks to the users.
- A1.7 A feedback to monitor effectiveness over time and make corrections as required further improve the process.

Figure 1 below shows the Activity based - Qualitative Evaluation Method for conducting a risk assessment.

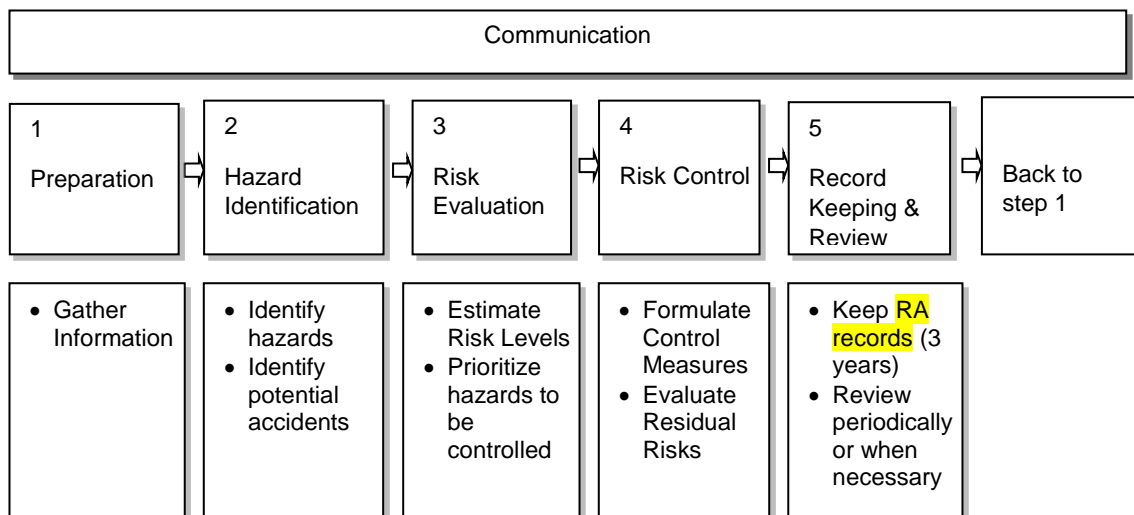


Figure A1: Activity based - Qualitative Evaluation Method

### A2 Methodology

#### A2.1 Preparation

The risk assessment should be performed by a team with vested interest in the activity and with adequate knowledge in the activities. All relevant information shall be gathered including process, equipment setup, SDS, instruction sheets and past accidents of similar setup, if any.

## A2.2 Identify Hazards

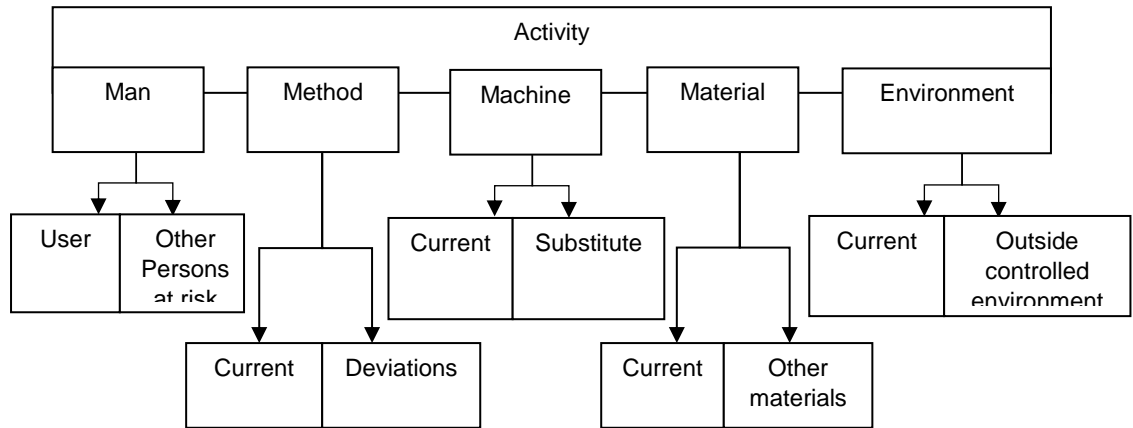
For each activity, the hazards shall be determined. This is the most important part, for without proper identification, the risk cannot be quantified and controlled. The hazards are based on, but not limited to, chemical, biological, mechanical, physical, ergonomic, electrical and psychosocial. For better identification, each of these main hazards is also coupled with different type(s) of sub-hazard. Table A1 below shows a few examples.

Hazard	Sub-Hazard
Biological	<ul style="list-style-type: none"> <li>• Contact with or infection by bacteria, virus, fungal spores or toxin</li> <li>• Release of biological agents to environment</li> <li>• Contact with animals</li> <li>• Contact with materials of human origin</li> </ul>
Chemical	<ul style="list-style-type: none"> <li>• Toxic</li> <li>• Poison</li> <li>• Flammable</li> <li>• Corrosive</li> <li>• Explosive</li> <li>• Oxidizing</li> <li>• Pyrophoric, self-heating or self-reactive</li> <li>• Mutagen</li> <li>• Carcinogen</li> <li>• Teratogen</li> <li>• Sensitizer or irritant</li> <li>• Emit flammable gases upon contact with water</li> <li>• Emit toxic gases upon contact with water</li> </ul>
Electrical	<ul style="list-style-type: none"> <li>• Contact with electrical energy</li> </ul>
Ergonomic	<ul style="list-style-type: none"> <li>• Repetitive movement</li> <li>• Improper lifting or manual lifting</li> <li>• Awkward posture</li> </ul>

Physical	<ul style="list-style-type: none"> <li>• High pressure</li> <li>• Contact with heated surface</li> <li>• Contact with cold surface</li> <li>• Noise</li> <li>• Vibration</li> <li>• Fire</li> <li>• Ionisation radiation</li> <li>• Non-ionisation radiation</li> <li>• Explosion</li> <li>• Implosion</li> <li>• Slips, trips and falls hazard</li> <li>• Extreme weather</li> <li>• Theft</li> <li>• Work at height</li> </ul>
Mechanical	<ul style="list-style-type: none"> <li>• Crush</li> <li>• Strike by falling object</li> <li>• Strike by moving object</li> <li>• Strike against</li> <li>• Caught in or between</li> <li>• Cut</li> </ul>
Psychosocial	<ul style="list-style-type: none"> <li>• Fatigue</li> <li>• Stress</li> <li>• Depression</li> <li>• Anxiety</li> </ul>

**Table A1: List of hazards and Sub-Hazards**

To assist the identification process, the reviewer should systematically review the activity from the man, machine, material, method and environment points of view to both the user and any other persons at risk in the vicinity of the workplace where the activity is being carried out. Figure A2 below explains the hazards identification process:



*Figure A2: Hazards Identification*

### A2.3 Risk Evaluation

Risk evaluation is the process of estimating the risk levels of the identified hazards and if the risks can be accepted. This is used as a basis for prioritizing actions to control identified hazards and thereby, minimizing safety and health risks.

Risk evaluation consists of:

- Determining likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards;
- Identifying existing risk control measures;
- Assessing potential severity of identified hazards;
- Evaluate risk levels based on the product of severity and likelihood. In the WRAS, the RPN will be generated once the severity and likelihood have been determined. The RPN is derived using the 5x5 risk matrix as shown in Table A4.
- Table A5 shows the required Action plan.

The risk severity and likelihood shown in Table A2 and A3 respectively shall be adopted.

Severity Index	Severity Description	Workplace Safety	Workplace Health	Environment	Fire Damage	Downtime Incurred
(5)	Critical	Fatality, permanent bodily injury or loss of use of body parts	Acute poisoning, failure of major bodily functions  Infection with no known cure	Spills to outside campus  Infection outside confines of campus	More than \$10 million damages	More than 1 year for full re-instatement
(4)	Very Serious	Temporary bodily injury requiring at least 30 days of hospitalization and/or medical leave	Moderate exposure results in reversible injury to bodily functions requiring with prolong recovery  Infection with Known Cure but extensive treatment	Spills to outside building  Infection outside confines of building, affecting neighbouring buildings, but contained within campus	More than \$1 million damages	More than 3 months for full re-instatement
(3)	Serious	Temporary bodily injury requiring at least 10 days of hospitalization and/or medical leave	Mild exposure results in reversible injury to bodily functions requiring less than 1 month recovery  Infection with known cure, but extensive treatment	Spills to outside laboratory/room  Infection outside confines of laboratory, but within building only	More than \$100k damages	More than 1 month for full re-instatement
(2)	Marginal	Temporary bodily injury requiring at least 3 days of medical leave	Very mild exposure results in reversible injury to bodily functions requiring less than 3 days recovery  Infection with known cure, but treatment needed	Spills to outside workplace but within laboratory  Infection outside confines of workplace, but within laboratory only	More than \$10k damages	More than 5 days for full re-instatement
(1)	Negligible	No injury or superficial injury requiring first aid treatment only	No exposure or very mild exposure results in reversible injury to bodily functions requiring less than 3 days to recover  No infection	Spills within Workplace only  No Infection or infection with no effects	Less than \$10k damages	No significant downtime





**Table A2: Severity Table**

Likelihood Index	Likelihood Description	Likelihood of Occurrence/Exposure Criteria
(5)	Frequent	Likely to occur many times per year
(4)	Moderate	Likely to occur once per year
(3)	Occasional	Might occur once in three years
(2)	Remote	Might occur once in five years
(1)	Unlikely	Might occur once in ten years

*Table A3: Likelihood of Occurrence or Exposure Criteria*

Severity \ Likelihood	Critical (5)	Very Serious (4)	Serious (3)	Marginal (2)	Negligible (1)
Frequent (5)	25 Operation not permissible	20 Operation not permissible	15 High priority	10 Review at appropriate time	5 Risk acceptable:
Moderate (4)	20 Operation not permissible	16 Operation not permissible	12 High priority	8 Review at appropriate time	4 Risk acceptable:
Occasional (3)	15 High priority	12 High priority	9 Review at appropriate time	6 Risk acceptable:	3 Risk acceptable:
Remote (2)	10 Review at appropriate time	8 Review at appropriate time	6 Risk acceptable:	4 Risk acceptable	2 Risk acceptable:
Unlikely (1)	5 Risk acceptable:	4 Risk acceptable:	3 Risk acceptable:	2 Risk acceptable:	1 Risk acceptable:

*Table A4: 5 x 5 Risk Matrix*

Colour	Score	Risks	Action
	16 - 25	High	<p>Operation not Permissible</p> <p>Stop operation and review controls. If necessary abort experimentation.</p> <p>In the WRAS, the system will prompt the user to stop, save draft and approach the RO.</p>
	12 - 15	Warning	<p>High priority remedial action</p> <p>Proceed with extreme caution with PI present at all times. Implement additional (secondary) controls immediately.</p> <p>Review within 7 days. Emergency control measures shall be in place.</p> <p>In the WRAS:</p> <p>(i) RPN from existing control: Prompt the user for additional control measures (compulsory)</p> <p>(ii) RPN after adding new control measures: Warning message pops up to alert the user</p>
	8 - 10	Medium	<p>Take remedial action at appropriate time</p> <p>Proceed with care. Additional control is advised. Review shall be implementation within 30 days.</p> <p>In the WRAS: RPN from existing control: Prompt the user for additional control measures (compulsory)</p> <p>Note: Where all possible control measures have been exhausted, user may indicate 'as per existing control measures' under the column of 'Additional control measures'.</p>
	1 - 6	Low	<p>Risk acceptable: Residual Risk</p> <p>If possible, risk reduction should be further considered, particularly severity.</p> <p>There are no imminent dangers. Frequent review shall be in place especially changes in procedures, materials or environment.</p>

*Table A5: Action Table*



## A2.4 Hierarchy of Control Measures

It is essential for risks to be controlled. This is usually by elimination or reduction “at source”. If a risk cannot be controlled completely by engineering measures, it is necessary to protect the employees by administrative control or personal protection.

The control of hazards and reduction of risks can be accomplished by following the hierarchy of controls. These control measures are not usually mutually exclusive e.g. engineering controls can be implemented together with administrative controls like training.

Preference	Control Measure	Description	Examples
Very High	ELIMINATION	The total removal of the hazards. If the hazards are eliminated, the risk associated of the hazard will be eliminated.	Use water based solvents instead of organic based solvents.
High	SUBSTITUTION	This involves replacing the hazard by one that presents a lower risk.	Use toluene instead of benzene.
Preferred	ENGINEERING CONTROLS	Engineering controls are physical means that limit the hazard. These include structural changes to the work environment or work processes, erecting a barrier to interrupt the transmission path between the worker and the hazard.	Fume Cupboard glove boxes
Satisfactory	ADMINISTRATIVE CONTROLS	These reduce or eliminate exposure to a hazard by adherence to procedures or instructions, including training. Documentation should emphasize all the steps to be taken and the controls to be used in carrying out the activity safely.	Work instruction. Tight laboratory setup. Training on hazards of organic solvents.
Least	PPE	This should be used only as a last resort, after all other control measures have been considered, or as a short term contingency during emergency/maintenance/repair or as an additional protective measure.  Often this is used as secondary protection or general protection to third party users.  The success of this control depends critically on the protective equipment being chosen correctly, fitted correctly, worn at all times and maintained properly.	Use of safety eyewear plus respiratory protection.

*Table A6: Hierarchy of Control Measures*

The residual risk should be acceptable and manageable; there is a need to highlight the residual risks of each of the controls and training shall be provided to ensure the residual risk are not amplified due to misunderstanding of the use of engineering controls, work procedure or the use of PPE.

Once all the risk controls are selected and their residual risks highlighted, the specific action officers to implement the controls can be clearly identified, and the follow-up dates will help to ensure timeliness in implementation.

#### A2.5 Risk Assessment Records & Reviewing

Records of risk assessment shall be kept in the WRAS and the users or the Department Administrator may download a copy to be kept for further use

**Appendix 2 – Sample of the RISK ASSESSMENT FORM**

<b>School / Department &amp; Exact Location Of The Work Performed:</b> (Example NBS 01a-23)		<b>Project/Work Description:</b>	
<b>Conducted By:</b>		<b>Approved By:</b> (Name & Signature)	
<b>Date Conducted:</b>		<b>Date Approved:</b>	
		<b>Next Review Date:</b>	

Hazard Identification					Risk Evaluation				Risk Control					
1a	1b	1c	1d	1e	2a	2b	2c	2d	3a	3b	3c	3d	3e	3f
S/N	Work Activity	Hazard	Sub Hazard	Possible Accident/ill health to persons, fire or property loss	Existing Risk Control	S	L	RPN*	Additional Risk Control Measures	S	L	RPN*	Follow up by (name) & date	Remarks

\*RPN - Risk Prioritization Number