Planning

The planning step involves getting everyone who will be doing the work activity and other experts to sit down and discuss the flow of the work process. This step will also involve reading and preparing any other related safety documents such as standard operating procedures (SOPs), safety data sheet (SDS) and safe work procedures (SWPs).

Communication is important here and everyone should fully understand the workflow of the activity and actively participate and brainstorm ideas for the development of the related safety documents.

Hazard Identification

After listing down every step of the work process, the team will then identify the potential hazards (anything, situation and / or condition with the potential to cause harm) in each step. Some examples of hazards to be considered are listed in the table below:

Hazard	Sub-Hazard
Biological	• Contact with or infection by bacteria, virus or fungal spores • Release of biological agents to environment
Chemical	• Toxic • Corrosive
Ergonomic	• Repetitive movement • Awkward position
Physical	• Noise • Slips, trips and falls
Electrical	• Electrocution • Electrical fires
Mechanical	• Strike by moving objects • Caught in between equipment
Psychosocial	• Stress • Fatigue
External (Others)	• Earthquakes • Volcanoes

Risk Evaluation

After identifying the hazards, the next step is to conduct risk analysis to better understand the consequences of the risks by defining the severity and probability for each hazard.

Severity Table

The severity table describes the severity of hazard. The following table can help to give an idea of how to define the severity (accordingly to NTU's definition).

Severity Index	Severity Description	Workplace Safety	Workplace Health	Environment	Fire Damage	Downtime Incurred
1	Critical	Fatality or permanent loss of limbs / speech etc.	Infection / acute poisoning with no cure	Spills to outside campus	More than $10 million damage	More than 1 year for full re- installment
2	Very Serious	Injury requiring more than 30 days of medical leave	Infection / exposure with known cure but require extensive treatment	Spills to outside building	More than $1 million damage	More than 3 months for full re- installment
3	Serious	Injury requiring more than 10 days of medical leave	Infection / exposure with known cure but requires prolong treatment	Spills to other laboratories within the same level	More than $100k damages	More than 1 month for full re- installment
4	Marginal	Injury requiring maximum 3 days of medical leave	Infection / exposure with known cure but treatment needed	Spills confined to the laboratory only	More than $10k damages	More than a week for full-re- installment
5	Negligible	Simple first aid treatment only	No exposure or no known health hazards	Spills within workplace area (e.g. fumehood) only	Less than $10k damages	No significant downtime

Risk Evaluation

Likelihood Table

The likelihood is the probability (frequency) of being affected by the hazards. It can changed depending on the existing risk controls measures (e.g. likelihood of slips, trips and falls will be reduced if there are signs to warn of the dangers of wet floor)

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

Risk Evaluation

Risk Matrix Table

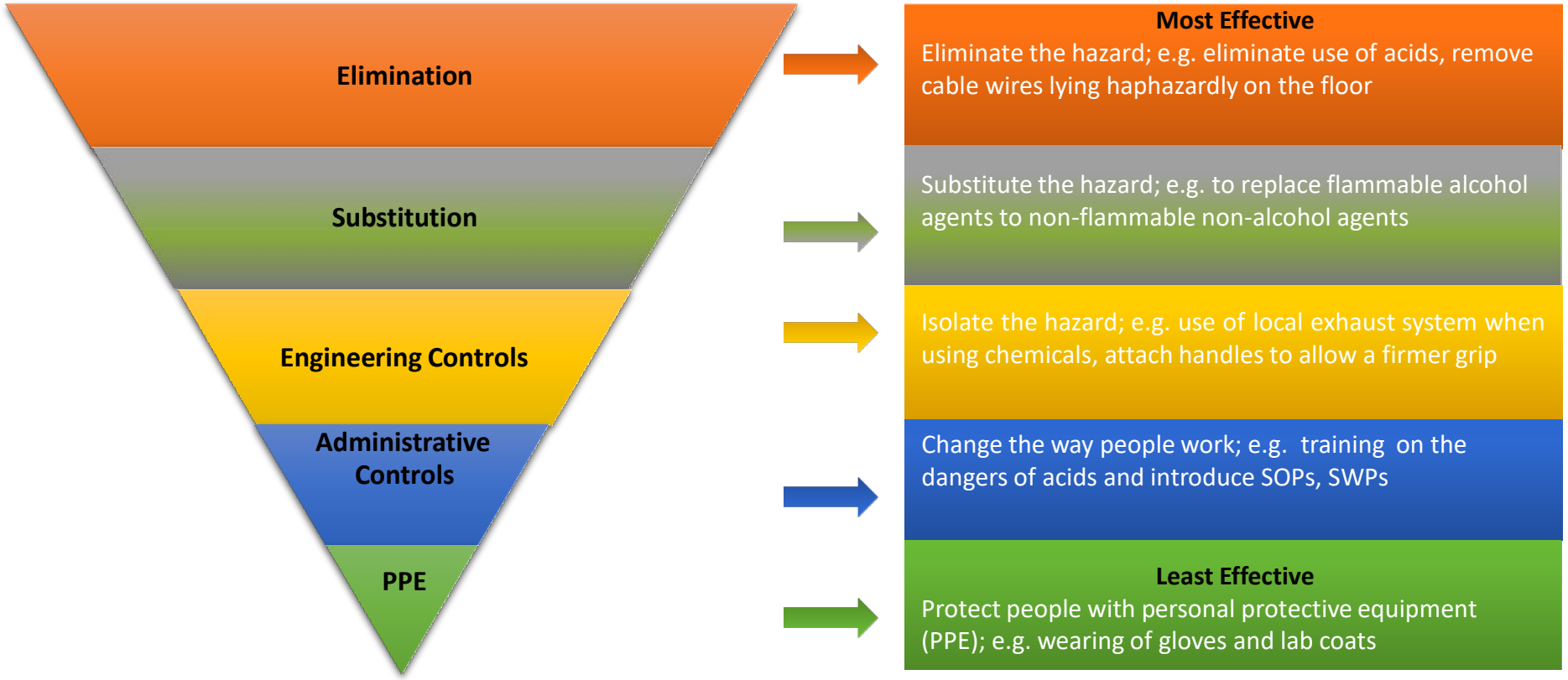
The Risk Matrix Table shows the risk prioritization number (RPN) which is obtained by multiplying the severity and likelihood. For risks with RPN of more than 16, the work activity should not be continued until it is reduced. For risks with RPN of between 8 and 15, additional control measures should be in-place to reduce RPN to 6 and below.

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:

Risk Control

Risk controls are measures implement to reduce the severity and / or and the likelihood of the hazards. There are many different types of risk controls and they are generally divided into 5 board types. The more effective control measure should be consider first before deciding on the next level of control measures.

The diagram below shows the hierarchy of risk controls:



Record Keeping

After completing the risk analysis and introducing risk control measures processes, all communication should be documented and the RA should be sent for approval by the Person-in-Charge (PIC) or Principal Investigator (PI). The person (s) conducting the RA CANNOT be the approver.

All documents are then to be communicated to the rest of the team and to be kept for at least six years. These documentation records serve as evidence that efforts have been taken to provide a healthy and safe workplace and will be legally examined if an accident were to happen.

Implementation and Review

After approval, the risk control measures stated must be implemented by responsible person (s). In addition, the stated control measures should also be regularly maintained / calibrated and tested if needed (e.g. fumehoods and safety valves).

All implementation must be communicated and all feedback on the control measures should be noted and documented. It is also important to review and evaluate the control measures to measure their effectiveness.

Some examples of evaluation tools used in measuring the effectiveness of control measures are:

- Feedback
- Inspections and observations
- Interview and discussions

If there is a need, the RA should be reviewed and redo if the control measures are found not to be effective.