HAZARD AND RISK ASSESSMENTS

Risk Assessment Key Components

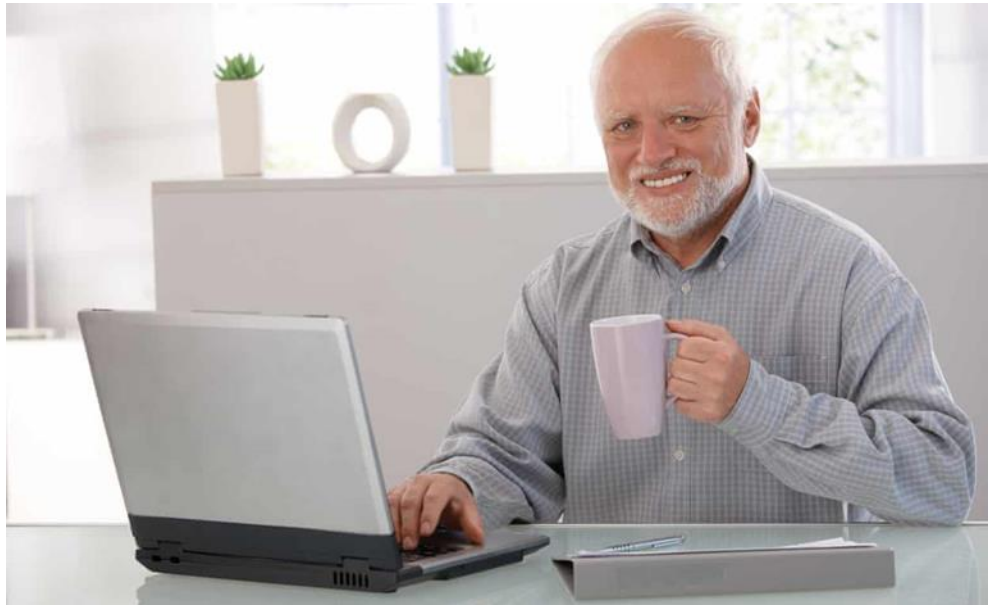
CONTENTS

- ILOs
- Relevant Definitions
- Useful Documentation and Resources
- Scope and ‘Safety Boundary’
- Hazards
- Accidents
- Causes
- Risk Estimation and Classification (Pre-Risk Reduction)
- Risk Reductions (Control Measures and Mitigations)
- Risk Estimation and Classification (Post-Risk Reduction)
- Risk Status
- Recommendations
- Next Topics

INTENDED LEARNING OUTCOMES

To understand:

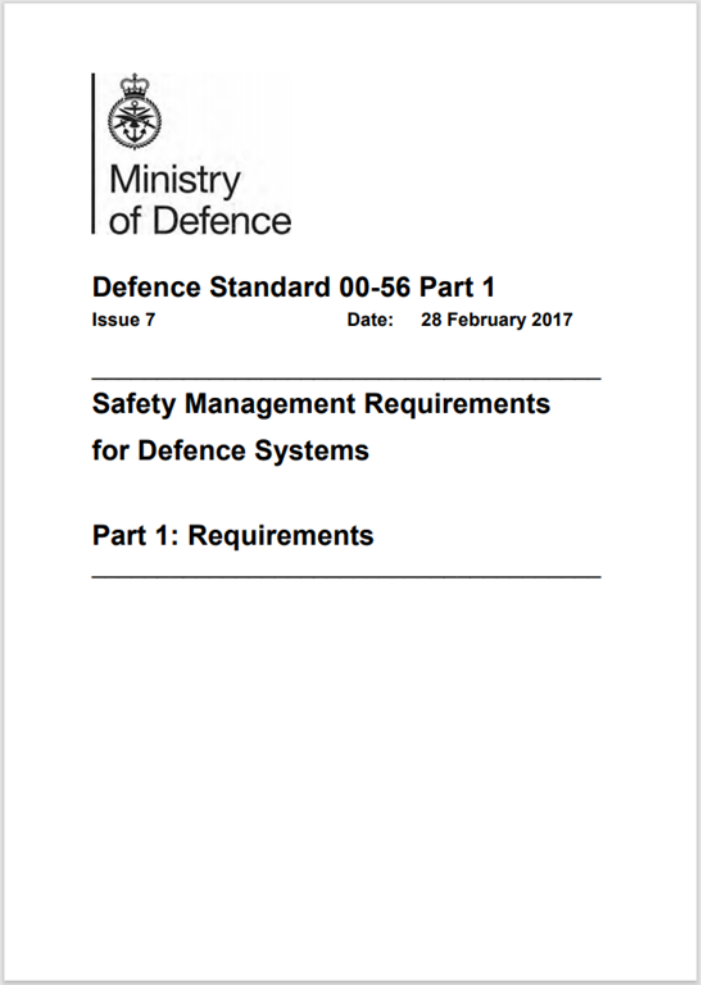
- The importance of defining the Scope and Safety boundary of a risk assessment.
- What the key components of risk assessments are.



RELEVANT DEFINITIONS

Def Stan 00-056, Part 1, Issue 7 - Definitions:

- **Harm**: Adverse impact on people, including fatality, physical or physiological injury, or short- or long-term damage to health.
- **Hazard**: Potential to cause Harm. e.g. A physical situation or state of a system, often following from some initiating event that may lead to an Accident.
- **Accident:** An event, or sequence of events, that causes unintended Harm.
- **Risk:** Combination of likelihood of Harm and the Severity of that Harm.
- **Likelihood:** A measure of the probability that the Accident will occur.
- **Severity:** A measure of the degree of Harm.
- **Risk to Life (RtL):** Risk of Harm.



Ministry of Defence

Defence Standard 00-56 Part 1

Issue 7 Date: 28 February 2017

Safety Management Requirements for Defence Systems

Part 1: Requirements

RELEVANT DEFINITIONS

Duty Holder

Def Stan 00-056, Part 1, Issue 7 – Definition:

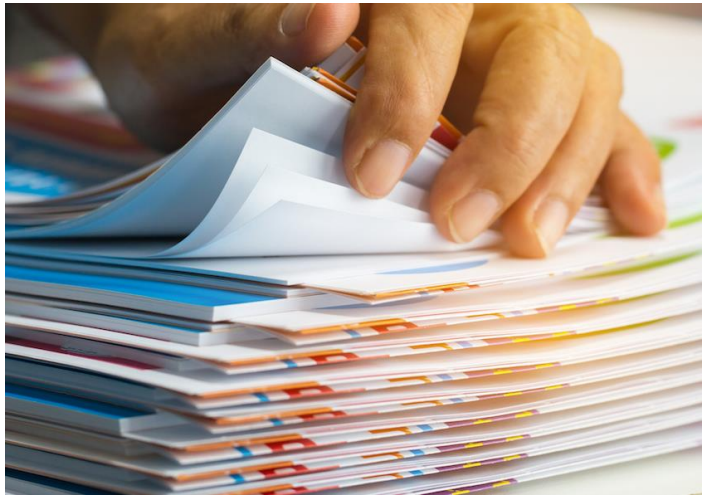
- A duty holder is a MoD person who is in a key position which is responsible and accountable for the control of activities that are so hazardous that they could give rise to a Risk to Life…

Defence Safety Authority, DSA01.2 Implementation of Defence Policy for Health, Safety and Environmental Protection, Chapter 3, Duty Holding, Issue 1.1 – Definition:

- Duty Holders shall actively manage RtL, mitigation associated risk to a level that is considered ALARP and Tolerable by accountable individuals.

Note: In some cases, UK Health and Safety legislation and the HSE refer to those with specified legal responsibilities for managing the safety of activities as Duty Holders. The use of this term should not be confused with MoD's requirements for Duty Holding (Defence Safety Authority, DSA01.1 Defence Policy for Health, Safety, and Environmental Protection (V1.0 August 2016)

USEFUL DOCUMENTATION & RESOURCES



Useful documentation and resources:

- [1] Def Stan 00-56: The standard for "Safety Management Requirements for Defence Systems".
  - Access (Free): https://www.dstan.mod.uk/StanMIS/
- [2] The MOD's Acquisition Safety and Environmental Management System (ASEMS) Online:
  - Access (Free): http://www. https://www.asems.mod.uk/
- [3] Health and Safety at Work Act 1974
  - Access (Free): https://www.legislation.gov.uk/ukpga/1974/37/contents
- [4] The Management of Health and Safety at Work regulation 1999:
  - Access (Free): https://www.legislation.gov.uk/uksi/1999/3242/contents/made
- [5] HSE Risk Assessment - A Brief Guide to Controlling Risks in the Workplace
  - Access (Free): https://www.hse.gov.uk/research/rrhtm/rr151.htm
- [6] HSE Reducing Risks, Protecting People
  - Access (Free): https://www.hse.gov.uk/managing/theory/r2p2.pdf
- [7] Defence Safety Authority, DSA01.2 Implementation of Defence Policy for Health, Safety and Environmental Protection, Chapter 3, Duty Holding, Issue 1.1
  - Access (Free): https://www.gov.uk/government/publications/implementation-of-defence-policy-for-health-safety-and-environmental-protection-dsa-012

SCOPE AND SAFETY BOUNDARY?

What is the subject of the risk assessment?

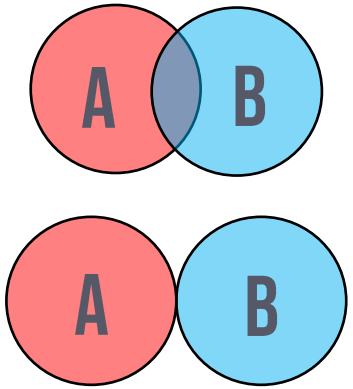
A piece of equipment, an activity, the management of personnel, a system of systems etc.

Provide a Scope defining the boundaries of responsibility

i.e. who's responsible for managing what risks etc.

Blurred Boundaries

When there is shared ownership and responsibility to manage a Hazard, or, perhaps your Hazard may be a potential Cause of a Hazard outside of your ownership.



HAZARDS

Hazard: Potential to cause Harm. e.g. A physical situation or state of a system, often following from some initiating event that may lead to an Accident.

- **Physical Hazards Examples:** Inadvertent Detonation of Munition Warhead, Sharp Edges and Excrescences, Manual Handling etc.
- **Functional Hazard Examples:** Guidance System Failure, Flyout Safety Functions Failure etc.
- **Blurred Boundary Examples:** Transfer Alignment Failure, Munition Impacts Outside Safe Area (Trials) etc.

[12, 13]

EXAMPLE RISK ASSESSMENT.....

Hazard Identifier	Hazard	Hazard Description
Hazard 01	Inadvertent Detonation of Munition Warhead	The potential for the munition warhead to undergo detonation outside of normal operational conditions at any point during its predicted lifespan. In this case, normal operational conditions relate to the planned consent to release/fire the munition, the munition undergoing the designed arming process, and the munition receiving the correctly specified detonation stimuli.

- Give each Hazard a Unique Identifier – easier to manage going forward.
- Provide a Hazard Description to better bound the subject of analysis and give the reader more understanding.

ACCIDENTS

Accident: An event, or sequence of events, that causes unintended Harm.

Once something (or someone) has interacted with the Hazard there will always be a consequence. The Accidents are the range of Credible consequences that should be included in a risk assessment.

Credible Accidents: Will everything lead to the worst case scenario?

Accident Examples (General):

- Fatality or Injury (Physical, Mental, Long-Term, or Short-Term);
- DIRECT PERSONNEL, INDIRECT PERSONNEL, GENERAL PUBLIC

EXAMPLE RISK ASSESSMENT.....

Hazard ID	Hazard	Hazard Description	Accidents
Hazard 01	Inadvertent Detonation of Munition Warhead	…	Detonation of the Munition may lead to: • Fatality of DIRECT PERSONNEL due to Warhead Effect. (Fragmentation, Blast, Heat) • Fatality of GENERAL PUBLIC due to Warhead Effects.

Provide a description of who might be harmed and how:

Who: Determine which type of personnel may be credibly harmed by the identified hazard. The consequences for each type is weighted differently in terms of acceptability of risk.

How: Briefly describe in what way the Hazard will interact with the personnel.

The Worst Case Credible Accident will drive the initial Risk Estimation.

CAUSES

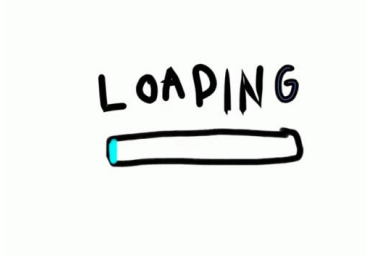
Causes: The failures, conditions, environments etc. that may either directly or indirectly, singularly or collectively lead the realisation of a Hazard.

Cause Examples: Failure of Safe and Arming Unit (SAU), Exposure to Electromagnetic Interference (EMI), Exposure to Fast Heating Environments (aka Fast Cook-Off), Exposure to Electrostatic Discharge (ESD) etc.

The majority of Causes are likely identified during the Hazard ID stage, but, further down the development process additional Causes may be identified.

Causes can also be used to inform Safety Design Requirements for the subject under assessment. That is, is the defined Safety Design Requirements are met then the business can assure themselves that the related Cause can be considered less of an issue.

EXAMPLE RISK ASSESSMENT……



H ID	H	HD	A	Causes	Cause Descriptions
Haz 01		…	…	Failure of SAU	Failure of the SAU leads to removal of safety barriers and enables uninterrupted alignment of munition warhead explosive train.
				Exposure to EMI	Exposure to EMI presents credible energy stimulus to initiate the munition warhead.
				Exposure to ESD	Exposure to ESD presents credible energy stimulus to initiate the munition warhead.

In some cases, for example when dealing within complex or especially hazardous systems, further description of the Cause may be required.

Human Error – Don’t forget the Human Element!

Be careful not to mix up Hazards and Causes – very easy to do!

RISK ESTIMATION AND CLASSIFICATION 1

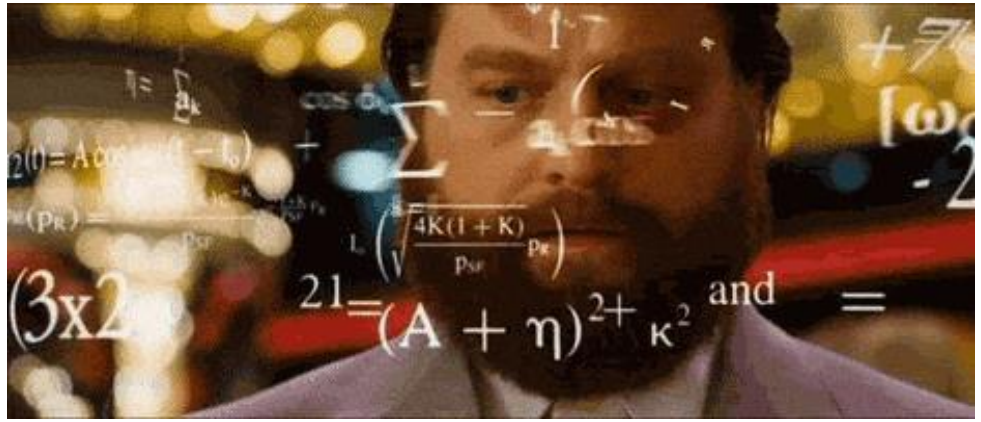
Risk: Combination of likelihood of Harm and the Severity of that Harm.

Likelihood: A measure of the probability that the Accident will occur.

Severity: A measure of the degree of Harm.

Risk Estimation is used determine the credible likelihood and consequences of individual Hazards and Accidents, and the overall safety risks for the subject under assessment.

It is linked to the type of risk assessment being conducted (e.g. quantitative or qualitative etc.) and provides the basis for assessing risks against requirements, the needs for Risk Reduction, the selection between alternative options on safety grounds and ultimately the acceptability of the system.



RISK ESTIMATION AND CLASSIFICATION 1 (2)

The combination of both the Likelihood and Severity will result in a Risk Class.

Each resultant Risk Class shall be defined such that it conveys how that level of risk is perceived by The Business. e.g. Is the Risk: Broadly Acceptable; Tolerable and ALARP; Tolerable if deemed ALARP; Intolerable.

See HSE's "Reducing Risk, Protecting People" for understanding of the Tolerability of Risk Framework.

Alongside, or embedded within, the definition for the different Risk Classes should be a defined Acceptance Criteria. The Acceptance Criteria will state at what level within The Business that each Risk Class can be accepted.

Risk Estimation should be undertaken both before and after the implementation of Risk Reduction measures.

EXAMPLE RISK ASSESSMENT……

H ID	…	Causes	Cause Desc	Likelihood (P(O))	Severity	Risk Class
Haz 01		…	…	Frequent ($10^{-3} < O \leq 10^{-2}$) Likely ($10^{-4} < O \leq 10^{-3}$) Occasional ($10^{-5} < O \leq 10^{-4}$) Unlikely ($10^{-6} < O \leq 10^{-5}$) Improbable ($O \leq 10^{-6}$)	Catastrophic Critical Severe Minor Marginal	A B C D

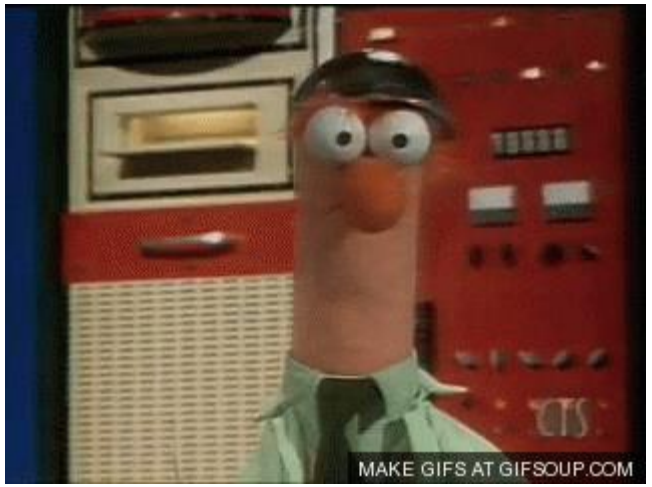
Whether the risk is estimated using qualitative or quantitative means, each criterion for Likelihood (or Probability of Occurrence) must be defined.

Think about Credibility when estimating pre-risk reduction likelihoods.

The Risk Class should be mapped to an agreed Safety Acceptance Criteria. For example, Class D risk might be considered Broadly Acceptable and require no further risk reduction, and can therefore be accepted on behalf of the business by personnel of Department Head level. Class A risks might be considered Intolerable and not ALARP and require greater amounts of risk reduction; Class A risks can only be accepted by those at Managing Director level.

RISK REDUCTION

- Designed to reduce the likelihood of the event occurring (Control Measures)
- Designed to reduce or lessen the effects of the consequential outcome (Mitigations)
- Back-up all risk reduction measures with demonstrable evidence. Easier to defend.
- Allocate Owners to risk reductions to ensure easier to management.



EXAMPLE RISK ASSESSMENT.....

LOADING

H ID	…	Likelihood (P(O))	Severity	Risk Class	Risk Reductions
Haz 01		Frequent ($10^{-3} < O \leq 10^{-2}$) Likely ($10^{-4} < O \leq 10^{-3}$) Occasional ($10^{-5} < O \leq 10^{-4}$) Unlikely ($10^{-6} < O \leq 10^{-5}$) Improbable ($O \leq 10^{-6}$)	Catastrophic Critical Severe Minor Marginal	A B C D	Control [Ref 1] (Owner 1) Control [Ref 2] (Owner 2) Control [Ref 3] (Owner 3) Control [Ref 4] (Owner 4) Mitigation [Ref 5] (Owner 5) Mitigation [Ref 6] (Owner 6)

RISK ESTIMATION AND CLASSIFICATION 2

Conduct Risk Estimation again!

Calculate the level of risk for each Hazard now that the Risk Reductions have been added.

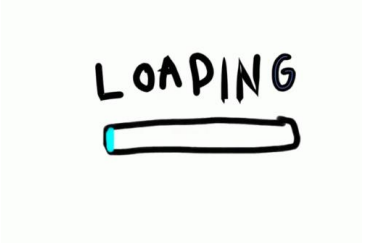
How effective are each of the Risk Reduction measures?

Determine the Residual Risk.

Have the final Risk Class changed?

Does the risk need to be reduced more?

EXAMPLE RISK ASSESSMENT……



H ID	…	Likelihood (P(O))	Severity	RC	Risk Red.	Likelihood (P(O))	Severity	RC
Haz 01		Frequent ($10^{-3} < O \leq 10^{-2}$) Likely ($10^{-4} < O \leq 10^{-3}$) Occasional ($10^{-5} < O \leq 10^{-4}$) Unlikely ($10^{-6} < O \leq 10^{-5}$) Improbable ($O \leq 10^{-6}$)	Catastrophic Critical Severe Minor Marginal	A B C D	…	Reduced?	Reduced?	?

Both the Likelihood and Severity can be reduced – in the majority of cases the Likelihood is reduced, but, the in some cases the Risk Reduction measure can also reduce the Severities.

Risk Reductions that reduce the Severity could be those that reduce the number of people that might be exposed to the Hazard – Reduced from a ‘Multiple Fatality’ outcome to a ‘Single Fatality’.

RISK STATUS

Open or Closed?

Open:

- ‘Still Under Assessment’ or ‘Needs further Assessment’.
- Not ALARP.
- Residual Risks not yet accepted by The Business.

Closed:

- Residual Risks accepted by The Business.
- Not currently under assessment.

All Safety Documents are Live and should be CONSTANTLY EVOLVING.

EXAMPLE RISK ASSESSMENT……

H ID	…	Risk Red.	Likelihood (P(O)) (Residual)	Severity (Residual)	Risk Class (Residual)	Risk Status
Haz 01	…	…	Reduced?	Reduced?	?	Open? Closed?

RECOMMENDATIONS

“Safety Documentation is Live and CONSTANTLY EVOLVING”

Can you foresee anything that may need to be considered or investigated that would help reduce or understand any of the identified Hazards or Risks?

Updates to Operating Procedures? Planned updates to facilities? New software-related aspects?....

Can’t think of any?

The identified recommendations will be subject to scrutiny at the next review of the risk assessment.

DATE OF NEXT REVIEW

“Safety Documentation is Live and CONSTANTLY EVOLVING”

A Risk Assessment is not designed to live its life on a shelf!

It requires regular, periodic review to understand if any changes have occurred e.g. annual review following final sign-off by The Business.

If there are known changes, **do not** wait for the planned review date.

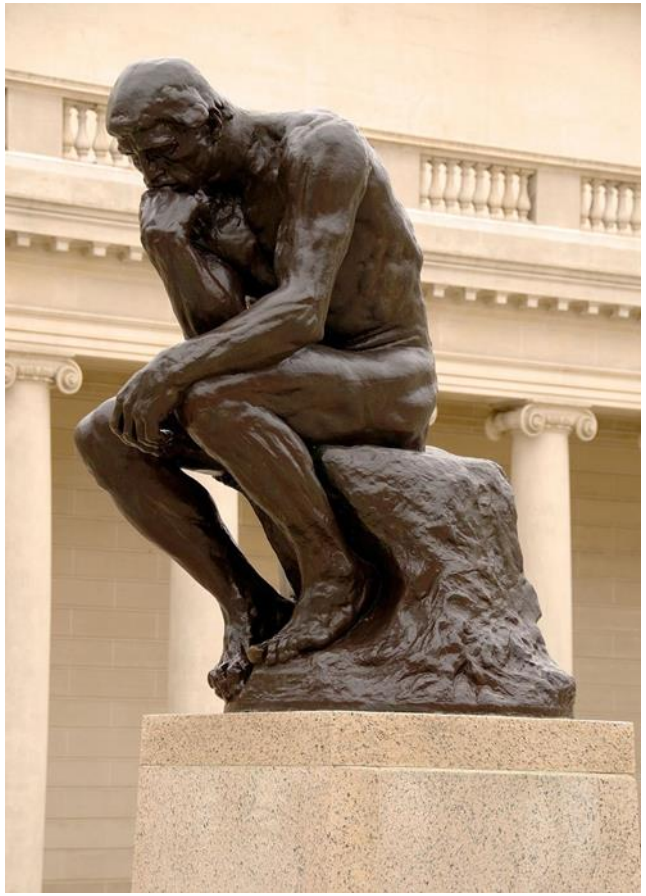
Part of an active document set for a piece of equipment or activity

ILO RECAP

To understand:

- The importance of defining the Scope and Safety boundary of a risk assessment.
  - Who is responsible for managing what risks? Spheres of Influence? What can you directly/indirectly control?
- What the key components of risk assessments are.

  Hazards; Accidents; Causes; Risk Estimation (Pre Risk Reduction); Risk Reduction Measures; Risk Estimation (Post Risk Reduction); Risk Status; Recommendations; Date of Next Review.



NEXT TOPICS...

Risk Classification Matrix and Safety Acceptance Criteria

- Likelihood / Probability of Occurrence;
- Severity;
- Risk Class.

THANK YOU FOR LISTENING

ANY QUESTIONS?

SAFETY SERVICES ORGANISATION

REFERENCES

[1] Def Stan 00-56: The standard for “Safety Management Requirements for Defence Systems”.

[2] The MoD’s Acquisition Safety and Environmental Management System (ASEMS) Online

[3] Health and Safety at Work Act 1974

[4] The Management of Health and Safety at Work regulation 1999:

[5] HSE Risk Assessment - A Brief Guide to Controlling Risks in the Workplace

[6] Joint Service Publication (JSP) 375, Volume 1, Chapter 40

[7] Defence Safety Authority, DSA01.2 Implementation of Defence Policy for Health, Safety and Environmental Protection, Chapter 3, Duty Holding, Issue 1.1

[8] Image - https://bbs.binus.ac.id/international-business/2017/11/writing-course-intended-learning-outcomes-cilo/

[9] Image - https://www.theguardian.com/lifeandstyle/2019/nov/08/experience-hide-the-pain-harold-face-became-meme-turned-it-into-career

[10] Image - https://tradevistas.org/blockchain-could-replace-mounds-paper-at-border/businessman-hands-searching-unfinished-documents-stacks-of-paper-files-on-office-desk-for-report-papers-piles-of-sheet-achieves-with-clips-on-table-document-is-written-drawnpresented/

[11] Image - https://www.pinterest.com/pin/650559108661874594/

[12] Image - https://www.raytheonmissilesanddefense.com/capabilities/products/paveway-bomb#gallery-1

[13] Image - https://imgur.com/gallery/vFZOx

[14] Image - https://gfycat.com/gifs/search/peter+griffin+injury

[15] Image - https://blogs.umass.edu/Techbytes/2014/06/04/accidental-damage-liquid-spill/

[16] Image - https://giphy.com/gifs/back-to-the-future-doc-brown-bttf-vASwXhikF0Dug

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[20] Image - https://gfycat.com/readypossibleballoonfish

[21] Image - https://gfycat.com/thoughtfulhighcardinal

[22] Image - https://www.tripimprover.com/blog/the-thinker-by-auguste-rodin

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[24] Image - https://marketinginsidergroup.com/content-marketing/content-marketing-gifs/

[25] Image - https://tenor.com/view/loading-bar-waiting-load-cyan-blue-gif-13956215

[26] HSE Reducing Risks, Protecting People