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| Loughborough University | **Failure Modes Effects Analysis** |
| **The Centre for Biological Engineering** |
| Document Ref: CBE-RA-FORM/001 | Version No: | 1.0 | Issue Date: |  |
|  |  |
| **FMEA No: CBE/FMEA/001** | [x] Facilities [x] Equipment [x] Processes  | **Reason for Assessment:** Annual review of processes and procedures for work with HTA licensable material under the Loughborough University HTA compliance quality manual  |

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| --- | --- | --- | --- | --- |
| Date of Assessment | Assessed by: | Checked by: | Location | Review Date |
| 25th June 2025 | Name: C.Kavanagh | Name:  | Centre for Biological Engineering Laboratory Unit Holywell Park, Loughborough University. | 4th June 2027 |
| Signature:  | Signature: |

| **Process/****Activity**  | **Failure Mode** | **Effect** | **Cause** | **Existing Control Measures** | **Severity** | **Likelihood** | **Detection** | **Risk Level** | **Recommended Action** | **Severity** | **Likelihood** | **Detection** | **Final Risk Level** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Acquisition of HTA licensable material**  | Acquired without sufficient evidence of ethical approval / consent | Breach of ethical standards or HTA licence conditions | Misclassification of material as non-licensableUnplanned transfer | Risk based process in place to classify material before acquisition to ensure 3rd party providers have obtained material ethically with informed donor consent. Consent Training given & procedures followed & audited. | 4 | 5 | 3 | **3** | None |  |  |  |  |
| Acquired from non-licensed organisation in England, Wales or N.Ireland | Breach of ethical standards or HTA licence conditions | Misclassification of material as non-licensableUnplanned transfer | Risk based process in place to classify material before acquisition to ensure licensable material is obtained from HTA licensed organisations | 9 | 5 | 3 | **15** | None |  |  |  |  |
| Acquired without MTA or appropriate agreements in place | Breach of ethical standards or HTA licence conditions | Misclassification of material as non-licensableUnplanned transfer | Risk based process in place to classify material before acquisition to ensure appropriate transfer agreements are in place | 9 | 5 | 3 | **15** | None |  |  |  |  |
| Material arrives on-site unexpectedly | Breach of ethical standards or HTA licence conditions | Unplanned transfer-mainly visitorsInsufficient trainingLack of awareness of all CBE workers | Process to raise and maintain awareness of requirements. All HTA users have local HTA training. | 16 | 3 | 5 | **25** | Monitor. Likelihood considered ‘occasional’ due to new users.  |  |  |  |  |
| **Transport & transfer of HTA licensable material** | Material transferred without a MTA or agreements in place | Breach of ethical standards or HTA licence conditions | Misclassification of material as non-licensableUnplanned transfer | Process in place to ensure appropriate transfer agreements are created | 16 | 5 | 3 | **15** | None |  |  |  |  |
| Material transferred without being recorded | Loss of continuity in the chain of custody | Misclassification of material as non-licensableHuman error | Documented training programme for staff involved in HTA activities | 3 | 3 | 3 | **3** | None |  |  |  |  |
| Inappropriate environmental conditions chosen for transport | Damage/loss of material integrity due to degradation, decomposition or contamination | Human error No MTA | Documented procedure and guidelines for safe transport available | 16 | 1 | 7 | **7** | None |  |  |  |  |
| Loss/deterioration of environmental conditions during transport | Damage/loss of material integrity due to degradation, decomposition or contamination | Incorrect containers, preservative or packaging Unauthorised couriers | Documented procedure and guidelines for safe transport available Authorised couriers | 16 | 1 | 7 | **7** | None |  |  |  |  |
| Prolonged delay in transit or loss of material in transit | Loss of material integrity. Loss of material | Incorrect sample ID and/or package labellingUnauthorised couriers | Authorised couriers | 4 | 3 | 3 | **3** | None |  |  |  |  |
| Delay in transit of material to storage area on receipt | Loss of material integrity. | Human errorIncomplete delivery documentation | Process for acquisition and receipt in place | 4 | 3 | 3 | **3** | None |  |  |  |  |
| Incorrect or lack of transport / delivery / receipt records | Loss of continuity in the chain of custody | No MTAUnauthorised couriers | Authorised couriers System in place to track samples.. | 1 | 5 | 3 | **3** | None |  |  |  |  |
| Incorrect packaging, labelling and identification of samples | Breach of legislation for transport of hazardous material | Human error  | Documented procedure and guidelines for safe transport available | 9 | 3 | 5 | **5** | None |  |  |  |  |
| **Storage of HTA licensable material** | LN2 storage system failure/malfunction  | Damage/loss of material integrity due to degradation, decomposition or contamination | Insufficient maintenance, monitoring/inspectionMisuse or incorrect use of equipment | Documented procedure to ensure equipment is maintained. Process for reporting adverse events, CAPA and contingency plan in place. Temperature is monitored, equipment alarmed. Data is continually collected and can be accessed by specific personnel.. E-mail & Text Alerts sent when temperature out of range . Currently no system for 24/7 response | 9 | 5 | 5 | **25** |  Robust System to ensure 24/7 response to alarms still required. Require additional persons of contact  | 9 | 5 | 1 | **5** |
| Incorrect use of LN2 storage equipment | Damage/loss of material integrity due to degradation, decomposition or contamination | Human errorIncorrect documented procedure | Document procedures and change control mechanism for equipment. Training in use and maintenance. | 9 | 9 | 3 | **3** | None |  |  |  |  |
| Cold chain equipment failure/malfunction | Damage/loss of material integrity due to degradation, decomposition or contamination | Insufficient maintenance / cleaningInsufficient monitoring/inspectionMisuse or incorrect use of equipment Utility failure | Documented procedure to ensure equipment is maintained. Process for reporting adverse events, CAPA and contingency plan in place. Temperature is monitored, equipment alarmed .Data is continually collected and can be accessed by specific personnel.. E-mail & Text Alerts sent when temperature out of range. Currently no robust system for 24/7 response | 9 | 5 | 5 | **25** | More Robust system for 24/7 response to alarms required for CBE Additional contacts required. | 9 | 5 | 1 | **5** |
| Cold chain alarm failure/malfunction | Damage/loss of material integrity due to degradation, decomposition or contamination | Insufficient maintenance / cleaningInsufficient monitoring/inspectionUtility or sensor failure | Process for regular inspection and reporting of adverse events, CAPA in place | 25 | 1 | 7 | **7** | None |  |  |  |  |
| Facility/utilities failure or malfunction | Damage/loss of material integrity due to degradation, decomposition or contamination | Insufficient maintenance / cleaningInsufficient monitoringExternal impacts eg Cold weather | Process for reporting of adverse events, CAPA and contingency plan in place. | 25 | 1 | 1 | **1** | None |  |  |  |  |
| Unauthorised access to facility and storage areas | Loss of material or dataBreach data protection/ confidentiality | Building, facility, laboratory security failure  | System in place to secure entry into CBE and authorise access to laboratory unit, includes card ley entry, permit to work and out of hours system. T208b is key access to authorised users only. | 16 | 1 | 5 | **5** | None |  |  |  |  |
| Procuro database system failure/ malfunction | Loss of traceabilityMix up of samplesLoss of data | Hardware or server failure,Power outage,Misuse or incorrect use of software | Back-up/recovery system in place | 25 | 3 | 3 | **15** | None |  |  |  |  |
| Unauthorised access to database | Breach in data protection and/or loss of data. Loss of traceability | Hardware, server or software security control failure | System in place to secure entry into CBE and authorise access to laboratory unit. Key access to T208b to authorised users only.Database password protected and issued to authorised users only. No personal data is retained.Back-up/recovery system in place | 25 | 3 | 3 | **15** | None |  |  |  |  |
| Incorrect or incomplete database entry or use of the system | Loss of traceabilityMix up or loss of samples | Human error | Documented procedure and training in use of the system.Internal inspection audit programme in place | 1 | 5 | 3 | **3** | None |  |  |  |  |
| Incorrect or inappropriate storage location | Loss of traceabilityMix up or loss of samplesDamage/loss of material integrity | Human error Insufficient storage spaceLabelling errors on receipt | Process in place to correctly identify material on receipt to ensure material is stored in correct conditions. System in place to track samples.Training on how to label correctly and importance of traceability.Regular audits  | 4 | 5 | 5 | **5** | Continue to Monitor and audit every 3 months. Audit schedule to include T208b once stored HTA material work starts. |  |  |  |  |
| Unauthorised release of material to untrained individuals  | Loss of continuity in the chain of custody | Human error  | Quality assurance process for acquisition and receipt and release of material in place | 9 | 1 | 1 | **1** | None |  |  |  |  |
| **Use of HTA licensable material** | Unauthorised use of material  | Breach of ethical standards or HTA licence conditions | Sample mix upsConsent withdrawn | Risk based process for each project to ID appropriate controls for material and work activity are regularly reviewed.Change control system in place.Internal inspection audit programme in place | 9 | 1 | 7 | **7** | None |  |  |  |  |
| Use of material by unauthorised personnel | Breach of ethical standards or HTA licence conditions | Human errorSample mix ups | Unique sample Identification system and labelling of samples and storage units.Internal inspection audit programme in place | 9 | 1 | 7 | **7** | None |  |  |  |  |
| Informed Consent not taken for sample  | Breach of ethical standards or HTA license conditions  | Human Error/Non compliance  | Consent Training & Consent observation  | 9 | 3 | 5 | **5** |  |  |  |  |  |
| Laboratory equipment failure/malfunction eg BSC | Damage/loss of material integrity due to degradation, decomposition or contamination | Insufficient maintenance / cleaningInsufficient monitoringUtility failure Misuse or incorrect use of equipment | Documented procedures to ensure equipment is calibrated and maintained, including service agreements | 4 | 5 | 1 | **1** | None |  |  |  |  |
| Incorrect use of laboratory equipment  | Damage/loss of material integrity due to degradation, decomposition or contamination | Human error  | Document procedure and change control mechanism for equipment. Training in use and maintenance. | 4 | 3 | 7 | **7** | None |  |  |  |  |
| **Disposal of HTA licensable material** | Unauthorised disposal of material | Loss of continuity in the chain of custody | Human error Labelling/ID errors | System in place to track samples. Internal inspection audit programme in place | 9 | 3 | 5 | **5** | None |  |  |  |  |
| Disposal of material that should have been retained or returned to provider | Loss of continuity in the chain of custody | Human error Labelling/ID errors | System in place to track samples.Internal inspection audit programme in place | 9 | 3 | 5 | **5** | None |  |  |  |  |
| Retention of material that should have been disposed of | Loss of continuity in the chain of custody | Human errorConsent withdrawnNo MTA | System in place to track samples.Internal inspection audit programme in place | 9 | 3 | 5 | **5** | None |  |  |  |  |
| Incorrect/inappropriate disposal route | Breach of ethical standards or HTA licence conditions | Human error Labelling/ID errorsDisposal of HTA Material in normal public waste streams  | Documented procedures for safe disposal as clinical waste. | 9 | 3 | 5 | **5** | None |  |  |  |  |
| Equipment failure/malfunction eg autoclave | Delay in disposal | Insufficient maintenance / cleaningInsufficient monitoringUtility failure Misuse or incorrect use of equipment | Documented procedure to ensure equipment is calibrated and maintained, including service agreements | 1 | 5 | 1 | **1** | None |  |  |  |  |
| Incorrect use of sterilisation equipment  | Non- sterilised disposal of material waste | Human error  | Document procedure and change control mechanism for equipment. Training in use and maintenance. | 4 | 5 | 5 | **5** | None |  |  |  |  |
| Incomplete or no records of disposal, inc’ reason for disposal | Loss of continuity in the chain of custody | Human error | System in place to track samples.Internal inspection audit programme in place | 9 | 3 | 3 | **3** | None |  |  |  |  |

**Guidance Notes for HTA Relevant Material Risk Assessment Form**

1. The hierarchy of control measures employed should primarily be aimed at eliminating or reducing the hazards in a procedure, followed by early detection of risks and contingency planning. One example of a hierarchy of control measures is regular maintenance of storage facilities to prevent failure; followed by installation of an early warning system to detect changes in storage temperature; and finally alternative on-site storage facilities in the event of storage failure. Other examples of control measures include appropriate training, written procedures [Standard Operating Procedures, Method Statement] and supervision by an appropriate person. The level of supervision must always be appropriate to the competence of the individuals involved in the work activity.

2. Record when each control measure has been implemented and the new numerical risk rating following its implementation. The aim should be to achieve a progressive reduction in risk.

3. Calculate the risk for existing activities taking into account any control measures in place. This is estimated by considering both the probability of exposure to a risk, the severity of the consequences of such an exposure and the likelihood of detection.

4. The calculation of risk should be done as follows:

Select an appropriate number for both Probability (P) and Severity (S) from Table 1 and multiply them together. Cross reference your score on the coloured part of the table. This is the initial risk rating; Low, Medium or High.

Select an appropriate number for Detectability (D) from Table 2 and multiply it by the risk rating identified in Table 1. Cross reference your score on the coloured part of the table. This is the final risk priority number rating (RPN); Low, Medium or High.

Table 3 shows the Score Action to be taken:

**Table 1: Risk Matrix for calculation of initial risk rating**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Probability of** **Occurrence (P)**Probability of the hazard occurring  | **High** | **9** | **9** | **36** | **81** | **144** | **225** |
| **Moderate** | **7** | **7** | **28** | **63** | **112** | **175** |
| **Occasional** | **5** | **5** | **20** | **45** | **80** | **125** |
| **Remote** | **3** | **3** | **12** | **27** | **48** | **75** |
| **Unlikely** | **1** | **1** | **4** | **9** | **16** | **25** |
|  |  | **Severity Level (S)** | **1** | **4** | **9** | **16** | **25** |
|  |  | **Failure effect/impact** | **Low** | **Minor** | **Moderate** | **Major** | **Critical** |
|  |  | Breach of ethical standards | Minor infringement of normal practice or near miss | Single failure to adhere to internal standards,policies & procedures | Single failure toadhere toHTA Codes ofPractice andregulations | Multiple failures to comply withinternalstandards,policies &procedures | Multiple failuresto comply with HTA Codes ofPractice andregulations |
|  |  | Loss or damage to Relevant Material and/or data.Breach of data protection/confidentiality | Temporary lossof data - recoverable No loss or damage to material | Minimal/minor loss of dataMinimal/minor loss or damage to material | Single failure to ensure material/ data security &integrity Significant loss or damage to material | Multiple failuresto ensure material / datasecurity & integrityMultiple data losses. Material destroyed but replaceable | Total loss ofmaterial / data. Confidentiality jeopardised Material destroyed and irreplaceable |

**Table 2. Calculation of the Risk Priority Number**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Risk (S\*P)** | **High** | **9** | **9** | **27** | **45** | **63** | **81** |
| **Medium** | **5** | **5** | **15** | **25** | **35** | **45** |
| **Low** | **1** | **1** | **3** | **5** | **7** | **9** |
|  |  | **Likelihood of Detection** | **1** | **3** | **5** | **7** | **9** |
|  |  | **(D)** | **High degree** | **Good** | **Likely** | **Fair** | **Low or none** |
|  |  | Likelihood that if the hazard were to occur it would be detected | Calibrated automatic & direct detection system, 24/7 | Calibrated automatic indirect system, 24/7 or 2 or more direct manual detection system | Calibrated automatic direct/indirect system, not 24/7 or single direct manual detection system | Indirect manual system/ visual check/inspection | Little or no ability to detect failure |

**Table 3: Assignment of Risk Level**

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk Priority Number (RPN)** | **1-15** | **16-46** | **>46** |
| **Risk** | Low risk | Medium risk | High risk |
| **Action** | No further action required | Additional control measures may be required to improve risk control | Additional and/or alternative risk control measures required |