University Occupational Health and Safety Guidance Notes

UNDERTAKING A RISK ASSESSMENT FOR GENETICALLY MODIFIED ANIMALS

The SACGM Compendium of Guidance Part 5 provides comprehensive guidance on the risk assessment of work activities involving GM animals. This should be used in conjunction the guidance below when completing the GM Animal Risk Assessment.

GM animals are those where their genetic material has been altered using a method that does not occur naturally, but excluding chemical or physical mutagenesis. In its broadest sense this includes both vertebrates and invertebrates. The legislation also covers the breeding on of a genetically modified animal. Even when a GM animal is crossed with a non-GM animal the progeny will be considered to be GMOs.

All activities involving GM animals must be risk assessed in relation to human health and safety as well as the environment, and records kept for 10 years. When undertaking a GM risk assessment for GM animals, the specific species must be considered on a case-by-case basis.

In outline, the GM risk assessment process involves:

(i) Risk assessment for environmental protection (including hazard identification, assessment of likelihood and consequences; determination of risk; assignment of risk management measures to protect the environment);
(ii) Risk assessment for human health and safety;
(iii) Review of procedures and control measures.
(iv) Assignment of the final containment and control requirements.
(v) Determination of HSE notification requirements.

As part of the consideration under (ii) it is important to determine whether the GM animal is more likely to cause harm to humans than the non-modified parental organism. Hazards to consider include:

(i) Capacity to survive, establish, disseminate, compete with and / or displace other animals;
(ii) (Direct) adverse effects on animals and plants;
(iii) Potential for transfer of genetic material between the GMO and other organisms;
(iv) Products of gene expression, particularly if they are toxic or otherwise biologically active;
(v) Phenotypic and genetic stability; and
(vi) Other negative effects on organisms.

Capacity to survive, establish, disseminate, compete with and / or displace other animals

- The capacity of the GM animal to survive in the environment will be a key factor to consider. If the animal cannot survive outside of containment, it is unlikely to cause environmental harm.
- Some animals, even when they cannot survive in the long term, may be able to survive for a short period when conditions are favorable.
- Where a GM animal has an intrinsic ability to survive it is important to consider how they might interact with the environment.
- GM animals may cause harm simply by their presence in the environment.
    - If they are intrinsically adapted to the climate and environment they may out compete and displace other populations of animals.
    - Predation may be a problem.
    - Effects on plant species should also be considered.
    - Establishment of significant populations of escaped GMOs may lead to serious ecological impacts.
    - Loss of biodiversity in plant species could in turn adversely affect the ability of the environment to support its normal animal populations.
    - Care must be taken over non-indigenous species.
    - Problems have included excessive growth in numbers, over successful competition with native species and physical damage to the environment.

Whilst it seems probable that GM animals would be no more likely to cause such problems than non-manipulated species, it is possible that the genetic modification itself gives the GM animal a competitive advantage in the natural environment. Conversely the modification may lead to decreased fitness and weakened ability to compete. The small size and complex life-cycle of many of these GM animals may open up additional pathways for dispersion, and tracking of the animals may be difficult if not impossible.

Potential for transfer of genetic material between the GMO and other organisms

Consideration should be given to the possibility of the modified genetic material being transferred to wild or domesticated relatives. Factors to consider will include:

- The presence of sexually compatible species in the environment;
- Whether the GM animal is sterile;
- The sex of the GM animal. If only females escape (and they are recallable) the chances of gene transfer into the wider population will be greatly reduced.

The likelihood of selection pressure acting on the modified trait should also be considered, as it would affect the likelihood of the gene being spread through the population.

Products of gene expression, particularly if they are toxic or otherwise biologically active

- The possible harmful effects of biologically active substances, such as toxin production, on other animals should be considered, but are relatively unlikely to pose a serious hazard.
- Given that genetic instability is most likely to result in loss of the introduced trait it will rarely be a source of potential harm. One exception to this is when the genetic modification itself is used as a biological control method. For instance, one of the aspects of control may involve sterility introduced by the genetic modification. If this were to revert, the level of control would be reduced. Similarly there may be an introduced nutrient dependency. If removed through genetic instability there could be an increase in the possibility of dissemination in the environment.
- Consideration should also be given to the possibility of the GM animals acting as novel animal disease vectors.

Assessing environmental risk by :

(i) Hazard identification; then if hazards are identified
(ii) Assessment of the likelihood of identified hazards being manifested;
(iii) Assessment of the consequence of identified hazards being manifested;
(iv) Determination of risk of “harm” (likelihood x consequence);
(v) Selection and assignment of appropriate control measures (risk management);
(vi) Reiteration of the above steps to determine if risks have been reduced to “low” or “effectively zero”.

An assessment of risks to human health is also required. It is recognised that for the majority of GM animals currently being used the modified animal poses no additional risk to workers over those that would be expected from the parental (unmodified) animal. These intrinsic hazards will include such things as scratches, bites, allergenicity and zoonoses (especially the possibility of persistent or latent infection). All of these aspects must be considered in any risk assessment so that appropriate containment and control measures can be assigned. However, these potential hazards are, of course, common to all animals, whether GM or not. The risk assessment under the Genetically Modified Organisms (Contained Use) Regulations 2014 should focus more on the possible additional hazards to human health which result from the genetic modification itself. For example, if an animal line was produced which was modified to contain a receptor for a human virus, these animals may act as a novel reservoir for human disease. Although the possibility of such additional hazards to humans must always be considered, it is recognised that in most cases the activities will not pose any extra hazards to humans.

If any additional risks to humans might result from the genetic modification itself, such hazards might include:

- Novel or increased allergenicity;
- Possible toxic effects (from the production of toxins or other biologically active proteins);
- Adverse effects from a change in behaviour or in physical nature. This might include increased aggression;
- Changes in the ability of the animal to act as a human disease reservoir (eg the insertion of a novel viral receptor).

For each hazard identified, you should consider the likelihood of the hazard being realized (given the containment assigned to protect the environment)

Notification to the Health and Safety Executive

The Genetically Modified Organisms (Contained Use) Regulations 2014require that all activities involving GM animals, where the animal poses a greater risk of harm to human health and safety than the non-modified equivalent are notified to HSE. (Note that the trigger is in relation to human health and safety only. There is no equivalent notification trigger in respect of the environment.)

The final containment and control measures assigned must be sufficient to reduce all risks to both humans and the environment to “low” or “effectively zero” and prevent harm from occurring. In all cases ‘not notifiable’ is only suitable if the risk assessment, taking into account the animal, modification, activity and containment is shown to be low or effectively zero. Examples of the types of GM animals for which this containment is appropriate are likely to include “knockout” mice.

The hazards to humans from GM animals are most likely to be those also associated with the non-modified equivalent animal. It will be relatively rare that a significant hazard will result from the genetic modification itself but should be considered. Of course, in some cases there may be very minor increases in possible risk that would not trigger a notification.

By analogy, hazards resulting from the genetic modification which could give risk to “medium” or even “severe” consequences for human health would trigger a notification requirement, as the risk would be truly greater than that posed by the non-modified animal. For example, a GM animal line might be produced which is susceptible to a human virus through insertion of a viral receptor. The animal might act as a novel reservoir for the human disease and if this were to happen the consequence would probably be “medium” to “severe”, depending on the seriousness of the disease in question.

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