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WORKING MATERIAL

GENERIC DESIGN, TECHNICAL GUIDELINES AND OPTIMAL LOCATION OF TSETSE FLY MASS-REARING FACILITIES

Report and recommendations of a consultants group meeting organised by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Vienna, Austria, 11–15 October 2004

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EXECUTIVE SUMMARY

Tsetse and trypanosomosis (T&T) severely affect human health – sleeping sickness – and there is evidence for a causal relationship of T&T with food insecurity, rural poverty and overall development constraints for people living in 36 countries of sub-Saharan Africa. Direct annual losses in livestock production and the cost of continuous control measures have been estimated to range between US$ 600 million and $ 1.2 billion, and the lost potential in agriculture and livestock productivity may be as high as $ 4.75 billion per year. T&T must be considered and treated as one of the most serious pest problems and development constraints in the world today.

Several developments in recent years contributed to an increased feasibility and sustainability of efforts against the T&T problem:

1. Following a decision of the African Heads of State and Government at their Lomé summit in 2000, to eventually eradicate tsetse flies from Africa, there is an increased commitment among the national and international authorities and other stakeholders to solve the T&T problem in a sustainable manner through the creation and subsequent expansion of T&T free zones.
2. The concept of areawide integrated pest management (AW-IPM), including a sterile insect technique (SIT) component, where feasible and justifiable, was adopted for intervention against the T&T problem in the context of overall efforts towards sustainable agriculture and rural development (SARD).
3. The AU-Pan-African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) and the Programme Against African Trypanosomiases (PAAT; a forum used by AU, FAO, IAEA and WHO to harmonize their efforts against T&T) jointly developed criteria and guidelines for identifying priority areas for T&T intervention, where there is high potential for agriculture and livestock development and where intervention measures would likely result in early and sustainable success.

SIT will likely play a role in several of these AW-IPM based efforts to create T&T free zones. It is, therefore, foreseeable that the demand for good quality sterile tsetse fly males will increase. This is already resulting in proposals to establish additional tsetse fly mass-rearing facilities ~~factories~~ in Africa.

AW-IPM programmes against T&T involving a SIT component will require high investments at an early stage of programme implementation, particularly for the mass-rearing facilities. In order to realize optimum efficacy and efficiency, these programmes must be carefully planned and implemented in a consistent and flexible manner over sufficiently large areas and a rather long time frame. Decisions on the geographic location and design of rearing facilities must be objective, and based on sound assessment criteria.

A meeting of expert consultants was convened in Vienna, Austria October 11-15, 2004 under the auspices of FAO/IAEA, in an effort to assist countries in planning the geographic location and in designing large tsetse fly mass-rearing facilities. With regards to assessing the suitability of (proposed) tsetse mass-rearing locations, the meeting identified a number of critical, important and desirable criteria under four(4) main categories, namely Site Characteristics, Climate and Environment, Manpower & Infrastructure and Social & Political supports. A worksheet was developed to summarize scores reached for the identified criteria, in order to ensure that the assessments are objective and verifiable. The meeting also elaborated on the concept of tsetse factory design, based on considerations regarding the involved rooms, their functions, ergonomic flow of the production process and other relevant factors. Required support services were identified and specifics were provided on aspects like controlled environment system design, desired room conditions and occupancy, air filtration and distribution and electricity supply.

The consultants' recommendations underline that meeting and this consultants' report represents the beginning of several steps that aim at facilitating planning and decision making in Member States regarding the location and the design of tsetse mass-rearing facilities in Africa.

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1 INTRODUCTION

The impact of the tsetse and trypanosomosis (T&T) problem on the well-being of the 36 countries in Africa where it exists is enormous: Direct losses in meat production and milk yield and the cost of programmes to control trypanosomosis were estimated at US$ 600 million and $ 1.2 billion each year by FAO in 1994. The devastating effects of this complex on development opportunities in sub-Saharan Africa is of such a scale as to be ranked as one of the most serious pest problems in the world today.

Over the past several decades, significant advancements in eradication technology have been made. Indeed, the highly effective techniques currently available, along with the urgency of the problem, prompted the African Heads of State and Government, in July 2000, to pass a decision to eradicate tsetse flies from Africa. The sterile insect technique (SIT) is a fundamental component of the eradication strategy, and programmes to integrate the tactic into area-wide campaigns to create and subsequently expand, tsetse fly-free zones have been initiated by certain African countries and are likely to increase in the future.

These long-term (30-50 years) initiatives are costly to get off the ground, and must be carefully executed over their life to realize optimum efficacy and efficiency. One of the most basic early decisions in implementing an area-wide program using SIT concerns the geographic location and design of rearing facilities. Such decisions must be objective, and based on sound assessment criteria. Local (country-based) initiatives must be complementary with programmes underway (or planned) in other countries to achieve the ultimate goal of Continent-wide eradication of tsetse. Further, facilities in one country may well serve as back-up support to other countries involved in tsetse eradication.

A meeting of expert consultants was convened in Vienna, Austria October 11-15, 2004 under the auspices of the IAEA. That group prepared this report to assist countries in planning the geographic location and design of tsetse fly mass-rearing facilities to ensure efficient and effective implementation of SIT programmes. The report is presented in two main sections:

- A Protocol for Selecting the Optimal Location for Tsetse Fly Mass-Rearing Facilities; and
- Facility Design & Support Services

2 A PROTOCOL FOR SELECTING THE OPTIMAL LOCATION FOR TSETSE FLY MASS-REARING FACILITIES CURRENT STATUS

The construction of rearing facilities for tsetse SIT represents a major investment. The costs of facility construction and of its operation over the expected 30-year plus life of the facility are significant financial commitments. It is the purpose of this protocol to provide a framework for planning the creation of such new facilities. Decision-making on the physical location of the planned facility must be as objective as possible and based on the best information. It is envisioned that rearing facilities may be established that are permanent or relocatable. Permanent facilities will have an operating life for tsetse rearing of at least 30 years. Relocatable facilities are designed to be more mobile and will be established in a location for 2 – 5 years after which they will be dismantled and components redeployed elsewhere.

The protocol presents 56 separate factors arranged into 4 broad categories to consider in choosing a location for establishing a mass-rearing facility:

1. Site Characteristics – This category includes factors concerning the suitability of the site from an engineering and construction standpoint.
2. Climate and Environment – This category addresses implications of extreme climatic conditions on facility operation and how the surrounding environment may be favourably or unfavourably impacted by the presence of a facility.
3. Manpower and Infrastructure – Critical to the operation of a facility is access to adequate manpower, transportation systems, municipal services, utilities and communication means.
4. Social and Political Support – Factors in this category address the compatibility of the facility with the surrounding community and emphasizes the vital nature of strong political support in making the venture successful.

The various factors in each category are scored in relation to their criticality to the successful performance of the facility in providing rearing support to tsetse programmes.

1. Critical – Those factors characterized as critical must be satisfied at the location under consideration. These factors are so important that the facility cannot be successful if those factors are not affirmative.
2. Important – Factors that are characterized as important deserve special consideration because they tend to have a bearing on the cost of constructing or efficiency of operating the facility.
3. Useful – Factors characterized as useful convey certain advantages that should be taken into account, but do not indicate barriers to using a location for the facility.

2.1 SITE CHARACTERISTICS

Category	Factor	Level	Comments
Topography	Land area	Critical	At least 5 times projected final building area must be available to provide for a buffer area and some space for future expansion
	Drainage	Important	If no main sewerage is available, high soil percolation is required for effluent dispersal Implication for building design and cost
	Slope	Useful	Greater than 5% slope may impact building costs, less than 1% may result in higher drainage costs
	Orientation	Useful	Consider solar heat load, solar energy availability
Geotechnical	Soil condition & stability	Important	Engineering evaluation of the site may dictate that special construction methods be used to mitigate site condition problems, thus increasing the cost.
	Water table level	Important	Unusually high or low water table may have construction cost impact for drainage or water acquisition.
Hazards	Earthquake	Critical	Low risk of earthquake; facility design to accommodate maximum predicted earthquake severity over projected lifespan.
	Possible previous chemical contamination	Critical	Chemical residue testing demonstrates no residual insecticide, chemical or heavy metal contamination from previous uses.
	Neighbouring land use	Critical	Adjacent land uses do not generate chemical emissions damaging to tsetse operations
	Lightning strike	Important	Power conditioning may be required
	Eradication zone	Important	Facility that will be operated in a tsetse free zone will require bio-security
	Forest fire	Important	Frequent fires will compromise air-handling system and threatens direct building damage.
	Flood risk	Important	Above 20 year flood maximum. Cost implications
	Low Erosion	Useful	High levels of erosion of soil at the site from wind or water may have maintenance cost implications over the life of the facility
	Low risk of Landslide	Useful	Landslides could threaten the consistent long-term functioning of the facility

2.2 CLIMATE AND ENVIRONMENT

Category	Factor	Level	Comments
Environmental impact	EIA/EIS	Critical	To avoid conflicts with other interests, it is vital that establishing a tsetse facility at the location will be in compliance with local and national environmental and threatened and endangered species regulations
Climate impacts on facility efficiency and bio-security	Air quality (dust, pollution)	Critical	Air quality is sufficiently high such that no extraordinary air purification and handling systems are required to protect the facility from airborne dust, particulates and chemicals.
	Temperature	Important	High and low temperatures increase environmental control costs
	Humidity	Important	High and low humidity increase environmental control costs
	Local environment not conducive to tsetse survival	Important	Provided the site is close enough to field operations to be logistically viable, this factor reduces requirement for biosecurity
	Non-Corrosive environment	Critical	Remote to sea & industrial plants

2.3 MANPOWER & INFRASTRUCTURE

Category	Factor	Level	Comments
Transportation links	Roads	Critical	Roadways must be passable by commercial vehicles year around to ensure timely delivery of equipment and supplies as well as shipment of flies
	International/ Regional Airport	Critical	Commercial airport must be within 2 hours of the facility to ensure timely delivery of supplies and shipment of flies.
	Distance to current and future release sites	Critical	Total transit and release time to any projected release site must be cost effective and not result in unacceptable loss of quality.
	Local public transportation	Important	Important for workforce commuting
	Airstrip in vicinity of facility	Important	Facilitates transport of flies, supplies and equipment
	Rail	Useful	Of potential occasional value in transport of heavy equipment
	Navigable waters	Useful	Of potential occasional value in transport of heavy equipment
Population proximity.	Labour availability	Critical	Proximity (within reasonable commuting distance for the local area, e.g. 1 hour by bus) to population centre is vital to supply employees to the facility workforce

Category	Factor	Level	Comments
Population proximity (continued).	Technical support for repair and maintenance	Critical	In the event that facility engineers are not able to perform repairs necessary to keep the facility functioning, trade/technically (environmental control services) skilled personnel must be available within 3 hours for emergency service and within 24 hours for non-emergency repair.
	Scientific expertise availability	Important	External scientific and management expertise (university, other government facilities or international organizations) is necessary to support the facility and must be accessible for advice, research and methods development, trouble-shooting and consultation
Municipal services	Fire protection	Important	Municipal fire protection service is highly desirable; if not, it must be provided by the facility, but at an undesirable increased cost of operation.
	Medical facilities	Important	Within commuting distance for accident/ emergency services and routine health care
	Police	Important	These services are important to employees recruited to work in the facility
	Schools	Important	These services are important to employees recruited to work in the facility
	Means of public relations	Important	Mechanisms exist to keep the local public informed of activities of the facility
	Staff accommodation and housing	Important	If not available locally must be provided by facility
	Shopping, recreation facilities	Useful	Amenities useful for recruiting employees and visiting scientists
Utilities	Electrical power	Critical	Refer to engineers for requirements – back-up generators always required, but rating will depend on local supply reliability
	Water supply	Critical	Obviously, a ready and adequate supply of water is vital to the functioning of the facility Possibly supplied from bore holes and/or require additional treatment
	Blood source	Critical	The source(s) of blood for feeding must be stable to ensure uninterrupted supply and economical delivery.
	Waste disposal	Important	Lack of public means for disposal of waste entails constructing own facilities
	Offsite industrial scale irradiator	Useful	If irradiator not available it will have to be provided by the facility
	Potable water	Useful	Municipal potable water would be convenient, but alternative means of supply can be employed, perhaps at greater cost.
	Proximity to abattoir	Useful	Serve as backup in case the established sources of supply are disrupted.
	Gas service	Useful	Gas is cheaper than electricity for heating – bottle gas much more expensive than mains

Category	Factor	Level	Comments
Communications	Phone (mobile and fixed) and fax	Critical	Commercial service is available in the area and interruptions in service are infrequent
	Internet	Critical	Commercial service is available in the area and interruptions in service are infrequent – preferably broadband, 128 kB or more
	Courier services	Critical	Dependable daily courier service is available.
	Postal services	Important	For non-critical communication
	Satellite communication	Useful	As backup to primary communication means

2.4 SOCIAL & POLITICAL SUPPORTS

Category	Factor	Level	Comments
Political support	Local and central government support	Critical	Political commitment to provide support for the life of the program
	Land tenure, ownership/use	Critical	Legal arrangements have been made to ensure that the land will be available for the life of the project and support for expansion is guaranteed.
	Zoning	Critical	Current and future use of land adjacent to the facility (buffer zone) must be regulated by zoning laws to ensure that land uses inconsistent with tsetse operations are prohibited. Impact assessment of future land use on tsetse rearing required
	Legal authorization for using radioactive	Critical	Government agencies have established proce-dures to regulate and authorize the use of radioactive sources for SIT ("Milestone 2"), thus ensuring the uninterrupted use of irradiators for the life of the program.
	Fiscal incentives	Important	Government accommodations to the costs of establishing and operating the facility could be important in choosing a location
Public support	Social acceptance by the local population	Critical	Evidence can be presented that the local community is supportive of the establishment of the facility.

The following worksheet is for use in ~~for~~ assessing a location or comparing several candidate locations for the establishment of a tsetse fly mass-rearing facility. Each location under consideration is scored by the same assessment committee and ranked according to the following formula:

- Any unfavourable response to one of the 23 "**critical**" factors eliminates a location from consideration. Only those eligible locations with favourable responses to all 23 critical factors are included in the ranking.

- "**Important**" factors receive 5 points for each favourable response and 0 point for each unfavourable response.
- "**Useful**" factors receive 1 point for each favourable response and 0 points for each unfavourable response.

Locations are ranked according to the total points tallied for each and this result, along with any further explanatory information is forwarded to the decision- maker.

2.5 Worksheet for Scoring Factors pertinent to the Selection of a Location for a Tsetse Fly Mass-Rearing Facility

Category	**Factor**	**Level**	**Favourable**	**Unfavourable**
Site Characteristics				
Topography	Land area	Critical		
	Drainage	Important		
	Slope	Useful		
	Orientation	Useful		
Geotechnical	Soil condition & stability	Important		
	Water table level	Important		
Hazards	Earthquake	Critical		
	Possible previous chemical contamination	Critical		
	Neighbouring land use	Critical		
	Lightning strike	Important		
	Eradication zone	Important		
	Forest fire	Important		
	Flood risk	Important		
	Low Erosion	Useful		
	Low risk of Landslide	Useful		
Climate & Environment				
Environmental impact	EIA/EIS	Critical		
Climate impacts on facility efficiency and bio-security	Air quality (dust, pollution)	Critical		
	Temperature	Important		
	Humidity	Important		
	Local environment not conducive to tsetse survival	Important		
	Non-Corrosive environment	Critical		
Manpower & Infrastructure				

Category	Factor	Level	Favourable	Unfavourable
Transportation links	Roads	Critical		
	International/ Regional Airport	Critical		
	Distance to current and future release sites	Critical		
	Local public transportation	Important		
	Airstrip in vicinity of facility	Important		
	Rail	Useful		
	Navigable waters	Useful		
Population proximity.	Labour availability	Critical		
	Technical support for repair and maintenance	Critical		
	Scientific expertise availability	Important		
Municipal services	Fire protection	Important		
	Medical facilities	Important		
	Police	Important		
	Schools	Important		
	Means of public relations	Important		
	Staff accommodation and housing	Important		
	Shopping, recreation facilities	Useful		
Utilities	Electrical power	Critical		
	Water supply	Critical		
	Blood source	Critical		
	Waste disposal	Important		
	Offsite industrial scale irradiator	Useful		
	Potable water	Useful		
	Proximity to abattoir	Useful		
	Gas service	Useful		
Communication	Phone (mobile and fixed) and fax	Critical		
	Internet	Critical		
	Courier services	Critical		
	Postal services	Important		
	Satellite communication	Useful		
Social & Political Supports				
Political support	Local and central government support	Critical		

Category	Factor	Level	Favourable	Unfavourable
	Land tenure, ownership/use	Critical		
Political support (continued)	Zoning	Critical		
	Legal authorization for using radioactive	Critical		
	Fiscal incentives	Important		
Public support	Social acceptance by the local population	Critical		

3 FACILITY DESIGN & SUPPORT SERVICES

3.1 GENERAL

This section describes the various buildings and associated facilities required to design a Tsetse Fly Mass-Rearing Facility.

The buildings required for the facility are generally as follows:

- Production (Rearing) Module/s (Number of modules depending on the rearing capacity required of the facility)
- Common Production Facilities
- Male Module
- Staff Facilities
- Maintenance Workshop
- Utilities Building
- Guardhouse.

3.2 ROOMS AND FUNCTIONS

The various rooms and their function required in the various buildings are as follows:

Production (Rearing) Module/s	
Room	***Function***
Production Room -Rearing	Main Rearing
Pupal Incubation Room	Pupal incubation
Pupal Emergency (SSPC)	Emergence- self stocking into production cages (for separation of male and female flies)
Blood Preparation & QC	Preparing blood for feeding and blood quality assurance
Blood Store	For storage of blood required for feeding at the module

Production (Rearing) Module/s	
Room	***Function***
Store	For storage of equipment, stationary, etc.
Production Office	Office for production module supervisor
Tray & Membrane Washing	For washing of tray and membrane
Cage Empty (Female disposal) & Oven	To remove dead female flies from cages and tray drying
Toilet	For use by production workers

Common Production Facilities	
Room	***Function***
Cage & Trolley Washing	For washing used cages and trolleys from production modules
Central Equipment Store	For storing cleaned cages and trolleys after washing
Hotroom	For drying of cages and trolleys
Cage Making	Area where cages are made
Membrane Making/Preparation	Area where membranes are made and prepared for use at each production module
Blood Preparation & QC	Preparing blood for feeding and blood quality assurance
Blood Processing	For sieving and batching in containers and blood sample testing
Irradiation #1	Area where flies (males) are sterilized
Irradiation #2	Second irradiator may be needed to sterile blood supply
Walk-in Freezer Blood Store (Pre-Test)	For long term storage of blood supply after blood processing
Packing & Despatch	Area where sterile flies are packed into boxes
Male Chilling	For chilling sterile flies in boxes before despatch

Male Module	
Room	***Function***
Male Pupal Incubation	Area for male pupae to incubate
Male Emergence	Area for emergence of male flies
Blood Preparation & QC	Preparing blood for feeding and blood quality assurance
Blood Store	For storage of blood required for feeding at the module
Store	For storage of equipment, stationary, etc.
Office	Office for male module supervisor
Holding & Feeding –Male Flies	Area for Male flies to mature (2-3 days duration)

Staff Facilities	
Room	***Function***
Offices	-
Conference Room	-
Canteen/Lunchroom/ Tearoom	-
Restroom	-
Changerooms & Toilets - Male & Female	For staff, production workers & visitors
First Aid	-

Maintenance Workshop, Utilities Building, Guardhouse	
Room	***Function***
Maintenance Workshop	For engineering/maintenance works
Utilities Building	For accommodating standby power generator/s and Electrical Substation and Fire/Water Services Pumphouse as and where required
Guardhouse	-

The ceiling height throughout the whole facility should generally be 3000 mm with probably higher ceilings in areas like mechanical & electrical services plantrooms and store or warehouse.

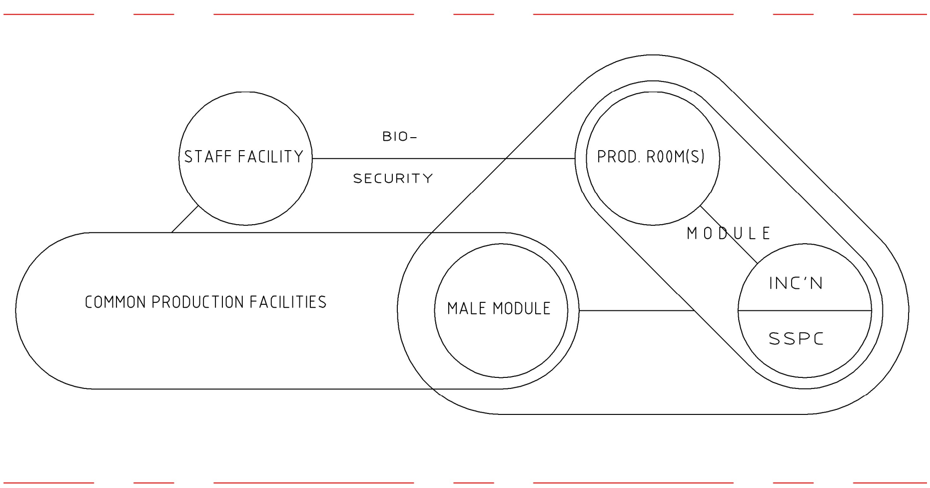
3.3 DESIGN CONCEPT

The building layout should take into consideration the following needs:

- Production capacity (generally in terms of number of flies per week)
- Bio-security
- Personnel flow taking into consideration bio-security and personnel safety
- Administration needs
- Material flow for material supplies, cage preparation, process flow path, irradiation procedure and final despatch of sterile flies
- Amenities for convenient use by various personnel
- Cross-contamination control (i.e. need to segregate various rearing areas and production modules)
- Emergency evacuation
- Shared support services – Common production facilities
- Rack and tray cleaning, sterilisation, drying and storage needs
- Utilities supplies
- Road access-traffic flow
- Landscaping needs
- Staff accommodation where needed

Production modules should preferably be positioned to facilitate easy and logical flow of personnel and rearing equipment to and from the common production facilities and to suit the logical transfer of flies to various rooms for processing. The following diagram serves to show the interaction of the various building units of the rearing facility. The type of construction should generally conform with the local building practices and methods. Local construction materials should be used as and where appropriate. The construction should also be in accordance with the recommendation of the Code of Good Manufacturing Practices (cGMP). Materials of construction used should therefore be durable and all walls and floor finishes should be hard, smooth and easily cleanable, using probably epoxy paint or self-levelling epoxy coating on concrete or cement plaster. Construction using modular sandwich panels consisting of two pre-finished steel skins bonded by rigid polyurethane foam and having smooth surfaces should also be considered.

The design of the facility and rooms should be adaptable, taking into consideration ease of future expansion and alterations, i.e. flexibility in partitions and room layout.



Interactive Bubble Diagram

3.4 SUPPORT SERVICES

The facility should be equipped with the following services:

- Controlled Environment Systems (a guide is included in this report)
- Electrical Services
- Lightning Protection
- Communications
- Fire Services
- Potable and Process Water
- Sanitary Waste
- Trade Wastewater
- Security

Each of the above systems should be designed and documented by Consultants who are qualified in the respective fields, taking into consideration the relevant local and international standards and codes that are applicable. In electrical services, particular attention should be given to selection of appropriate light fittings for the rearing rooms as tsetse would be sensitive to certain harmonic frequencies generated by certain types of fluorescent light fittings.

3.5 CONTROLLED ENVIRONMENT SYSTEM DESIGN

The Controlled Environment Systems should be designed to suit the following operating conditions taking into consideration the design ambient climatic conditions applicable to the country where the facility is located. This consideration should include the prevalent ambient conditions of wet and dry seasons.

Air-handling system serving each set of rearing/incubation/blood preparation rooms shall be separate. Bio-secure containment requirements dictate that ducting shall not penetrate the bio-secure boundary.

All exhaust discharges and outside air intakes should be fitted with stainless steel fly screen mesh.

Air-curtains shall be provided at the main entrance to bio-secured areas of the rearing facility, on the exterior side of the main bio-secure airlock entry and to operate when the door is opened.

The Controlled Environment Systems should be designed to minimize initial and operating costs. To achieve this objective, the system should be simple in installation and psychrometrically efficient. The system should be designed to make 100% use of the favourable ambient conditions.

The system should be designed to control and maintain the desired conditions within the desired operating tolerances. Air-cooled split system has been used to serve the rearing facility. This system has been low in initial cost. Face and bypass system in conjunction with air-cooled split system should be considered to minimize the need for humidification which should be achieved with proprietary made humidifier only if deemed absolutely necessary to keep the rearing room within the desired conditions. Irrespective of the system adopted, the Systems should be designed to maintain the stringent temperature and humidity tolerances required in the various rearing rooms, especially in the pupal incubation and emergence rooms.

Odour control should be considered in the Controlled Environment System design to minimise the odour within the Production Rearing Rooms.

3.5.1 Desired Room Conditions

Area	Desired Room Conditions	
	°C Dry Bulb	% RH
Production (Rearing) Module		
Production Room -Rearing	24±2	75±5
Pupal Incubation Room	24±1	75±5
Pupal Emergence (SSPC)	26±0.5	80±5
Blood Preparation & QC	22±2	55 nominal
Blood Store	22±2	55 nominal
Store	24±2	55 nominal
Production Office	22±2	55 nominal
Tray & Membrane Washing	24±2	55 nominal
Used Female Fly Kill	24±2	55 nominal
Cage empty	Ventilation only, minimum 15 air changes per hour	
Membrane & Tray Sterilisation	24±2	55 nominal
Toilet	Ventilation only, minimum 10 air changes per hour	
Common Production Facilities		
Trolley Washing	Ventilation only, minimum 10 air changes per hour	
Central Equipment Store	24±2	55 nominal
Cage Making	Ventilation only minimum 15 air changes per hour	
Membrane Making/Preparation	22±2	55 nominal
Blood Preparation & QC	22±2	55 nominal
Common Production Facilities		
Blood Processing	22±2	55 nominal
Irradiation #1 & #2	22±2	55 nominal
Walk-in Freezer Blood Store (Pre-Test)	-20±2	Not controlled
Male Chilling	4±2	80±5
Packing & Despatch	22 ± 2	55 nominal
Cage Empty Room (Female disposal)	Ventilation only minimum 15 air changes per hour	
Male Module		
Male Pupal Incubation	24±1	75±5
Male Emergence	26±0.5	80±5
Blood Preparation & QC	22±2	55 nominal
Blood Store	22±2	55 nominal
Store	22±2	55 nominal

Area	Desired Room Conditions	
	^{o}C Dry Bulb	% RH
Office	22±2	55 nominal
Holding & Feeding –Male Flies	24±2	80±5
Packing & Despatch	22 ± 2	55 nominal
Biosecure Corridors	22 ± 3	55 nominal
Staff Facilities		
Female Changeroom	22 ± 2	55 nominal
Male Changeroom	22 ± 2	55 nominal
General Offices & Meeting Room	22± 2 ^{o}C Dry Bulb	nominal 55 %RH
Staff Facilities		
Canteen/Lunchroom/Tearoom	22± 4 ^{o}C Dry Bulb	nominal 55 %RH
Guardhouse	22± 4 ^{o}C Dry Bulb	nominal 55 %RH

3.5.2 Outside Air

Outside air intake should be in accordance with the requirements of the local regulatory authorities or minimum of 10% of supply air (whichever is greater) unless otherwise stated hereinafter. Recirculation of room air will be permitted generally except for washrooms and toilets. All laboratory exhaust should be taken to discharge at not less than 3m above the roof. All other exhaust roof discharge should be kept at least 1m above the roof and kept at least 6m from any thoroughfare and outside air intake.

Area	Outside Air Intake
Generator Room	Ventilation rate to maintain not more than 10^{o}C rise above ambient or minimum 15 air-changes per hour whichever is higher
LV Switchroom	Ventilation rate to maintain not more than 10^{o}C rise above ambient or minimum 6 air-changes per hour whichever is higher
Warehouse	Ventilation only, minimum 10 air changes per hour

3.5.3 Lighting Loads

As per the Electrical Services general lighting design.

3.5.4 Internal Loads

Equipment: As per the list of equipment to be provided and installed with the facilities. Allow minimum 5 kW for each sterilizing oven.

3.5.5 Occupancy

Production Module each – 7-10 Workers

Administration – Generally 1 person per 10 m2

3.5.6 Supply Air

As required to meet the cooling load and ventilation requirements or to meet the minimum airflow rate specified.

3.5.7 Air Filtration and Air Distribution

3.5.7.1 Minimum Air Filtration Standard

Production Rooms:

Controlled Environment System serving	Mix Air
Rearing Room, Incubation Room, Blood Store, QA & QC Rooms, Irradiation Rooms, Bio-secured corridors	Class G4 600 mm Deep Bag/Deep Bed Compact Filter
Other Areas of Rearing Facility, Administration Building, Workshop and other Support Facilities	Class G3 600 mm Deep Bag/Deep Bed Compact Filter

Other Areas of Rearing Facility, Administration Building, Workshop and other Support Facilities

Generally, not less than Class G3 using 600 mm Deep Bag Filter

3.5.7.2 Air Distribution

Rearing Room, Incubation Room, Blood Store, QA & QC Rooms, Irradiation Rooms, Bio-secured corridors:

Using ceiling-mounted diffusers of swirl type (or equal) to achieve uniform desired room temperature distribution

Other Areas of Rearing Facility, Administration Building, Workshop and other Support Facilities

Using ceiling-mounted diffusers of swirl/louvred face type (or equal) to achieve uniform air flow

3.5.8 Noise Levels

Administration Building, Workshop and other Support Facilities:

- NR40 - 45 in general office and laboratory areas
- NR60 in Production areas

Noise emanating from Controlled Environment plants at the site boundary shall not exceed the State Environmental Protection Authority's statutory requirements.

3.5.9 Electrical Supply

All equipment electrical characteristics shall match the local electricity authority's supplies

Over-capacity Allowance

10% minimum on Cooling and Heating Units serving rooms for Production Rearing, Incubation, Blood Store and Colony Room

The complete Controlled Environment systems shall satisfy the relevant requirements of the local Regulatory Authorities.

4 RECOMMENDATIONS:

1. The IAEA has provided critical leadership to the advancement of operationally viable area-wide pest control programmes world-wide. It is strongly recommended that they continue to work with member countries to facilitate the development and implementation of SIT programmes for area-wide tsetse eradication.

2. The generic guide for rearing facility design contained in this report should be used as a stepping stone toward the next level of refinement. It is recommended that critical evaluation of individual components be performed with the mind of ensuring they work effectively and efficiently in a complete rearing system. This should be pursued with focus on the following specific issues

   - Expertise in time in motion, process engineering and ergonomics should be engaged.
   - An electronic spreadsheet similar to that in use in medfly programmes should be developed for tsetse to facilitate harmonizing the size of the facility, equipment requirements and material needs with the scope of the eradication program which the facility supports.
   - Ethiopia is currently constructing a modern facility. It is recommended that IAEA obtain the architectural and engineering documentation from that project and incorporate pertinent design details into a generic design document and make this material available to member states as they make plans for constructing additional tsetse fly mass-rearing facilities in the future.

3. The IAEA should ensure that interested parties receive copies of the location selection protocol and that its use be encouraged at all opportunities. It is advised that IAEA work with those member states known to be planning facilities in the next 3-5 years and facilitate application of site selection criteria, making modifications as necessary to accommodate local needs and interests.

4. Great advancements in efficiency of production and quality of flies can be gained through automation and the committee recommends that TPU 3 be implemented on a pilot scale as soon as possible.

5. It is recommended that IAEA facilitate the development of a method for measuring the efficiency of tsetse fly mass-rearing facilities that establishes the relationship between cost of operation and productivity toward tsetse eradication.

ANNEX I.: LIST OF PARTICIPANTS

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ANNEX II: AGENDA

Consultants Group Meeting organised by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture on

'Generic Design, Technical Guidelines and Optimal Location of Tsetse Fly Mass-Rearing Facilities'

11-15 October 2004, Vienna, Austria

Monday 11 October

08.30 – 09.00	Arrival at VIC – Obtain ground passes
09.00 – 09.30	**Jorge Hendrichs** - Opening Meeting
	Udo Feldmann – Administration
09.30 – 10.15	**Marc Vreysen** – The Sterile Insect Technique in integrated pest management programmes
10.15 – 10.45	Coffee Break
10.45 – 11.15	**Andrew Parker** – The Tsetse R&D programme in Seibersdorf
11.15 – 12.00	**Udo Feldmann** – An overview of planned/potential tsetse SIT programmes in Africa and sterile male requirements
12.00 – 14.00	Lunch
14.00 – 14.45	**Chuck Schwalbe** – Quarantine considerations in establishing and maintaining rearing facilities
14.45 – 15.30	**Idrissa Kabore –** Major achievements of more than 20 years autonomous mass rearing of three West African *Glossina* species.
15.30 – 16.00	Coffee Break
16.00 – 17.00	Discussion
17.00 – 18.00	Cocktails

Tuesday 12 October

09.00 – 09.45	**Gustavo Taret** – Parameters to consider for the selection of a location for an insect mass rearing facility.
09.45 – 10.30	**Carlos Caceres** - Automatic spread sheet for generic Medfly facility design
10.30 – 11.00	Coffee Break
11.00 – 12.00	Discussion
12.00 – 14.00	Lunch
14.00 – 14.45	**Dejene Taye** – Generic Design Models
14.45 – 15.30	**Albert Ooi** – Services and controlled environment impact on mass rearing facilities.
15.30 – 16.00	Coffee Break
16.00 – 18.00	Discussion

Wednesday 13 October 2004

09.00 – 10.30	Initial discussion on key issues to be addressed
10.30 – 11.00	Coffee Break
11.00 – 12.00	Continued discussions
12.00 – 14.00	Transport to Seibersdorf (lunch on the way)
14.00 – 16.00	Visit Entomology Unit Seibersdorf.
16.00 – 17.00	Return to Vienna

Thursday 14 October 2004

09.00 – 10.30	Discussion (in working groups)
10.30 – 11.00	Coffee Break
11.00 – 12.00	Discussion (in working groups)
12.00 – 14.00	Lunch
14.00 – 15.30	Discussion and drafting report
15.30 – 16.00	Coffee break
16.00 – 18.00	Drafting report
starting 19:00	Social event in Vienna (location to be announced)

Friday 15 October 2004

09.00 – 10.30	Drafting of report
10.30 – 11.00	Coffee Break
11.00 – 12.00	Drafting of report
12.00 – 14.00	Lunch
14.00 – 15.30	Presentation of report / Discussion on report and recommendations
15.30 – 16.00	Coffee break
16.00 – 18.00	Final comments/discussion and closing meeting

ANNEX III: WORKING PAPERS

Charles B. Schwalbe:	Quarantine Considerations in Establishing and Maintaining Rearing Facilities *(handout of PowerPoint presentation)*
Idrissa Kabore:	Major achievements of more than 20 years autonomous mass rearing of three West African *Glossina* species *(handout of PowerPoint presentation)*
Gustavo Taret:	Parameters to consider for the selection for an insect mass rearing facility *(paper)*
Dejene Taye:	Generic Design Models *(handout of PowerPoint presentation)*
Albert Ooi:	Services and Controlled Environment Impact on SIT Mass-Rearing Facilities *(paper)*