Target product profile: mosquito tracking system for vector control product evaluation

The following target product profile criteria describe the minimum characteristics of a semi-field mosquito tracking system suitable for IVCC-supported evaluation of vector control products.

Measure	Criteria	Reference/Rationale	Status/Evidence to be provided
Efficacy and Design			
Semi-field application	*Minimum:* The system can record mosquito movement and product interaction inside an open experimental hut or comparable semi-field environment, including use with a human host sleeping under an insecticide-treated net. *Aspirational:* The system can record mosquito movement in a peri-domestic setting as well as inside a semi-field environment.	Required to support evaluation of vector control products under conditions that better reflect field use than standard laboratory assays.	Applicants could describe existing evidence, proposed adaptations, and any validation required in experimental hut settings.
Target products	*Minimum:* The system can support evaluation of: 1. Insecticide-treated nets, including products with multiple active ingredients, different active-ingredient placements, panel-specific treatments, and alternative net designs. 2. Spatial emanators	Aligned with two of IVCC strategic pillars; next-generation ITNs and spatial emanators, where product performance may depend on mosquito movement, exposure, avoidance, or altered host-seeking behaviour.	Applicants could specify which product classes can be evaluated immediately, and which would require further development.

	Aspirational: The system can support evaluation of a combination of products in use at one time. *Aspirational*: The system is versatile and can be used to evaluate future product classes.		
Target species and strains	*Minimum:* The system is suitable for use with relevant malaria vector species. The system can differentiate mosquitoes from larger non-target insects. *Aspirational*: The system is also suitable for us with other mosquitoes such as *Culex* and *Aedes*.	Tracking outputs should be applicable to free flying mosquito populations relevant to product development and resistance-management decision-making.	Applicants could describe any previous use with *Anopheles* species and any constraints associated with mosquito density, size, flight behaviour, or strain.
Effect on assay conditions	*Minimum:* The system should not alter mosquito behaviour, host cues, airflow, temperature, humidity, product exposure, or other conditions relevant to the assay.	Tracking must measure behaviour without substantially changing the behaviour being measured.	Applicants could explain how potential system artefacts will be assessed and controlled.
Tracking capacity	*Minimum*: Ability to track at least 10 free-flying mosquitoes simultaneously during an overnight recording period. *Aspirational*: Ability to track higher mosquito densities while	Reflects the overall objective and the need to generate interpretable data from realistic overnight recordings.	Applicants could provide evidence of tracking performance, including mosquito numbers and recording duration.

	maintaining reliable individual trajectories and contact-event detection.		
Recording duration	*Minimum:* The system can record mosquito activity continuously or at appropriate intervals across the full overnight host-seeking period. *Aspirational*: The system can record mosquito activity continuously overnight and throughout the non-active resting portion of the day.	Overnight recording is required to capture relevant behavioural outcomes.	Applicants could specify maximum recording duration, data volume, battery or power requirements, and any need for operator intervention.
Spatial coverage	*Minimum*: The system can capture mosquito movement around the whole intervention area of interest, including a full ITN and surrounding space (the inside of an experimental hut), or an equivalent defined space around a spatial emanator. *Aspirational*: The system can record mosquito interactions and resting behaviours on wall and roof surfaces.	Whole-product coverage is needed to assess treated-zone interactions, avoidance, approach paths, and contact distribution.	Applicants could describe field of view, blind spots, calibration method, and whether three-dimensional tracking is available or feasible.
Data outputs and analysis			
Core behavioural outputs	*Minimum*: Outputs include flight path, approach behaviour, contact	Outputs should assist with explaining the behaviour underlying standard entomological	Applicants could provide example outputs, definitions of each metric,

	location, contact frequency and contact duration. *Aspirational*: Outputs include speed, turning behaviour, resting events, host approach, exit or avoidance behaviour, and repeated contact events by individual mosquitoes.	endpoints such as mortality, blood-feeding inhibition and deterrence.	and the level of automation used to generate them.
Timeliness of outputs	*Minium:* Processed outputs suitable for interpretation should be available within 10 days of completion of a recording night.	Analysis timelines need to be compatible with iterative product evaluation and development decision-making.	Applicants could describe expected processing time, computing requirements, and major causes of delay.
Data quality and validation	*Minimum:* The system includes defined quality-control procedures (for example: track completeness and contact-event classification). Performance should be benchmarked using appropriate validation datasets or manual annotation.	Confidence in behavioural outputs requires validation and repeatable quality-control procedures.	Applicants could propose validation methods, acceptable error thresholds, and approaches for handling incomplete or ambiguous tracks.
Data management	*Minimum*: The system includes practical arrangements for secure data storage, transfer, processing, archiving, and sharing, with clear file formats and metadata standards. *Aspirational*: The system allows for remote access of data. The system	Large overnight recordings and derived behavioural datasets must be manageable across multi-site studies and future comparative analyses.	Applicants could describe raw and processed data formats, storage requirements, data security and access arrangements.

	allows for use of artificial intelligence for data processing.		
Usability and implementation			
Installation and operation	*Minimum*: The system can be installed and operated in semi-field facilities with limited disruption to standard experimental hut procedures and without altering mosquito behaviour or product performance.	The tracking system must be compatible with practical product evaluation workflows.	Applicants could describe installation time, calibration procedures, staffing needs, training requirements, and operational constraints.
Field robustness	*Minimum*: The system is robust to heat and high humidity experienced in East and West Africa, dust, rain, insects, variable power supply, low-light conditions, and multi-year use in semi-field trial facilities.	Systems intended for IVCC-supported studies must withstand field-relevant environmental and operational conditions.	Applicants could describe environmental tolerances, maintenance requirements, spare parts, and failure modes.
Power and computing requirements	*Minimum*: The system has power and computing requirements that are feasible for field facilities, including options for backup power and local processing where internet connectivity is limited.	Operational feasibility depends on reliable power levels, manageable data volumes, and realistic computing infrastructure.	Applicants could specify power draw, backup-power requirements, computing hardware, software dependencies, and connectivity assumptions.
User burden	*Minimum*: The system minimises manual cleaning, annotation, and analysis. Any required manual steps should be clearly defined, time-bounded, and supported by standard operating procedures.	Low-burden analysis is essential for scalability and comparability across studies and facilities.	Applicants could estimate staff time per recording night and identify where automation is already available or still under development.

Safety, ethics and regulatory alignment			
Human host compatibility	*Minimum*: The system can be used safely in studies involving a human host, with no unacceptable risk from any equipment involved.	Human-host studies require appropriate safeguarding, ethics, and health-and-safety controls.	Applicants could describe relevant safety assessments, and mitigation measures.
Freedom to operate and access			
Software access and support	*Minimum*: Software access, licensing, updates, support, and maintenance arrangements are clear, sustainable, and compatible with IVCC-supported collaborative studies.	Long-term use requires clarity over access, version control, support, and dependency on proprietary tools.	Applicants could describe licensing model, update policy, support model, and any restrictions on use or publication.
Data ownership and publication	*Minimum*: Data ownership, access rights, confidentiality, publication rights, and reuse of analysis or derived datasets are clearly defined.	Collaborative product evaluation requires transparent arrangements for data use and dissemination.	Applicants could identify any constraints on data sharing, publication, analysis transparency, or independent validation.
Affordability and market fit			
Target cost	*Minimum*: Final total equipment and computing costs should preferably not exceed USD 50,000 for a deployable system suitable for use in one semi-field facility. *Aspirational*: The system should be modular and scalable across multiple sites/experimental huts.	Affordability is required for wider adoption across product evaluation facilities and multi-site studies.	Applicants could provide indicative costs for equipment, computing, software, maintenance, training, travel, and technical support.
Scalability and transferability	*Minimum*: The system can be transferred, installed, and operated across more than one semi-field	Multi-site comparability is important for future validation and broader product evaluation use.	Applicants could describe site requirements, training package,

	facility with appropriate training and support.		transferability constraints, and capacity-building approach.
Development timeline	*Minimum*: The approach has a credible pathway to meet the overall objective by Q4 2028, including milestones for prototype adaptation/development, semi-field testing and validation, data-analysis and operational readiness.	Timeline should align with IVCC's intended product evaluation needs.	Applicants could provide a milestone-based development plan, key risks, dependencies, and decision points.