# Appendix 2: Full Project Proposal Template (once the EoI is shortlisted)

**(1) Summary page**

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|  | **Mekong-ROK Cooperation Fund (MKCF)****Project Proposal** |

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| **Project Classification (check all that applies and underline the most key area)** |
| □ Culture and Tourism□ Human Resources Development□ Agriculture and Rural Development□ Infrastructure□ Information and Communication Technology (ICT)◼Environment□ Non-traditional Security Challenges |
| **Project Title** |
| A commercial prototype for the life cycle of solar panels in Mekong nations |
| **Brief Description of the Project** |
| Case study, software development, scientific research, educational event planning |
| **Country / Region** |
| Thailand  |
| **Budget** |
| Total budget (USD): 606,262.00Total budget requested from MKCF (USD): 606,262.00Total contribution if any including from third parties (USD): |
| **Proponent** |
| Name | Dr. Md Shahariar Chowdhury |
| Address | Faculty of Environmental Management, Prince of Songkla University |
| **Date of Submission** | 05/02/2024 |

**(2) Full Proposal Format**

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|  | **Mekong-ROK Cooperation Fund (MKCF)****Project Proposal** |
| **Project Information** |
| 1.1. Project Title | A commercial prototype for the life cycle of solar panels in Mekong nations |
| 1.2. Country (s) / Region | Thailand, Cambodia, Vietnam |
| 1.3. Date of Submission | 04/08/2023 |
| 1.4. Proponent Contact Details |
| Contact person, positionOrganisationEmail addressTelephone numberMailing address | Dr. Md Shahariar ChowdhuryResearcherHealth and Environmental Research Center, Faculty of Environmental Management, Prince of Songkla UniversityMdshahariar.c@psu.ac.th +66802641513Faculty of Environmental Management, Prince of Songkla University, Hatyai-90110, Songkhla, Thailand |
| 1.5. Project Area (check all that applies and underline the most key area) |
| □ Culture and Tourism□ Human Resources Development□ Agriculture and Rural Development□ Infrastructure□ Information and Communication Technology (ICT)◼ Environment□ Non-traditional Security Challenges |
| **Project Milestone** |
| Estimated implementation start dateEstimated implementation end dateProject duration | 01/03/202401/03/2026\_\_2\_\_\_\_ year(s) \_\_\_0\_\_\_ month(s) |
| **Description of Financial Elements** |
| Project cost (USD) | Contribution (USD) if any | Total Project Cost (USD) |
| *606,262.00* |  | 606,262.00 |
| **General description of organization (***approx. 500 words)* |
| *Prince of Songkla University (PSU) is an institution committed to pioneering innovation, academic excellence, and societal development. With a vision to evolve into a global standard research university, PSU aims to significantly influence sustainable development locally in Thailand, regionally, and globally. PSU is on a mission to foster academic leadership and groundbreaking innovations through focused research initiatives, with a special emphasis on Thailand's southern region development. It aims to create meaningful connections between the society and a global network, thereby propelling nationwide progress. PSU is devoted to educating world-class graduates, emphasizing not just academic prowess but also essential 21st-century skills, integrity, discipline, and a commitment to public service. This holistic approach to education is grounded in practical experiences, nurturing students to be well-rounded and competent individuals ready to meet global challenges. Embracing multi-culturalism and the principles of a sufficiency economy, PSU seeks to transform into a learning society that offers easy access to a variety of knowledge resources for the public. Ultimately, PSU is geared towards being a primary mechanism for the development and betterment of southern Thailand and the country as a whole.* |
| **Project background and justification** *(approx. 500 words)* |
| *The unprecedented decrease in the cost of solar PV technologies over the past half-decade has paved the way for the increased adoption of solar power in Thailand's energy sector. This aligns with the country's Alternative Energy Development Plan (AEDP 2012-2021), aiming to amplify the share of renewable energy to 25% of the total energy consumption by 2021. Such initiative has led to a drastic surge in the nation's solar power-generating capacity from 57 MW in 2010 to 2,640 MW by September 2017, and is anticipated to reach 6,000MW by 2036. This substantial growth, however, gives rise to a significant concern — solar waste. Thailand currently lacks a clear strategy to manage solar waste, with up to 246 tonnes being improperly discarded in local landfills over the past two decades. Projections suggest that by 2036, solar waste could escalate to 800,000 tonnes, mirroring the increasing popularity of solar power, particularly solar rooftop installations. Despite the country's full support for solar farm developers, it grapples with the challenge of managing the toxic waste from these projects. Comparatively, neighboring countries, such as Vietnam, Laos, and Cambodia, have also been investing in solar energy. Vietnam 16,500 MW, far surpassing the government’s target of 850 MW. The Lao government has approved feasibility studies for and the installation of 58 solar power plants around the country with a total installed capacity of 7,656 MW. In Cambodia installed solar PV totaled 376.8 MW in 2021, it was 296.80 MW of solar installed, representing 3.38% of the energy mix in 2020. Which will become waste within 2035 around 28200 metric tons. However, their projected solar waste is also staggering. Further east, South Korea, a leader in solar power, anticipates 1,222 tonnes of solar module waste by 2025, escalating to 9,632 tons by 2032. These issues underline the pressing need to address the solar waste management gap. Despite the immense potential of solar energy, it comes with inherent health and environmental risks, primarily concerning the disposal of used panels. Effective recycling methods need to be instituted to tackle this concern. Hazardous substances, such as lead, present in solar panels, need regulated disposal, as they could pose a threat to human health and the environment. Despite the European Union's (EU) stringent restrictions on the usage of hazardous substances in consumer electronics, stationary PV equipment is not yet subjected to these requirements. Amending the EU's regulations on Waste Electrical and Electronic Equipment (WEEE) in July 2012 included PV equipment and end-of-life (EOL) electronic products, setting a precedent that other nations could emulate. This approach necessitates the proper disposal of all electronic items in compliance with WEEE directives at the end of their working lifetime, emphasizing the importance of isolating hazardous materials before they can be recycled or treated. Given these considerations, the proposed project is justified as a critical initiative to tackle the mounting challenge of solar waste management, ensuring the sustainability of solar energy in the long term.* |
| **Problems (to be addressed)** *(approx. 300 words)* |
| *As renewable energy technologies, particularly solar power, have seen significant adoption in Mekong countries, the exponential increase in solar power-generating capacity has resulted in a concomitant growth in solar waste. Despite efforts to increase the share of renewable energy in total energy consumption, there is a substantial gap in strategies to manage the ensuing waste, particularly in Thailand. In the last two decades, approximately 246 tonnes of solar waste have been improperly discarded in local landfills. Projections suggest an alarming rise in solar waste to 800,000 tonnes by 2036, exacerbated by the growing popularity of solar rooftop installations. This situation is reflected across South Korea. South Korea, a leader in solar power, anticipates 1,222 metric tonnes of solar module waste by 2025, with Mekong countries like Vietnam, Laos, and Cambodia also generating substantial solar waste. The problem is further complicated by the inherent health and environmental risks associated with used solar panels. Hazardous substances, such as lead, that are present in solar panels necessitate regulated disposal to prevent potential threats to human health and the environment. The aim of this project is to underscore the necessity for stringent, widespread legislation that governs the disposal of solar waste, ensuring hazardous materials are appropriately isolated before recycling or treatment. Therefore, the primary problem to address is the lack of effective and universally enforced regulations and strategies for solar waste management. The challenge is to devise a comprehensive plan that not only facilitates the disposal and recycling of solar waste but also minimises the environmental and health risks associated with it. The problem is urgent, given the projected exponential increase in solar waste in the coming years, with long-term implications for the sustainability of solar energy and the broader renewable energy sector.**.* |
| **Project Objective (***approx. 500 words)* |
| *The primary objective of this project is to address the burgeoning issue of solar waste in Thailand, Vietnam, and Cambodia by understanding its current scope, forecasting future volumes, and implementing effective management strategies, thereby aligning with national, regional, and MKCF priorities for renewable energy and sustainable waste management.****Specific Objectives:****Conduct a field study of solar photovoltaic waste in Thailand, Vietnam, and Cambodia to accurately estimate current and projected volumes of solar panel waste in these countries. Develop Android and iOS applications to facilitate comprehensive data collection and analysis of solar PV waste across these countries, providing real-time information and contributing to more informed waste management strategies. Establish a sustainable system for recycling solar PV waste, leveraging advanced thermal and chemical treatments to process waste materials safely and effectively. Develop methods for the recovery of materials from processed solar waste and integrate these materials into the production of new solar cells, promoting a circular economy approach to solar PV production and disposal. Subsequently, proceed to develop a commercial prototype for life cycle assessment of the recycling of solar PV panels. As a final integral component of this project, we propose the organization of an educational awareness event. This gathering would serve as a platform to unite policymakers and key stakeholders from Thailand, Cambodia, Vietnam, and Mekong leadership.**The project aligns with (1) national strategies to transition to renewable energy while addressing waste issues; (2) regional priorities of Southeast Asia to manage the environmental impact of solar energy growth; and (3) MKCF priorities to promote sustainability, waste management, and innovation.* |
| **Project Description (***approx. 500 words)* |
| *The project's main activities are designed to directly contribute to the achievement of the outlined specific objectives. Below is a summary of these activities along with their linkages to the corresponding objectives.**Activity 1: Field Study - The project will initiate a detailed field study in Songkhla,Thailand, Vietnam, and Cambodia to assess the current status of solar PV waste and estimate its future waste volumes. This study is a critical first step in establishing a baseline understanding of the extent of the problem (Objective 1).**Activity 2: Development of Mobile Apps - This phase involves the technical development and deployment of Android and iOS applications. These applications will allow for real-time collation and analysis of data on solar PV waste, which is essential in formulating strategic waste management plans (Objective 2).**Activity 3: Recycling Process Setup - In this activity, the project team will establish facilities for recycling solar PV waste through thermal and chemical treatment processes in Thailand. This step directly contributes to the objective of creating a sustainable and efficient system for solar PV waste management (Objective 3).**Activity 4: Material Recovery and Solar Cell Production - The project team will explore methods for recovering valuable materials from processed solar waste. This activity, culminating in the reproduction of new solar cells, underlines the commitment to a circular economy approach and directly relates to Objective 4.**Activity 5: Organizing Educational Awareness Event - The project will culminate with an educational event, bringing together policymakers, stakeholders, and leaders from Thailand, Cambodia, Vietnam, and the Mekong region. This event aims to foster collaboration and stimulate dialogue on mandating solar panel recycling by manufacturers, contributing directly to the objective of driving legislative changes (Objective 5).**Each of these activities is interlinked and progressive, thereby ensuring a systematic approach towards achieving the project's overall objective of effective solar waste management.* |
| **Regional nature of the project** *(with the maximum length of approx. 300 words)* |
| *Songkhla, Thailand: These provinces are characterized by high solar irradiance levels, making them ideal for solar energy projects. The diverse topography across these locations provides an excellent opportunity to study the performance of solar panels under different environmental conditions, such as varying humidity and temperature.**Dak Lak Province, Vietnam: Dak Lak's geographical position on the Central Highlands offers unique climatic conditions conducive to solar power generation. The province has seen increasing interest in renewable energy projects, supported by the government's commitment to sustainable development.**Banteay Meanchey Province, Cambodia: This province is selected for its rapidly growing demand for electricity and its strategic location near the Thai border, facilitating cross-border collaboration and knowledge sharing in renewable energy technologies.*  |
| **Partnership with organisation(s) in Mekong countries and RoK** *(approx. 300 words)* |
| *In this project, institutions from Thailand, Cambodia, and Vietnam collaborate in a concerted effort. Prince of Songkla University (Thailand), National University of Meanchey (Cambodia), and Tay Nguyen University (Vietnam) actively participate in joint field studies and educational events. These universities, bound by official Memorandums of Understanding (MOUs), conduct their work in a spirit of academic cooperation and shared endeavor. At Prince of Songkla University, specialized scientific research is underway, focusing on the recycling of solar panels and the fabrication of solar cells. Moreover, this institution spearheads the development of applications pertinent to this project.* |
| **Target beneficiaries and Project Coverage (***approx. 300 words)* |
| *Direct Beneficiaries include:**Solar Panel Manufacturers: By providing a sustainable method for disposing of end-of-life panels, manufacturers can enhance their sustainability credentials and potentially reduce production costs by reusing recycled materials.**Recycling Companies: The project offers an opportunity to expand into a new market, leveraging innovative recycling technologies to process solar panel waste efficiently.**Local Governments: With an effective recycling program in place, municipalities can achieve significant waste reduction goals, mitigating landfill use and environmental pollution.**Indirect Beneficiaries encompass:**Local Communities: Improved environmental quality and the creation of green jobs contribute to healthier living conditions and economic opportunities.**Energy Sector: The project sets a precedent for sustainable practices in the energy industry, encouraging the adoption of renewable energy by demonstrating responsibility throughout the solar panel life cycle.**Geographical Coverage: The project's geographic scope spans across three key provinces in the Mekong region, each chosen for their significant potential for solar energy utilization and the need for sustainable waste management solutions. Songkhla Province, with its burgeoning solar energy sector, stands to benefit from innovative recycling technologies. Dak Lak Province, a leader in Vietnam's solar power boom, offers a vast market for the project's recycling services. Banteay Meanchey Province, representing Cambodia's commitment to renewable energy, provides a strategic location for promoting solar panel recycling in the country. Collectively, these areas offer a diverse testing ground for the project, ensuring its applicability across different environmental, economic, and social contexts within the Mekong region.* |
| **Value Add for the MKCF Involvement/ Potential (***approx. 300 words)* |
| *Recycling solar photovoltaic (PV) panels can bring several potential benefits to the Mekong countries (Cambodia, Laos, Myanmar, Thailand, and Vietnam), contributing to sustainable development, economic growth, and environmental protection.**Economic Opportunities: By developing solar PV recycling facilities, Mekong countries could create new jobs and stimulate local economies. This sector could also promote innovation and attract investment in green technologies.**Resource Efficiency: Solar panels contain valuable materials such as silicon, glass, and various metals. Through effective recycling, these resources can be reclaimed and reused, reducing the demand for raw materials, and thereby contributing to the circular economy.**Energy Security: Solar power is a renewable source of energy. By focusing on the lifecycle of solar panels, including recycling, Mekong countries can increase their energy security, reducing reliance on imported fossil fuels.**Environmental Protection: Solar panel recycling can help minimize waste going into landfills. This reduces the potential for toxic materials leaching into the environment and contributing to pollution.**Climate Change Mitigation: Recycling solar panels helps reduce greenhouse gas emissions by reclaiming materials that would otherwise require energy to extract and process.**Policy and Regulatory Framework: Implementing a solar PV recycling project could lead to the development of regulations and standards in the renewable energy sector. This could also stimulate policy dialogue and cooperation among the Mekong countries.**Knowledge and Skill Development: A solar PV recycling project could enhance technical knowledge and skills in the region, particularly in the fields of renewable energy and waste management.**It's important to note that realizing these potential benefits would require careful planning and policy support, and the exact benefits might vary depending on the specific circumstances in each country.* |
| **Project Sustainability** *(approx.300 words)* |
| *Localized Economic Models: The project will adapt its business model to the specific economic conditions of Songkhla, Dak Lak, and Banteay Meanchey. By creating a market for recycled solar panel materials and engaging with local manufacturers, it aims to ensure financial sustainability and reduce reliance on external funding.**Regulatory Engagement and Support: Collaborating closely with the governments of Thailand, Vietnam, and Cambodia to foster supportive policy environments is crucial. This involves advocating for incentives for solar recycling, establishing mandatory recycling regulations, and potentially introducing tariffs on landfill disposal to encourage recycling.**Community and Stakeholder Engagement: Tailored community engagement strategies will be developed for each project area, involving local stakeholders in the recycling process. This includes partnerships with local solar panel manufacturers, waste management entities, and community organizations to build support and ensure the project's social acceptability.**Capacity Building and Skill Development: The project will invest in training programs for local workers in each province, enhancing their technical skills related to solar panel recycling and ensuring the project's operational efficiency and sustainability, even with staff turnover.**Innovation and Adaptation: Ongoing collaboration with research institutions will enable the project to stay at the forefront of recycling technologies, ensuring its processes remain efficient, cost-effective, and environmentally friendly.**Environmental Stewardship: Implementing best practices to minimize the environmental impact of recycling operations, including energy-efficient machinery and safe handling of hazardous materials, will ensure the project's environmental sustainability.*  |
| **Management Arrangements** *(approx. 500 words)* |
| *Project Management Structure:**The project management structure outlines how the project will be organized and managed. It typically includes roles, responsibilities, and reporting lines. The key elements of the project management structure may include:**Project Manager: Responsible for overall project planning, execution, and control.**Project Coordinator: Project coordinators play a central and multifaceted role in project management, acting as a bridge between different stakeholders, team members, and project managers.**Project Team: Comprised of individuals with specific roles and expertise relevant to the project's objectives.**Working Groups: Specialized teams formed to handle specific aspects or components of the project.**Consultant: External experts offer guidance and recommendations for the project.**Reporting Channels: Clearly defined lines of communication and reporting to ensure transparency and accountability.**Coordination Mechanism with Mekong Country Partners:**To ensure effective collaboration with Mekong country partners, the project should establish a coordination mechanism that fosters regular communication and engagement.* *Regular Meetings., Joint Workshops and Seminars Information Sharing**Coordination with Relevant Stakeholders:**Apart from Mekong country partners, other relevant stakeholders should be included in the coordination mechanism. This could include NGOs, local communities, private sector partners, and other organizations contributing to or impacted by the project.*Implementation Arrangement of Joint Activities with Partner Organisations:The implementation arrangement refers to joint activities with partner organisations in the Mekong countries and/or RoK will be planned and executed. In this project, three countries collaborate with three different universities, namely Prince of Songkla University, National of Meanchey University, and Tay Nguyen University. It follows the following information:Collaborative Planning: Jointly developing project case study activities and objectives with partner organisations to align with their priorities and expertiseResource Allocation: Determining how resources, such as funding, equipment, and manpower, will be shared or allocated among partnersRoles and Responsibilities: Clearly defining the roles and responsibilities of each partner in executing joint activitiesMonitoring and Evaluation: Establishing mechanisms to monitor the progress and impact of joint activities and evaluating their effectivenessOverall, a well-designed management arrangement considers the specific needs and context of the project, promotes effective communication, fosters collaboration, and ensures a smooth implementation process. It should be flexible enough to adapt to changing circumstances while maintaining a focus on achieving project goals and objectives.***Coordination with MKCF Secretariat and MoFA:****The project establishes a clear line of communication with the MKCF secretariat and MoFA, as these entities may play a role in providing support, funding, or strategic guidance. Regular updates, progress reports, and engagement sessions can help maintain a positive relationship with these entities.* |
| **Outcomes, Outputs, Activities and Inputs at Project level** |
| Expected Result | Indicator | Means of Verification | Target | Remarks |
| Mid-term | Final |
| Project outcomes |
| 1. Enhanced Knowledge from Data Collection on Solar PV Waste | Improvement in stakeholders' knowledge about solar PV waste management. | Pre- and post-intervention surveys | - | 10% increase in stakeholder knowledge of solar PV waste management | Focuses on raising awareness and understanding through data collection insights |
| 2. Improving Sustainability through Effective Solar PV Recycling | Implementation of new or improved solar PV recycling practices | Reports on recycling protocols and process efficiencies. | - | innovative recycling method for solar PV recycling  | Emphasizes the adoption of sustainable recycling methods as a direct result of enhanced knowledge |
| 3. Implementing Renewable Energy Practices via a Commercial Prototype | Deployment and usage rate of the commercial prototype | Usage data and feedback from stakeholders | - | Prototype in use by 30% of target stakeholders in study area | Highlights the application of research and recycling improvements in a commercial setting, showcasing practical benefits. |
| Project outputs (that contribute to outcomes) |
| 1. Development and utilization of a database for lab-scale solar cell recycling process. | Number of lab-scale recycling processes documented and supported by the database | Database logs and recycling process documentation. | Database supports at least 50% of planned recycling processes | Supports 100% of recycling processes. | Focus on expanding the database's functionality and content to cover all planned recycling processes |
| 2. Formation of a business prototype for managing solar PV waste. | Completion and operational status of the business prototype. | Prototype development reports and operational data. | Prototype design and initial testing completed. | Fully functional prototype (100%). | Based on field studies, app development, and lab research to assess recycling impact. |
| Activities | Description |
| * 1. Case study
 | A case study conducted across Songkhla Province in Thailand, Dak Lak Province in Vietnam, and Banteay Meanchey Province in Cambodia to evaluate the current status of solar PV waste management |
| * 1. Data collection
 | The project will gather both quantitative and qualitative data across Songkhla Province (Thailand), Dak Lak Province (Vietnam), and Banteay Meanchey Province (Cambodia), including solar panel efficiency, volume of solar PV waste (generated, recycled, disposed), and detailed capacity of Solar PV installations, alongside insights from interviews, surveys, and focus groups with stakeholders (government officials, recycling firms, solar PV experts, environmental organizations) to analyze trends, disparities, and commonalities in recycling methods, obstacles, and policy efficacy, culminating in a SWOT analysis on solar PV waste recycling in each country. |
| 1.3. Database Development | Real-time collation and analysis of data on solar PV waste, which is essential in formulating strategic waste management plans. |
| 2.1. Lab scale Solar cell recycling | Recycling solar PV waste through thermal and chemical treatment processes in Thailand (Prince of Songkla University), Recovering valuable materials from processed solar waste to produce new solar cells, Materials recovered will be repurposed to produce new solar PV panels. |
| 3.1 Commercial PV Recycling Prototype  | solar PV waste recycling for a commercial solar PV recycling prototype |
| 4.1 Organizing Educational Awareness Event | Promote collaboration and stimulate dialogue on mandating solar panel recycling by manufacturers.  |

**Monitoring and Evaluation (M&E) Framework**

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| **HIERARCHY OF RESULTS** | **RESULT STATEMENT(S)** | **OBJECTIVELY VERIFIABLE INDICATORS (OVIs)** | **DEFINITION** | **BASELINE** | **TARGET** | **DATA SOURCE / MEANS OF VERIFICATION**  | **FREQUENCY** | **RESPONSIBLE** | **REPORTING**  |
| How is it calculated? | What is the current value? | What is the target value? | How will it be measured? | How often will it be measured? | Who will measure it? | Where will it be reported? |
| **Impacts** | Reduced carbon footprint and contribution to the circular economy through solar PV waste recycling and policy development. | Cost savings, time efficiency, CO2 reduction, and resource savings from recycling and prototype production. | Life cycle assessment results and efficiency data of recycling processes. | Baseline environmental data | Quantifiable improvements in cost, time, CO2 reduction, and resource savings | Life cycle assessments, project records |  Annual  |  Project manager | MI  |
| **Outcomes** | Enhanced knowledge from data collection on solar PV waste and improving sustainability through effective solar PV recycling by implementing renewable energy practices via a commercial prototype. | Systematic assessment of the commercial prototype's impact on sustainability, environmental harm reduction, solar panel lifespan extension, cost savings, and improved renewable energy practices. . | Detailed metrics of the prototype's impact on sustainability and environmental practices. |  No available data |  10% increase in stakeholder knowledge on solar PV waste management, a 10% increase in the volume of waste data collected, and a 10% increase in the adoption rate of the commercial prototype | Survey data, environmental impact reports | Every 6 months   |  Project manager  | MI  |
| **Outputs** | A database will be developed to support lab-scale solar cell recycling process development, leading to a business prototype for managing solar PV waste in Songkhla, Dak Lak, and Banteay Meanchey provinces | Number and quality of solar PV waste collections; functionality and usage of the digital database | Metrics detailing waste collection amounts and database usage statistics |  Laboratory scale research | To establish a fully operational waste collection system and a comprehensive database across Songkhla, Dak Lak, and Banteay Meanchey provinces, alongside developing a prototype for efficient solar PV waste recycling |  Waste collection records, database logs |  6 months  |  Project manager | MI  |
| Enhanced empowerment of local manufacturers and stakeholders through educational workshops on solar PV recycling. | Number of workshops held; number of participants trained; app usage statistics. | Evaluation data on workshop effectiveness and app engagement levels. |  Pre-workshop survey data | Three workshops will be organized in each country, targeting the participation of 25 individuals from manufacturing, distribution, supply sectors, as well as stakeholders, local communities, and policymakers. Success will be measured by the attendance rates at these workshops and the subsequent increase in app usage, with the aim of enhancing engagement within the solar PV recycling sector | Workshop records, app analytics |  After each workshop |  Project manager | MI  |

# Appendix 3: [proposal package] Indicative budget

*The budget should be presented in this section and provided in a separate Excel file*

# Appendix 4: [proposal package] Indicative Work Plan

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|  | Month |
| Task | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| ***Output 1. (Result Statement****)* | *Total budget 322230.50 USD* |
| *Activity 1. Case study, efficiency measurement, data collection, field visit, data analysis, development of apps, recycling process setup* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ***Output 2. (Result Statement)*** | *Total budget 161516.50 USD* |
| *Activity 2 Recycling Process Setup, solar cell recycling and materials recovery, cooperation with solar PV company*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ***Output 3. (Result Statement*** | *Total budget 122515.00 USD* |
| *Activity 3. Commercial PV Recycling Prototype, organizing an educational awareness event, final report submission* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

# Appendix 5: TOR

**TERMS OF REFERENCE OF KEY PROJECT CONTRACTED PERSONNEL**

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| **No.** | **Name** | **Organization** | **Position** | **e-mail /phone** | **Remarks** |
| **1** | Dr Md Shahariar Chowdhury | Prince of Songkla University | Project Manager | Mdshahariar.c@psu.ac.th  | TOR No. 1 |
| **2** | Associate Professor Dr. Theerakamol Pengsakul | Prince of Songkla University | Project Coordinator  | theerakamol.p@psu.ac.th | TOR No. 2 |
| **3** | Prof. Dr Chia Chin Hua | Universiti Kebangsaan Malaysia | Consultant | chia@ukm.edu.my | TOR No. 3 |
| **4** | Dr. Ian Marius Peters, | Forschungszentrum Jülich GmbH | Consultant | ian.marius.peters@gmail.com | TOR No. 4 |
| **5** | Dr Veu Thangrak | National of Meanchey University | Consultant | veu.thangrak@nmu.edu.kh | TOR No. 5 |
| **6** | Dr Ao Xuan Hoa | Tay Nguyen University | Consultant | aoxuanhoa@ttn.edu.vn | TOR No. 6 |
| **7** | Dr Tofan Agung Eka Prasetya | Universitas Airlangga | Consultant | tofan-agung-e-p@vokasi.unair.ac.id | TOR No7 |
| **8** | Dr. Jin Seok Lee | Korea Institute of Energy Research | Consultant | jslee@kier.re.kr | TOR NO.8 |

**TERMS OF REFERENCE OF FULL-TIME PROJECT STAFF**

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| TOR No. 1 |
| **Position** | Project Manager |
| **Duty Station** | Full time  |
| **Responsibilities** |  * Lead project planning, execution, and evaluation.
* Manage resources, timelines, and stakeholder communication.
* Oversee risk and quality management, ensuring sustainability and compliance.
 |
| **Expertise**  | Solar cell, Semiconductor materials, E-waste recycling, Solar PV recycling |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |

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| TOR No. 3 |
| **Position** | Project Coordinator |
| **Duty Station** | Full time  |
| **Responsibilities** | * Assist with project operations, scheduling, and documentation.
* Support resource management and team communication.
* Help in monitoring project progress and addressing issues.
 |
| **Expertise** | Public Health and Safety Promotion, Environmental Management Practices, Comprehensive Surveying, Monitoring, and Prevention Strategies |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |

**TERMS OF REFERENCE OF CONSULTANTS/EXPERTS**

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| TOR No. 3 |
| **Position** | Consultant  |
| **Duty Station** | Field /Lab |
| **Responsibilities** | Activities 1, 2 and 3 |
| **Expertise**  | Nanomaterials & Nanocomposites, Waste management, wastewater treatment  |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |
| TOR No. 4 |
| **Position** | Consultant |
| **Duty Station** | Field /Lab |
| **Responsibilities** | Activities 1, 2 and 3 |
| **Expertise** | Machine learning, advanced computer simulation, optics and photonics, Solar cells, Solar PV recycling |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |
|  TOR No. 5 |
| **Position** | Expertise  |
| **Duty Station** | Field /Lab |
| **Responsibilities** |  Activities 1, and 3 |
| **Expertise** | Environmental Management, climate change, agriculture, and leadership |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |
|  TOR No. 6 |
| **Position** | Expertise |
| **Duty Station** | Field /Lab |
| **Responsibilities** | Activities 1, and 3 |
| **Expertise** | Economics development, economics Value, chain analysis, Sustainable energy |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |
|  |  TOR No. 7  |
| **Position** | Expertise |
| **Duty Station** | Field /Lab |
| **Expertise** | Hazardous materials, Occupational Health and Safety Management Systems, Chemical management, Chemical recycling.  |
| **Responsibilities** | Activities 1, 2 and 3 |
| **Requirements** | PhD |
| **Date** | 04/08/2023 |
|  |  TOR No. 8  |
| **Position** | Consultant |
| **Duty Station** | Field /Lab |
| **Expertise** | Energy storage, Solar cells, Solar PV recycling  |
| **Responsibilities** | Activities 1, 2 and 3 |
| **Requirements** | PhD |
| **Date** | 04/02/2024 |

# Appendix 6: CV

CVs of Proposed Project Team with passport-size photo

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| 1. **Name:** Dr Md Shahariar Chowdhury
2. **Proponent Organization:** Health and Environmental Research Center**,** Faculty of Environmental Management, Prince of Songkla University
3. **Proposed Position:** Project Manager
4. **Date of Birth:**  20/11/1987 **Nationality**: Bangladesh
5. **Complete personal contact details:**

Address: Room # 402/3, Level# 4, Faculty of Environmental Management, Prince of Songkla University, Hatyai-90110, Songkhla, Thailand Mobile: +66802641513Email: mdshahariar.c@psu.ac.th 1. **Education:**
* Doctor of Philosophy: Sustainable Energy Management (2023), Prince of Songkla University, Hatyai, Songkhla, Thailand
* Master of Science: Sustainable Energy Management (2019), Prince of Songkla University, Hatyai, Songkhla, Thailand
* Bachelor of Science: Electrical and Electronic Engineering (2015), Atish Dipankar University Science & Technology (ADUST), Uttara, Dhaka, Bangladesh
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|  |
| 1. **Membership in Professional Associations:**
 |
| * American Chemical Society; Membership number: 33358271
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| 1. **Other Trainings:**
 |
| * Thailand One Health University Network (THOHUN) Training, Nakhon Pathum, 2023
* TERRA School transdisciplinary research workshop (TD) (2022) for Early-career Researchers in Asia School at Research Institute for Humanity and Nature and Future Earth Japan
* SEED Symposium Bangkok 2020, Beyond Exchange: Empowering Green and Inclusive Partnerships to Promote Eco-Inclusive Entrepreneurship for Sustainable Development.
* Training on MESSAGE Modelling Tool on 1-3 May 2018 at Golden Crown Grand Hotel, Hat Yai, Songkhla, Thailand
* Workshop on Raman Spectroscopy in Science and Technology, Faculty of Science, Universiti Putra Malaysia, 29 January 2019
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| 1. **Countries of Work Experience:** [in the last 10 years]
* Malaysia, Thailand, Bangladesh, Indonesia
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| 1. **Languages:** [Mother Tongue/Excellent/Good/Fair/Poor]
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| **Language** | **Speaking** | **Reading** | **Writing** |
| * English
* Bangla
* Thai
* Hindi
 | ExcellentMother TonguepoorExcellent | Excellent Mother TonguePoorPoor | GoodMother TonguePoorPoor |
|  |  |  |  |
| 1. **Employment Record:**
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| --- | --- | --- | --- | --- |
| **Date from -to** | **Location** | **Employer organizations and reference persons**  | **Position** | **Work Undertaken that Best illustrates Capability to Handle the project** |
| 2020-Present | *Hatyai,**Thailand* | Prince of Songkla University | *Lecturer* | *Academic & research* |
| 2023- Present  | *Hatyai* | Health and Environmental Research Center, Faculty of Environmental Management, Prince of Songkla University | *Director* | *Management & Research* |
| 2023- Present  | *Nilai, Negeri Sembilan,**Malaysia* | Faculty of Health and Life Sciences, Inti International University | *Research Fellow* | *Research* |
| 2023- Present | *Indonesia* | Faculty of Vocational Studies Airlangga University | *Visiting* *Lecturer* | *Teaching Hazardous materials* |
| 2019-2020 | *HatYai,**Thailand* | Environmental Assessment and Technology for Hazardous Waste Management Research Center, Prince of Songkla University | *Researcher* | *Research* |

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| **Research Grants Received**

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| --- | --- | --- | --- | --- |
| ***Project Title*** | ***Source of Funding*** | ***Period******(Year t Year)*** | ***Total Budget******(US $)*** | ***Role******(PI or Co-Invstigator)*** |
| * Sustainable Energy Management and Solar Cell Recycling
 | Fundamental Fund: FF Year 2022(PSU) | 2021-2024 | US$ 100000 | Co-Investigator |
| * ZeroT waste recycling for laboratory-scale solar panels
 | Scholars Scholarship Year 2022 (PSU) | 2022-2023 | US$ 15000 | Researcher  |
| * Solar PV Waste effect on human health: current knowledge, attitude, perception, and practices among university students
 | SATU 2022 Joint research scheme (JRS) | 2023 | US$ 3000 | Researcher  |

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| **Other relevant information (**e.g., Publications**)**1. Hossain, S., Rokonuzzaman, M., Rahman, K.S., Habib, A.A., Tan, W.S., Mahmud, M., **Chowdhury, S.** and Channumsin, S., 2023. Grid-Vehicle-Grid (G2V2G) Efficient Power Transmission: An Overview of Concept, Operations, Benefits, Concerns, and Future Challenges. Sustainability, 15(7), p.5782.2. Doroody, C., Rahman, K.S., Chelvanathan, P., Ibrahim, M.A., Sopian, K., Amin, N., **Chowdhury, S**. and Channumsin, S., 2023. Incorporation of Magnesium-doped Zinc Oxide (MZO) HRT Layer in Cadmium Telluride (CdTe) Solar Cells. Results in Physics, 47, p.106337.3. Naveena, B.E., Keshavamurthy, R., Muthiya\*, S.J., Dhanraj, J.A., Sirisamphanwong, C., Channumsin, S\*., Channumsi, M. and **Chowdhury, S\*.,** 2023. Effect of plasma sprayed flyash based composite coatings on corrosion resistance. Heliyon, 9(4).4. **Chowdhury, S**., Najm, A.S., Luengchavanon, M., Holi, A.M., Chia, C.H., Techato, K., Channumsin, S. and Salih, I.K., 2023. Investigating the Effect of Nonideal Conditions on the Performance of a Planar Sb2Se3-Based Solar Cell through SCAPS-1D Simulation. Energy & Fuels, 37(9), pp.6722-6732.5. Kushwaha, A.K., Khan, W., AlQahtani, H.R., Laref, A., Monir, M.E.A., Nya, F.T., **Chowdhury, S.,** Alghamdi, E.A., Huang, H.M., Xiong, Y.C. and Yang, J.T., 2023. First-principles assessments of the electronic, and magneto-optical characteristics of Fe–Mn co-doped anatase TiO2 for photo-catalysis applications. Solid State Communications, 360, p.115059.6. Al-Amer, R., Khan, W., Laref, A., AlQahtani, H.R., Murtaza, G., Mahmood, Q., Nya, F.T., **Chowdhury, S.,** Monir, M.E.A., Alghamdi, E.A. and Huang, H.M., 2023. The carriers doping effect on electronic and optical behaviors of newly layered Sr1-xHfxFBiS2 alloying materials for light-modulator devices. Journal of Physics and Chemistry of Solids, 173, p.111097.7. Ait Lahoussine Ouali, H., Alami Merrouni, A., **Chowdhury, S**., Techato, K., Channumsin, S. and Ullah, N., 2022. Optimization and Techno-Economic Appraisal of Parabolic Trough Solar Power Plant under Different Scenarios: A Case Study of Morocco. Energies, 15(22), p.8485.8. Mostafaeipour, A., Jahangiri, M., Saghaei, H., Raiesi Goojani, A., **Chowdhury, M**. and Techato, K., 2022. Impact of Different Solar Trackers on Hydrogen Production: A Case Study in Iran. International Journal of Photoenergy, 2022.9. Thep-On, L., **Chowdhury, S**., Taechato, K.A., Kumar, A. and Chanakaewsomboon, I., 2022. Optimization of Biomass Fuel Composition for Rubber Glove Manufacturing in Thailand. Sustainability, 14(19), p.12493.10. Alam, S., Rahman, K.S., Rokonuzzaman, M., Salam, P.A., Miah, M.S., Das, N., **Chowdhury, S**., Channumsin, S., Sreesawet, S. and Channumsin, M., 2022. Selection of Waste to Energy Technologies for Municipal Solid Waste Management—Towards Achieving Sustainable Development Goals. Sustainability, 14(19), p.11913.11. Mughees, M., Sadaf, M., Erteza Gelani, H., Bilal, A., Saeed, F., **Chowdhury, M.S**., Techato, K., Channumsin, S. and Ullah, N., 2022. Comparison of Efficiency-Based Optimal Load Distribution for Modular SSTs with Biologically Inspired Optimization Algorithms. Electronics, 11(13), p.1988.12. Hussain, I., Khalil, I.U., Islam, A., Ahsan, M.U., Iqbal, T., **Chowdhury, M.S**., Techato, K. and Ullah, N., 2022. Unified Fuzzy Logic Based Approach for Detection and Classification of PV Faults Using IV Trend Line. Energies, 15(14), p.5106.13. Dhanraj, J.A., Alkhawaldeh, R.S., De, P.V., Sugumaran, V., Ali, N., Lakshmaiya, N., Chaurasiya, P.K., Priyadharsini, S., Velmurugan, K., **Chowdhury, M.S**. and Channumsin, S., 2022. Appraising machine learning classifiers for discriminating rotor condition in 50W-12V operational wind turbine for maximizing wind energy production through feature extraction and selection process. Frontiers in Energy Research, 10.14. Ait Lahoussine Ouali, H., Alami Merrouni, A., **Chowdhury, S**., Techato, K., Channumsin, S. and Ullah, N., 2022. Optimization and Techno-Economic Appraisal of Parabolic Trough Solar Power Plant under Different Scenarios: A Case Study of Morocco. Energies, 15(22), p.8485.15. Abbas, S., Bajgai, S., **Chowdhury, S.,** Najm, A.S., Jamal, M.S., Techato, K., Channumsin, S., Sreesawet, S., Channumsin, M., Laref, A. and Rahman, K.S., 2022. Numerical Simulation of the Performance of Sb2Se3 Solar Cell via Optimizing the Optoelectronic Properties Based SCAPD—1D. Materials, 15(18), p.6272.16. Najm, A.S., Alwash, S.A., Sulaiman, N.H., **Chowdhury, M.S.** and Techato, K., 2022. N719 dye as a sensitizer for dye‐sensitized solar cells (DSSCs): A review of its functions and certain rudimentary principles. Environmental Progress & Sustainable Energy, p.e13955.17. Erteza Gelani, H., Dastgeer, F., Ali Shah, S.A., Saeed, F., Hassan Yousuf, M., Afzal, H.M.W., Bilal, A., **Chowdhury, M.S.,** Techato, K., Channumsin, S. and Ullah, N., 2022. Comparative Efficiency and Sensitivity Analysis of AC and DC Power Distribution Paradigms for Residential Localities. Sustainability, 14(13), p.8220.18. Wahyuni, H., Aladin, A., Kalla, R., Nouman, M., Ardimas, A. and **Chowdhury, M.S**., 2022. Utilization of Industrial Flour Waste as Biobriquette Adhesive: Application on Pyrolysis Biobriquette Sawdust Red Teak Wood. International Journal of Hydrological and Environmental for Sustainability, 1(2), pp.54-69.19. Ali, F., Bennui, A., **Chowdhury, S**. and Techato, K., 2022. Suitable Site Selection for Solar-Based Green Hydrogen in Southern Thailand Using GIS-MCDM Approach. Sustainability, 14(11), p.6597.20. Khac, D.L., **Chowdhury, S**., Luengchavanon, M., Jamal, M.S., Laref, A., Techato, K., Sreesawet, S., Channumsin, S. and Chia, C.H., 2022. Influence/Effect of Deep-Level Defect of Absorber Layer and n/i Interface on the Performance of Antimony Triselenide Solar Cells by Numerical Simulation. Sustainability, [online] 14(11), p.6780.21. Kongklaew, C., Phoungthong, K., Prabpayak, C., **Chowdhury, Md.S**., Khan, I., Yuangyai, N., Yuangyai, C. & Techato, K. (2021). Barriers to Electric Vehicle Adoption in Thailand. Sustainability. . 13 (22). p.p. 12839.22. Gyawali, S., Goni, L.K.M.O., **Chowdhury, M.S**., Laref, A., Bajgai, S., Chantrapromma, S. and Techato, K., 2022. Effect of KOH concentration on the properties of ZnO nanoparticles. Materials Research Express, 9(5), p.055004.23. Pandey, R.R., Jutidamrongphan, W., Gyawali, S. and **Chowdhury, M.S**., 2022. Managing Sustainable Energy Projects: A Review on Success Factors. NeuroQuantology, 20(5), pp.215-230.24. Ali, L., Palamanit, A., Techato, K., Ullah, A., **Chowdhury, M.S**. and Phoungthong, K., 2022. Characteristics of Biochars Derived from the Pyrolysis and Co-Pyrolysis of Rubberwood Sawdust and Sewage Sludge for Further Applications. Sustainability, 14(7), p.3829.25. Khan, I., **Chowdhury, S**. and Techato, K., 2022. Waste to Energy in Developing Countries—A Rapid Review: Opportunities, Challenges, and Policies in Selected Countries of Sub-Saharan Africa and South Asia towards Sustainability. Sustainability, 14(7), p.3740.26. Rezaei, M., Sefid, M., Almutairi, K., Mostafaeipour, A., Ao, H.X., Dehshiri, S.J.H., Dehshiri, S.S.H., **Chowdhury, S**. and Techato, K., 2022. Investigating performance of a new design of forced convection solar dryer. Sustainable Energy Technologies and Assessments, 50, p.101863.27. Velmurugan, K., Elavarasan, R.M., De, P.V., Karthikeyan, V., Korukonda, T.B., Dhanraj, J.A., Emsaeng, K., **Chowdhury, M.S.,** Techato, K., El Khier, B.S.A. and Attia, E.A., 2022. A Review of Heat Batteries Based PV Module Cooling—Case Studies on Performance Enhancement of Large-Scale Solar PV System. Sustainability, 14(4), p.1963.28. Ninwijit, T., Palamnit, A., Luengchavanon, M., Marthosa, S., Osman, N., **Chowdhury**, M.S. and Niyomwas, S., 2022. Analysis of electric signals from micro-solid oxide fuel cell sensors detecting methane biogas. BioResources, 17(1), p.281.29. Kaewsichan, L., Techato, K., Qaisrani, Z.N., **Chowdhury, M.S**. and Yilmaz, M., 2022. Elimination of selected heavy metals from aqueous solutions using biochar and bentonite composite monolith in a fixed-bed operation. Journal of Environmental Chemical Engineering, 10(1), p.106993.30. Mostafaeipour, A., Zarezade, M., Soltani, S.R.K., Dehshiri, S.J.H., Dehshiri, S.S.H., Xuan, H.A., Dhanraj, J.A., Techato, K., **Chowdhury, S**. and Issakhov, A., 2022. A conceptual new model for use of solar water heaters in hot and dry regions. Sustainable Energy Technologies and Assessments, 49, p.101710.31. 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Sobayel, M.K., **Chowdhury, M.S.,** Hossain, T., Alkhammash, H.I., Islam, S., Shahiduzzaman, M., Akhtaruzzaman, M., Techato, K. and Rashid, M.J., 2021. Efficiency enhancement of CIGS solar cell by cubic silicon carbide as prospective buffer layer. Solar Energy, 224, pp.271-278.38. **Chowdhury, M.S**., Rahman, K.S., Selvanathan, V., Nuthammachot, N., Suklueng, M., Mostafaeipour, A., Habib, A., Akhtaruzzaman, M., Amin, N. and Techato, K., 2021. Current trends and prospects of tidal energy technology. Environment, development and sustainability, 23(6), pp.8179-8194.39. Sedaghat, A., Abbas Oloomi, S.A., Malayer, M.A., Alkhatib, F., Sabri, F., Sabati, M., Salem, H., Zafar, W.J., Mostafaeipour, A., Issakhov, A. and Jahangiri, M.,Kuaanan Techato,**Cowdhury.S** 2021. Effects of Window Films in Thermo-Solar Properties of Office Buildings in Hot-Arid Climates. Frontiers in Energy Research, 9, p.173.40. Jha, P.K., Khongnakorn, W., Chawenjkigwanich, C., **Chowdhury, M.S**. and Techato, K., 2021. 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Tamalouzt, S., Belkhier, Y., Sahri, Y., Bajaj, M., Ullah, N., **Chowdhury, M**., Titseesang, T. and Techato, K., 2021. Enhanced Direct Reactive Power Control-Based Multi-Level Inverter for DFIG Wind System under Variable Speeds. Sustainability, 13(16), p.9060.45. Rezapour, S., Jooyandeh, E., Ramezanzade, M., Mostafaeipour, A., Jahangiri, M., Issakhov, A., **Chowdhury, S**. and Techato, K., 2021. Forecasting rainfed agricultural production in arid and semi-arid lands using learning machine methods: A case study. Sustainability, 13(9), p.4607.46. **Chowdhury, M.S**., Rahman, K.S., Selvanathan, V., Hasan, A.M., Jamal, M.S., Samsudin, N.A., Akhtaruzzaman, M., Amin, N. and Techato, K., 2021. Recovery of FTO coated glass substrate via environment-friendly facile recycling perovskite solar cells. RSC Advances, 11(24), pp.14534-14541.47. Almutairi, K., Mostafaeipour, A., Jahanshahi, E., Jooyandeh, E., Himri, Y., Jahangiri, M., Issakhov, A., **Chowdhury, S.,** Hosseini Dehshiri, S.J., Hosseini Dehshiri, S.S. and Techato, K., 2021. Ranking locations for hydrogen production using hybrid wind-solar: a case study. Sustainability, 13(8), p.4524.48. Rehman, W.U., Khan, W., Ullah, N., **Chowdhury, M.D.,** Techato, K. and Haneef, M., 2021. Nonlinear Control of Hydrostatic Thrust Bearing Using Multivariable Optimization. Mathematics, 9(8), p.903.49. Kaewpraek, C., Ali, L., Rahman, M., Shakeri, M., **Chowdhury, M.S**., Jamal, M.S., Mia, M., Pasupuleti, J., Dong, L.K. and Techato, K., 2021. The effect of plants on the energy output of green roof photovoltaic systems in tropical climates. Sustainability, 13(8), p.4505.50. Almutairi, K., Mostafaeipour, A., Baghaei, N., Techato, K., **Chowdhury, S**., Jahangiri, M., Rezaei, M., Hosseini Dehshiri, S.J., Goudarzi, H. and Issakhov, A., 2021. Techno-economic investigation of using solar energy for heating swimming pools in buildings and producing hydrogen: a case study. Frontiers in Energy Research, p.171.51. Mehmood, Y., Aslam, J., Ullah, N., **Chowdhury, M.,** Techato, K. and Alzaed, A.N., 2021. Adaptive robust trajectory tracking control of multiple quad-rotor uavs with parametric uncertainties and disturbances. Sensors, 21(7), p.2401.52. Belkhier, Y., Achour, A., Shaw, R.N., Ullah, N., **Chowdhury, M**. and Techato, K., 2021. Energy-based combined nonlinear observer and voltage controller for a PMSG using fuzzy supervisor high order sliding mode in a marine current power system. Sustainability, 13(7), p.3737.53. Ullah, N., Sami, I., **Chowdhury, M.S.,** Techato, K. and Alkhammash, H.I., 2020. Artificial intelligence integrated fractional order control of doubly fed induction generator-based wind energy system. IEEE access, 9, pp.5734-5748.54. Ullah, N., Farooq, Z., Sami, I., **Chowdhury, M.S.,** Techato, K. and Alkhammash, H.I., 2020. Industrial grade adaptive control scheme for a micro-grid integrated dual active bridge driven battery storage system. IEEE Access, 8, pp.210435-210451.55. Najm, A.S., **Chowdhury, M.S**., Munna, F.T., Chelvanathan, P., Selvanathan, V., Aminuzzaman, M., Techato, K., Amin, N. and Akhtaruzzaman, M.D., 2020. Impact of cadmium salt concentration on cds nanoparticles synthesized by chemical precipitation method. Chalcogenide Letters, 17(11), pp.537-547.56. Ullah, N., Farooq, Z., Zaman, T., Sami, I., Ibeas, A., Techato, K., **Chowdhury, M.S**. and Muyeen, S.M., 2020. A computationally efficient robust voltage control for a single phase dual active bridge. Energy Reports, 6, pp.3346-3356.57. Mostafaeipour, A., Jahangiri, M., Haghani, A., Dehshiri, S.J.H., Dehshiri, S.S.H., Issakhov, A., Sedaghat, A., Saghaei, H., Akinlabi, E.T., Sichilalu, S.M. and **Chowdhury, S.,** 2020. Statistical evaluation of using the new generation of wind turbines in South Africa. Energy Reports, 6, pp.2816-2827.58. Sami, I., Ullah, N., Muyeen, S.M., Techato, K., **Chowdhury, M.S**. and Ro, J.S., 2020. Control methods for standalone and grid connected micro-hydro power plants with synthetic inertia frequency support: A comprehensive review. IEEE Access, 8, pp.176313-176329.59. **Chowdhury, M.S.,** Shahahmadi, S.A., Chelvanathan, P., Tiong, S.K., Amin, N., Techato, K.A., Nuthammachot, N., Chowdhury, T. and Suklueng, M., 2020. Effect of deep-level defect density of the absorber layer and n/i interface in perovskite solar cells by SCAPS-1D. Results in Physics, 16, p.102839.60. Mostafaeipour, A., Sadeghi Sedeh, A., **Chowdhury, S**. and Techato, K., 2020. Ranking potential renewable energy systems to power on-farm fertilizer production. Sustainability, 12(19), p.7850.61. Lan, T.T., Jirakiattikul, S., **Chowdhury, M.S.,** Ali, D., Niem, L.D. and Techato, K., 2020. The effect of retail electricity price levels on the FI values of smart-grid rooftop solar power systems: a case study in the central highlands of Vietnam. Sustainability, 12(21), p.9209.62. **Chowdhury, M.S.,** Rahman, K.S., Chowdhury, T., Nuthammachot, N., Techato, K., Akhtaruzzaman, M., Tiong, S.K., Sopian, K. and Amin, N., 2020. An overview of solar photovoltaic panels’ end-of-life material recycling. Energy Strategy Reviews, 27, p.100431. |
| **Certification:** |
| I, the undersigned, certify to the best of my knowledge and belief: |
|  | Yes | No |
| 1. This CV correctly describes my qualifications and my experience
 | ◼ | ☐ |
| 1. I am employed by the proponent organization
 | ◼ | ☐ |
| 1. I was part of the team who wrote the Expression of Interest (EOI) for this proposed project
 | ◼ | ☐ |
|  |
| I certify that I have been informed by the proponent organization that it is including my CV in the EOI/proposal. I confirm that that I will be available to carry out the assignment for which my CV has been submitted, in accordance with the implementation arrangements and schedule set out in the proposal.I understand that any willful misstatement may lead to disqualification or dismissal, and any other MKCF disciplinary action. |
|  |
| Name: Dr Md Shahariar ChowdhurySignature:   | Date: 19/02/2024 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. A person in a suit and tie  Description automatically generated**Name:** Associate Professor Dr. Theerakamol Pengsakul
2. **Proponent Organization:** Health and Environmental Research Center**,** Faculty of Environmental Management, Prince of Songkla University
3. **Proposed Position:** Project Coordinator
4. **Date of Birth:**  29/11/1983 **Nationality**: Thailand
5. **Complete personal contact details:**

Address: Room # 402/9, Level# 4, Faculty of Environmental Management, Prince of Songkla University, Hatyai-90110, Songkhla, Thailand Mobile: +66-98-394-9446Email: theerakamol.p@psu.ac.th 1. **Education:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year Awarded** | **Degree** | **Organization** | **Area** |
| 2013 | Ph.D. | School of life sciences, Xiamen University, Xiamen, Fujian, China | Zoology (Parasitology research) |
| 2009 | M.Sc. | Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand | Medical Sciences: Parasitology |
| 2007 | B.Sc. | Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok, Thailand | Medical Technology |

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|  |
| 1. **Membership in Professional Associations:**
 |
| N/A |
|  |
| 1. **Other Trainings:**
 |
| 2014 Certificate of Workshop "Basic Bioinformatics for Microbiology" organized by the Faculty of Medical Technology, Prince of Songkla University 2015 Certificate of Workshop "LMS2@PSU on Mobile: Active Learning with World Class Technology" at the Science Laboratory Building, Faculty of Science, Prince of Songkla University By the Center for Promotion and Development of Learning, Prince of Songkla University2015 Certificate of Workshop "Basic Bioinformatic tools for Single Nucleotide Polymorphism (SNP) and microRNA Research" from the Department of Pathology and the Department of Biomedical Sciences, Faculty of Medicine, Prince of Songkla University 2015 Certificate of Workshop "Urine and body fluid analysis" organized by Clinical Microscopy Group, Department of Medical Technology, Faculty of Medical Technology, Chiang Mai University2016 Certificate of Training under the Computer Literacy Project, "Using SPSS in Survey Research Data Analysis" course, Class 1/2016, by the Computer Center, Prince of Songkla University2016 Invited as a visitor on the topic "Medical Entomological Technology", by Yunnan Institute of Parasitic Disease, Pu'er City, Yunnan Province, P.R. China2017 Certificate of Good Clinical Practice: GCP Training from National Research Council of Thailand (NRCT) and Medical Research Network, Medical Research Foundation, Thailand 2018 Certificate of Applicant for a license to use animals for scientific purposes from Institute of Animals for Scientific Purposes Development (IAD) and National Research Council of Thailand (NRCT) 2018 Certificate of International Training Workshop on SCI&TECH of Marine Biodiversity Monitoring and Protection, from the Department of International Cooperation of MOST, Fourth Institute of Oceanography, State Oceanic Administration, Beihai, P.R. China 2020 Certificate of Biosafety and Biosecurity training course from National Research Council of Thailand (NRCT), Prince of Songkla University (PSU), National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA) 2023 Certificate of One Health Economics course, June 11-13, 2023 Novotel Marina Sriracha & Koh Si Chang, Chonburi, Thailand 2023 Short course on "Health Security, One Health and Zoonoses", Mekong One Health Innovation Program (MOHIP), Michigan State University, USA **Award Received**2018 Award for Researchers with the highest number of publications in the top 20 from the database Web of Sciences from Prince of Songkla University, Pride of PSU Day 20182020 Award for Invited Researcher Award as Keynote speaker from Prince of Songkla University, Pride of PSU Day 20202023 Award "Sing Thong" in the category of outstanding executives and corporate developers An exemplary person driven for the strength of the country at the 13th Good Governance Awards Ceremony, 2023 Amari Don Muang Airport Hotel, Bangkok, Thailand |
| 1. **Countries of Work Experience:** [in the last 10 years]
* Malysia, Indonesia, USA, China, Tiwan
 |
|  |
| 1. **Languages:** [Mother Tongue/Excellent/Good/Fair/Poor]
 |
|  |
| **Language** | **Speaking** | **Reading** | **Writing** |
| * English
* Thai
* Chinese
 | ExcellentMother TongueExcellent | Excellent Mother TongueVery Good  | GoodMother TongueVery good |
| 1. **Employment Record:**
 |
|

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date from -to** | **Location** | **Employer organizations and reference persons**  | **Position** | **Work Undertaken that Best illustrates Capability to Handle the project** |
| 2013-Present | Thailand  | Prince of Songkla University | Lecturer | Research & Academic service  |
|  |  |  |  |  |
| 2017-2020 | Thailand  | Prince of Songkla Unmiversity  | Project Manager | Field Experiment for Southeast Asian Emerging Diseases (LIFE for SEA-ED) project supported by the European Commission under the Erasmus+ program |
| 2023- Present  | Thailand  | Health and Environmental Research Center (HERC), PSU | Director | Research |

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| **Research Grants Received**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Project Title*** | ***Source of Funding*** | ***Period******(Year t Year)*** | ***Total Budget******(US $)*** | ***Role******(PI or Co-Invstigator)*** |
| * Study of Cytochrome C oxidase subunit I (COI) gene diversity in sand flies.
 | Department of Disease Control, year 2017 | 1 October 2016 – 30 September 2017 | 1,5891.00 | Co-PI |
| * Morphometric Analysis of Sandflies (Diptera: Psychodidae: Phlebotominae) in Caves Tourism of Southern Thailand
 | Fundamental scholarships, PSU, year 2018 | 1 July 2018-30 June 2020 | 5,532.54 | PI |
| * Development of rapid screening test kit for COVID-19 infection (SARS-CoV-2)
 | Mutual aid group (private sector) year 2020" | 1 April 2020-30 September 2020 | 278,017.00 | PI |
| * Control of Leishmaniasis an emerging disease in Thailand by using in-dept information
 | Budget for R&D. Full Proposal for the fiscal year 2021 | 1 October 2020 - 30 September 2023 | 152,909.00 | PI |

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|  |
| **Other relevant information (**e.g., Publications**)****Patents**No.1 Patent No.2003000824 Title: Antibody Test Kit for SARS-CoV-2 (SARS-CoV-2) and Test Kit Manufacturing Process Country Issued: Thailand**Publications** Ma, X.W., Xing, Y., Chen, X., Zhong, Sh.P., **Pengsakul, P.**, Qiao, Y. 2023. Integration of transcriptomic and metabolomic analyses reveal the molecular responses of the mud crab *Scylla paramamosain* to infection by an undescribed endoparasite *Portunion* sp., Fish & Shellfish Immunology, 2023, 108978. https://doi.org/10.1016/j.fsi.2023.108978.Szekely, J., Swangphon, P., Nanakorn, N., Chaimuti, P., Nualnoi, T., Wongwitwichot, P., Somapa, N., Somapa, D., **Pengsakul, T.** 2023. Breakthrough SARS-CoV-2 Omicron Variant in Individuals Primed with Heterologous Vaccines Enhances Inhibition Performance of Neutralizing Antibody to BA.2 Parental Lineage. Vaccines 2023, 11(7), 1230. doi: 10.3390/vaccines11071230**Pengsakul, T.**, Senarat, S., Sukparangsi, W., Wongkamhaeng, K., Poolprsert, P., Wangkulangkul, S., Kettratad, J., Jiraungkoorskul., W. 2023. Morphometric Analysis and Characterization of Peripheral Blood Cells in the Golden Tree Snake *Chrysopelea ornata* (Shaw, 1802). Russian Journal of Herpetology. 30 (1); 11-19. doi: 10.30906/1026-2296-2023-30-1-11-19Gopurenko, D., Bellis, G., **Pengsakul, T.**, Siriyasatien, P., Thepparat, A. 2022. DNA Barcoding of *Culicoides Latreille* (Diptera: Ceratopogonidae) From Thailand Reveals Taxonomic Inconsistencies and Novel Diversity Among Reported Sequences. J Med Entomol. 2022 Oct 3; tjac142. doi: 10.1093/jme/tjac142. Toontong, P., Sunantaraporn, S., Tiawsirisup, S., **Pengsakul, T.**, Boonserm, R., Phumee, A., Siriyasatien, P., Preativatanyou, K. 2022. First Report of Anuran *Trypanosoma* DNA in Flat-Tailed House Geckos (Reptilia: Gekkonidae) Collected from Southern Thailand: No Evidence as a Reservoir for Human Trypanosomatids. Pathogens. 11: 247.Buatong, J., Dvorak, V., Thepparat, A., Thongkhao, K., Koyadun, S., Siriyasatien, P**., Pengsakul, T.** 2022. Phlebotomine Sand Flies in Southern Thailand: Entomological Survey, Identification of Blood Meals and Molecular Detection of *Trypanosoma* spp. Insects. 13: 197.Szekely, J., Mongkolprasert, J., Jeayodae, N., Senorit, C., Chaimuti, P., Swangphon, P., Nanakorn, N., Nualnoi, T., Wongwitwichot, P., **Pengsakul, T.** 2022. Development, Analytical, and Clinical Evaluation of Rapid Immunochromatographic Antigen Test for SARS-CoV-2 Variants Detection. Diagnostics. 12: 381. Sookpongthai, P., Utayopas, K., Sitthiyotha, T., **Pengsakul, T.**, Kaewthamasorn, M., Wangkanont, K., Harnyuttanakorn, P., Chunsrivirot, S., Pattaradilokrat., S. 2021. Global diversity of the gene encoding the Pfs25 protein—a *Plasmodium falciparum* transmission-blocking vaccine candidate. Parasites Vectors. 14: 571. Thammapalo, S., Moonmek, S., Prikchoo, P., **Pengsakul, T.** 2021. The Potential Container Habitats of Chikungunya Vector in Outbreak Area of Southern Thailand. J Am Mosq Control Assoc. 2021, 37(3): 157-160. Nanakorn, N., **Pengsakul, T.**, Bunrod, K., Thammapalo, S., Prikchoo, P., Vongpunsawad, S., Poovorawan, Y. 2021. Chikungunya Fever in Southern Thailand, 2018. Am. J. Trop. Med. Hyg., 105(4): 955–959. Chumchuen, K., **Pengsakul, T.**, McNeil, E.B., Nanakorn, N., Chongsuvivatwong, V. 2021. Failure of space spraying to eliminate dengue virus-infected *Aedes aegypti* may explain failure to prevent secondary cases in Southern Thailand. Asian Pacific Journal of Tropical Medicine. 14(8): 378-380.Chumchuen, K., McNeil, E.B., **Pengsakul, T.** 2021. Effectiveness of space spraying in combating *Aedes aegypti* populations in dengue-endemic areas. Agr. Nat. Resour. 55 (2): 251–258. Vong, V., Ali, A., Onsanit, S., Thitithanakul, S., Noon-Anant, N., **Pengsakul, T.** 2021. Larval mosquito (Diptera: Culicidae) abundance in relation with environmental conditions of pitcher plants *Nepenthes mirabilis var. mirabilis* in Songkhla Province, Thailand. Songklanakarin J. Sci. Technol. 43 (2): 431-438.Senarat, S., Kettratad, J., Boonyoung, P., Jiraungkoorskul, W., Kaneko, G., Mongkolchaichana, E., **Pengsakul, T.** 2021. Ovarian histology of toadfish Batrachomoeus trispinosus from Pranburi River estuary, Thailand. Songklanakarin J. Sci. Technol. 43 (2): 384-391.Sulieman, Y., Afifi, A., Zakaria, M.A., **Pengsakul, T.** 2021. Prevalence and intensity of haemoparasites infecting the white-spotted gecko, *Tarentola annularis* in Sudan. 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Combined transcriptomics and proteomics to identify differential proteins involved in the immune response to the parasite *Schistosoma japonicum* in snail hosts pre-infected with *Exorchis* sp. Acta Trop. 211:105623. 1-10.Maneeroth, N., Noonanant, N., Thongkhao, K., **Pengsakul, T.** 2020. Morphometric analysis of sand fly (Diptera: Psychodidae: Phlebotominae), *Sergentomyia anodontis* Quate and Fairchild, 1961, populations in caves of southern Thailand. Asian Pacific Journal of Tropical Medicine, 13 (9); 415-422.Kittiwattanawong, K., Ponlawat, A., Boonrotpong, S., Nanakorn, N., Kongchouy, N., Moonmake, S., **Pengsakul, T.** 2020. The effect of *Plasmodium vivax* infection on SOCS gene expression in *Anopheles dirus* (Diptera: Culicidae). Tropical Biomedicine, 37 (2); 397-408. Buathong, D., Prajantasen, T., **Pengsakul, T.** 2020. Allele frequency of A385T in *Fucosyltrasferase* *2* gene (*FUT2*) among Southern Thai population. Songklanakarin J. Sci. Technol. 42 (5); 1022-1027. 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Histological structure of oocyte and follicular cells in breeding season of Wrestling halfbeak fish, *Dermogenys pusillus* (Kuhl & van Hasselt, 1823) from Paknam Pranburi Estuary, Thailand. Khon Kean Journal of Science. 46(2); 277-282. **Pengsakul, T**., Sudsom, N., Foakes, G., Bhatt, K., Eisenberg, M., and Siriyasatien P. 2017. Molecular DNA identification of blood sources fed on, for Culicine mosquitoes (Diptera: Culicidae) collected in the Songkhla province, southern Thailand. Songklanakarin Journal of Science and Technology. 39 (6), 731-737. Sulieman, Y., Ibrahim, S. O., Eltayeb, R. E., **Pengsakul, T.**, Afifi, A., Zakaria, M. A. and Rahman Khairala, M.A.R. 2017. Gastrointestinal helminth parasites of ruminants slaughtered in Shendi abattoir, River Nile State, Sudan. Journal of Coastal Life Medicine. 5(6): 249-253.Sulieman, Y., Eltayeb, R. E., **Pengsakul, T.**, Afifi, A., and Zakaria, M. A. 2017. Epidemiology of Urinary Schistosomiasis among School Children in the Alsaial Alsagair Village, River Nile State, Sudan. Iranian Journal of Parasitology. 12 (2): 284-291.Thongkhao, K., Jearnbut, P., Sriplong, W., and **Pengsakul, T**. 2017. Efficacy of *Stemona curtisii* Hook. f., *Eupatorium odoratum* L. and *Azadirachta excelsa* (Jack) Jacobs. extracts against *Aedes aegypti* (L.) by ultra-low volume (ULV) space spray. Disease Control Journal. 2017; 43 (1): 35-43.Senarat, S., Boonyoung, P., **Pengsakul, T.**, Wangkulangkul, S., Wongthamwanich, N., and Poolprasert, P. 2017. Histology of the lung tissue in dog faced-water snake, *Cerberus rynchops* from Pranburi eatuary, Thailand. YRU Journal of Science and Technology; 2 (1): 1-7.Sulieman, Y., Eltayeb, R.E., **Pengsakul, T.**, Afifi, A., Zakaria, M. A., and Khairala, M.A.R. 2017. Schistosomiasis as a disease and its prevalence in Sudan: An overview. Journal of Coastal Life Medicine 2017; 5(3): 129-133. Phumee, A., Tawatsin, A., Thavara, U., **Pengsakul, T.**, Thammapalo, S., Depaquit, J., Gay, F., and Siriyasatien, P. 2017. Detection of an Unknown Trypanosoma DNA in a *Phlebotomus stantoni* (Diptera: Psychodidae) Collected from Southern Thailand and Records of New Sand Flies with Reinstatement of *Sergentomyia hivernus* Raynal & Gaschen, 1935 (Diptera: Psychodidae). Journal of Medical Entomology, 54 (2), 2017, 429-438. Sulieman, Y., **Pengsakul, T.** and Afifi, A. 2016. Diet composition of subdesert toad, *Amietophrynus xeros* (Anura: Bufonidae) in Sudan, North Africa. Herpetological Conservation and Biology 11(2): 350–354. Zakaria, M. A., Afifi, A., Sulieman, Y., and **Pengsakul, T.** 2016. Some micro-ecological factors influencing the population dynamics of schistosomiasis intermediate host snail in Khartoum State, Sudan. International Journal of Research - Granthaalayah, Vol. 4(8): 147-151. Afifi, A., Ahmed, A. A., Sulieman, Y., Zakaria, M. A., and **Pengsakul T.** 2016. Evaluation of some microscopic technique for detecting bilharzia and intestinal parasites. International Journal of Research – Granthaalayah, Vol. 4(7): 185-195. Sulieman,Y., **Pengsakul, T.**, Afifi, A. and Zakaria. M.A. 2016. Bird diversity in Shendi area, Sudan. International Journal of Research – Granthaalayah, Vol.4 (Iss.6): 55-63. Afifi, A., Ahmed, A. A., Suleiman, Y. and **Pengsakul, T**. 2016. Epidemiology of Schistosomiasis among Villagers of the New Halfa Agricultural Scheme, Sudan. Iranian Journal of Parasitology: Vol. 11 (1): 110-115. Sudsom, N., Thammapalo, S., **Pengsakul, T**. and Techato, K. 2015. A spatial clustering approach to identify risk areas of dengue infection after insecticide spraying. Jurnal Teknologi (Sciences & Engineering), Vol. 78 (5-3): 73-77. Yassir, S., Ahmed, A. A., **Pengsakul, T**., Afifi, A. 2015. Laboratory Evaluation on the Biological Control of the Snail, *Biomphalaria pfeifferi*, the Intermediate Host of *Schistosoma mansoni*, Using the Fish, *Gambusia affinis*. Egyptian Journal of Biological Pest Control. 25(2): 351-354.Sudsom, N., Techato, K., Thammapalo, S., Chongsuvivatwong, V. and **Pengsakul, T**. 2015. High resurgence of dengue vector populations after space spraying in an endemic urban area of Thailand: A cluster randomized controlled trial. Asian Pacific Journal of Tropical Biomedicine. 5(11): 965–970. Sulieman, Y., Ahmed, A. A., Afifi, A. and **Pengsakul, T**. 2015. Laboratory evaluation of *Limnatis nilotica* leech (Annelida: Hirudinea) as a biocontrol agent for the schistosome-vector snail, *Bulinus truncatus*. Journal of Coastal Life Medicine. 3(10): 797-800. Sulieman, Y., Afifi, A., Awad, H.M., and **Pengsakul, T**. 2015. Helminth parasites of the subdesert toad, *Amietophrynus* (*Bufo*) *xeros* (Anura: Bufonidae). 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| **Certification:** |
| I, the undersigned, certify to the best of my knowledge and belief: |
|  | Yes | No |
| 1. This CV correctly describes my qualifications and my experience
 | ◼ | ☐ |
| 1. I am employed by the proponent organization
 | ◼ | ☐ |
| 1. I was part of the team who wrote the Expression of Interest (EOI) for this proposed project
 | ◼ | ☐ |
|  |
| I certify that I have been informed by the proponent organization that it is including my CV in the EOI/proposal. I confirm that that I will be available to carry out the assignment for which my CV has been submitted, in accordance with the implementation arrangements and schedule set out in the proposal.I understand that any willful misstatement may lead to disqualification or dismissal, and any other MKCF disciplinary action. |
|  |
| Name: Associate Professor Dr. Theerakamol PengsakulSignature:   | Date: 19/02/2024 |