Appendix 4.2

[Cyber to Real World Integrated Testbed for Dam Safety Management and Water Governance System] [Symposium and Meeting] Report Form

I. Organizer:

Name:	Mr. Kanokvate Tungpimolrut
Position:	Research fellow
Institution:	National Electronics and Computer Technology Center (NECTEC)

II. Program:

Date: 21 - 23 October 2025

Venue:

- Pullman Khon Kaen Raja Orchid Hotal, Khon Kaen, Thailand
- Ubol Ratana Dam

Program Agenda:

21 October *Symposium*	09:00 – 12:00	**Venue**: Hotel's meeting room - Project overview by Dr. Kanokvate (NECTEC) - "Paving the way for digital transformation of dam safety management and water governance system", by Dr. Jittiwut (NECTEC) - "Flood routing simulation for dam safety management and water governance system ", by Dr. Rangsarit (NECTEC) - "Deep learning techniques for dam safety management and water governance system", by Dr. Jessada (NECTEC) - "Enhancing flood routing simulation with inflow forecasting", by Mr. Chirapot (NECTEC) - "Machine learning based inflow forecasting for dam safety management and water governance system ", by Mr. Manut (NECTEC)
	12:00 – 13:30	Lunch
	13:30 – 16:00	**Venue**: Hotel's meeting room - "AIoT-Based Early Warning and Monitoring System for Natural Disasters and Dam Flood Risks in Lao PDR", by NUOL team - "Current Utilization and Future Potential of

		Safety Instrumentation at Upper Paunglaung Dam for Sustainable Dam Management", by UCSY team - "LSTM-Based River Hydrology Modeling for Dam Safety and Flood Risk Management", by UCSY team
22 October *Symposium*	09:00 – 12:00	**Venue**: Site visit to Ubol Ratana Dam
	12:00 – 13:30	Lunch
	13:30 – 17:00	**Venue**: Site visit to Ubol Ratana Dam
23 October *Meeting*	09:00 – 12:00	**Venue**: Hotel's meeting room Share information on current status and technical requirement of each member country - NICT team - NUOL team - UCSY team - NECTEC team
	12:00 – 13:30	Lunch
	13:30 – 16:00	**Venue**: Hotel's meeting room Conclude the output of symposium and reconfirm the future plan.

III. Participants:

No.	Name	Organization	Itinerary(check in/out)
1	Dr. Kanokvate Tungpimolrut	NECTEC, TH	Check in: 20 Oct 2025 Check out: 24 Oct 2025
2	Dr. Rangsarit Vanijjirattikhan	NECTEC, TH	Check in: 21 Oct 2025 Check out: 22 Oct 2025
3	Mr. Chirapot Vuthipraphan	NECTEC, TH	Check in: 20 Oct 2025 Check out: 24 Oct 2025
4	Mr. Manut Tanticharoen	NECTEC, TH	Check in: 20 Oct 2025 Check out: 24 Oct 2025
5	Dr. Jittiwut Suwatthikul	NECTEC, TH	Check in: 21 Oct 2025 Check out: 22 Oct 2025
6	Dr. Jessada Karnjana	NECTEC, TH	Check in: 20 Oct 2025 Check out: 21 Oct 2025
7	Mr. Arnan Jomtarax	NECTEC, TH	Check in: 20 Oct 2025 Check out: 22 Oct 2025
8	Dr. Somsanouk Pathumvanh	NUOL, Lao	On line participation
9	Dr. Khamla LinhAnonsavath	NUOL, Lao	Check in: 20 Oct 2025 Check out: 24 Oct 2025
10	Mr. Makmiphon Xayxana	NUOL, Lao	Check in: 20 Oct 2025 Check out: 24 Oct 2025

11	Dr. Thin Lai Lai Thein	UCSY, MM	Check in: 20 Oct 2025 Check out: 24 Oct 2025
12	Ms. Moe Moe Myint	UCSY, MM	Check in: 20 Oct 2025 Check out: 24 Oct 2025
13	Dr. Shinsuke Miwa	NICT, JP	Check in: 20 Oct 2025 Check out: 23 Oct 2025
14	Mr. Shinichi Miyakawa	NICT, JP	Check in: 20 Oct 2025 Check out: 23 Oct 2025
15-19	Representatives from Ubol Ratana dam	EGAT, TH	N/A

Remarks:

(1) The representatives of the dam operators in Lao PDR have been assigned to an urgent mission to address a crisis in the country. As a result, all team members must participate in that mission, and they were unable to nominate representatives with background knowledge in dam safety and water governance to attend the symposium.

(2) The CADT and Mapúa University teams have urgent business trips and internal tasks at their universities, so they are also unable to join the online meeting as scheduled.

IV. Summary of the activities corresponding to the objectives

In this three-day symposium and meeting, the following four objectives were set. The meeting was successfully completed as scheduled, and a summary of each objective is provided below.

Objective #1: To demonstrate the project's findings to the end users—dam operators in Thailand and Lao PDR—engage in discussions and gather feedback for further development.

- The team members from NECTEC, UCSY, and NUOL presented their recent activities with local partners, as well as the findings and outputs from each team. The main results focus on machine learning–based inflow forecasting for effective dam safety management and water governance, and on an AIoT-based early warning system for dam flood risks.
- The representatives from Ubol Ratana Dam of the Electricity Generating Authority of Thailand (EGAT), as end users in Thailand, provided comments and suggestions on the findings from each team. They also shared additional information about how they conduct dam safety management and water governance for all seven dams in the northeastern region of Thailand, including Ubol Ratana Dam**,** Chulabhorn Dam**,** and Huai Kum Dam**.** Furthermore, they explained their recent activities involving simulation, emulation, and forecasting**.** For example, they are currently using a machine learning–based system to forecast rainfall up to seven days in advance**.**

Objective #2: To share progress updates from NICT and other project members, engage

in discussions, provide mutual feedback, and explore potential solutions within the scope of the project.

- For the simulation mode on CyReal, the UCSY team has been continuously coordinating with local partners from the Ministry of Electric Power and the Ministry of Agriculture, Livestock, and Irrigation for the implementation of the HE-CRAS–based program on the CyReal testbed. However, UCSY is required to renew the application form for using the CyReal testbed for this fiscal year and submit it to NICT.
- For the emulation mode on CyReal, NECTEC has performed inflow forecasting for the Ubol Ratana Dam as a use case by utilizing previously available environmental data — such as rainfall, temperature, humidity, and wind speed — collected from the Dam Safety Remote Monitoring System (DS-RMS) over the period from 2016 to 2024 (a total of nine years). The NECTEC team also plans to install a Universal Terminal Unit (UTU) to collect the required data separately at the Ubol Ratana Dam and other nearby dams, including Chulabhorn Dam and Huai Kum Dam. This is necessary because the DS-RMS is a closed system owned by EGAT (Electricity Generating Authority of Thailand), which includes security measures to protect sensitive data. Additionally, the DS-RMS is primarily based on commercial software, whereas the CyReal system relies mainly on open-source software and tools. The UCSY team has also conducted similar inflow forecasting for the Praluang Dam using five years of daily environmental data from 2020 to 2024. Other teams are also in discussions with local organizations to obtain available data required for water level or inflow forecasting.
- The data collected by the UTU can be transmitted to Google Sheets and uploaded to the CyReal testbed via a RESTful API, which is also installed on CyReal. Since the API uses open-source tools, there are no issues related to licensing fees. This integration enables the connection between CyReal and sensors in the real-world environment.

Objective #3: To observe the real system in operation at Ubol Ratana Dam, engage with the dam's representatives who will use the developed system, and clarify specific requirements and concerns. This includes exploring the possibility of expanding the project's outcomes to other dams in the northeastern river basins of Thailand and/or to broader regional areas involving Thailand and Lao PDR.

- All project members visited the North Eastern Hydro Power Plant (NEHPP) Control Center located at the Ubol Ratana Dam. The NEHPP is mainly responsible for monitoring and controlling both electricity generation and water governance systems for all seven large dams in the northeastern provinces of Thailand. Dam safety is also one of the key issues und

er its monitoring and control. Representatives from this center serve on national and regional committees for water resources management, covering both hydropower generation and disaster management, including flood and drought.

- Inflow forecasting is a key element for proper dam operations. Recently, the center has collaborated with Khon Kaen University to develop a seven-day-ahead rainfall forecasting model to enhance dam operation performance. The center typically receives the target volume of water to be released from each dam for the next three months from the committees; therefore, a longer-term inflow forecast with acceptable error margins is still needed. The 15-day-ahead inflow forecasting results developed by the NECTEC team are expected to be useful for improving dam operation efficiency. The center plans to discuss the details further with the NECTEC team.
- The NUOL team inquired about the center's early warning system, as they are currently discussing this topic with their local partners.
- The NECTEC team showed the Remote Terminal Unit (RTU), which is part of the DS-RMS installed at the Ubol Ratana Dam area, and explained in more detail about its installation, operation, and maintenance. The sensors used for collecting environmental data at the dam site for inflow forecasting were also demonstrated and discussed. The tentative plan for installing the new UTU was also presented

Objective #4: To organize a meeting among project members to discuss R&D requirements and identify tentative activities for each institute in order to complete the project within the timeline.

- The project leader informed all project members about the budget reset scheduled for the end of next March. All project members who participated in the symposium and meeting agreed to conclude the project by next March without requesting an extension of the project period. The project leader will directly inform and discuss the conclusion with CADT and Mapúa University.
- The future plans for the simulation and emulation discussed during the symposium have been confirmed.
- The project leader will verify the exact amount of the remaining project budget and will inform all project members via email to facilitate budget planning for each institute.
- The project leader will schedule the next online meeting around the beginning of December. The available dates and time slots will be announced soon.
- The project leader also discussed plans for the next progress meeting and/or project closing meeting to be held in Japan and/or the Philippines

. The final decision will depend mainly on the remaining budget and th e outcome of discussions during the next online meeting.

V. Others


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VI. Workshop Evaluation Questionnaire

WORKSHOP EVALUATION QUESTIONNAIRE

Workshop Name: ___ Symposium and meeting on Cyber to Real World Integrated Testbed for Dam Safety Management and Water Governance System
Location: _ Pullman Khong Kaen Raja Orchid Hotel, Khon Kaen, Thailand __

Date: ___21 – 22 October 2025____

Participant Name (optional): ___Mr. Chansak Thanee_____

Institution /Company name of participant (optional): ___EGAT _

Job Title: _____Representatives _____

Please give us your comments here:

It was a valuable opportunity for the representatives from Ubol Ratana Dam to join this symposium as end users and learn about the ASEAN IVO program, example research projects from NICT, and recent R&D activities related to dam safety management and water governance systems conducted by NECTEC and other international members. They also had the chance to learn more about artificial intelligence technologies and their potential applications in inflow forecasting, which is one of the main focuses of the North Eastern Hydro Power Plant Control Center under EGAT.