Project Title: Cyber to Real World Integrated Testbed for Dam Safety Management and Water Governance System

Background :

In ASEAN countries, dams have helped to remedy life-threatening problems such as poverty from lack of economic development, famine resulting from drought, devastation from floods, and disease from lack of water supplies. However, dam failure risks loom due to evolving hydrological and seismic hazards induced by climate change, aging infrastructure, and varying levels of expertise in dam safety management.

Targets:

"Cyber to Real World Integrated Testbed for Dam Safety Management and Water Governance System in ASEAN Countries" aims to bridge the gap between digital simulations and real-world implementations. Building on existing initiatives like Thailand's Dam Safety Remote Monitoring System (DS-RMS), the project seeks to enhance dam safety protocols and water governance frameworks across ASEAN nations

Speaker:

Dr. Somsanouk Pathoumvanh, LAOS

Project Title: Cyber to Real World Integrated Testbed for Dam Safety Management and Water Governance System

Project Members :

NUOL, Laos:
Dr. Somsanouk Pathoumvanh*
Dr. Khamhou Xaphouvong
Dr. Kamla Non Alinsavath

NECTEC, Thailand:
Dr. Kanokvate Tungpimolrut

NICT, Japan:
Dr. Toshiyuki Miyachi
Dr. Shinsuke Miwa
Mr. Shinichi Miyakawa

CADT, Cambodia:
Dr. Ly Rottana
Dr. Cheab Sovuthy
Mr. Thear Sophal

UCSY, Mynma:
Dr. Thin Lai Lai Thein
Mr. Nay Win Aung
Ms. Zin May Oo
Ms. Moe Moe Myint

Mapua, Phillipine:
Prof. Febus Reidj Cruz
Dr. Jennifer C. Dela Cruz
Dr. Meo Vincent Caya

Project Duration:

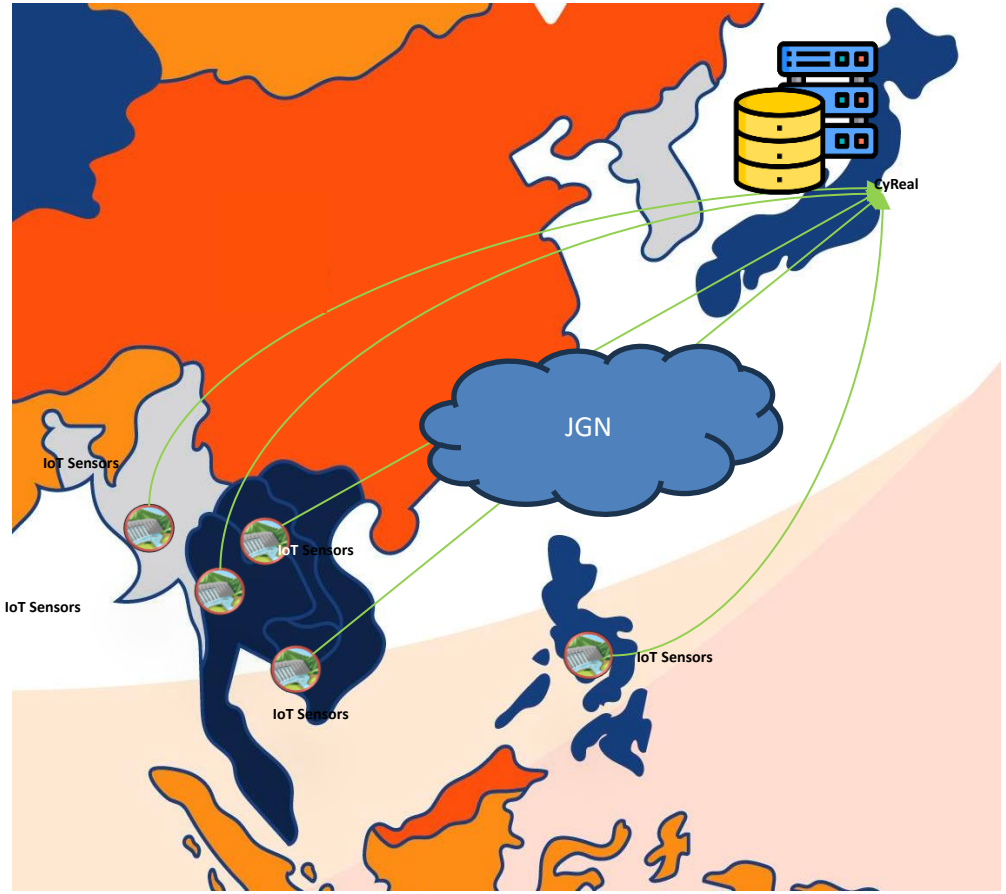
May 2024 – Aril 2026

Project Budget:

80,000 USD

Project Activities: The concept of the project

- The simulation environment for Dam Safety and Water Governance will be implemented under CyReal Integrated Testbed Technologies which is developed by NICT.
- The testbed ICT infrastructure and the High-Speed R&D Network will be used as a tool to connect to each country for facilitates comprehensive testing, validation, and optimization of dam safety measures.



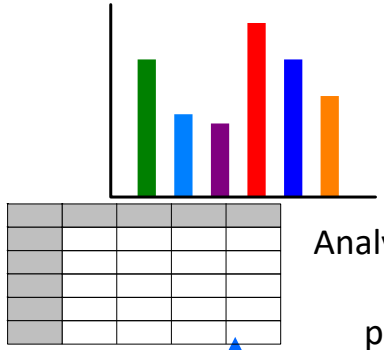
The Testbed Network Infrastructure

Project Activities: Works of CyReal Testbed

Development and enhancement of new technologies based on various requests and experimental results

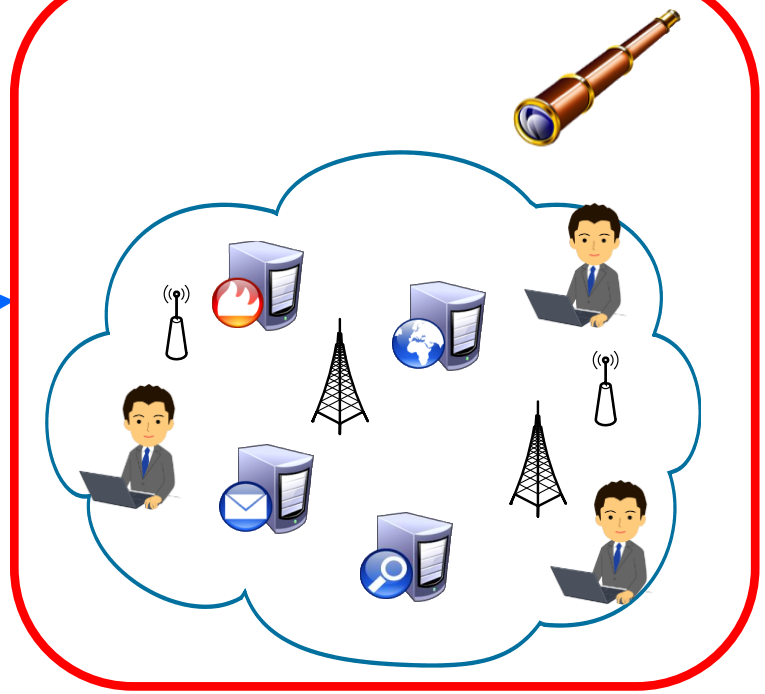
Feedback analysis results to the development site to fix issues

Implement in a test environment to evaluate the safety of new technologies



Analyze data acquired from various perspectives to identify issues and areas for improvement

Obtained various data from experimental results for analysis



Construct a realistic environment on the experimental platform

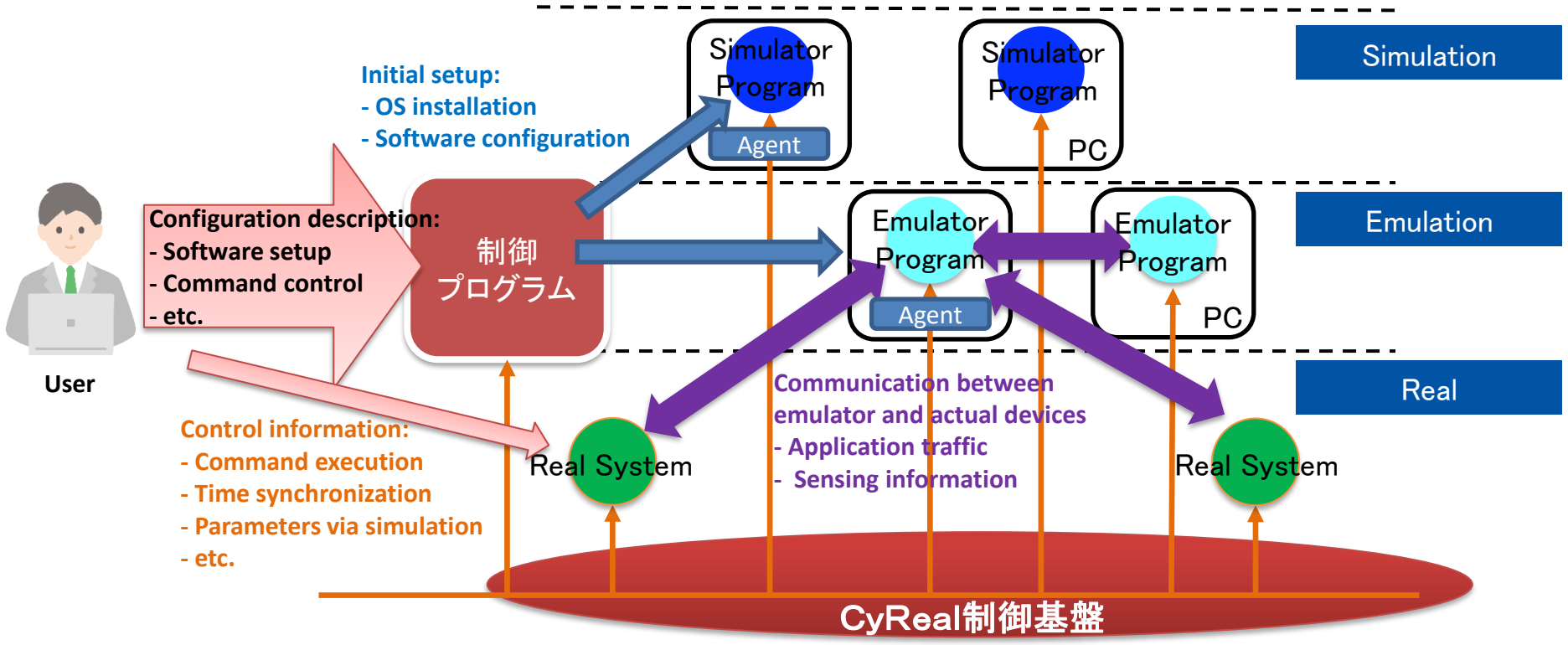
Support in the Testbed

- Construct an environment dedicated to large-scale and complex experiments.
- Replicate the entire environment realistically.
- Minimize the costs for conducting experiments.
- Monitor of the entire environment

Project Activities: Works of CyReal Testbed

The CyReal Testbed offer a control infrastructure that facilitates information exchange among elements:

- Enables collaboration between simulators, emulators, and real devices
- Allows experiment traffic to communicate freely, mimicking real-world conditions
- Users can bring in their own programs by packaging them



The basic concept of CyReal testbed of NICT

Project Activities: 1st Symposium and Meeting in Bangkok, 8 – 10 May 2024

Objective #1: To share information and knowledge of the implemented collaborative project between NECTEC and EGAT (Electricity Generating Authority of Thailand), the Dam Safety Remote Monitoring System (DS-RMS), to all project members by visiting to the dam site.

Objective #2: To share information and knowledge of utilization of the CyReal Testbed which was designed and developed by NICT team to all project members as well as participants from NECTEC and EGAT for further research activities in each member country.

Objective #3: To organize a meeting among all project members to conclude the output of symposium and to reconfirm the scope, action plan and output of the project and to identify the tentative activities in each member country in more detail.

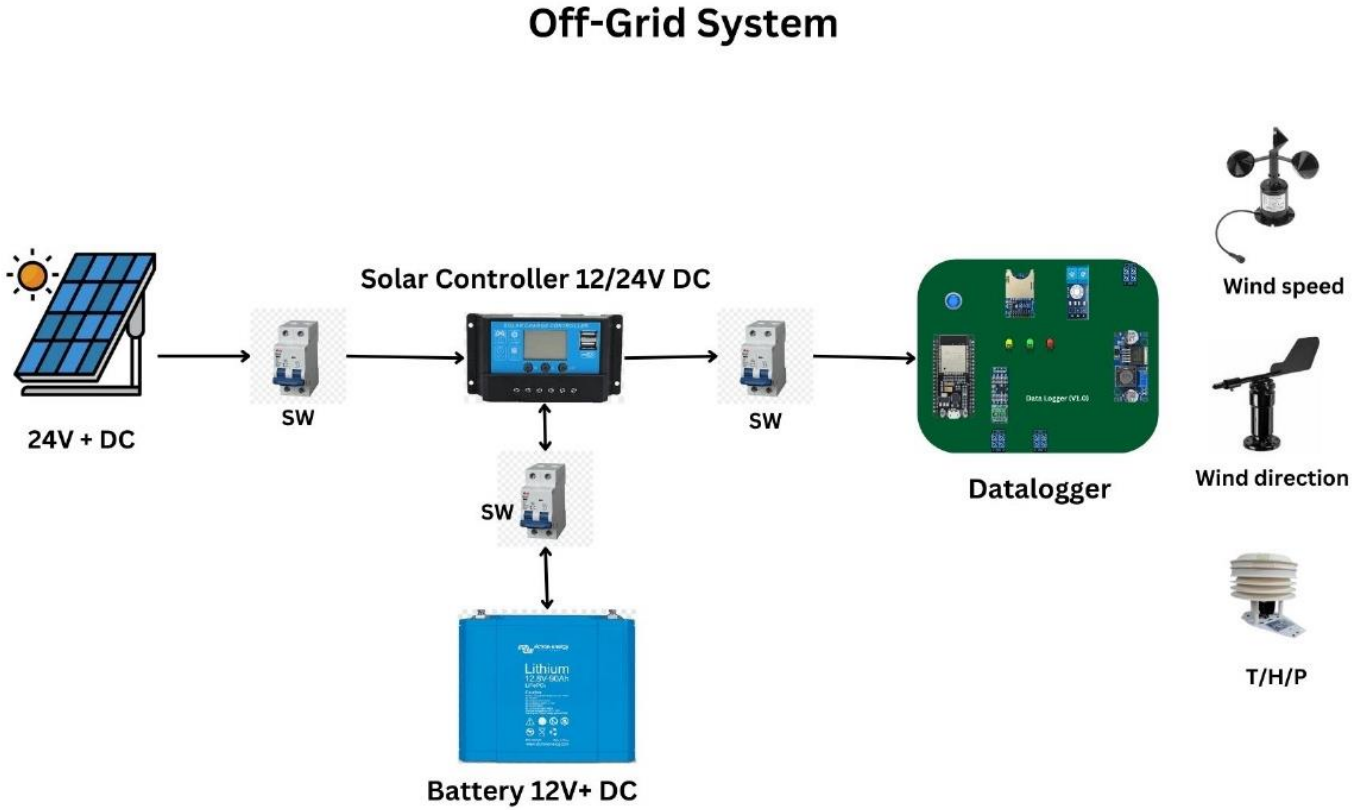
Project Activities: 2nd Symposium and Meeting in Myanmar, 3 – 5 Sep 2024

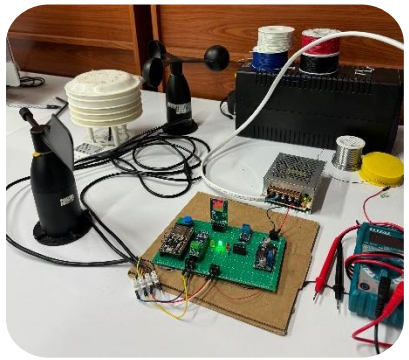
Objective #1: To share information and knowledge of the implemented collaborative project between NECTEC and EGAT on the Dam Safety Remote Monitoring System (DS-RMS), to representatives of dam operator in Myanmar and to visit to the targeted dam site with UCSY.

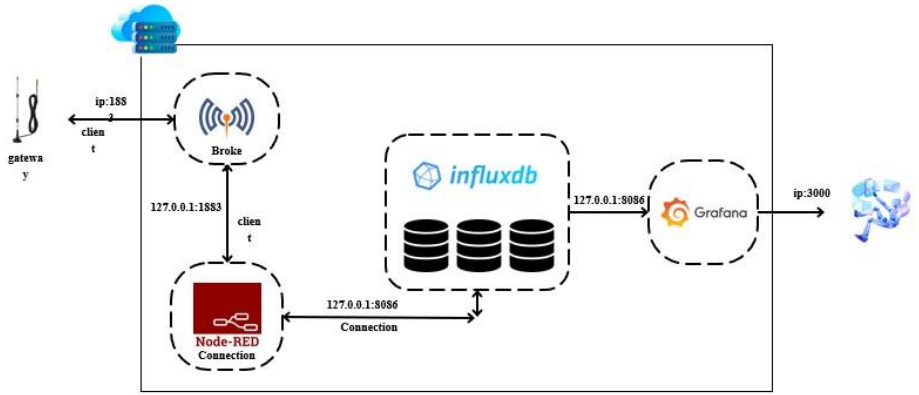
Objective #2: To remotely share information and knowledge of utilization of the CyReal Testbed which was designed and developed by NICT team to UCSY team and representatives of dam operator in Myanmar for further research activities in Myanmar.

Objective #3: To organize a meeting among project members from NICT, NECTEC and UCSY as well as experts of EGAT and representative of local dam operator under Ministry of Electric Power (MOEP) for discussing about the requirements of R&D and possible solutions from this project and to identify the tentative activities in Myanmar.

Project Activities: The Prototype of the Data collection System Development



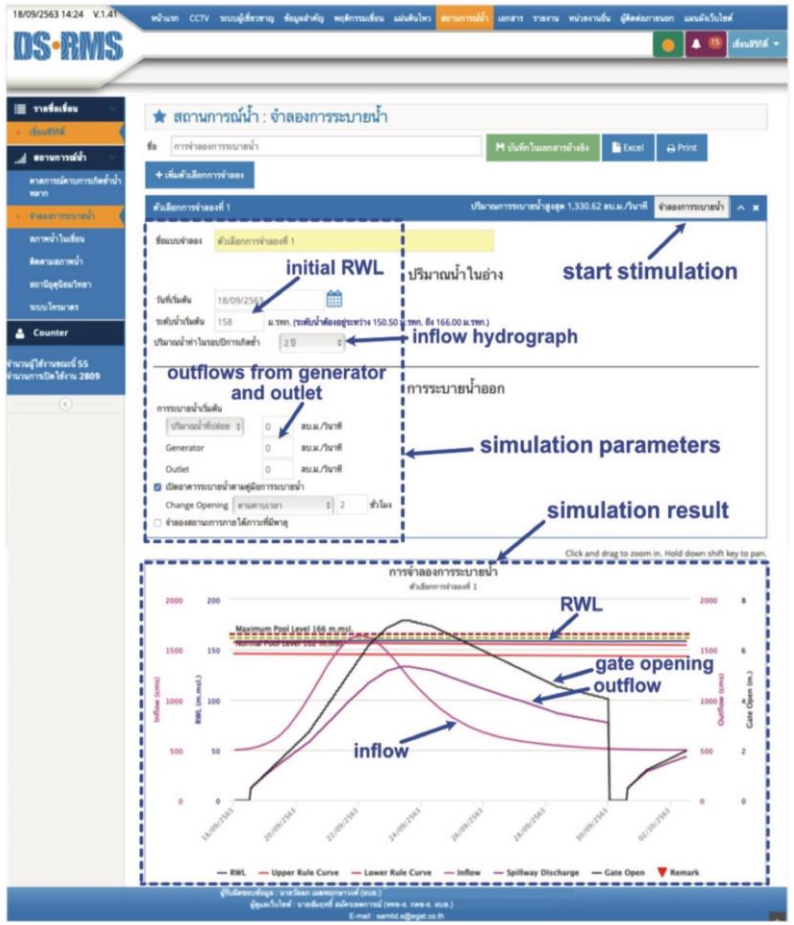




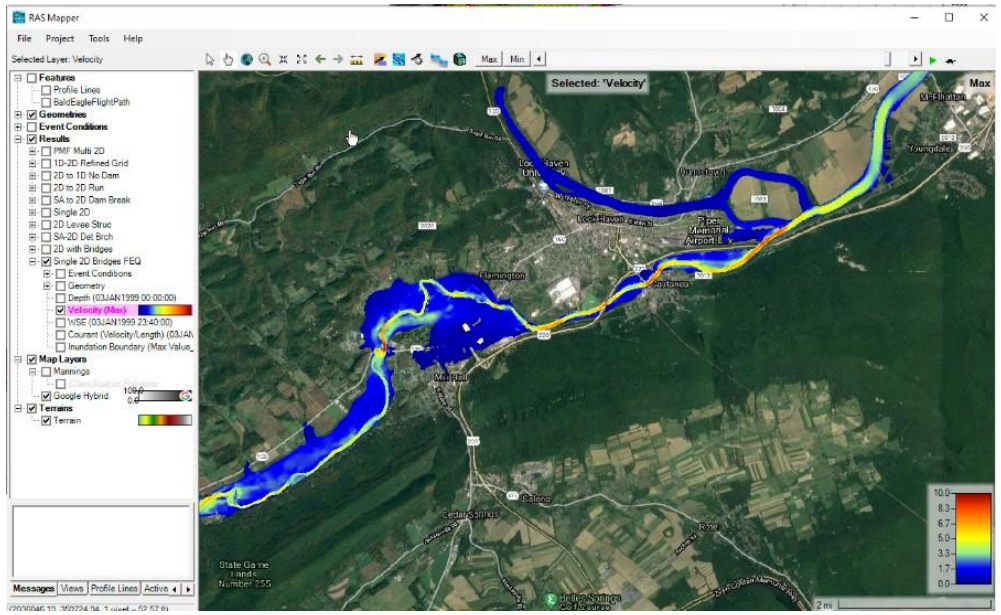
The Prototype of the IoT sensors and Cloud based Data collection System is Developed at the National University of Laos

R&D results: Key factors for the Project

1. Determine the use cases to be emulated/simulated based on the NECTEC Flood Simulation Software.



2. Identify available software and simulators.
   - HEC-RAS (Open source)
   - MIKE11 (Commercial Software)

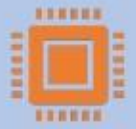


R&D results: Step to Realize the CyReal to Dam Safety

Step 1	First, operate the existing NETCTEC's simulator in the CyReal environment on StarBED.
Step 2	Implement a simulator or emulator that either provides input data to or receives output from the existing simulator.
Step 3	Enhance reliability by integrating the operation of the simulator or emulator with real-world data.

R&D results: Toward Build a High-Precision CyReal Environment

1.Data Collection and Model Construction: Collect historical water flow data, rainfall data, topographical data, etc., from the dam in Thailand and use this to build a simulation model in CyReal. By using actual dam operation data, it is possible to conduct simulations that reflect real conditions.



2. Scenario Analysis: Set up multiple simulation scenarios based on different weather conditions and discharge patterns, and analyze the impact of each scenario on the dam and surrounding areas. This enables the development of optimal discharge strategies.

3. Prediction and Optimization: Based on the simulation results, forecast future water flows and optimize discharge plans. For example, pre-releases to reduce flood risk and management strategies to secure water resources during dry seasons can be considered.

4. System Integration: Integrate the simulation model into the CyReal platform and connect it with real-time data. This allows for dynamic water flow management and quick decision-making even in situations requiring immediate response.

Conclusions:

- The Project Kickoff and Symposium is organized in Bangkok during 8 – 10 May 2024

- The Foundation on CyReal is introduced
  - Part 1: Basics of CyReal Testbed (StarBed/TENTOU) and
  - Part 2: Hands-on of CyReal Testbed (StarBED/TENTOU).

- Each project member presented about the targeted dam and local partners in their country. More information about targeted dam has been also discussed and confirmed. More discussion about system implementation, simulation and emulation have also been discussed in more detailed.

- Each project member will coordinate with the local dam operator to share information about our project and collect the requirement for setting scope of R&D in this project.

- The 2nd Symposium is organized in Nay Phi Taw, Myanmar on 3 – 5 Sep 2024, NICT team has browsed the web site of HEC-RAS in order to clarify about how to arrange the environment on CyReal to perform any simulation and emulation for HEC-RAS and the issue about the operation system on CyReal which is Linux based have been mentioned.

Future works:

1. After concluding the CRDA (Collaborative Research and Development Agreement), NICT prepare a detailed application form for use.

2. NECTEC and NICT will deploy the existing simulator as a CyReal environment on StarBED by implementing it as a TENTOU facility.

3. NECTEC modify the input/output APIs of NECTEC's existing simulator to make them more compatible for integration.

4. Each institutions implement the necessary simulators, emulators, and other components.

5. All of institutions integrate the simulators and emulators, and collect and analyze the data.