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MI-DAM – Observation and real-time risk assessment of hydropower plants in Kyrgyzstan

Client II – International partnerships for sustainable innovations

The infrastructure of hydropower plants in the Kyrgyz Republic is very prone to failure. This is because it is largely based on outdated systems. Natural hazards in particular, such as earthquakes and landslides, currently threaten the country's facilities. Novel structural and environmental monitoring systems can help detect structural changes to dams and the surrounding slope environment in real time and warn decision-makers in an emergency. The German-Kyrgyz collaborative project "MI-DAM" works to develop and enhance these systems at the Kurpsai Dam in central Kyrgyzstan.

Early-warning system for hydropower plants

In the Kyrgyz Republic, minimal maintenance work and severe climatic fluctuations have made the existing hydropower infrastructure very vulnerable to failure. Currently, there is no continuous, precise, and comprehensive hazard and risk analysis of the entire plant infrastructure. The "MI-DAM" project develops innovative methods for monitoring the dam systems of hydroelectric power plants and their surrounding slopes as well as a real-time early-warning system in the event of damage.

The pilot project is based at the Kurpsai Dam in central Kyrgyzstan, where a robust, cost-effective, and adaptable system for risk monitoring and analysis will be developed. It will continuously monitor the condition of the dam and the surrounding slopes and process the recordings on-site. An early-warning system will forward the user-relevant information to the appropriate operations centers, such as dam operators and the Ministry of Emergency Situations.

Innovative combination of methods

The existing infrastructure of the dam and its slope environment will be analyzed and modeled in detail in order to aid project implementation. Fragility curve calculations will be carried out describing the occurrence of possible damage for individual infrastructure objects, for instance, due to a strong earthquake. The slopes in the nearby vicinity of the dam will be studied in terms of the likelihood of slope failure due to ground movements. The installation of novel, cost-effective multi-parameter sensors will establish a system for continuous and long-term monitoring and the prediction of earthquake-induced ground vibrations and structural deformations. This includes the implementation of efficient systems for data transmission and decision-making. Planned measures also include developing a prototype software for real-time risk analysis for both the monitored slopes and the dam itself.

Installation of seismic sensors and the real-time data transmission system using WLAN technology.

"MI-DAM" uses an innovative combination of modern GPS technology monitoring, a state-of-the-art fibre optic system for measuring dam deformation and sensors to monitor ground and dam motion. The results from each individual system are incorporated into the development of the real-time monitoring system, allowing all relevant information to be transmitted directly to the relevant authorities and decision-makers. It is intended that it will be possible to use the resulting monitoring system for a wide range of structural investigations and monitoring tasks. Part of the project also involves providing training for local end users and technicians on-site so that they can use the methods and instruments that have been developed. This also includes the opportunity for scientists from the Kyrgyz Republic to work closely with the German project partners to carry out the analysis tasks.

Application for other infrastructures

The outcome of "MI-DAM" will be a process that will cover a wide range of applications, thanks to its flexibility. In addition to hydroelectric power plants, it would also be possible to use the systems to monitor other infrastructures and the interactions between them and the environment (for instance, coupling and transmission of seismic energy).

The results of the joint project will provide additional support to operators and Kyrgyz decision-makers for future dam operation. In addition to innovative aspects of research such as the combination of long-term deformation measurements and short-term vulnerability analyses of earthquakes and landslides, the project could also open up a market for novel and cost-effective monitoring systems for the project's German industrial partners.

The overall aim of the project is to help reduce the risk of natural hazards damaging vital infrastructure in the Kyrgyz Republic by developing effective and innovative methods for monitoring dams and their surrounding slopes as well as establishing an early-warning system.

View of the Kurpsai dam and surrounding slopes in Central Kyrgyzstan.

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