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EMERGENCY WARNING SYSTEM

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ABSTRACT

This paper presents the Emergency warning system focused on alerting inhabitants at downstream valley of the dam in case of rapid floods during dam failure or Dam over flow. The warning system consists of sirens that can be activated remotely from the control centre. Sirens can be used to broadcast emergency messages much more accurately regarding the nature of the emergency as well as the seriousness of the impending danger. Data such as flood map, dam breach flood wave analysis and information about the population of the areas at risk are used to assess the point of siren installation.

1. INTRODUCTION

There have been about 200 notable failures of large dams in the world up to 1965. Globally about 2.2% of dams built before 1950 have failed, while the failure rate of dams built since 1951 has been less than 0.5%. India too has had its share of dam failures. The first such failure was recorded in Madhya Pradesh during 1917 when the Tigra Dam failed due to overtopping. The worst dam disaster was in 1979, the failure of Machu dam in Gujarat. There are 36 reported failures cases so far.

In any case of Dam failures like Overtopping due to inadequate slipway capacity, breaching failure due to flooding etc, the localities on downstream valley are the immediate area of impact. Thus, these areas should be equipped and prepared for worst disaster or emergency situation. Disaster and/or emergency management is defined as a cycle of activities including mitigation, preparedness, response and recovery.

Mitigation efforts refer to those activities which reduce the vulnerability of society to the impacts of disasters. Preparedness efforts refer to those activities which make the government and disaster agents prepare for responding to a disaster, if it occurs. Response refers to the activities necessary to address the immediate and short-term effects of a disaster, which focus primarily on the actions necessary to save lives, to protect property, and to meet basic human needs. Relief, search, rescue, disaster fighting, medical service, permit control, sheltering, evacuation, law enforcement and many others are samples of disaster response activities. Recovery efforts refer to those activities that bring communities back to normal (such as infrastructure and house reconstruction) and they should be developed toward meeting mitigation and preparedness needs.

Mitigation and preparedness activities assume a crucial part, especially in emergency planning, which includes disaster definition scenarios; elaboration of resources lists and its characterization and categorization relevant to emergency response; and definition of actions to pursue using those resources according to the defined scenarios.

The planning of the search and rescue activities constitutes an important part of the Civil Protection tasks. In most cases, the planning related to the disasters risk minimization is based in emergency plans. Dams must have breach analysis and flood wave studies, flooding risk zones maps, and alert and warning systems. All these activities are included in the dam emergency plans that are an important tool in an emergency response situation.

Warning systems helps to mitigate the disaster in case of emergency by immediately warning people when any abnormality is sensed in the dam. This will give people just enough time to move away from danger zone and take correct exit routes and assemble in safe zones as per emergency response plan.

2. REQUIREMENTS ANALYSIS

The aim of Emergency warning system is to warn people located in the downstream valley as early as possible, with the initial stage of emergency response being very critical. One of the successful outputs is rapid action, because response time is important for crisis situations and emergency services. Therefore, any problem or delay in information gathering and management has negative impacts on the quality of decision-making and hence on the quality and success of disaster response. The act of alerting public as a part of emergency response should be rapid. Clear Audible warning messages direct from Emergency response authorities will cause communities to take rapid action.

For dam-break flooding accidents or dam incidents, the safety management, the emergency planning and the actions to pursue should be regulated in a way that these dams must have rupture risk analysis studies, flood propagation studies, risk zones mapping and alert and warning systems. All these elements are part of the dams' emergency plans.

Emergency plans must also contain a set of procedures related to hydro-meteorological monitoring, to dam structure observation and to the dam hydraulics. It should also include detailed information on the people and assets located in

the downstream valley, and the nearby resources available for rescue in case of an emergency. In the context of the dam-break flooding, the dams' emergency plans are the basis of the development of the emergency information system.

In case of an emergency, operational centers will activate the warning system, depending on the nature, severity and extension of the effects of the phenomenon. The system must broadcast to remote locations, usually geographical dispersed, and make it available to all areas covered under flood and related calamity anticipated zones.



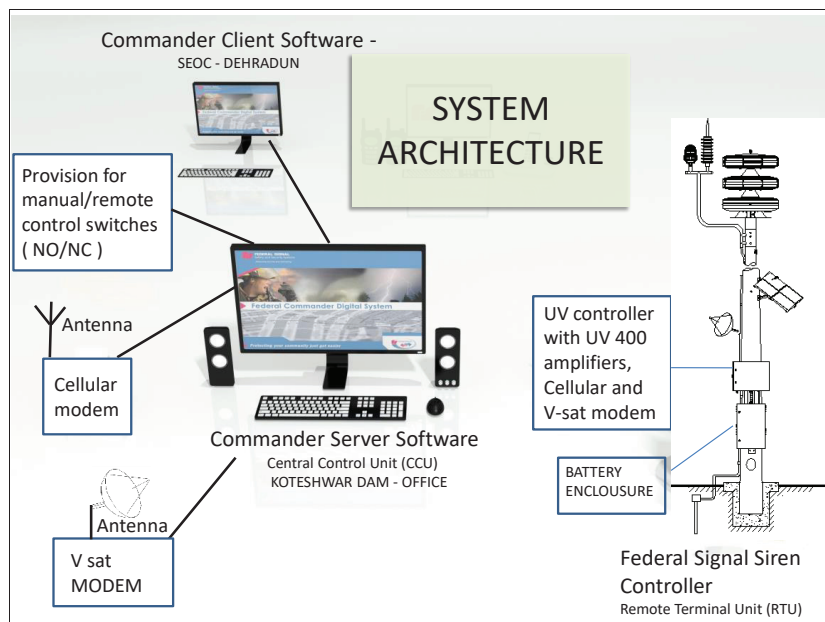
Map of Koteswar Dam Early warning system with siren locations

Early warning system for Koteswar dam is a typical example of an Emergency warning system where sirens are located in strategic locations where people presence and rapid flood prone areas are coinciding. Koteswar dam have a capacity of 72,072 acre-ft which is in turn fed by water dispersed by Tehri dam having Reservoir Capacity: 2,100,000 acre-ft.

Total 8 Sirens are installed starting at Koteswar Dam. Remaining sirens are installed at downstream valley locations of Koteswar Mahadev Temple, Devaprayag, Kaudiyala, Byasi, Laxman Jhula, Shri Ram Jhula and finally at Triveni Ghat. This system can activate all sirens together or each siren independently which give the flexibility of warning required locations separately as per emergency scenario.

Federal Signal Corporation, a leader in Safety and security solutions is the manufacturer of siren system installed in Koteswar. In Koteswar dam Emergency warning system, the Controller unit is installed in Koteswar Dam office. Main server is linked to all sirens by GSM cellular network and V-sat connectivity.

Controller PC is configured with Federal signal proprietary software- Commander, and is used to activate sirens. Activation can be done manually and required alarm can be activated in each siren depending on the emergency.



System architecture of Koteswar Dam Early warning system

Every system requires proper maintenance to have a failsafe operation. The service life of a dam is as long as proper maintenance can be guaranteed. This means the service life can be very long. However, this will not be the case if a dam is no longer maintained and monitored. Likewise, the Emergency response system also should be maintained in timely manner. Failure of siren unit or improper activation of the unit will turn out to be disaster as surrounding area will be oblivious of the emergency situation when it happens. To avoid this scenario siren system should be continuously checked for any faults in the system. This will be tedious if the locations are in remote locations. To overcome this problem the siren system installed for Koteshwar dam has a feature of monitoring healthiness of its field controllers and sending status data to the main server in real time. Commander Software warns the user about the system faults immediately when detected. This helps to do timely maintenance and potential downtime can be avoided.

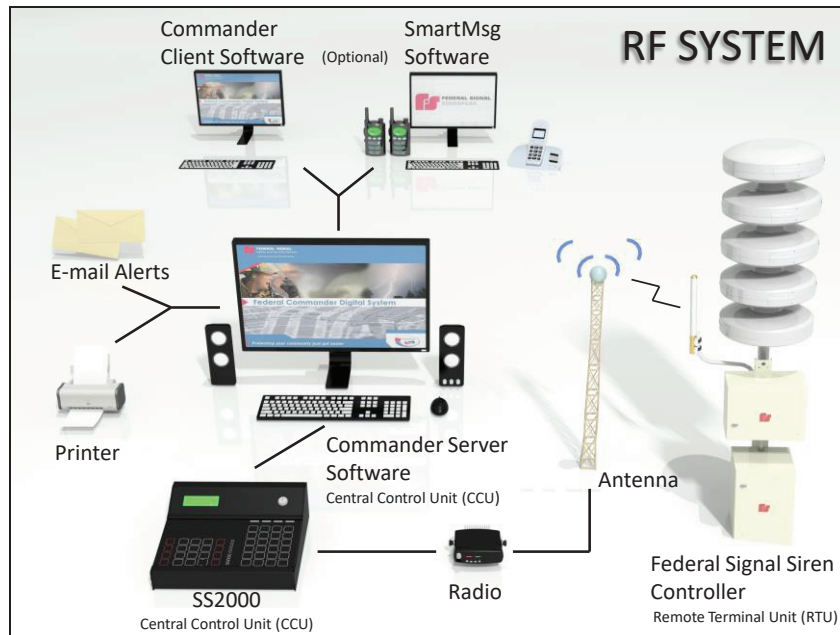
The system can be controlled by a secondary controller which has all alarm activation functionality and fault monitoring facilities. In Koteshwar Early warning system a secondary client system is installed in State Emergency Operation Center (SEOC), Dehradun. This Secondary controller is more than 100Km from the dam field. If the main controller is not accessible due natural disasters, even then sirens can be activated from the backup secondary controller.

The system consists of two type of sirens. One is Legacy Modulator siren and other is Directional Speaker Array (DSA) siren. Legacy Modulator Sires are used in koteshwar mahadev temple, byasi, Triveni Ghat and Kaudiyala locations and Directional Speaker Array (DSA) siren are used in Dev Prayag, Ram Jhula and Laxman Jhula locations.



Installation of Legacy Modulator siren in Triveni Ghat and Direction speaker array siren in Ram Jhula

Other common mode of communication in the siren system is by radio signal also which requires the controller and siren antenna to be in line of sight. System with instant mail service and instant messaging services sends messages to concerned Civil protection authorities and emergency response centers and will help for comprehensive alerting. This type of alerting will ensure the emergency message is not only sent to the location with impending danger via siren broadcast, but also the messages will be conveyed to different departments or authorities who are handling emergency situation. This feature should be implemented to ensure the system capability to broadcast the danger is not bound to a small geographical vicinity. Instead mail and messaging facilities will let the emergency message to be known anywhere in the world.



Typical system architecture with RF system and additional mail alerting facility

Commander software has the option for visualizing the distribution of siren on a geographical map. It can install up to twenty maps. Sirens activation status and fault status are directly updated on the map with color status representing the site conditions at the time of the last pole response from each siren. This provides a visual representation of the whole system status. It reports faults back to the base station so that corrective actions can be made on time.

Advancement of technology has automated all tasks in the modern age. So is the monitoring system for critical process like Dam surveillance. If Dam safety surveillance system is equipped with automated structural monitoring sensors, any abnormalities affecting the structural integrity or failures of modules like spillway can be easily identified and notified to the authorities on real time. The same alerting option can be used to activate siren system. This can be automatically attained by activating the inputs of the main controllers. Controllers should be further configured to handle these input activations and broadcast messages as per cause and effect philosophy. This will help the Dam monitoring team and Emergency response team to save precious time in case of actual emergency situation.

Workplace Alerting System

Key Solution Features:

- Indoor and/or outdoor alerting
- Automatic alert messages
- Pushbuttons for alert activation
- Multi-site capability
- Control station for local PA
- Interfaces existing Public Address System
- Two-way Intercom
- Announcements to radio systems

All intelligent systems should follow the following three prima characters in future

- More Connected
- More Speed
- More Secure

3. CONCLUSION

Emergency planning and installation of warning systems in the downstream region of large storage dams is a must. Even if a dam is structurally safe, there are natural calamities or man-made errors that could cause failure. For emergency planning to be effective, the population affected must be involved and informed about what to do in an emergency.