FLOROSENSE

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GUIDANCE NOTE ON REAL TIME MONITORING OF DAMS FOR EARLY DETECTION OF INTERNAL EROSION

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General

1. Aims and use of Guidance Note

The purpose of this Guidance Note is to

> "To facilitate the take up of real time monitoring of dams for early detectionof internal erosion, where the cost is proportionate, by carrying out a feasibility report into relevant recent/ ongoing developments in other industries "

2. Relationship to other Guidance

This report should be read in conjunction with the "Guidance on Early Detection of Internal Erosion", produced in parallel with this report.

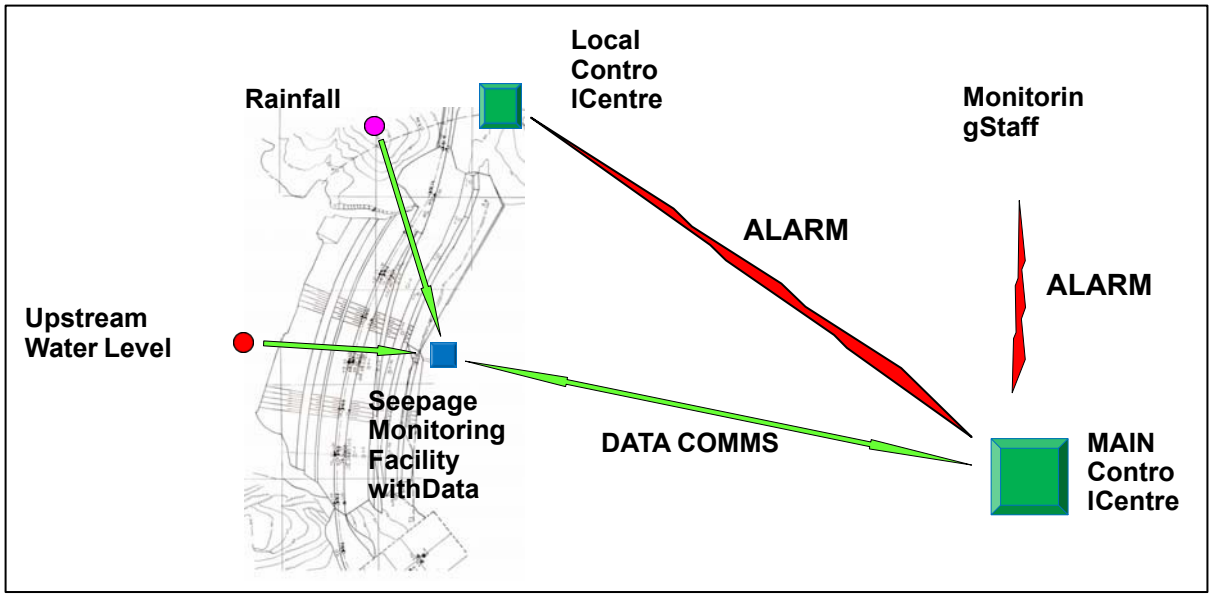
3. Definitions

Key terms are defined in Table 1.1, whilst the various components of a system forreal time monitoring are illustrated in Figure 1.1 and Figure 1.2.

Table 1.1 Key terms in relation to real time monitoring

Term	Definition (as Glossary in ICOLD Bulletin No 118, 2000, with some modifications)
Alert system	A system which automatically warns an operator or user if any unusual activity is detected by the monitoring system
Automatic monitoring system (AMS)	A complete monitoring system which includes three components: • Automatic data acquisition system (ADAS); • Data transmission system (DTS) and • Data processing system (DPS).
Datalogger	A microprocessor based programmable device which energises, measures and stores (or records) the output of an instrument. Usually operated as a standalone unit with data uploads to a PCor laptop computer at specified intervals
Real time monitoring	Where a) readings of an indicator are taken at a frequency greater than that of surveillance visits, for example every hour or more frequently. b) the readings are then automatically checked for any change from normal behaviour, with an alarm triggered where behaviour varied from previous experience
SCADA	Supervision, Control And Data Acquisition
Sensor	A device designed to detect, measure or record physical phenomena. On energising manually or automatically, it convertsa variable input into a signal suitable for measurements

Figure 1.1 Components of systems for real time monitoring (standalone)



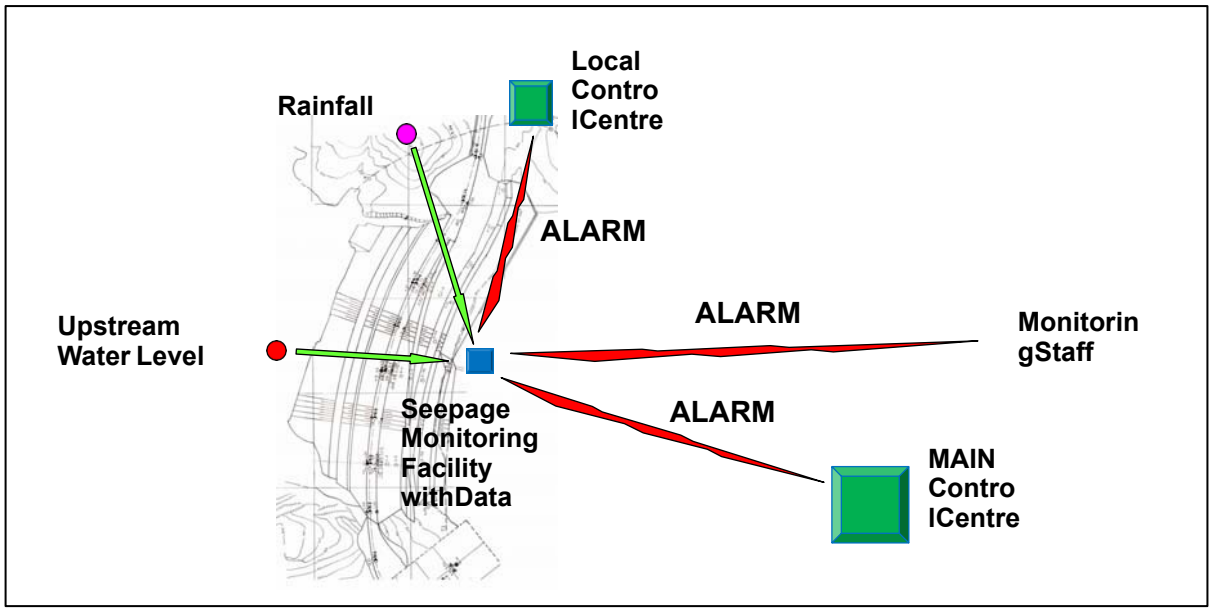


Figure 1.2 Automatic Monitoring Facility enabled for Remote Data Handling and Alarms

4. The role for real time monitoring of dams

There is evidence that although in some situations internal erosion may continue at a slow rate for years, in other situations the rate of deterioration can be rapid (or accelerate after a long stable period) and lead to rapid failure. Internal erosion in thevicinity of appurtenant works appear to be particularly vulnerable to this rapid deterioration.

Thus although surveillance (visual inspection) should always be the primary tool for assessing the condition of a dam, in some circumstances real time monitoring of key indicators may be a proportionate part of the dam safety management process. This applies where the nature of the soils and/or detailing of interfaces between the embankment and structures is such that internal erosion could progress rapidly to failure ("progressive internal erosion") and the consequences of failure include significant risk to people downstream

It may also be appropriate in some circumstances to provide quantitative readings at frequent intervals due to fast changes in local environmental conditions, such as

a) reservoir levels in pumped storage schemes
b) where the structure is very sensitive to temperature variations, which occur overa dally cycle
c) where there is concern over leakage at high reservoir levels, as floods pass through the reservoir. This may be monitored as part of an investigation, as it islikely that physical works would be carried out if this was considered to be an issue.

A third scenario where real time monitoring may be useful is to understand how seepage, or other indicators react to rainfall or other changes, and thus to better understand the behaviour of a dam. In this case it would be similar to real time monitoring to provide early detection of progressive internal erosion, but without an alarm.

It is implicit in real time monitoring for early detection of internal erosion that the primary objective is to increase the time available between an erosion incident developing from the point that it is detectable, to the point of failure of the dam and consequent release of the reservoir. Thus to be of value all parameters which are measured in real time must have corresponding trigger levels and a data processingsystem which automatically triggers an alarm when a trigger is exceeded. These trigger levels must also be meaningful in terms of providing warning.

It should be noted that

a) real time monitoring does not replace surveillance, but complements it
b) it is suggested that a risk based approach is adopted to decide when real time measurement would be worthwhile, based on the cost of real time monitoring relative to the reduction in risk that it achieves

Where real time monitoring is being considered as a candidate risk reduction works then the thought process to evaluate the practicalities and costs are set out in Figure 1.3. The indicators of internal erosion which are most likely to be practicable to monitor in real time are seepages (and associated suspended fines) emerging onthe downstream face of the dam. It is these that this guide concentrates on, although providing comment on other indicators which could be monitored.

5. Structure of Guide

The report is structured into the following parts
Chapter 1 : Sets out the aims of the guidance Chapter 2 : Current practice in real time monitoringChapter 3 : Instrumentation hardware
Chapter 4 : Physical installation
Chapter 5 : Use of data

Interested in reading the complete document? please contact your nearest FLO team for further guidance