

RESERVOIR SAFETY – Are things improving ?

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SYNOPSIS

This paper seeks to look at reservoir safety over the years and how some things have changed. The paper suggests that there have been some significant improvements in reservoir safety such as the creation of the Supervising Engineer role, the creation of the single Enforcement Agency, but it also suggests that there are a number of areas where improvements have not been made and in fact the situation might be getting worse. The paper suggests some areas for improvements but also invites readers to think whether the issues raised apply to their organizations and situation in a hope that they will then bring about change.

HISTORICAL BACKGROUND

Reservoir safety on the whole in the UK has been driven by the legislative framework which has been developed with time. The Reservoirs (Safety Provisions) Act, 1930 brought in the regular and frequent inspection of dams by Panel Engineers and was prompted by a couple of failures, which caused loss of life – notably the failures in the Conway Valley at Eigiau and Coedty Dams, and Skelmorlie on the Forth of Clyde. This set the definition of a ‘large raised reservoir’ as a reservoir containing 5 million gallons above the level of the natural ground, adjoining the reservoir.

As a result of a number of further incidents and failures, particularly in Europe, an ad-hoc committee of the Institution of Civil Engineers was set up to review the legislation, and this committee made a number of recommendations which eventually resulted in the Reservoirs Act 1975. This Act brought in a number of new features, the main ones being the creation of the role of the Supervising Engineer, the creation of the Enforcement Authority and thus enforcement of recommendations, and registration of reservoirs.

The UK has had no dam failures resulting in loss of life since 1925 although there have been a number of failures, mainly of small dams and there have been a large number of incidents/accidents – some more serious than others

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– some would say that the UK has been fortunate in not having failures resulting in loss of life since 1925.

In 2006 the question I wish to pose is ‘have we made progress in the field of reservoir safety since 1925 – what have we achieved in 81 years?’

In looking for the answer to this question there are a number of issues which I have considered and present in this paper;

THE SUPERVISING ENGINEER

There is no doubt in my mind that creation of the role of the Supervising Engineer has been a useful addition to improve reservoir safety. The Supervising Engineers have become the ‘eyes and ears’ of the Inspecting Engineers and certainly in recent years there seem to have been more inspections called for under Section 10 (2)(d) – by the Supervising Engineer.

It has been recently suggested in some quarters that the Reservoirs Committee has raised its standards, resulting in a number of failures of candidates seeking appointment and/or re-appointment to the Supervising Engineers Panel. Many of those failures have been cited as people who were nearing the end of their career, who had a low level of activity and/or could not display the commitment to continued professional development (CPD) or do not have confined space training.

In my personal opinion a number of people who have not been re-appointed are Supervising Engineers especially if one remembers that the original idea of the group formulating the legislation was that the Supervising Engineer would be the Reservoir Keeper at the site. However, the role of the Supervising Engineer is changing and I believe the role of the Supervising Engineer will become more onerous with time. Already, the Supervising Engineers are ‘responsible at all times’ when there is not a Construction Engineer and as time progresses are likely to get more involved with monitoring progress with recommendations in the interests of safety and perhaps calling for inspections as conditions deteriorate within the 10 year period set by the Inspecting Engineer. They are also likely to get more involved with the checking, exercising and even rehearsal of Flood Plans.

THE ENFORCEMENT AUTHORITY

The creation of an Enforcement Authority was undoubtedly an improvement and important addition to the legislation in the form of the Reservoirs Act 1975. Unfortunately, in the 1980’s and 90’s, the Enforcement Authority role was vested in 168 organisations, and still remains the responsibility of 32 different organizations in Scotland. However, the Scottish Executive has

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seen the advantages of the new system in England and Wales and is consulting on change. This led to an enormous range of different standards throughout England, Wales and Scotland.

In the Water Act 2003, the Enforcement Authority role in England and Wales transferred to the Environment Agency. The Agency has set up an office in Exeter, which monitors compliance with the Act. Undoubtedly some would be critical of the system developed and the way the EA has been making decisions within the enforcement framework. However, I believe all would agree that there have been many advantages that have occurred as a result of the adoption of a single Enforcement Authority, even though some will have been subject to a significant amount of paperwork! Certainly since formation of the 'new' Enforcement Authority some reservoirs have been registered (195 are 'new' and currently a review of in excess of 400 potential reservoirs is under way). Inspecting Engineers have been appointed to over 40 reservoirs that had not been inspected and Supervising Engineers appointed to reservoirs reducing the number of reservoirs with no known SE from 379 to currently 19 – they would not have been appointed had the enforcement system not changed.

One of the roles that the Enforcement Authority undertakes is to ensure that recommendations in the interests of safety have been completed. This has been achieved by asking for copies of Certificates under Section 10(6) of the Act, often within 6 months of the registration. In recent times, an exercise has been undertaken to pursue owners with outstanding recommendations in the interests of safety which are more than 5 years old. In adopting a risk based approach to the backlog of non compliance, the approach of the Enforcement Authority has been to interpret that 'as soon as is practicable' means that a delay of 5 years or more is unacceptable. I understand that they will be turning their attention to those that are 3 and 4 years overdue shortly! In other cases where measures are outstanding for over 5 years, Enforcement Notices have been issued with time periods stated which have been agreed with a 'qualified civil engineer'. This has led to some differences of opinions associated with the phrase 'as soon as practicable' and 'problems' with tools such as 'portfolio risk assessment'. These issues will have to be resolved in order to make progress and the timely use of resources.

MAINTENANCE

The provision of maintenance and getting owners to undertake works has always been something difficult to achieve – depending on who the owner is. It is the case that some issues which would be classed as maintenance today, if not repaired, will become recommendations in the interests of safety. What I have noticed is that, as the major water undertakings have

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changed and in particular where they have reduced manpower and outsourced works there is often a significant reduction in the level of maintenance and capability to carry out minor works. Whilst it can probably be accepted that the levels of staffing in the 1970's/80's were too high I would argue that perhaps they have gone too far the other way. No longer do we have the dedicated reservoir keeper with a pride in his site; very rarely do we have a maintenance team with a maintenance at reservoirs; usually we have to wait for the resources of an external contractor provided through a framework contract – usually selected on a lowest price basis. How often have we heard the words – I no longer have any staff to do the maintenance work?

I have witnessed in recent years; saplings growing on land adjacent to dams; grass up to a metre high; drains overgrown and malfunctioning; valves inoperable; turf ripped off the faces of embankments; stones missing from wave walls and upstream protection systems; broken windows to valve towers. In general there appears to have been a reduction in the frequency of providing maintenance and in the quality of that maintenance.

One area that seems to cause moderate amounts of problems is the cutting of grass on embankments. In most cases water companies have outsourced this and it is often the case that the grass is not cut at the correct time, is cut too frequently or not enough times, grass cuttings are not removed, inappropriate machinery is used causing damage to and rutting on the embankment, wet patches are just driven through. Long gone are our beautifully manicured embankments and perhaps they should but some do not reach an acceptable standard that allows inspection and examination! Contractors are also less likely to observe and understand the relevance of new damp patches, areas of settlement etc.

Valve operating – how many times are valves being fully exercised? Have we seen a situation where valves are being exercised less frequently or not over their full range resulting in valves which become stiff or inoperable? Some companies have had to increase the frequency of operation back to what they used to, to ensure the valves remain operable.

Historically we have often experienced a reluctance to operate scour valves because 'we might not get them shut, and also the EA will object to the discharge of dirty water'. Following the Rivington Incident where the scours were vital to the satisfactory resolution of the problem I now recommend a full scale scour test, with the water left running until the flow runs clear to try to ensure the scour facility is operable and does not silt up. The Environment Agency is being very helpful in developing protocols which will allow these tests to be carried out.

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Are we seeing what would in the past have been called day to day maintenance not being carried out? Are there times when Supervising Engineers have said 'I've been trying to get this done for months' – I certainly have heard this on a number of occasions. Will we see a need for Supervising Engineers to recommend an inspection if maintenance is not provided?

PROCUREMENT OF ENGINEERING SERVICES

In many cases, and particularly in the large water undertakings, companies have embarked on procurement strategies which have led to 'outsourcing' and a reduction of 'in house' staffing and also a number of frameworks, alliances, and strategic partnering initiatives have been set up. These initiatives I have always understood to have been set up to make things easier, cheaper and quicker. Unfortunately I have experienced situations which it has been difficult, certainly more expensive, very protracted and in some cases the services provided have been inappropriate.

It seems to be impossible to procure the services of an Engineer or get an Engineer to procure services, as one used to some years ago, when the Engineers were trusted to carry out this role, devise a contract, get prices from three contractors and then arrange and supervise the works. Nowadays the formal procedures can take many months to procure a team to do the works and secure the finance. I have also seen the procurement of consultants and contractors who have little or no experience of doing work related to dam safety, but who have won frameworks on the basis of other skills offered. Then we get badly designed schemes which cost too much, take too long and in some cases after several millions of pounds of expenditure, and don't work – or we get protracted arguments over the skills and qualifications of staff and the rates at which they should be charged out!

I have also had personal experience of carrying out the role of Inspecting Engineer, making recommendations in the Interests of Safety and the spending time and clients' money in briefing yet another consultant to carry out the recommendations – double counting and double expense!

I personally have seen situations of poor communication and support within alliances where the consultants never seem to talk to, or work with, the contractor, and contractors working on reservoirs who have never worked on reservoirs before – just because they have insufficient work of other types from the alliance.

What about site supervision? How many times are we told that site supervision is not required because we trust the contractors or we don't want

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to pay for full time supervision? How many times are young inexperienced staff asked to supervise works? How many times have you seen mistakes made, inappropriate materials used and poor workmanship not only accepted but also paid for? Are we getting the level of site supervision correct?

In cases where I have requested surveys, site investigations, and leakage investigations, many organisations can no longer procure these quickly and it can take weeks to get this information which is essential if one is to make decisions regarding safety or any design works.

OPERATIONAL RISK

I detect that there is also a distinct lack of willingness to take operational risks, in some of the water undertakings. For example in reducing water levels to carry out works or taking a service reservoir out of service in the summer. There have been many problems, which have affected a company's ability to programme and carry out works "in the interests of safety" which has, in some instances, resulted in Enforcement Notices being served.

Is this because there is a lack of communication within the organisation? Is it because reservoir safety is seen to be the poor relation of the organisation? Is it because the managers either do not have the knowledge and confidence in their own abilities and in that of their systems? Is it because they are not engineers, or is it because a blame culture exists within the organisation? Is it fuelled by media reaction to problems? Whatever it is, I perceive there is a lack of understanding within organisations about the need for planning and execution of works, required to meet the recommendations made in the interests of safety in a timely manner and often a reluctance to give sufficient regard to reservoir safety.

RISK ASSESSMENT

Risk assessment is now a major part of ensuring the safety of our dams and one which seems to impact on all aspects of our lives these days. In fact the inspection process itself is, and has always been, an observation based risk assessment. I am sure all would agree that the Reservoirs Act 1975 needs to be modified to embrace a risk based approach, if nothing else in the definition of what a reservoir is – i.e., not one based on retained capacity alone.

However, are some of our risk assessments techniques too complicated and too costly to make them universally acceptable? Are owners, and consultants for that matter, using risk assessment for the right reasons and then using it in the right way? Are the opportunities and improvements that risk assessment brings being utilised in terms of improving reservoir safety,

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bringing about organisational change, directing research etc? To the last question I should say – not often!

RESEARCH

As problems are experienced and conditions change there is a need for research in a number of areas of reservoir safety. There are a number of research organisations, universities, and companies undertaking in house research, specialists offering enhanced services based on research, funded by agencies including Defra, the EA, NERC and others. Yet we do not seem to have a coordinated approach to research. Indeed, there are areas of research that many of us will not even know are being carried out.

In addition, there are cases where there are research needs and there are insufficient funds from one body to meet the needs of that research. I believe that there is a clear need to firstly understand, and communicate to all of the profession, what research is being undertaken, that there is a requirement to develop a list of prioritised research needs, there is a need to attract funding sufficient to carry out that research and then there is a need to communicate the results of that research to the profession. Unfortunately I believe we are falling short of the mark in all areas.

Our judgements and decisions are often supported by Guidance Documents. We must continue to review and update those guides as new information becomes available and ensure there is transfer of information from other sectors, e.g. coastal engineering technology applied to waves and wave impact forces on wave walls etc.

INCIDENTS

Whilst we have had no recent failures, we have experienced a number of incidents some of which have been quite serious. Years ago there were many professional papers written on these incidents, for example one can remember papers on Balderhead, and very more recently Upper Rivington and Ogston and Carsington, where the consultants and owners were prepared to present information/’air their dirty washing’ for the benefit of the profession. I congratulate those prepared to do this but there are others who are more concerned about company reputation, share price etc. who are more secretive about the technical information associated with the incidents and the way they have managed the incident. In these cases we ‘cannot learn from our mistakes’.

The proposal to have a system of ‘Incident Reporting’ is an initiative that I consider must be supported. It might be, as I have suggested in the past that the report will have to be done by an Inspecting Engineer who commands the confidence and respect of the owner, and it may result in a report which

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‘sanitises’ the incident without mentioning the dam but we must get reports of incidents reported to the owners and Panel Engineers so that we can learn.

I fully support a voluntary incident reporting system, managed by the Enforcement Authority, in order to learn from our mistakes – if owners will not co-operate then it must be made a mandatory requirement.

TRAINING AND SUCCESSION PLANNING

It becomes clear that we must ensure that the engineers associated with reservoir safety are properly trained. We must ensure Supervising Engineers can not only exercise the judgement necessary to call for a statutory inspection but also review and rehearse flood plans, monitor progress with respect to recommendations in the interests of safety etc.

The average age of our Supervising Engineers is 56 years – are we doing enough to train the prospective Supervising Engineers of the future? In 2000 we had 94 SE’s under the age of 50, now we have 54. Are we doing enough to train the Inspecting Engineers of the future? The average age of our All Reservoirs Panel is 60 years. In 2000 we had 63 All Reservoirs Engineers, in 2005 only 53. How are we going to provide for the future?

Recommendations in the Interests of Safety must be enforceable – in other words they must be certifiable – and hence well defined and not open ended. Yet, examples of actual recent recommendations in the interests of safety have included:

- ‘Regularly clear weed growth and vegetation from around the main circular overflow and the secondary concrete weir overflow to maintain a clear water area to and around the cill. Keep both spillways clear of debris.’
- ‘..... stoplogs may be installed between 1 April and 30 September each yearto a level not more than 180mm above the sill of the main spillway. The stoplogs must be removed not later than 30 September each year and must not be reinstalled before 1 April.’
- ‘I recommend in the interest of safety that the above points of maintenance should be continued.....’
- ‘No residential caravans should be sited in the area where the natural ground is below the water level in a 10,000 year flood (assuming no breach).’

- ‘No homes to be built on plateaux immediately downstream of the dam.’

Currently the Inspecting Engineer inspects a reservoir and has no idea of the condition of the reservoir next in the cascade or in the next valley. Consequently he has no idea whether resources, often limited, should be directed towards the reservoir being inspected or another in the owner’s stock. Portfolio Risk Assessment (PRA) seeks to address this problem enabling an owner to reduce the total risk he faces as quickly as possible. The risks can be measured in a number of ways; - probability of failure, consequence of failure, in terms of life, or economic loss, security of supply to customers (single source supply reservoirs) etc. Portfolio Risk Assessment can be used to direct limited resources in a way that reduces the risk posed by an owner’s reservoirs. However, for the system to be of use it will need both Inspecting Engineers, who are making recommendations, and those who are enforcing to understand the concepts and take account of the assessments – in other words more education is needed.

CONCLUSIONS

In my opinion, we have undoubtedly made progress in some areas of reservoir safety. Our enforcement system is undoubtedly better; our Supervising Engineers are carrying out a very useful role – but there are many areas where we are not doing well and I suggest we are not improving– we can do more. I have not made an attempt to answer some of the questions I have posed – they have been posed to generate thought and debate. However, I do believe we need to:

- Ensure the adequate training and assessment of Supervising Engineers.
- Ensure the adequate training and assessment of Inspecting Engineers.
- Improve the quality of maintenance of our reservoirs.
- Review the methods of procuring the services of all work associated with reservoirs.
- Educate those associated with the operation and maintenance of reservoirs.
- Raise the profile of reservoir safety in owner organisations.
- Educate the profession in general about risk assessment – its advantages and disadvantages.
- Achieve an integrated, well funded programme of research.
- Establish an incident reporting system.
- Engage in a programme of succession planning.

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In conclusion, yes, we have improved in some areas, but in some areas things are worse and certainly we can do better.

NOTE

The views expressed in this paper are the personal views of the author and not necessarily the views of Atkins Ltd, Defra, ICOLD or the British Dam Society.

REFERENCES

HMSO, Reservoirs Act 1975

HMSO, Reservoirs (Safety Provisions) Act 1930
