

Exercising of Emergency Draw-down Plans

DAVID BROWN, British Waterways, Warwickshire UK

KEITH GARDINER, United Utilities, Warrington UK

NEIL WILLIAMS, Severn Trent, Warwick UK

SYNOPSIS. Emergency plans are discussed by some of the major reservoir owners. Published guidance is considered, exercising regimes are discussed and tests of plans are documented. Proposals are made for appropriate exercising frequencies.

EXTERNAL GUIDANCE AVAILABLE TO UNDERTAKERS

There are a number of sources of guidance on emergency plans. Defra published an *Engineering Guide to Emergency Planning for UK Reservoirs*¹ in June 2006 as an informal consultation draft. No guidance was given on suitable drawdown rates but examples of practices adopted by some major undertakers were given.

It was proposed that each plan be updated annually for contact information, every owner do an annual desktop exercise and that plans be tested on site as follows:

	Frequency for Overall Consequence Category			Application
	A1	A2	B	
Site attendance	2 years	5 years	5 years	One reservoir of
Site trial	5 years	Not required	Not required	every group

For British Waterways, with six disparate A1 reservoirs, this would have meant at least one full test involving deploying pumps per year.

In April 2009, Defra issued a consultation on an on-site emergency plans, including a template². Exercising frequency was initially proposed as follows:

MANAGING DAMS: CHALLENGES IN A TIME OF CHANGE

Frequency Category	No. of Reservoirs owned by Organisation	Type and Frequency per Organisation
1	1	One Type C per annum.
2	2 to 10	One Type C and one, separate, Type A per annum (total of two exercises).
3	Greater than 10	One Type C per annum One Type B per first management group per annum. One Type A per staff group per annum According to a schedule which works through all reservoirs

A type A exercise was a table top exercise of plan against a scenario.
 A type B exercise also involved on site deployment of staff and equipment
 A type C exercise was a full organisation major incident exercise, integrating with an off-site plan exercise if appropriate

British Waterways would have needed to have done one Type C exercise, fourteen Type B exercises and forty-six Type A exercises per year based on this guidance.

The guidance was revised in November 2009³. It is now suggested that owners with more than five reservoirs do one full exercise per year.

A proposal for standardising emergency draw-down rates has been made by Jonathan Hinks⁴. Alan Brown has proposed a risk based approach⁵.

UNDERTAKERS' INTERNAL PROCEDURES

British Waterways

A Direction issued by the Technical Director requires that all reservoirs, except for a handful presenting minimal risk, have an on site plan, reviewed annually. There is a standard template.

A risk based approach is adopted and the plans require that 50% of the volume of water retained in the reservoir is removed in a time based on the consequence of failure and the surveillance frequency, a measure of how long the defect would have had to develop before intervention. An average winter inflow is assumed. These times are given below.

BROWN, GARDINER AND WILLIAMS

Category	weekly surveillance	twice weekly surveillance
A1	3 days	5 days
A2	5 days	7 days
B, C & D	7 days	9 days

If the installed capacity is insufficient to achieve this, temporary pumping is installed. British Waterways relies on hired pumps provided and installed by a framework contractor. It is considered that owning emergency pumps would be extravagant for the unlikely nature of these events. The pumps would require storing, testing and servicing. There would be a temptation to press them into use for day to day work. At a central depot, say in the English Midlands, they would be remote from a reservoir in the Scottish Highlands.

It is assumed that up to 1 m³/s of pumping can be operational within 24 hours. This is provided by up to ten, 'eight inch' electric submersible pumps. More than ten pumps, their generators, fuel tanks, switch gear etc, would be unrealistic.

Each plan where pumping is involved specifies a 'meeting point' where delivery vehicles arrive and a 'set down area' where the equipment is deployed.

All the plant needed is hired, the main piece of equipment being an off-road telehandler. The plant and equipment needed is standardised for all reservoirs, the only difference being the numbers of pumps and generators. Consideration was given to purchasing a Swedish Hagglund BV206 off-road amphibious crawler machine with a crane for the least accessible reservoirs. These are not available to hire in the UK. As only one reservoir, Birkenburn, is so remote that the standard equipment would struggle to cope, the access track was improved to carry out other works and the plan was written to use hired tracked dumpers instead.

There are other inaccessible reservoirs such as March Haigh. Here, increasing the frequency of surveillance to twice weekly obviated the need to bring in temporary pumps. Surveillance was also increased at Rotton Park, also a category A1 reservoir, in order to bring the numbers of pumps needed down to a realistic level.

A few reservoirs cannot meet these criteria and increasing the installed capacity is under consideration.

MANAGING DAMS: CHALLENGES IN A TIME OF CHANGE

United Utilities (UU)

Frequent exercising is an essential element of any contingency plan. It ensures that all participants with a role in an emergency response are aware of their responsibilities. It is an opportunity to review the accuracy and completeness of the plan.

The policy for the review and exercising of plans developed by UU, is very similar to that contained in Defra 2009². This comprises:

- An annual review of every plan by its author with the revised plan approved according to the organisation's arrangements. Ideally the review should include all front-line personnel who operate the reservoir.
- When required the Company will cooperate with the exercise of off-site plan for the reservoir (which will be lead by a Category 1 Responder under the Civil Contingencies Act) and any on- or off-site plan exercise involving a reservoir which is part of a cascade which includes our reservoir.
- One full exercise every 10 years for each reservoir; this may coincide with S10 inspections under the Reservoirs Act 1975 and will involve all personnel in the organisation with a role in responding to a major reservoir incident and should include: deployment of staff as per the plan requirements, contacting of equipment/materials suppliers to confirm availability during the emergency, involvement of Supervising or Inspecting Engineers and the operation of valves and drawdown facilities. It may also include participation of organisations managing reservoirs in cascade. Relevant Category 1 Responders should be invited as observers.

The running of such exercises involving incidents at impounding reservoirs is consistent with the future statutory requirement to test reservoir contingency plans due to come into effect in 2010.

Severn Trent Water Ltd

Severn Trent Water (STW) has a policy of exercising their emergency plan on an annual basis for a site. On-site plans defined by a STW template have been in place for some 10 years and are tied intrinsically in to the Company's emergency plan for responding to major incidents. Information is held both in paper form and electronically. This will allow any one Supervising Engineer to respond to an emergency at a site that he may have only basic familiarity with. The information will guide him/her to the site, provide information on historical performance and basic constructional details as well as how the maximum discharge rate can be achieved

BROWN, GARDINER AND WILLIAMS

assuming average inflow rate and the implications of maximising that release rate.

The annual exercise is of a desk top type with the actual date not been made known but only the likely period (normally a month) over which it will run. This is intended to give a better idea of response. Invariably, the exercise is run such that an unfamiliar Supervising Engineer responds to the emergency rather than the named Supervising Engineer under Section 12 of the Reservoirs Act 1975.

The perceived emergency is intended to exercise the Emergency Call Centre (ECC), a Supervising Engineer, the Company's Business Resilience Team as well as Suppliers Contractors and Consultants.

The emergency is initiated with a call to the ECC purporting to be a member of the public who paints a scenario of a potentially serious incident at a reservoir site. The exercise unfolds such that a Supervising Engineer is contacted and who then runs with the exercise ensuring that appropriate contacts are made to an Inspecting Engineer, Business Resilience Team, County Emergency Planning Officers, Environment Agency and the Company hierarchy.

The exercise will continue to assess draw down potential and the means by which it can be achieved with contact being made with pump suppliers and other contractors who can support the exercise. Response times are requested from Inspecting Engineers and suppliers to determine their suitability. To date exercises have not involved mobilisation of people or equipment.

EXPERIENCES OF EXERCISING PLANS

British Waterways

It was felt that there was a need to exercise a plan, in particular to test the validity of the assumption that 1 m³/s of pumping could be operational within 24 hours. On 22 September 2008 an exercise was staged at Lower Foulridge Reservoir, near Colne in Lancashire. Only a few senior staff were aware that such an exercise was to take place. Other than these people, until they arrived on site, other participants were unaware that it was not a real incident.

Lower Foulridge Reservoir was built in 1798, has an earth dam 8.5m high and 745m long. It holds 1,488,020 m³ of water and has a surface area of 35 hectares. It is a Category A reservoir, with two draw-offs having a combined capacity of 1.93 m³/s at full head. To meet the criteria an

MANAGING DAMS: CHALLENGES IN A TIME OF CHANGE

additional 0.9 m³/s of temporary pumping is needed. In the exercise it was decided to install only two pumps in the interests of economy but to investigate the availability of the remainder.

This reservoir was chosen because access was fairly good, avoiding the need to deploy plant on third party land. The local team was also enthusiastic about emergency planning.

At 03:40, a time chosen to ensure that much of the exercise could be conducted in the hours of daylight, a local engineer rang the published emergency number, a UK based emergency call service, claiming to be a worried resident, below the dam. British Waterways' call out system was set in motion and a local supervisor was roused from slumber. He sent two operative to investigate and at 04:40 they were on site and were briefed on the nature of the exercise. They discussed with the exercise team on site what action they would take i.e. opening the valves, one of which is in a confined space and confirmed that they would not cut corners regarding normal safety protocols. They reported back to their supervisor and requested that an engineer be called out. A discussion about evacuation took place but the site team suggested that the engineer give an opinion first. The duty engineer arrived from Wigan at 06:20, wishing he hadn't swapped his roster the previous day. Once apprised of the situation he decided to invoke the emergency plan and call out the framework contractor, then Morrison Construction, to install pumps.

The Supervising Engineer, Paul Howlett, was summoned from Yorkshire. He contacted the last inspecting engineer, John Gosden, with little difficulty to test the communications and discuss the exercise. As the exercise progressed, senior managers were apprised; the Asset and Programme Manager for the North-West came to site to take charge as 'silver command' with 'gold command' being the general manager. Press and publicity both real and theoretical was addressed. Contact was made with the Local Resilience Forum, which was aware of the exercise in advance.

Morrison's staff started to arrive at 08:09 having been diverted from another waterway job nearby. The plant and equipment started to arrive from 10:35, the first pump coming from Winsford in Cheshire at 15:45. The telehandler was used to place the pumps in the floatation unit and lift the assembled unit into the water. The pumps were towed across the reservoir from the launching point, which was in a sailing club yard, to the spillway where they were to be set up. By 19:40, the two pumps were operating satisfactorily, discharging 0.2 m³/s, as measured at a gauging weir, over the spillway. Had additional pumps been ordered, they could have been supplied but from other depots, arriving at later times. The pumps were working 14 hours

BROWN, GARDINER AND WILLIAMS

after the incident was first identified and a full contingent of pumps could have been functioning within 24 hours.

The exercise was regarded as a success; it had proved the workability of the assumptions made in preparing the plans. Lessons learnt included:

- the value of using a framework contractor to provide labour, plant, materials and expertise through an established supply chain;
- there was scope for improvement in internal and external communications;
- the plan as written assimilated site specific matters and communication channels with generics from the template, e.g. how to identify an emergency; matters giving information on what to do, who to contact, etc. needed separating out into appendices;
- including post codes would greatly assist delivery drivers in finding remote sites;
- the need to add certain items of plant and equipment to the schedules in the plan;
- the heavy electrical cables needed to supply the pumps are not readily available in unlimited quantities and the plans needed to be refined to optimise their use;
- British Waterways was acting as ‘main contractor’, assisted in part by the framework contractor, not the arrangement with which personnel were familiar; the standing instructions, risk assessments and method statements needed review to reflect this;
- inundation maps (QRA based maps had been prepared for this reservoir) need to be available, yet secure; the Defra mapping exercise will address this point;
- the access to the reservoir, the weather and traffic conditions were ideal; what would have happened if this had not been so?

United Utilities

A series of one live and five desk top exercises have recently been carried out by UU. The aim of the exercises was to practice the response by United Utilities to a major, potentially escalating, incident and to test the robustness of the emergency contingency plans as well as exercising the Operations Incident Management Procedure.

The aim was supported by the following objectives to:

MANAGING DAMS: CHALLENGES IN A TIME OF CHANGE

- Identify challenges associated with major and potentially escalating incidents at impounding reservoirs;
- Test the Emergency Plant equipment and organisational response;
- Assess how quickly roles and responsibilities are allocated to employees;
- Test communication practice between tactical and operational staff;
- Practise employee response routines and planning capabilities;
- Test and validate emergency contingency dam plans;
- Consider issues that may impact the public;
- Exercise the external communications and engagement with respect to the public, media, bluelight services and other key stakeholders.

All exercises incorporated a series of injects to present realistic challenges and a number of resources were provided including the dam plans, inundations maps and the UU incident manual.

The table top exercises were carried out with a team of key players and observers chosen based on their expertise and the involvement that would be required should an incident occur, for example, Supervising Engineer, Duty Operational Response Manager, Treatment Manager, Headworks Controller, Reservoir Safety Manager. The scenario was set prior to the meeting; an 'incident response' was carried out by the players and the timeline was extrapolated in some exercises to cover three days' activity.

The live exercise incorporated only the initial stage of the emergency response, which was lead by the Incident Manager, at the Operational Response Centre (ORC), and the Forward Incident Controller (FIC) on site at the reservoir. The incident team at the ORC managed the emergency response from a strategic level supporting the team on site the reservoir. They considered and dealt with the issues identified within the emergency plans including how to obtain resources and equipment for use on site as well as considering treated water supplies for the wider network.

An incident team handling Emergency Plant equipment was established at the reservoir and was directed by the FIC. This injected an element of realism and stimulated a sense of urgency prompting a reactive response. The two teams were encouraged to work together testing communication links (both visual and audio).

Representatives from the following external agencies visited the reservoir to observe the live exercise:

BROWN, GARDINER AND WILLIAMS

- County Council Emergency Planning Team
- Local Resilience Forum
- Environment Agency

The key recommendations from the exercises are given in order of importance

- Those who would take on the role of FIC should receive specific leadership training in command and control situations.
- The FIC should have an assigned deputy who can continue the co-ordination of activities on site, alternating with the FIC if necessary.
- Staff training should incorporate an understanding of the roles and responsibilities for all involved, not just their own team.
- A designated person, such as an Administrative Officer should be responsible for giving inductions to those entering the site, giving out radios to individuals, keeping a register of who is on site, and should be easily identifiable.
- Consideration should be given to live coverage of site activity to be transmitted to the incident room. However, photographs showing activities on site sent by e-mail to the Incident Meeting did prove to be very useful in the live exercise.

When incidents have occurred at reservoirs, liaison with external agencies has been critical to the incident response and recovery. Feedback from external agencies was favourable. They noted the positive attitude and culture of team and their willingness to take action to resolve issues. Face to face meeting with professional partners and being able to discuss progress of the incident as it happened enabled them to see each other's view points; Seeing UU equipment being used and having discussions with operational staff about availability of equipment and usage meant a better understanding of operational activities.

The risk to the Business should these exercises not be carried out is far greater than the cost of the management of a major incident. Exercising the contingency plans highlights gaps in knowledge and incident management procedures. Although incidents of this kind rarely occur, when they do the response needs to be rapid and reactive and therefore exercising the plans is crucial to the training of our employees. It is also critical with respect to the proactive reputation United Utilities currently has with respect to contingency planning.

MANAGING DAMS: CHALLENGES IN A TIME OF CHANGE

Severn Trent Water Ltd.

Some of the learning points arising from the last run exercise are as follows:

- Rules for the exercise are laid down beforehand. This involves the requirement that every oral or written message is prefixed by 'Reservoir Exercise'. Initially this was adhered to but lapsed as the exercise progressed with the risk that it could be interpreted by unknowing players as a real incident, thus raising unnecessary alarm.
- There is a requirement that an exercise log be maintained by all informed players. However this again can lapse as the exercise progresses such that response time and appropriateness of instruction can get lost.
- The exercise needs to be tightly controlled such that the start and finish needs to be made known. There should therefore be a clearly identified 'Exercise Controller' such that he/she communicates to all participants the end of the exercise.
- It is known that the site in question has communication difficulties such that a false sense of achievement can sometimes be gained when run as a desk exercise. It is accepted that it is essential at forthcoming exercises that the real physical difficulties be identified by fully mobilising resources.
- It is essential that different failure mode scenarios be considered to cover all failure possibilities. In the exercise in question, high leakage rates into the tunnel were reported as the main threat, whilst the physical arrangement was for the scour to discharge into the upstream end of the tunnel. The dichotomy therefore existed that adding further extreme flow through emergency draw down through the tunnel could accelerate the rate of breakdown of the tunnel lining.

PROPOSALS ON THE WAY FORWARDS

There is great value in exercising emergency plans, demonstrating that they are not merely desk exercises, teaching valuable lessons leading to improvements in the plans. Site trials are expensive and time consuming. The Lower Foulridge test cost £12,500 in direct costs, took up about 25 man days of staff time and resulted in loss of productivity elsewhere. Whilst exercises are very valuable, doing them too frequently does not proportionately increase their usefulness.

In its response to the Defra consultation in 2009, British Waterways suggested that an appropriate time frame for a large undertaker would be one desk exercise every two years and a site exercise every five.

BROWN, GARDINER AND WILLIAMS

REFERENCES

- 1 Defra (2006). *Engineering Guide to Emergency Planning for UK Reservoirs*, Defra, London
- 2 Defra (2009). *On-Site Plan for Reservoir Dam Incidents Defra Guidance on Reservoir Emergencies*, Defra, London
- 3 Defra website (accessed 4 January 2010)
<http://www.defra.gov.uk/environment/flooding/documents/reservoir/onsite-plan.pdf>
- 3 Hinks, J. (2009). *Low level outlets 1: formula for target capacity*, Dams & Reservoirs, Vol 19, No 1, pp7-10, Thomas Telford, London
- 4 Brown, A. (2009). *Low level outlets 2: risk assessment*, Dams & Reservoirs, Vol 19, No 1, pp11-14, Thomas Telford, London