RESERVOIR RENOVATIONS: BEST CHANCE OR LOST CHANCE

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ABSTRACT

Design and configuration of water storage reservoirs has in the past predominantly been focused on personnel safety, with very little consideration given to the quality of the water. As these reservoirs approach their half-life many require upgrades to their access areas, internal structures and pipework.

This paper will highlight five key areas where old designs have proved to be deficient and will offer solutions to improve the safety of both operating personnel and the stored water.
The key areas include: Internal access ladders, entry hatches and platform areas, roof and platform drainage, ventilation systems, internal fittings and pipe work

KEYWORDS

Reservoirs, Ladders, Hatches, Platforms

1.0 INTRODUCTION

Many steel water storage tanks in NSW and Victoria were built in the mid 1980's and have been in service for 20 to 30 years now. At the same time many earlier concrete tanks were covered with roof structures to improve water quality.

Design requirements at that time were focused almost solely on personnel safety. Access ladders, entry hatch areas, roof drainage and ventilation systems have consequently failed to deliver the safety requirements to the stored water that consumers are expecting and are entitled to.

Times have changed significantly and exposure to other industry requirements regarding storage systems (such as the food and beverages industry) as well as an increase in public awareness has driven a 'renaissance' to upgrade our water storage reservoirs. This process can only be carried out effectively if all the issues involved are understood and a practical balance between personnel and water safety is achieved. Frequently money is spent on one or two less important items, while missing out on the critical ones which are often inexpensive to fix. A successful outcome depends on a willingness to recognise errors already made in the original design and construction, determine the most appropriate solution and implement a detailed scope of works for the intended renovation project.

Maintaining protective coatings is the single most important periodic maintenance required for steel reservoirs. This provides the ideal opportunity to remedy a lot of the other design issues that were implemented in the initial construction period. A lot of reservoirs have already been re-coated and the chance to resolve these issues concurrently has been lost due to a poor understanding of the holistic requirements of water quality.

2.0 INTERNAL ACCESS LADDERS

Until the mid 1990's, most tanks were emptied and drained for cleaning and inspection purposes.
This entailed personnel climbing down into the tanks, often without the benefit of confined space knowledge or training. Ladder materials were also limited and galvanized steel was the preferred option, even though galvanizing had a limited protective life when immersed in water. Ladder and platform designs were based on the ability of personnel to climb them unassisted and rescue scenarios were often neglected or given low priorities. The AS 1657-1992 (fixed platforms, walkways, stairways and ladders) was used extensively, with little thought given to how it impacted on both confined space requirements (AS 2865- 2001 Safe Working in a Confined Space) or water quality. Consequently we have tanks fitted with sloping ladders and platform structures that prevent effective rescue from within the confined space environment. These same ladders generally have stiles protruding from out of the tank that makes it impossible to seal the entry hatch areas against natural or deliberate contamination.

Figure 2: ***Ladder stiles protruding from an unsealed entry hatch area.***

Solution:
Use longer lasting, non polluting ladder materials such as FRP, and configure the designs to assist in a rescue scenario if required. Vertical ladders are good for assisted climbing (using appropriate PPE) and they have benefits for rescue situations requiring several personnel at once to be lifted into or out of the tank. But these ladders should not continue out through the entry hatch area – there are better methods of providing hand contact for the climber that do not jeopardise stored water quality.

Figure 3: ***The hatch frame sealed off and a new vertical ladder fitted.***

3.0 ENTRY HATCHES AND PLATFORM AREAS

Entry hatches were primarily designed to keep out unauthorised personnel or larger vermin. Rescue scenarios were not considered. The openings are often too small and the front edges of the hatch frame were seen as being a potential trip hazard to maintenance personnel, and removed in most cases. Safety will always have priorities and frequency is an important factor in deciding which of these priorities takes precedence. The risk of someone tripping over a very obvious entry hatch frame, when stepping into the tank is minor when compared to natural pollutants entering our stored water 365 days of the year. The tank platform and roof areas are already full of trip hazards (if operators choose to walk around with their eyes closed), so why was the entry hatch in particular singled out for special attention? Hatch covers also had to accommodate the extended internal ladder stiles, so there was little chance of these original designs protecting the product stored within the tank.

Solution:
Entry hatches need to be enlarged to at least 900mm by 900mm to allow easy access. The frame should be sealed onto the surrounding platform areas, the covers overlapped around the edges of the frame and having nothing protruding through them. Storm water and debris ponding needs to be eliminated from the immediate area to maintain a clean working environment when entering or exiting the tank.

Figure 4: ***The existing ladder stiles trimmed off, the front edge sealed and an overlapping cover fitted.***

Platform areas need to be enlarged and sloped to encourage effective drainage, there needs to be adequate clearance to allow debris to be removed easily. Larger, uncluttered work areas assist in improving ergonomics and rescue systems need to be incorporated to assist confined space entry and exiting of the tank.

Guard rails need to be put in place to prevent personnel from falling off the immediate platform or roof area, but not to limit access to the safer areas of the roof, where regular maintenance needs to be carried out.

Figure 5: ***Typical platform area – roof debris is ponding, unsealed hatch area and lack of effective guard rails.***

Figure 6: *An upgraded platform area including additional guard rails.*

4.0 ROOF AND PLATFORM DRAINAGE

Any drainage system that is not obvious and external to the tank has a potential to fail. The platform areas were forgotten when it came to drainage issues – a bit of water draining back into the tank was probably looked on as being a bonus during dry times! The natural contamination present from leaf material, dust and bird faeces was not considered important and now our precious water is being polluted on a daily basis. Roof and walkway areas that drain internally often overflow and deposit waste materials directly into the stored water. This can be through poor alignment of the internal drain with the overflow bell mouth or under estimated volumes of water collected on the roof area during peak rain periods. Box type gutters can fail through blockage or corrosion and contamination will occur with no-one the wiser.

Figure 7: *A roof drain point not connected into the overflow.*

Solution:
Change roof designs to avoid internal gutter systems, enlarge and re-align existing drainage points to cater for peak storm activity.

Install drainage points in ponded platform areas that exit out through the adjacent wall

area and carry out regular monitoring during heavy rain periods to ensure contamination isn't occurring within the tank (an unpleasant and wet activity but necessary to avoid failures).

5.0 VENTILATION SYSTEMS

Effective and well designed ventilation is required to protect roof framing from premature corrosion. It can also remove condensate material that collects under the roof sheets and which drops back into the water and affects taste and odour in the stored water.

In some cases too much or poorly positioned ventilation areas can cause more contamination issues than they solve – there has to be a balance depending on the surrounding environment. Tanks surrounded by overhanging trees will be subject to excess leaf debris which can enter the tank through the vents. Also tanks in very dusty or industrial areas will need to have ventilation limited or re-positioned to avoid additional contamination from occurring.

Figure 8: ***Ventilation mesh not effective against leaf debris & wind born contamination.***

Solution:
Design ventilation systems to suit the local environment. Windy areas should not have turbine vents fitted as these will wear out quickly through over use – fixed vents are preferred.

Mesh panels should be positioned away from prevailing wind areas to avoid excessive wind born contamination, the materials used should be corrosion proof and be fine enough to keep out insects and larger leaf type contamination.

6.0 INTERNAL FITTINGS AND PIPE WORK

Removing or replacing any fitting that adversely affects water quality is important. Materials such as AC overflow risers, ductile iron pipes, galvanized metal items and any un-coated penetrations all need to be attended to during the renovation process. Fittings placed inside steel tanks are commonly coated with the same materials used on the wall and floor, but some items such as ladders and support brackets have been galvanized and these have deteriorated at a far quicker rate than the wall and floor areas.

Figure 9: ***An AC overflow riser pipe that is de-laminating.***

Concrete tanks generally have uncoated fittings as no-one considered protective coatings due to concrete being relatively stable from a corrosion perspective – the unprotected items however corrode and continue to pollute the water on a continual basis.

Solution:
Replace corroded or structurally deteriorated items with materials that are cathodically compatible and suitable for immersion.

Simplify pipe work systems so that effective water blending takes place and sediment disturbances are minimilised as water passes in and out of the tank. Fit directional nozzles to inlets to avoid disturbing existing sediments and to also blend the stored water and keep it fresh.

Fit well designed safety screens to outlets that avoid sediment entrapment and resulting poor quality water leaving the tank.

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