CONFINED SPACES REVISITED - TRENDS IN WORKPLACE PROCEDURES

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ABSTRACT

Confined space entries have always been part of maintenance work on water and wastewater systems. Many tragic accidents have occurred due to a lack of understanding of the hazards in such environments. In recent years, the introduction of stringent new regulations has enforced the application of safe systems of work for these activities in the Water Industry. These requirements have also encouraged the development of new designs and workplace trends, which enable work to be undertaken without the need for personnel entry into these spaces. This study documents the new regulation together with some of these trends and initiatives, which are now being practiced in the water industry.

KEY WORDS

Confined space Design Entry Permits Hazards Manholes Regulation Training Ventilation

1.0 INTRODUCTION

Operations personnel in the Water Industry in 1999 are well aware of what a confined space is and that safe systems of work are required for personnel entry into them.

This is a significant difference to the situation of some 20 years ago when the Water Training Centre, in its infancy, identified some serious deficiencies in the manner in which confined spaces were entered. Confined spaces in the water industry include manholes, pipes, shafts, pump wells, tanks, pits and other environments which have restricted access and because of ventilation limitations, have the potential to contain atmospheric hazards.

This change in awareness is the result of-

- Government Regulation and stricter compliance requirements;
- Severe accidents reported in confined spaces; and
- The impact of training in safe entry procedures.

Confined spaces were characterised along with their toxic hazards in a paper presented to the 45th Engineers and Operators' Conference (De Silva, 1982). Ten confined space accidents which occurred in Victoria between 1945 and 1981 resulting in 16 fatalities and 9 serious incidents were documented. This current paper does not attempt to document the track record in confined space accidents in more recent times, however it is widely known that serious accidents caused by inappropriate entry procedures have continued right up to the present time.

In 1985, the Occupational Health and Safety Act 1985 was proclaimed resulting in the reform of workplace health and safety regulation. The Occupational Health and Safety (Confined Spaces) Regulations 1996 came into force in 1997 requiring employers to identify confined spaces, assess hazards and institute control measures to protect the health and safety of employees required to

work in confined spaces.

Stricter compliance requirements, reform in the Victorian Water Industry and moves to contain operating costs but maintain a high level of service to customers has led to some significant trends in the way confined space work and other activities are being undertaken.

The purpose of this paper is to highlight some of these trends which will, no doubt, ensure that the tragedies of the past will not recur.

Some important aspects of the new Regulations are discussed together with the following issues that have been introduced to alleviate the hazards of confined spaces-

Improved design of confined spaces to control confined space hazards and, in some cases, enable work to be performed without the need to enter;
Re-design and alteration of existing confined spaces to overcome previous hazards;
Introduction of new appliances and techniques which enable maintenance work to occur without the need to enter and work in the confined space.

2.0 DISCUSSION

2.1 New Regulatory Requirements

The Occupational Health and Safety (Confined Spaces) Regulations 1996 now place responsibility on the employer to undertake risk assessments of activities occurring under their direction.

Risk management involves three components:-

(i) Hazard identification- the first step is to identify the confined spaces under the organisation's control.[1]

The application of the definition of a confined space should, in most water industry situations, readily confirm whether a particular working environment is a confined space requiring the application of the regulations to it.

Put simply, if a particular instance meets the following criteria, then it is a confined space:-

- The space is intended to be entered by personnel, and
- It has limited access, and
- It is at atmospheric pressure, and
- It has the potential to contain a harmful atmosphere

The author suggests that in any case where the outcome of hazard identification is unclear, such as an open tank, that case should be taken as a confined space for the purposes of this process.

Note that should personnel entry not be physically possible or if the space can be secured in such a way that it is not possible for personnel to gain access into the space, then confined space entry provisions do not apply. This point is very significant to the outcomes of this paper as will be seen in later discussion.

(ii) Hazard assessment- once a situation is identified as a confined space, the hazards likely to be encountered should be itemised and fully assessed in terms of the level of risk posed to entry personnel.

[1] The definition of a confined space in the Regulations together with the Code of Practice for Confined Spaces (Victorian Government, 1997) should be consulted to assist in this process.

This assessment should consider the severity of the risk in the light of access/exit available, obstructions and plant inside the space, the nature of atmospheric contaminants and their sources, together with the type of work to be performed in the space and the efficiency of any existing ventilation.

***(iii) Hazard control*-** for each confined space and the hazards identified, a specific control procedure should be adopted according to the degree of and range of risks posed.

The Code of Practice (Victorian Government, 1997) recommends the application of a priority control sequence to determine the appropriate entry strategy. This sequence suggests the order of importance to be placed on the most effective control:-

- *Elimination*- prohibit entry and defer work until hazards are avoided or undertake work without entry.
- *Substitution*- eg. should hazardous cleaning materials be used, is it possible to substitute an alternative lower risk chemical?
- *Isolation and Engineering Control*- can atmospheric and other hazards be prevented from entering the space during occupancy or can the space be designed for effective isolation and ventilation to remove the risk.
- *Administrative control*- a specific entry procedure (safe system of work) should be developed and personnel adequately resourced and trained in its implementation.
- *Personal Protective Equipment (PPE)*- where other higher priority controls cannot be implemented, or PPE is considered necessary in conjunction with other control measures above, PPE should be made available and specified.

Occupational Health and Safety Regulatory Reform

The Occupational Health and Safety Act 1985 requires that a safe system of work be provided for the health and safety of employees where assessed risks need to be controlled as outlined above. The risk management exercise discussed is a legal obligation on the employer and marks a significant trend in occupational health and safety regulatory reform which has occurred since Ms De Silva's 1982 paper. At that time, the Health (Entry into Confined Spaces) Regulations 1984[2] which were in force, were quite prescriptive, requiring specific entry procedures to be observed.

Today, risk management techniques involving the use of the Code of Practice for guidance, provides far greater flexibility and, importantly, practicability, in confined space work. This method of control will ensure that old outmoded techniques are not retained by Regulation.

To illustrate this point, the following example explains how the new regulations have overcome previously inflexible requirements:-

> *The old regulations stipulated that before an entry into a confined space could occur, a suitable respiratory protective device was required to be worn. Alternatively, the space had to be ventilated by blowing air in for a period of time not less than 10 minutes. This old regulation permitted the use of a distant breathing respirator, a device which consisted of a facemask, air hose and an open end which was affixed in fresh air outside the space! By 1993, when these regulations were still in force, this type of respiratory protection was not considered*

[2] These regulations sunsetted in 1994 and were replaced in 1997 as previously outlined.

adequate for confined space use in the relevant Australian Standard[3].

This example illustrates how old prescriptive regulations can go out of date with the development of improved and more effective equipment and work practices. It further highlights the inflexibility of application of control measures as a result of specific regulation ie. it is now possible to accurately assess atmospheric air conditions and ventilate in several of alternative ways. The new regulation provides flexibility in order to do this and ventilation guidelines are provided in the Code of Practice.

Entry Permit

Possibly the most significant component of the new confined spaces regulations is the requirement for an Entry Permit to authorise personnel to enter confined spaces.

The Entry Permit is a written authority which is designed to be signed by entry personnel indicating that they understand the requirements to be observed during the entry and also signed by the person responsible, authorising the work to proceed.

Entry Permits must be completed prior to entry and a permit can only apply to one confined space. The author considers that there are two major concerns regarding the application of such permits in the water industry:-

- The attitude of water industry personnel to the requirement, and
- The obligations of and competence of responsible persons.

The author has observed some instances where resistance to this requirement is the result of the "get on with the job" attitude and "we do not have time for all the paperwork!" Regardless of the urgency of any job or shortage of manpower, any person responsible for work involving confined space entry must understand that a permit is a legal requirement.

Personnel in the water industry who are required to enter confined spaces are normally trained in appropriate entry techniques and it is easy for water authorities to assume that having trained personnel, having provided safe systems of work and the necessary equipment and resources, that the employer obligations have been met. It is important to understand that whilst practical competence is vital, the literacy skills of the responsible person together with an understanding of the obligations and the authority given under the entry permit, must also be carefully considered.

The responsible person has to be fully competent to accurately complete a written assessment of the confined space (required by the Entry Permit) and must ensure that the work is performed according to the provisions stated on the permit.
A sample Entry Permit form is given in the Code of Practice.

The Entry Permit requirement is an effective method of ensuring that confined space hazards are controlled prior to entry and provides an efficient method for the implementation of a suitable safe system of work. The permit is a checklist of activities which must be undertaken before entry is permitted, eg. atmospheric assessment and ventilation requirements. It also lists the equipment required and precautions to be undertaken during the work. Finally, the permit provides a formal record of the work activity, the safety measures utilised and the personnel involved.

It should be noted that the effective application of a permit system in all recently recorded confined space incidents would almost certainly have avoided the serious outcomes.

2.2 Trends in Confined Space Activities

[3] AS 2865 **Safe Working in a Confined Space** (note the 1985 Standard was superseded by AS 2865:1995)

The author has been involved in confined space entry training for 15 years and has observed some significant trends in the design of confined spaces and the manner in which work in these environments is carried out.

Recently, in order to document these initiatives and improve the content and objective of confined space entry training, a survey of some of these initiatives has been undertaken. This survey has included several site visits and discussions with relevant water industry personnel from throughout Victoria.

The intent of the survey was also to assess the validity of the author's contention that many existing confined spaces were designed for hydraulic functionality with no consideration for the health and safety of maintenance personnel.

Some of these trends include:-

Pump Stations

Wastewater pump stations have long presented confined space entry problems to water industry personnel. Hazards are particularly encountered in wet wells and the installation of submersible-type pump stations has been the most significant trend in the avoidance of confined space entries.

Suitably designed, this type of pump well should enable all maintenance to be undertaken outside the space by the remote removal of pump sets from the well. Unfortunately, these good intentions are flawed in some cases where inlet/outlet valves and other ancillary equipment is located in the wet well. Some examples of this have been observed where pumps can be removed without entry, however maintenance on other items including valves, can only be achieved by entry into the well. A better design is where all ancillary equipment is located in an adjacent pit isolated from the live sewer well.

Sewer Collection Systems Without Manholes

Traditional design of sewer collection systems has always made provision for manholes at various locations throughout the urban pipe network. The original intent of these manholes is aptly described in Tchobanoglous (1981) which states that "the principal appurtenance associated with most wastewater collection systems is the manhole which interconnects sewer pipes and allows entry for sewer cleaning."

Unfortunately, the minimum dimensions of these spaces makes it difficult to enter these shafts and extremely difficult to move about in order to undertake maintenance work.

Improved equipment for sewer cleaning, discussed later in this section, has reduced the requirement for entry into these confined space environments. However human nature being what it is, the old habit of "getting in and on with the job" still occurs resulting in entry into the confined space often when not necessary.

Manholes, traditionally have been designed into collection systems at 100m intervals, at changes of grade, invert elevation and direction of sewers. The purpose of these structures was to provide access to address sewer blockages and also to make provision for flood storage.

The author has examined two new sewer schemes that have been constructed without manholes by using access shafts instead. These recent schemes include the Bannockburn Wastewater System at Bannockburn, constructed by Barwon Water and the Bundalong Wastewater Scheme on Lake Mulwala by North East Region Water Authority.

These schemes utilise access shafts, which consist of 100mm riser pipes at usual manhole location points. These access shafts are designed to admit sewer cleaning and inspection equipment but

prevent personnel access. The advantages are-

- No manholes means no personnel entry
- Cost savings in sewer construction
- No manual handling problems with manhole covers
- Fewer confined spaces on the system
- Better health conditions for wastewater field personnel

The disadvantages include:-

- No flood storage in the event of high flows or blockages
- Limited access may handicap some maintenance work

The major concern for these new systems is the lack of flood storage and likelihood of sewer overflows leading to environmental issues. Whilst this is recognised and could lead to possible lake contamination in the Bundalong scheme, it is pointed out that most blockages on conventional manhole systems are only identified when sewer overflows are reported. Manholes have been provided at changes of invert level to compensate for this.

To cater for pump failures at pump wells on the Bannockburn scheme, a sensible compromise has been designed into the system- the installation of two manholes upstream of the only pump station in the system to provide an estimated two hour flood back-up in the event of pump failure. This lead time is sufficient to enable a portable pump to be brought in to clear the problem.

These two schemes have only been in operation for a short time, however, with below design flows currently being experienced and, consequently low sewer velocities, no problems have been reported.

The author believes that this concept is a significant step forward in protection of the health and safety of wastewater system personnel. It is a method by which designers can meet their obligations under the regulations as well.

Maintenance Equipment – New Initiatives

Maintenance crews have a broad range of equipment available to undertake system maintenance without the need for confined space entries. Such equipment includes:-

- Jet cleaning systems- these sewer cleaning systems utilise the hydraulic force of water jets to rotate the cutting head and propel the cutter forward to clear blockages. They are designed to be installed into a manhole or access shaft from above ground.
- Root foams- regular application of proprietary root foams to sewer systems can kill roots and avoid mass build-ups leading to blockages.
- High Pressure Jet/Vacuum Machines- these truck mounted systems operated by several contractors are ideal for tank clean-outs without the need to enter the tank until it is fully cleaned and ventilated.
- CCTV Inspection Systems- although these have been available for several years, closed circuit television systems now provide high quality colour transmissions of the internal condition of pipeline systems. Advances in technology has led to the development of very small self propelled camera systems which can be fully operated and located from above ground.
- Tank maintenance using divers- North East Water have been using professional SCUBA divers to clean sediments and deposits from water supply tanks avoiding the need to drain them and undertake confined space entry activities. This activity has the added benefit of causing minimal supply disruption.

3.0 CONCLUSIONS

The Water Industry has been through many significant reforms in recent years. These reforms have been intended to reduce the costs of operation of water systems but at the same time provide improved services to customers through more effective operations.

It is appropriate that improvements to the efficiency of the design of water and wastewater systems include due consideration of the health and safety of maintenance personnel, something often missing in the past.

These system improvements will lead to cost savings both in capital costs, eg. fewer manholes and more streamlined submersible pump stations, but also operating costs by requiring fewer confined space entry activities.

It is considered that the thorough application of the Occupational Health and Safety (Confined Spaces) Regulations 1996 has led to a reduction in confined space entry activities and the implementation of new initiatives designed to enable work to be performed outside the space with significantly lower risks to maintenance personnel.

The application of suitable safe systems of work for confined space activities will undoubtedly prevent future tragedies.

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