

# UPGRADING JET RODDING AT ACTEWAGL



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## ABSTRACT

ActewAGL have four specialist choke trucks incorporating a Jet Rodder as their primary method of cleaning sewer mains in the Australian Capital Territory largely replacing hand and machine sewer rods. This followed a history of accidents with sewer rods, rodding machines and sewer eels

Two lost time accidents and numerous near misses using the jet rodders prompted ActewAGL to look for engineering solutions and training in their use.

However it became obvious that there were underlying issues with the jet rodders that led to a complete review of the whole process with the following conclusions:

- Training was ad hoc and full of misconceptions about the jet rodder use.
- No standard work method for cleaning sewer mains
- Cleaning was unsatisfactory with significant revisits
- Equipment was not treated with respect required
- Trucks and equipment in poor condition with safety systems bypassed.
- Problems maintaining competence

ActewAGL undertook a complete program, which included fixing equipment reviewing work methods and developing training to the new Water Industry Package Unit 255A

The program is getting results with the machinery working properly, reduced rework and a greater feeling of ownership among the operators.

## KEY WORDS

Jet rodder, sewer, training, cleaning, ActewAGL, safety.

## 1.0 INTRODUCTION

ActewAGL is a private company that has ACT Electricity and Water (ACTEW) Corporation and AGL as its shareholders. The water division of ActewAGL carries out the water and sewer system maintenance and operation on contract for ACTEW Corporation. The system consists of 2,900 kilometres of sewer mains to service some 300,000 people in the ACT. Because of the dry climate and amount of trees in the bush capital there are a high number of chokages because of tree roots. Each year ActewAGL clears over 5,000 chokes 95% of these within the 5 hour customer service response requirement.

About 5 years ago the organisation determined that the choke clearing operation could be carried out more effectively by using high pressure water cleaners instead of the sewer rods and mechanised system. Part of this decision was the amount of incidents and injuries resulting from the use of those methods. The cold winters in Canberra also caused problem for mechanical methods of sewer cleaning.

ActewAGL presently leases a fleet of 5 Jet Rodders.

Four of the trucks are set up as choke trucks and are used on a shift rotation basis. The other truck has a high volume set up and is used in conjunction with CCTV for more specialised work.

ActewAGL also uses the services of a jetter/eductor contractor for stormwater and other specialist work.

**Figure 1:** *Typical choke truck*



Following two accidents with the jet rodders where the nozzle left the sewer and struck a worker a safety audit was carried out. The initial response was to look at a physical barrier to the nozzle leaving the access chamber and grills to cover open access chamber were manufactured for field trials.

During the investigation grills the Engineer Peter Burgess talked with the operators of the machinery to find out how the jet rodding operation was carried out so the design could be tested. The message from the operators was fairly clear. They thought the machines were “useless” and didn’t do the job so they wanted bigger machines. This sentiment was echoed in the supervisor level.

Inspections indicated the machines weren’t in good condition and weren’t being used correctly. The effectiveness of the jet rodding was well down from when they were first introduced. In some cases the nozzle were apparently only travelling 50 metres before stopping because the friction of the hose. The effectiveness was well down of the manufacturers specifications and there was no apparent reason for the problem. Advice from suppliers also seemed to blame the adequacy of the trucks to do the job.

The results of these preliminary investigations were reported to the Field Services Manager, Paul Wheatley with a strong recommendation that the total process be investigated to discover the real problems as the grill was seen as a further imposition on the field staff. This wider investigation was commissioned and commenced in July 2002.

The investigation was carried out with four objectives:

- Determine why the jet rodders weren’t working properly;
- Find out what was wrong with the trucks;
- Review the instructions and work processes;
- Review the training and competencies.

Graeme Whelan, the plant coordinator, was set the task of investigating the trucks and jet rodding machines. Also helping were the safety officer and a trainer.

## **2.0 INVESTIGATING THE EFFECTIVENESS OF THE JET RODDERS**

A review of the specification was carried out and this indicated that the Jet Rodders were suitable for what they were doing. They were in fact a very reliable unit which should have had no trouble in giving years of long service. The pump motor was a very reliable diesel unit and not expected to give trouble as they were only doing 1200 hrs per year. The pump was fairly robust and not seen as a source of trouble.

The trucks were set differently for example the pulley's and drive ratios were different. However, this didn't seem to be the major problem. Static pressure tests where the nozzle was inserted in a stormwater in the yard was used to test the set-up. These showed different results for the trucks. The pressure shown was 1800 psi when the manufacturer recommended 2,000 psi. The pressure gauge was checked and calibrated and was found to be working properly.

The tests pointed to the pressure relief valve as the problem. The system uses a pressure relief system that returns the excess pressure to the tank. The pressure relief valves were not working properly and releasing too much pressure and because they were inline were causing a high pressure loss.

A new system of operation was devised where the pressure blow off was moved out of the main feeder line. The pressure for relief was adjusted to 2,200 psi to minimise the amount of bypass

A simple test was devised to check the pressure and flow for the trucks. This involved holding the hose without the nozzle parallel to the ground and measuring the distance that jet travelled. From this information the flow and pressure available from the pump was calculated. This indicated that pumps were working correctly and any differences due to different hose lengths. The hoses were replaced to the correct length of 140 metres and a leader hose attached. Each truck was now about the same pressure and flow.

The in pipe tests were now repeated using the same nozzle for the different trucks and different nozzles for the same truck. These tests indicated that different nozzles were the problem and were too small or too large. It was suspected that they had been set up for the trucks when they were not operating properly and thus were now wrong

The basic nozzles used for jet rodding have two actions. Forward or sideway jets cut into the obstruction and the rear facing jets provide thrust. The effectiveness of the jet rodder is very dependant on the pressure and flow at the nozzle. If the jets are too big there will be high flow but little force and vice versa.

**Figure 2:** *Typical nozzles*



Tom Williams from DCS industries was called in to calibrate the existing nozzles and to fix up root cutters. All nozzles now became interchangeable between the trucks and thus we could reduce the inventory. Tom also pointed out a few other problems and issues with the pumping controls and trucks. All of these problems happened within the next three months as predicted.

The jet rodder were now up to scratch and field reports started to come in indicating they were working including root cutters. To quote an operator "I don't mind working on these now because it does the job"

### **3.0 INVESTIGATING THE TRUCKS**

Close inspection of the trucks and equipment was carried out with the following results:

#### **3.1 Water Tanks**

Close inspection of the tank mountings revealed wear had loosened the mounting straps and they could be pulled out of position.

The tanks had been supplied unlined and were starting to leak. These have been sealed. Internally the baffles were broken and made the tanker unstable when full. These were reinstalled.

#### **3.2 Location of Valves and Pipework**

The pressure lines and valves were set up on the truck during assembly. The last item assembled was the tank so that many of the working parts and valves were under the tank and not accessible or maintained. The “pressure on” valve could not be opened more than a quarter turn. On some trucks there were seven small diameter connectors located on a straight pipe under the tank. All these factors contributed to poor performance of the machine.

The pipework was replaced in larger 25 mm diameter hose and connectors. For some of the trucks replacement pipes were threaded through and replaced with operating valves relocated to where they were accessible but covered to prevent damage. One truck had to have the tank taken off to replace a failed main operating valve. This valve was relocated to the outside where it was more accessible.

#### **3.3 Operating Valve**

On one truck the linkages that connected the “pressure on” valve and the bypass shut off had been replaced upside down and the “pressure on” valve could only be opened a quarter turn. This set-up was replaced

#### **3.4 Pressure Relief Valve**

These were broken or not set up properly. The principle of these jet rodders was that when the pump pressure reached 2,000 psi the pressure relief valve would start to open and relieve the pressure. This was a safety device to protect the pumps. However as the Jet Rodders are supposed to work at 2,000 psi this set up is marginal and the pressure relief valve would be constantly operating.

In our case the pressure setting was below 2,000 and the valves were wearing out through constant use. As they were online it was found that we were losing some 400 psi in head losses. A decision was taken to increase the relief pressure to 2,200 psi to minimise the working of the relief valve.

A different set up was also manufactured where the relief valve was placed off line. To operate the pump the bypass valve had to be shut and this was fail safe to open position. This set up is under trial.

#### **3.5 Hose Reel Hydraulic System**

The hydraulics for winding the reel in and out were not very effective. The operators were pulling the hose back by hand. It is suspected that the oil filter in the hydraulic lines had never been changed as it was in a rear cabinet and not on the engine maintenance schedule. The hydraulics

were serviced and are working to full capacity.

### **3.6 Road Worthiness**

Various safety and operating features on the trucks were outside of Australian design rules and were replaced.

### **3.7 Other Improvements**

- An oil bath was incorporated in the tray to take the root cutters.
- Steps were included so the controls could be accessed more easily especially for the shorter operators.
- A remote control line was included so the jet rodder could be operated from the ground near to the access chamber.
- An extended hose guide was added so the hose could be directly lowered into an access chamber
- The trucks were cleaned professionally
- Boxes for instructions and paperwork were installed
- Instructions and labels were fixed near the controls

### **3.8 Results**

The trucks had some teething problems while this process was carried out and sometimes only one or two trucks were on the road. This caused a lot of truck swapping and some grumbling but persistence paid off because eventually all the trucks were brought up to good working condition. The other advantage was that the operators were able to try out different trucks and were able to comment on any differences they found.

All operators have a check sheet for the trucks and nearly all faults are being reported, and are fixed. This has helped the operators to understand the jet rodgers and to look after the trucks and is a big part of the change in work practices. This system is not perfect because of the high changeover of personnel through the trucks but it is much improved and the trucks are in better condition.

## **4.0 REVIEWING THE INSTRUCTIONS AND WORK PROCESSES**

The instructions had not been updated for some time, they were very basic and based on a type of truck that no longer existed. The instructions did not address the whole system of work and did not indicate a standard method.

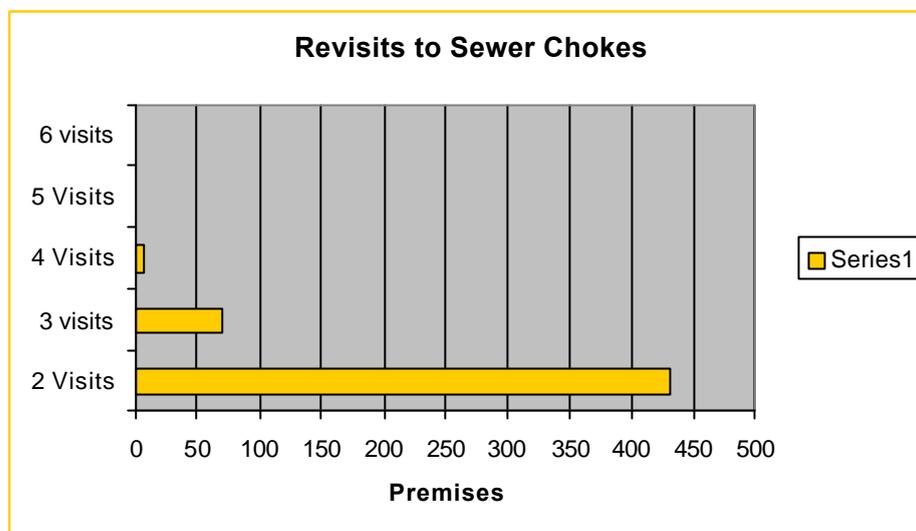
Interviews with experienced operators indicated many misconceptions and different work practices were being passed on from team to team.

One misconception was that the jet rodder had to travel at high speed to punch a hole in the choke whereas the proper procedure is to let the water jets do the work. Contact with the choke is counter productive and allowing the nozzle to fly freely is hazardous. Teams were manually retracting the hoses risking injuries. The teams were clearing the water back up rather than fixing the choke and this was leading to further blockages at the same point

An overall review of the system blockages was carried out and it was that the teams were returning

to the same site twice and sometimes up to six times (See figure 3). It was determined by the field service manager that we should look at the work practices and try to reduce this figure as based on a cost of \$165 per choke and some 680 revisits a saving of up to \$112,000 per annum was possible.

**Figure 3:** *Number of multiple visits to properties*



The main issue here was the difference between unblocking the pipe and removing the blockage. It is possible to punch a hole through the choke and to release the water backed up but this self seals and within two days the choke is back. Where there is some clearing of the roots the choke can take a bit more time to come back but this can be as short as three months.

It was decided that the work practice would change so that the crews removed the blockage so it would remain free for a longer period. The work method became to use a jetting nozzle to pierce the choke and then use a root cutter to remove the choke. This method was included in the training package and was to become the standard method. This became possible because when the choke trucks were brought up to specification they could easily run the root cutter.

This change in work practice has been incorporated in instructions and training. It is too early yet to gauge the results but the feedback from the field indicates that the amount of rework has reduced and the change in work practises

## 5.0 TRAINING AND COMPETENCY

Training had been carried out but this was purely about the operation of the pump and motor not about the cleaning method. With the release of the new national training package this training course was seen as a first step to gaining national qualifications for the operators. ActewAGL is a registered training Organisation and is able to issue certificates. The training package was organised so that it would met the requirements of the competency unit NUW 255A Maintenance of Sewer Systems.

The training was carried out in two phases. Classroom style training was carried out for one day and on the second day the operators were taken to a purpose built training area at Mitchell depot for initial induction and competency assessment. Further assessment is planned in the work location so the operators can gain their certificate of attainment.

The training package is flexible and can be adapted to the different skill levels of the operators. All of the sessions were fairly lively with a lot of input from the operators. A lot of this discussion was

about how to make the system work better now that the equipment was working well.

## **6.0 SAFETY**

Safety was one of the key drivers for this investigation and change. The accidents were happening to more experienced personnel rather than inexperienced starters so the whole work practice had to be examined.

Some of the more important aspects of safety was a lack of understanding or willingness to comprehend the power of the high pressure water and the force that the nozzle could exert. The other problem was the bacteria in the sewer that could be forced below the skin and create extreme problems for recovery if not informed. All operators now carry a health warning card.

Most of the other safety problems had to do with the inadequacy of the machine. Pulling the hose by hand etc was all a result of the poor state of the equipment. Even simple items like a work light were installed as part of the review.

The safety has improved and no further accidents directly applicable to the jet rodders have been reported. However regular checking will be carried out to ensure this high standard remains.

## **7.0 SUMMARY OF THE FINDINGS OF THE INVESTIGATIONS**

The whole of the jet rodder operation was found to be flawed and inefficient.

- Ad hoc training passed on from one employee to another full of misconceptions about the jet rodder use.
- No standard method
- Poor results with significant rework
- Equipment not treated with respect and poorly maintained
- Trucks and equipment in poor condition with safety systems bypassed.
- Problems maintaining competence

The result of all of the above was poor effectiveness and increasing probability of safety being compromised as the operators made do.

## **8.0 RECOMMENDATIONS**

A program that addressed all the issues at once was recommended. It was pointless training the people if they went back to the same old equipment that wasn't doing the job.

### ***Training***

A training course to be developed for all people involved in Jet Rodding.

The training to be equivalent to the National Water Industry training package - NWP 255A.

All current field staff are to undertake the training and assessment.

A proper induction is to be carried out for all new starters.

A specialist training area has been set up and is available for further training as necessary.

### ***Equipment***

A major decision was to ensure the jet rodder were maintained and in good working condition otherwise the training would be lost. All the trucks were to be standardised and regular checks

made of their performance. A specialist contractor is used to maintain specialist nozzles and root cutters. An adequate inventory of spares is to be maintained.

### ***Trucks***

Ongoing maintenance to be carried out and checklists completed regularly to ensure the trucks are maintained in good working order.

### ***Work practices***

The biggest time waster is rework and new work methods are introduced so that revisits to the same site especially within one week are minimised.

## **9.0 CONCLUSIONS**

The success of this project is a result of looking at the total issue to ensure that the operators have the knowledge skill, tools and equipment to carry out the work properly. The enable this to happen each of the following areas has to be addressed and checked on a regular basis.

- Equipment
- Trucks
- Work Method
- Training

If these aspects are in place then the safety of the work and operators satisfaction is improved.