Closure report for Doris Blast cleaning system (TFT/2007/BP076)

Background

A high standard of cleaning & preparation of gas containing plant & equipment, ie. Metallic pipes, mains, joints and support structures etc. is required by NG policy & procedures prior to the application of field or workshop applied coatings and paint.

Grit blasting has been the only method available that creates surface cleanliness and roughness to ensure that the coating or paint applied adheres to the metallic surfaces. This has given problems to users with the operation, containment & spillage of the abrasive and the safety of the users and the safety of anyone in the vicinity of the blasting.

Other methods of cleaning by, hand & mechanical brushing, HP water blasting have been tried; they do clean the surfaces but do not create the surface roughness required by policy documents.

A suitable & equal cleaning alternative has been sourced for many years by NG gas engineers to replace HP Grit blasting (using the pressurised pot method) to reduce the hazards and environmental issues when used on site. A contractor (engaged by NG) has designed and tested a new cleaning system to replace the HP grit blaster and is keen to introduce its use. Their new idea is called **'DORIS'**, it is similar to operate to the HP blast system. It uses a blast material projected through a nozzle with compressed air onto the surface to be prepared. The designers also claim that;
DORIS will achieve the correct surface roughness,
DORIS is lighter in weight and will reduce manual & mechanical handling issues,
DORIS will reduce costs by using a re-cycled crushed glass as the blast material
DORIS can operate with smaller compressors reducing the carbon output from wheeled plant thus reducing our environmental foot print
DORIS significantly reduces the affected blast material debris problems created By using the Jblast material

The designers suggest there are advantages with the **DORIS** system and this will be proved by a trial, the conclusion of that trial is to be read below.

Object of the trials

This trial assessed The **DORIS** blast cleaning method (which is self contained as a small & light weight unit) by making a comparison of;

- transportation,
- set up,
- connectivity of separate pieces,
- using different blast materials ie

1. crushed glass on steel pipes,
2. fine crushed glass on concrete support structures
3. fine crushed glass & water combination on Graffiti on a Cellette GRP simulated brick kiosk.

The standards of surface finish were assessed to ensure the NG policy is adhered to.

How it worked

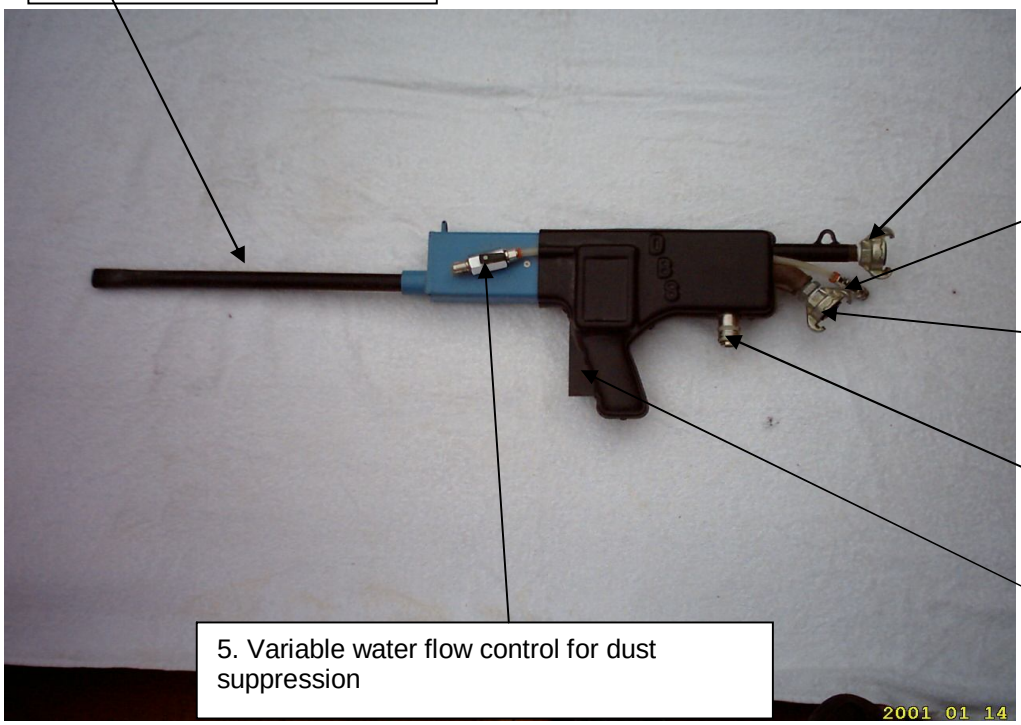
The DORIS system works on the Vortex air traced system and is promoted as suitable for one person operational working, giving a better efficiency return as the traditional blaster requires constant attention and operation by two persons. The DORIS system can be switched between cleaning materials easily and quickly, it can also be used with water injected at the same time as blast material to suppress dust created by the process (although not for steel pipe preparation for coating).

DORIS came with a proven trial history at a few sites, where different NG personnel have witnessed demonstrations given by the designer and the supporting contractor.

Accordingly, comments received have confirmed that;

- DORIS is manageable by a single person (although it needs to be considered by the lone working procedure),
- The set up and tidy removal process is quicker than using the traditional blast pot methods taking 10mins to set up or remove,
- The weights of the individual items of DORIS equipment are less.
- The risks assessed using DORIS were considered to be fewer than the traditional grit blaster because of the design of the system & the method adopted, ie The Vortex action the cleaning system creates produces a different cleaning profile at the blast nozzle. This provides a the cleaning system materials in a circular motion and does not spray/spill blast materials in a wide area.

Principal of operation of the DORIS grit blaster gun and system



Descriptions of connections to blast gun & nozzle

1. The blast gun requires a compressed air connection using an 85, 100 or 125 cfm compressor (The on board power unit fitted to NG vehicles is rated 100 cfm).
2. The top connection is for the blast material supplied from a reinforced plastic bucket via a rubber hose.
3. The third end connection is for a 6mm plastic water hose from a container or other water storage facility, it is not a pressurised system.
4. The optional forced air flow connection to a face mask is on the underside of the gun
5. The variable water flow is controlled by the valve shown
6. The operators handle or dead mans handle
7. The blast nozzle which can be curved to get to difficult places

Blast material hose

Air intake

Reinforced plastic container for blast material

10mm dia hole in top of 20mm dia steel pipe through walls

Blast material approx half full

Air hose

Compressor

How it works continued;

1. The blast material is loaded into the plastic container to about the half full level with the selected medium.
2. The blast material hose is connected from the plastic container to the top connection on the gun, both have compressor hose connectors and the hose is dedicated to the blast medium.
3. A compressed air hose is connected from an available compressor to the gun.
4. Compressed air is introduced through a vortex within the gun by switching on the compressor and depressing the 'Dead mans handle'.
5. The material supply pipe within the plastic material container has a 10mm dia hole in the top at the lowest point to allow the blast material to be drawn in.
6. The open end of the supply pipe is used as an exhaust point, facing downwards. This prevents a vacuum being formed by the suction with the container
7. The compressed air does not force the materials out of the gun, the air flows out through the blast nozzle and due to the venturi action created this and the vortex the flow of air pulls the chosen blast material along the hose from the container (in a rotating/spinning motion) mixing with the compressed air at the nozzle and firing the material onto the surface to be cleaned from the end of the blast nozzle.
8. Water is introduced (if needed) only after the materials have passed the vortex
9. If the nozzle becomes blocked it is cleared by holding the blast nozzle against the flat surface whilst depressing the trigger which creates a 'backfire' of air/material to clear the blockage through the container vent.

The pressurised air never forms a static pneumatic pressure and is therefore this unit is not subject to pressure systems inspections as it is not deemed a pressure vessel.

The spinning blast materials do not have the same exit point energy exiting the blast nozzle as the Jblast materials do from a grit blast pot. If the process creates a large dust cloud during use this can be damped by the introduction of water through the separate connection, with water being sucked from a container, not from a pressurised water main.

Trial Results

The trial was carried out on an Operational site at Shustoke in WM network, previously in workshop conditions at Windsor Street. The weather at Shustoke was overcast and occasional showers providing difficult conditions for blast cleaning.

The blast cleaning equipment was trialled on;

1. above ground pipe work in the AGI,
2. a concrete support pillar in the AGI
3. offsite at a District kiosk which had been vandalised by the application of a sprayed Graffiti paint
4. offsite in the workshops at Windsor street on valves and pipe work

Photo's 1 & 2 show the rear of the standby inlet filter at Shustoke (operating at 50 bar gas pressure) being blast cleaned for inspection purposes. The photographs show the operator using the DORIS blast gun (minus his gloves). The area was cleaned to sufficient standard to complete NDT inspections to be carried out.

The blast time to clean a section of filter 300mm x 300mm using an 85 cfm compressor and 5mm crushed glass was less than 5 minutes

The first photograph illustrates the smaller light weight gun, the smaller light weight face mask which is supplied with filtered air through the blue hose, the yellow compressed air & blast material hoses. The mask air is supplied via an oil separator within the gun which removes all traces.

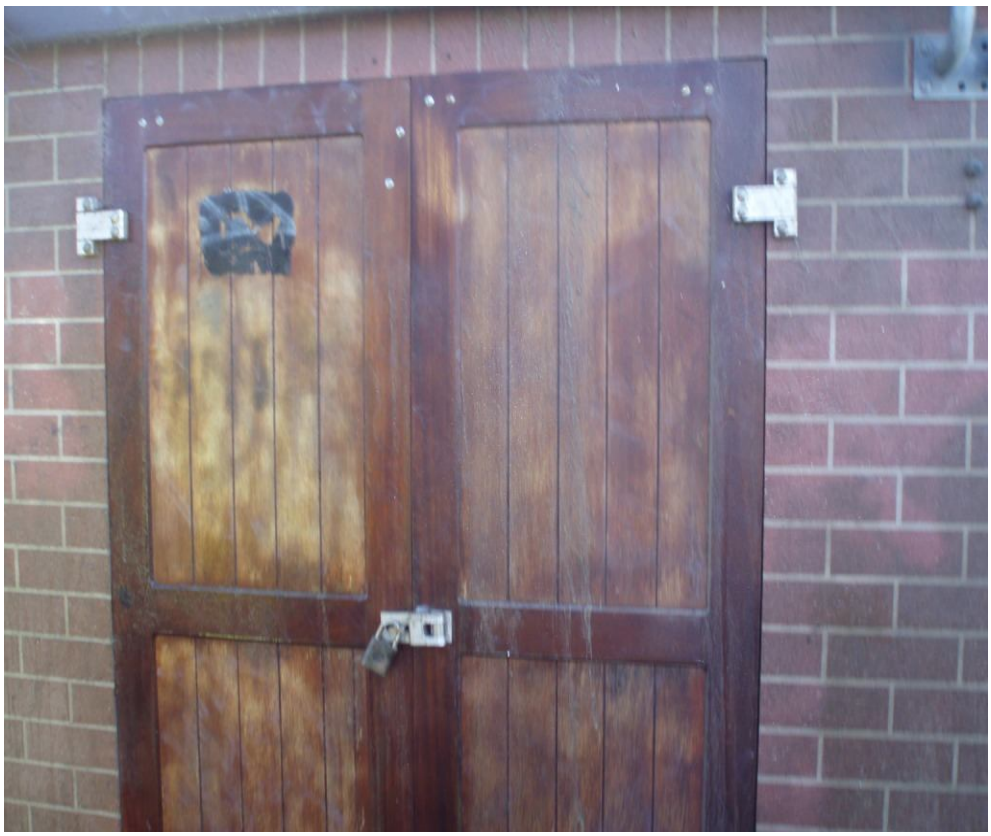
The second photograph shows the area of blasted steel and the edges which are naturally feathered by the crushed glass. The finish was sufficiently clean of all debris & paint to carry out NDT inspection if required

Photo 3 shows a concrete support pillar which has weathered and is showing signs of algae and moss growth which would require cleaning to facilitate maintenance painting.

Photo 4 shows the same pillar after blasting using DORIS with fine glass & water spray for approx 3 minutes. All signs of algae & growth have been removed to allow paint to be applied when dried. There were no visible signs of contaminated spent grit to clean up.

Photograph 5 shows the district kiosk with Graffiti painted on the doors & walls. This was cleaned using the same DORIS equipment as above using the combination of fine crushed glass & water.

Photograph 6 shows the final cleaned kiosk which took approx 20 mins to complete



Trial misses

Unfortunately the Coatings Inspector could not attend the site trials and therefore DORIS could not be assessed by a qualified competent inspector on the standard of finish that the system produces with the varying different compressor sizes.
Subsequent advice from the qualified Inspector is that although the DORIS blast system is not proven by this trial to produce the required surface roughness, the cleaning ability of the DORIS system to remove all surface debris is, and if the surface has been previously grit blasted using Jblast, then the surface roughness created by that Jblast cleaning will be still etched on the surface of the steel. The only time a surface finish cannot be guaranteed is on new steel which has not been blasted and coated. This advice may change with more experience of use of DORIS may be confirmed to produce the surface roughness.

The NG engineers witnessing the trial were all familiar with Jblast cleaning previously employed and the reasoning of the need to clean and all had had some experience of what finish is visually required. The NG engineers all agreed that DORIS as seen was a significant step forward in the areas under trial. The weather on the day did not allow perfect blasting conditions.

No glass was collected for re-cycle purposes during the trial due to the frequent rain showers, but the contractor did show the collection is possible from photographs.

Conclusion

- Transportation of the equipment including 50Kg of crushed glass, hoses, gun, PPE and plastic material container was in a contractor's car (A traditional grit blast pot etc would have had to be transported to site by a special vehicle with mechanical lifting aide to load & un-load). Blast materials are in 25 Kg bags, water in a 25litre container and two compressor hoses rolled up, PPE in a bag.
- Set up time from boot to start blasting was 10minutes.
- Connectivity of all components was simply and consistent with familiar operational equipment
- The blast gun was much easier to handle & was user friendly
- The smaller face & air mask was a huge improvement
- Use of different materials was demonstrated. All materials are tipped into the plastic container and emptied back into bags if surplus remains, no material is wasted. The plastic container is fitted with a lid to keep water out. Demonstrations of coarse crushed glass to clean steel, Jblast via DORIS using the same system to clean steel, fine grain glass to clean the concrete, brickwork & kiosks, water & fine grain glass for graffiti.
- Adequate cleaning and coverage is achieved by using the on board compressor in a NG Mercedes sprinter or Ford van which omits the need to tow a compressor.
- Using crushed glass reduces costs to £3.50 per 25kg bag, from £8.50 for Jblast.
- The designer is working on modifying the blast gun to operate as a Hoover to pick up spent materials for re-cycle.
- A smaller blast gun is available together with longer and curved nozzles for awkward places
- The smaller gun was identified as ideal for cleaning paint from bolts & threads etc to allow dismantling of equipment.

Following the site demonstration & trial the review by those present Paul Green, Matt Wilkie & Paul Toon concluded that this DORIS blast system should be accepted and deemed as fit for purpose for use within Distribution Operations.

The DORIS blast equipment can be continually operated whilst being refilled; the second man need not be dedicated to the operation.

The weight of the blast gun is significantly less. The face mask is lighter and the hose connection much shorter (gun to mask) than on traditional equipment.

The performance and surface cleaning ability is visually consistent with Jblast, costs are less for the raw materials, and the glass is more environmentally suitable because the escaped residue spilt on the floor does not require cleaning up.

In the trial the crushed glass cleaned the surface better than Jblast.

The crushed glass can be reused up to 5 times before the grain size reduces below that which no longer gives the surface roughness required by NG. Disposal of the waste products, which is not considered as a hazardous waste, are easier to manage and provides reduced cost to operations.

It is unlikely that reduced compressor sizes will be used by NG for the DORIS cleaning & blasting system in the field (except in large cleaning and coating works), it is more likely that the on board power units on a typical NG team vehicle will be used. This trial concluded the on board power compressor does provide sufficient air flow to supply the process at 100cfm.

The trial did utilise a smaller 85 cfm compressor, it concluded that 85 cfm does provide sufficient air to give a high standard of cleanliness for large site cleaning.

The DORIS system should be available through hire or purchase to NG.

The system should be recommended for adoption as the first choice in NG Distribution operations for cleaning & preparation work described above, it has proven it is fit for purpose.