Appendix C of Information letter 4-2006

Letter regarding minimum spin up time and adequate mixing

9 May 2005

Dear Sir / Madam

In Situ Resin Lining - Determination of Minimum Spin-Up Time and Adequate Mixing

1. The modified conditions of approval for all *in-situ* applied coatings impose a requirement to apply the coating in accordance with the 2005 Operational Requirements (OR) document. This modification takes effect from 1st April 2007. Until this date lining may continue under the current Operational Requirements, however, voluntary adoption of the new OR prior to this date is desirable.

2. *In-situ* spray lining of potable water mains involves the application of a 2-part resin system to the prepared bore of the pipe. Developments in application technology now ensure that components are accurately pumped to an in-line mixer positioned just upstream of the spinner head and once equilibrium has been reached, the mix ratio of the applied product will be as required by the manufacturer and in compliance with the Operational Requirements.

Spin Up Time

3. The rig spin-up procedure is designed to identify the time required for the rig/material combination to achieve equilibrium. This point is marked by a colour change in the mixed material. Determining the minimum spin up time involves the preparation of a series of dip cards covering the period before colour stabilisation and for several 10-second intervals afterwards. Following the curing time (as per the manufacturers' instructions for the specific product) the degree of cure of each dip card is tested. Full curing is indicated by a snapping of the cured resin, which occurs cleanly in a brittle manner. In practice the first dip card that has the correct colour and is fully cured (clean snap) represents the minimum spin up time for the prevailing conditions. A safety margin of at least 30 seconds is added to this minimum spin-up time to give the spin-up time to be employed in the *in-situ* application.

4. Some new generation resins demonstrate a ductile failure mode, which makes this method unsuitable. For these ductile materials the spin-up time needs to be assessed using other methods. Currently, reliable methods do not exist and it is proposed that a research programme is conducted to determine the most appropriate methodology.

In Line Mixer

5. In addition to the spin-up time to achieve equilibrium, the mixer length and design is critical to the mixing efficiency. A minimum length and design should be stipulated to ensure component mixing. Currently a safety margin is added to this minimum length.

6. It has been identified with some new products that adding on a large safety margin is not practical as the resin sets rapidly. It should also be noted that with materials of lower viscosity the efficiency of the mixer will be affected. The OR requires the material manufacturer to provide an audit trail for approved in line mixers.

Investigation Required.

7. Without refinements in methodology for *in-situ* resin application it is considered that there could remain a risk of inadequate mixing, and hence water quality contamination, if the spin-up time identified is not adequate (a risk for the brief period until equilibrium is reached) or the mixer length is not sufficient (a continuous risk while the particular mixer/material/rig is used).

8. Currently, reliable methods to ensure mixing has occurred have not been confirmed. It is therefore required that a research programme is conducted by manufacturers with the support of Contractors to determine/confirm the most appropriate methodology. A provisional list of parameters which may offer some potential for spin-up determination include; colour consistency; chemical leaching tests; mechanical properties (e.g. compressibility). It is required that a research programme into spin-up also includes a review of the longer-standing 'brittle' materials and testing methodologies in order to consolidate understanding. The outcome of this proposed research will be:
    - A methodology to define spin-up time for a specific rig design/material combination which accounts for the new generation of 'flexible' resins or to confirm that colour stabilisation is fine).
    - A defined mixer length range for a specific rig design/material combination.

9. It is the responsibility of the nominated Certifying Body to ensure that a contractor is capable of applying *in-situ* lining materials and that full mixing can be achieved Approval will not be given under the new Operational Requirements: *In Situ* resin Lining of Water Mains 2005 (Section 3.5 and 6.6) or the current *In-Situ* Epoxy Resin Lining – Operational Requirements and Code of Practice 3rd edition (Section 3.6 or 6.8) or In-Situ Rapid Setting

Polymeric Lining – Operational Guidelines and Code of Practice (Section CP 3.5 or CP6.8) if adequate mixing cannot be confirmed.

10. **The DWI therefore requires lining manufacturers to be able to confirm the appropriate spin up time and in line mixer length. This is to ensure that mixing is satisfactory. An appropriate safety margin with a view to the spin up time and mixer length should be specified for various rig/material combinations.**

11. **It is the responsibility of the lining manufacturers to ensure that appropriate mixing is determined. It is required that this research is conducted by all lining manufacturers and should be conducted in consultation with the lining contractors. This work should be completed by January 1st 2007.**

Yours sincerely

Dr. Nick Hallam

Inspector
Operations Group