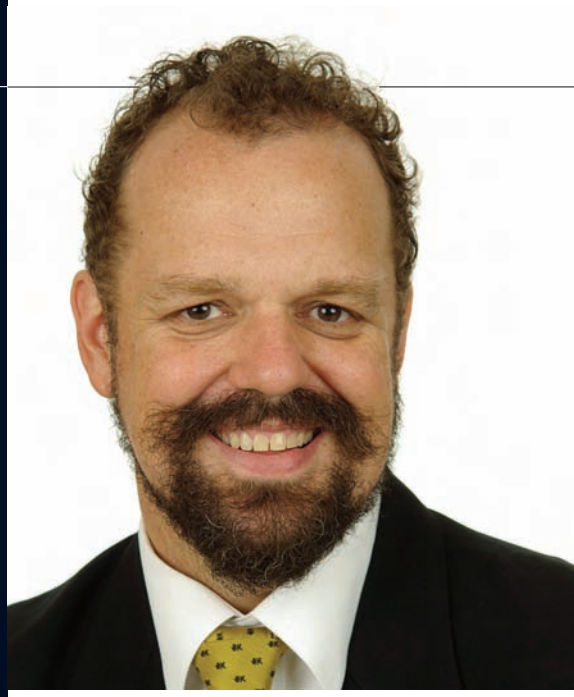
Emergency Cable Certification Withdrawal – the problems gone global - could "equivalency" be part of the solution?

Following on from the article "US Tunnel Emergency Systems Cables Fire Rating Withdrawn – A Crisis or Crossroad?" in the last issue of North American Tunneling Journal, Arnold Dix assesses the international ramifications of the ratings withdrawal



Professor Arnold Dix

THE MOST BROADLY used and recognised fire and life safety standards in the world are the NFPA 130 and NFPA 502 fire life safety standards for road and rail tunnels. These standards are integrated by law and by contract in projects on every continent – especially outside the USA – most often where urgent urban tunnelling activity is a recent phenomenon in response to pressing planning and transportation needs.

The impact of the withdrawal of UL certification of a range of emergency electrical circuit protective systems is being felt especially acutely in these foreign jurisdictions as engineers grapple with safety and compliance issues in tunnels proposed, existing and under construction. In these jurisdictions outside the USA it is extremely difficult for local authorities to assess the merits of any proposed variation from the strict interpretation of the NFPA standards. Put bluntly, dealing with the withdrawal of emergency cable certification may be difficult in the USA but it is a potential crisis in countries outside the USA.

The emerging global challenge is to take a professional approach to quantifying and managing our changed understanding of emergency cable certification, cable performance and its impact on life safety in our underground infrastructure. This may require stepping outside the strict wording of the NFPA Standards themselves.

The electrical performance of fire resistive cables underlies the achieved level of safety in NFPA 130 and NFPA 502 compliant tunnels. This is because the integrity of safety critical electrical cabling is often fundamental to achieving a deemed safe road or rail tunnel through the control and operation of alarms, control circuits, emergency ventilation systems, communications systems, lighting and the like.

To compound these challenges, as a matter of law, it is accepted in most countries that there is a residual level of risk of injury and death for tunnel users but that so long as tunnel systems are built, maintained and operated in accordance with an appropriate 'standard' the residual risk is acceptable. In other words any injury caused as a result of an accepted residual risk is legally acceptable (This is normally described more diplomatically as, "the risk has been managed to As Low As Reasonably Practicable "ALARP"").

The withdrawal of the UL 2196 certification of electrical circuit protective systems, and the withdrawal of the right to stamp cables with UL certification by implication suggests utilising cabling or protective systems of the type withdrawn from the market does not meet the performance requirements necessary to satisfy NFPA 130 and NFPA 502 fire and life safety

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requirements. This means that the acceptability of the achieved level of fire and life safety performance in tunnels must be reviewed. This is not a matter of routine 'risk assessment', it is a matter of reassessment and judgement based on the new information available about the performance of emergency cables in a fire.

Interim Certification Inferences

UL have released information about interim certification arrangements in the absence of current UL certification and the withdrawal of prior UL certification. The interim provisions provide a window into the variables which UL have identified as important when determining functional performance of a proposed new interim circuit protective system. These requirements provide an insight into the multiple critical factors associated with the fire performance of such electrical systems. UL 2196 now requires (on an interim basis) the following details:

- Jacket-thickness, material designation/formulation, including raw materials by manufacturer and part number
- Conductor-type/grade of copper or other alloy (if used)
- Insulation-thickness, material designation/formulation, including raw materials by manufacturer and part number
- Any other cable material, such as a shield, drain wire, rip cord, reinforcing materials, etc. will require a detailed description, by type, dimensions, material description, manufacturer and part number
- Raceway-type, trade size and manufacturer
- Couplings/Connectors - type, model number, and manufacturer
- Boxes - type, model, and manufacturer
- Supports - spacing, type, model number, and manufacturer
- Pulling Lubricants - If used, described by amount to be applied, manufacturer, and part number
- System orientation - vertical, horizontal, s-type, or other is to be described in detail along with the detailed description of other system components"

Furthermore under the interim arrangements follow up testing is required of the original tested material every six months.

"Follow-Up Testing

Every six months:

Cables – In addition to normal FUS inspection, a one foot long sample of each cable type will be selected by UL Field Services staff and sent to UL laboratory facilities for a detailed analysis. The analysis report will be compared to the previous sample analysis and stored as a test reference.

Systems - Sufficient cable to construct 5 test systems for each of the systems described in the FUS procedure will also be selected by UL Field Services staff. If cable is not available, the authorization to utilize UL's certification mark on the cable will be suspended until samples for test are available and found compliant. The systems described in the FUS Procedures will be subjected to the UL 2196 test."

A reasonable inference that can be drawn from these interim requirements is that the overall performance of these fire resistant assemblages is the function of a range of interdependent variables and that the performance may vary with time.

The testing every six months of cables and assemblies raises the prospect that UL have identified significantly changed fire performance between the initial testing of a product and subsequent testing. It is conceivable that processes - such as the release of volatile fire suppressants from cables with time - have now been identified by UL as a significant factor in the ongoing performance of these emergency systems in fire challenge scenarios.

The fact that UL has not re-instated certification for these emergency cables and assemblies also suggests that the failure modes identified are potentially significant.

NFPA 130 & NFPA 502 Update

NFPA is currently trying to reformulate prescriptive tests for cable performance. During November NFPA held urgent meetings of both its 130 and 502 committees to formulate

revised certification testing standards for emergency cables. These tests will necessarily prescribe onerous fires during which electrical performance of cabling systems must be maintained.

The challenge with formulating such tests is that the origin of the performance criteria which must be met is often obscure – more a matter of practice than a matter of pure science. For example the time temperature curve for electrical cable continuity is in substantial part derived from forensic examination following real fire events but these challenges may (or may not) be an appropriate performance standards for a specific tunnel.

By way of example there is a strong argument that the electrical cabling performance in a tunnel fitted with an aggressive fire suppression system and with cabling installed at a low level within the tunnel may rightly differ from the cabling performance required in a tunnel with no active fire suppression system and cabling running along the tunnel crown.

Other discussions may rightly emerge in tunnels where there is redundancy of emergency circuitry or other aspects of the design or operational risk profile that make the electrical and mechanical systems performance less vulnerable to single point electrical cabling failure.

To highlight this point an inspection of a tunnel in late November in the Middle East revealed electrical cabling in hot dipped conduit controlling a mist system in a road tunnel. The level of fire risks is substantially reduced albeit that the control cabling may be more vulnerable to fire damage than originally thought. Careful engineering judgement must be exercised in such circumstances.

Fit for Purpose

The impact of the UL certification withdrawal directly impacts the findings of any "bureaucratic" assessment of fitness to operate tunnels because the performance of the cabling installed in fire conditions has been questioned and NFPA 130 and 502 mandate certified cable. Our immediate challenge is to use engineering judgement to determine which tunnels are in substance affected by the current emergency cabling issues and to mitigate those risks.

Improper Responses

It has been suggested during meetings over the last few weeks that cables bearing the UL marking should be sourced and used without fear or hesitation as the marks the cable bears were lawfully applied and therefore the cable can properly be used. Such assertions reflect an inappropriate and highly unprofessional approach to ensuring the performance of underground fire and life safety systems and thereby the safety of tunnel users. The issue is not whether cable bears the UL mark - it is whether cable used will perform appropriately in a fire situation. No matter what cable is used (certified or otherwise) the cable fire performance must be understood and incorporated into the fire safety design of the project.

I am also aware of other projects in which an executive decision has been taken, "not to worry – fires don't happen here". Such a response would constitute criminal conduct in some countries if a fire occurs and death results as a result of failed cable performance. In many countries such conduct by professionals may result in a prison sentence if there is a loss of life). In the absence of UL certification engineering analysis is an appropriate means of documenting and determining if the use of a specific cable in a unique application is appropriate. A professional response is required from engineers in such circumstances.

Looking Forward

NFPA 130 and NFPA 502 are robust standards which recently adopted the concept of 'equivalence'. Equivalence is a mechanism NFPA use to promote innovation and enhancements to fire and life safety in circumstances outside the prescriptive requirements of the standards.

The current certification withdrawal highlights the need for an 'equivalence' in the overarching framework specifying NFPA 130 and 502 standards. Drafting regulatory provisions contemplating a departure from strict compliance with the standards could be included in projects (especially outside the USA) in order to mitigate the risks caused by changes or flaws in the NFPA standards which occur or are revealed in circumstances outside the control of the client. Furthermore such equivalency positions (if properly drafted) provide a way of customising an NFPA standard for local conditions, or unique circumstances, without invalidating the overall fire safety performance achieved by the NFPA standard.

Such overarching equivalency provisions would supplement and be consistent with the internal equivalency provisions within NFPA 130 and NFPA 502.

Currently NFPA 502 2011 Edition provides:

"1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard, provided sufficient technical data demonstrates that the applied method material or device is equivalent to or superior to the requirements of this standard with respect to fire performance and safety.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose.

1.5.3 Alternative methods or devices approved as equivalent shall be recognized as being in compliance with this standard."

Such equivalency provisions within these NFPA standards highlights there potential to embrace change, innovation and unique project circumstances. The current withdrawal of UL emergency cable system certification could readily be navigated if there were equivalency provisions in the documents mandating use of the NFPA 130 and 502 standards.

Conclusions

The current UL certification situation demands, at the very least:

- Informed prescription of minimum cable fire performance requirements
- Urgent revision of what constitutes "Listed" fire cable
- The establishment of pragmatic testing criteria – to better represent the conditions of real cable installation and set reliable, functional, performance requirements and, where appropriate, reflect the unique circumstances of a tunnel
- An assessment of the expected performance of existing installed cables in a fire Emergency and, depending upon the results of the expected cable performance
- mitigation of any unacceptable consequential safety risks

For those of us tasked with making and advising on immediate decision making on operational and in construction subsurface infrastructure matters, a steady hand with an eye to documentation and detail must be applied. Now is the time to exercise informed expert judgement and to well document the process. In the event of failed tunnel emergency systems with implicated failed emergency wiring the importance of this step will be critical. Exercising judgement in the absence of a genuinely fire rated cable or a proscriptive code is absolutely essential.

It is by no means clear the extent to which the vulnerabilities revealed in the US are also mirrored in other markets where other certification and standards are applied. It would be naive to presume there are no issues elsewhere.

In the future it would be useful to draft an equivalency framework where NFPA 130 and NFPA 502 are specified. This would invite innovative and effective solutions when problems arise like the blanket withdrawal of certification of emergency cabling for road and rail tunnels.

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