

Equivalent solutions – How do they work?

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ABSTRACT

The new standards for commercial vessels contained in the National Standard for Commercial Vessels establish the concept of an equivalent solution. There has been considerable uncertainty about what equivalent solutions mean, how they work, when can they be used, how they will be assessed and will they be accepted by other agencies.

This paper explains the concept and application of equivalent solutions. It looks at their purpose, the different types, and how they might be assessed. It also considers who is responsible for proving an equivalent solution and what is needed for the equivalent solution to be accepted by other agencies.

1. INTRODUCTION

The first sections of the National Standard for Commercial Vessels (NSCV) are due to be implemented within an amended version of the Uniform Shipping Laws Code (USL Code 2008) in October 2008¹. The new USL Code 2008 will apply to new vessels, vessels seeking survey for the first time and vessels being upgraded in service. What has been just on the horizon for some years will soon be in force subject to mandatory application.

The NSCV introduces some new concepts that may appear unfamiliar and, to some, may not sit comfortably with previous experience. Amongst the most controversial has been the concept of equivalent solutions which has already raised questions amongst some stakeholders. Some of these questions include:

- What is an equivalent solution?
- Why have equivalent solutions?
- How is an equivalent solution assessed?
- Who is responsible for the equivalent solution?
- Will an equivalent solution be accepted by another Authority?

Before attempting to respond to these questions, it is important to realise that the concept of equivalent solutions is nothing new. Surveyors have been considering equivalence on vessels for decades if not centuries². What is new is the systematic framework specified within the NSCV that is intended to improve the objectivity and consistency of decisions made regarding equivalence. Access to better decision making will allow Authorities to accept greater flexibility of solutions while at the same time providing sufficient confidence for the decision to be mutually recognized.

2. WHAT IS AN EQUIVALENT SOLUTION?

Chapter 2 of NSCV Part B³ sets the framework of the NSCV including equivalent solutions. The framework is based on that developed in the Building Code of Australia⁴. At

the time that NSCV Part B was written, the performance-based structure of the BCA incorporated the experience gained from over a decade of practical application.

Clause 2.3.6.2 of Part B of the NSCV defines an equivalent solution as follows:

Equivalent solutions are solutions that satisfy the required outcomes by a means that differs from that prescribed for deemed-to-satisfy solutions in this National Standard. They are performance-based solutions that must be proven to satisfy the required outcomes to the extent specified within the standard.

Clause 2.3.5 describes a required outcome as follows:

Required outcomes state the essential outcomes that must be met for compliance with the National Standard...

Required outcomes are essentially the safety outcomes that need to be addressed. While required outcomes are expressed using the emphatic term “must”, compliance with required outcomes is rarely in absolute terms. Usually, required outcomes are met to the extent prescribed within the standard by the deemed-to-satisfy solution.

A deemed-to-satisfy solution is defined in Clause 2.3.6.1 as follows:

Deemed-to-satisfy solutions are solutions that are deemed-to-satisfy the required outcomes. Deemed-to-satisfy solutions are specified within the NSCV using the terminology “shall”. They are normally prescriptive in form and represent one common means of meeting the required outcomes. Proof of compliance with the prescription is deemed-to-satisfy the standard specified in the required outcomes...

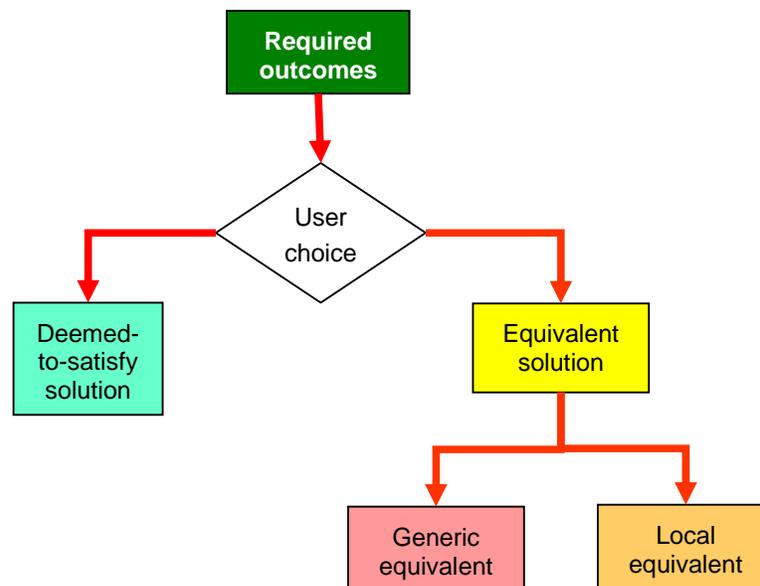


Figure 1—Solution options within the NSCV

The safety outcomes specified by the required outcomes can be achieved in two ways, the first is by using the deemed-to-satisfy solution prescribed within the standard, and the second is by using an equivalent solution that is formulated and specified by the proponent, see Figure 1. The key characteristic of equivalent solutions is that they must provide safety outcomes at least ‘equivalent’ to the deemed-to-satisfy solution prescribed within the standard. However, as we shall see, this

does not necessarily mean that they have to be measured directly against the deemed-to-satisfy solution.

It is also worth clarifying what is not an equivalent solution.

1. A solution that does not provide at least equivalent safety is not an equivalent solution. This can only be accepted as an exemption issued under the legislation of the jurisdiction.
2. A different set of requirements specified by a Marine Authority instead of the deemed-to-satisfy solution contained in the NSCV is not an equivalent solution. This is a requirement outside the NSCV imposed by the jurisdiction in accordance with powers conferred by its legislation.
3. An alternative deemed-to-satisfy solution that is specified within the NSCV is not an equivalent solution. While the alternative deemed-to-satisfy solution would typically be considered equivalent in outcome; its equivalence does not need to be proven for the alternative to be applied; and thus it is not an equivalent solution within the context of the standard.
4. An equivalent solution is not a back-door means to justify acceptance of an arrangement that is substandard in terms of safety outcomes. Checks and balances must be implemented to ensure that a purported equivalent solution does indeed meet at least the minimum required levels of safety. There will be proposed solutions that cannot be accepted as deemed-to-satisfy or equivalent solutions.

3. WHY INTRODUCE THE CONCEPT OF AN EQUIVALENT SOLUTION?

The activities of the NMSC are governed by a Strategic Plan⁵ that arose from a Council of Australian Governments (COAG) agreement⁶ and has been endorsed by the Australian Transport Council (ATC). The structure of the NSCV has been developed to fulfill a series of key strategic principles contained within the Strategic Plan. These include:

- Incorporate recognized and relevant national and international standards;
- Encourage professional competence;
- Incorporate a performance-based approach;
- Facilitate approval of new technologies;
- Incorporate OH&S principles;
- Encourage recognition of duty of care; and
- Develop the safety system based on sound information.

Equivalent solutions form a key element in applying many of these principles. First and foremost, equivalent solutions are intended to support the ongoing innovation and efficient operation needed to underpin the future economic viability of the Australian Maritime sector, while at the same time maintaining safety standards that are also essential to community well-being and future success.

The NSCV is a hybrid performance-based standard; i.e., one that provides for performance based approaches (equivalent solutions) while retaining the benefits of best practice prescriptive solutions (deemed-to-satisfy). A major advantage of equivalent solutions is that they can provide for much greater flexibility; an essential feature when considering new technologies. Equivalent solutions require an improved understanding of the concept of risk: the nature of hazards, their likelihood and consequences. Moreover, they also highlight the limitations as to the extent and level of risk control inherent within the minimum requirements specified by the deemed-to-satisfy solutions contained within the standard. This, together with the onus of proof discussed below enhances professional competence and recognition of duty of care.

The equivalent solution approach mirrors modern Occupational Health and Safety concepts⁷ that are applied nationally and internationally. The onus of proof requires that equivalent solutions be developed and verified based on objective information. By measuring equivalent solutions against

deemed-to-satisfy solutions as part of the verification process, this inevitably will ensure that deemed-to-satisfy solutions are also placed under a level of scrutiny not previously applied.

While the terminology and processes relevant to equivalent solutions in Part B may be unfamiliar, surveyors have always been required to assess equivalents and exemptions on a day to day basis. For example, the USL Code Section 1⁸ contains the following two clauses:

- 8.1 *The Authority may, subject to the principles embodied in these Uniform Requirements, exempt a vessel, or vessels included in a specified class of vessel, from the application of any of the provisions of these Uniform Requirements to the extent that the Authority is satisfied that compliance with such provision or provisions is unreasonable or impracticable in relation to that vessel or those vessels.*
- 8.2 *Where these Uniform Requirements provide that a particular fitting, material, appliance or apparatus, or type thereof, shall be fitted or carried in a vessel, or that any particular provision shall be made, the Authority may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made to that vessel, if it is satisfied by trial thereof, or otherwise, that such fitting, material, appliance or apparatus, or type thereof, or provision, is at least as effective as that required by these Uniform Requirements.*

The problem with the status quo has been that:

1. There is no clear safety outcome specified or benchmark for compliance. Variations from the prescribed requirements are normally described in terms of exemptions. Sometimes an exemption is equivalent and sometimes it is something less. Thus, there is a level of individual discretion and even subjectivity that finds its way into the equivalent or exemption giving rise to arguments between jurisdictions as to the effectiveness of the outcome.
2. The Authority is given discretion whether or not to even consider alternative arrangements. Sometimes this means that a surveyor or jurisdiction will feel obliged to refuse to consider anything other than the prescriptive provisions of the standard, oblivious to the merits of the proposal.
3. It is unclear whether or not a vessel that has been surveyed invoking either of these Clauses should be considered in compliance with the USL Code. The common view has been that such a vessel falls outside the standard, creating an orphan and significantly impairing the chances of mutual recognition.
4. The burden of proof of equivalence is not clearly specified. Frequently this burden is shouldered by a surveyor who is likely to be ill-prepared to make what is frequently an on-the-spot decision. In the absence of sufficient facts, the surveyor's response can vary anywhere from being ultra-conservative to blatantly cavalier.

By adopting the concept of equivalent solutions within the NSCV, these problems will be reduced or overcome. In particular:

1. The standard provides a framework for equivalent solutions within Part B Chapter 2 that specifies them as a bona-fide alternative to achieve *compliance with the standard*.
2. The standard specifies that the choice of whether to propose a deemed-to-satisfy solution or an equivalent solution lies with the proponent. The Authority is obliged to consider an equivalent solution on its merits relative to the required outcomes and the deemed-to-satisfy solution (subject perhaps to the payment of an additional fee to cover the increased cost in resources and time).
3. The standard places the onus of proof of equivalence on the proponent.
4. The standard specifies assessment methods for verification. These methods are intended to improve the objectivity and consistency within the verification processes, thereby providing greater reliability and confidence in the outcomes.

Equivalent solutions have another important benefit in that they have allowed the removal of the discretionary clauses that were frequent within prescriptive provisions within the USL Code. This improves certainty and transparency within the deemed-to-satisfy provisions while still allowing for flexibility by means of an equivalent solution.

4. THE CHALLENGES PRESENTED BY PERFORMANCE-BASED APPROACHES

An equivalent solution is essentially concerned with performance. The equivalent solution must have safety performance equivalent to that of the deemed-to-satisfy solution. Given the flexibility of solution that performance-based approaches appear to promise, why is there a need to include deemed-to-satisfy provisions within the NSCV? Why not just specify performance outcomes and expect people to develop their own solutions?

Anyone who has participated on any of the NMSC's reference groups for the development of standards will appreciate the enormous effort that goes into even just revising a standard, let alone developing a new one. To a greater or lesser extent, the application of an equivalent solution requires the development of an alternative standard for a specific vessel or component on the vessel, and verification against that alternative standard.

A truly performance-based approach relies on there being sufficient information, knowledge, experience, methods of analysis, and tools for assessment available to objectively develop a solution and measure the solution against the relevant performance requirements. The assumption is that there is a body of science readily available that can sustain the approach. In reality, this frequently is not the case. The NSCV equivalent solution provisions merely open the door to the application of the science as and when it is developed. The NSCV does not, in itself, invent or define the science needed to satisfy a performance-based approach. That is a matter for the proponent to source or develop and apply.

Equivalent solutions come with an extra cost. There are the direct costs of developing the specific solution and proving equivalence. It is also more expensive for the Authority to verify compliance than for a deemed-to-satisfy solution, and these added costs may also be passed on to the proponent. The benefits that might arise from developing and proving an equivalent solution have to be weighed against the additional costs that are likely compared with just adopting the deemed-to-satisfy solution.

Hence, the structure of the NSCV gives people a choice. You can adopt the ready to go deemed-to-satisfy solution that (hopefully) provides a practical solution at reasonable cost but which is relatively rigid. Alternatively, you can develop and prove an equivalent solution that is much more flexible, but which requires an assessment to be made as to benefit versus the extra cost, with a possibility of non-acceptance.

4. EQUIVALENT SOLUTIONS NEED NOT BE EQUIVALENT IN EVERY CIRCUMSTANCE

The NSCV differentiates between generic equivalent solutions and local equivalent solutions; see Figure 1. A generic equivalent solution is defined in Part B Clause 2.7.2.1:

Generic equivalent solutions are solutions that are independent of the circumstances of a particular locality or operation within a locality. Generic equivalent solutions shall continue to fulfill the applicable required outcomes, notwithstanding that a vessel may transfer to a different locality or jurisdiction or may engage in a different operation within the limits of its service category.

A local equivalent solution is defined in Clause 2.7.2.2 as follows:

Local equivalent solutions are solutions that are specifically customised for the circumstances of a particular locality or operation within a locality. Local equivalent solutions shall fulfill the applicable required outcomes while the vessel is operating within the particular locality or operation. Information and controls shall be provided to ensure that the effectiveness of the safety system is reassessed prior to the vessel being used in another locality or for an operation where the same special circumstances no longer apply. Additional measures to control risk shall be provided if, upon reassessment, the standard of safety falls below that specified in this National Standard.

Hence, a local equivalent solution takes into account the specific circumstances of the vessel's intended operation. There may no longer be equivalence when the vessel moves to another locality or is used in another type of operation. So why have local equivalents if the objective is to have uniformity and mutual recognition? Doesn't this work against mutual recognition? The rationale behind the local equivalent solution option is to accommodate those operators that would rather optimize a specific operation rather than incorporating what to them may be unnecessary or uneconomic features to facilitate a possible move to another jurisdiction that may never materialize. The applicant has therefore been given a choice, whether to:

1. adopt a deemed-to-satisfy or generic equivalent solution that would be acceptable in all jurisdictions, or
2. optimize the vessel for its given operation using a local equivalent solution with the restrictions that such an approach places on the vessel's movement.

It therefore becomes an economic decision. Consider for example a specialised pearl farm vessel of the type used in the North West of Australia, see Figure 1. On some of these vessels, it has been practice to only provide a single battery for engine starting instead of having the redundancy of two batteries as specified in the USL Code. The rationale is that, because such vessels are only used at the pearl farm, they are always available to support one another in the event of one boat having a flat battery. But this arrangement is a local equivalent; i.e., only equivalent when the vessels are operating in close proximity to one another, as is the case within the pearl farm. Hence, the conditions of equivalence must be expressly stated, clearly understood and properly adhered to if equivalent safety is maintained. Furthermore, the safety of these vessels needs to be reassessed should they be transferred or sold of other uses.



Figure 2—Pearl cleaning boat

5. THE ASSESSEMENT OF EQUIVALENT SOLUTIONS

The big questions facing proponents and approvers alike include: How does one know if an equivalent solution is in fact equivalent? What does equivalence mean? What objective measure

can be used to determine equivalence, particularly in the absence of complete and comprehensive information?

Clause 2.7.3 of Part B states:

The following assessment methods, or any combination of them, may be used to determine whether a solution complies with the required outcomes:

- a) *Evidence to support that the use of a material, form of construction, design or system of work meets a deemed-to-satisfy solution.*
- b) *Evidence to support that the use of a material, form of construction, design, or system of work meets the applicable required outcomes.*
- c) *Quantitative comparison with the deemed-to-satisfy solution.*
- d) *Quantitative risk analysis.*
- e) *Expert judgment with or without qualitative risk analysis.*

The content of the Clause 2.7.3 provides a range of potential methodologies for proving equivalence. Note in particular that a *combination* of these methods may also apply. Such combinations may help to significantly improve confidence in the conclusions of the assessment.

a) Evidence to support that the use of a material, form of construction, design or system of work meets a deemed-to-satisfy solution

Upon first reading, the relevance of the method to equivalent solutions is not apparent given that it appears to apply to deemed-to-satisfy solutions. However, it may have relevance when used in combination with other methods. For example, in considering an equivalent solution, information as to the overall extent of compliance with the deemed-to-satisfy solution may well be relevant; especially where the equivalent solution represents a relatively small departure from the deemed-to-satisfy solution. Thus the height of a single coaming below the deemed to satisfy solution may be considered in the context that all other coamings on the vessel do comply with the minimum deemed-to-satisfy requirement. In this case, the potential changes in risk that could arise from the equivalent are isolated to the one coaming, a potentially important factor in assessing the risk associated with an equivalent solution.

b) Evidence to support that the use of a material, form of construction, design, or system of work meets the applicable required outcomes

Clause 2.3.5 of Part B says:

Required outcomes state the essential outcomes that must be met for compliance with the National Standard.The required outcomes may state the level of compliance required, but more frequently will not be quantified.

The required outcomes are the safety outcomes of the standard, to be achieved by whatever means, provided it is effective, reliable and auditable. As an example, consider the following required outcome from NSCV Part F Subsection 1C⁹:

2.3.1.2 Protection of persons from excessive accelerations

*Spaces that accommodate persons **must** be designed and arranged to protect their health and safety from the risks of the accelerations or decelerations that may arise in normal and abnormal conditions of operation.*

Note that the required outcomes expressed in absolute terms using the term “must”. However, the deemed-to-satisfy solution normally does not provide an absolute solution. One normally finds the

degree of protection provided by the deemed-to-satisfy solution is relative rather than absolute. This apparent inconsistency stems from the relative infancy of the performance approach. As mentioned previously, the science is generally yet to be developed. Adequate descriptors of required performance in terms of probability of successful protection have not yet been sufficiently investigated or established.

As time goes by and the science matures, it is intended to add to the standard appropriate descriptors of acceptable relative performance. These will be in the form of Required Outcome Verification Criteria. Such criteria will allow the application of objective means such as statistical analysis, tests, inspections, calculations or other methods to determine whether an equivalent solution satisfies the relevant required outcomes to the extent deemed necessary.

In the meantime, consideration of the required outcome approach is still valuable when the proposed equivalent solution side-steps the problem altogether. For example, consider the required outcome from NSCV Part C Subsection 5A¹⁰:

ENGINE EXHAUSTS

The exhaust system must be arranged and constructed to dispose of the products of combustion while—

- a) protecting the health and safety of personnel; and*
- b) maintaining the watertight integrity of the vessel.*

A vessel propelled by solar cell technology may not have an exhaust system that is dangerous to health and safety and which does not affect the watertight integrity of the vessel. Hence, the equivalent solution may satisfy this required outcome.

The required outcomes also provide important insights as to the performance criteria that should be used when applying other methods. In this example, two issues are identified as relevant when assessing an equivalent solution for an exhaust system installation: The health and safety of personnel and the watertight integrity of the vessel.

c) Quantitative comparison with the deemed-to-satisfy solution

This is likely to be the preferred method for assessing equivalent solutions that are significant departures from the deemed-to-satisfy solution. In some ways it is an expansion of method b), except that the level to which the required outcomes are satisfied is established by measuring the performance of the deemed-to-satisfy solution. The performance of the deemed-to-satisfy solution then becomes the benchmark for assessing the measured performance of the equivalent solution.

An example of the application of quantitative comparison might be for an equivalent solution to the deemed-to-satisfy fire extinguishing system within the machinery space of a vessel. The performance of the deemed-to-satisfy solution is set by the standards specified in Table 62 of NSCV Part C Subsection 4¹¹. The deemed-to-satisfy solution is required to meet the relevant performance standards within the IMO Fire Safety Systems Code— Chapter 7 & Chapter 8, NFPA 15, NFPA 750, AS 2118, AS 4587, or SP-method 2377. These standards also provide a benchmark to measure the performance of an equivalent solution.

The challenge is to ensure that the comparison takes into account all the key factors that the developers of the deemed-to-satisfy solutions took into account in the deemed-to-satisfy solution, plus any additional factors that might be introduced by the equivalent solution. The equivalent solution may have characteristics so different from the deemed-to-satisfy solution that they too must be taken into account. For example, the accidental discharge of some aerosol fixed fire extinguishing systems can result in fire risks that are unique to this type of system and are not

considered as part of the assessment of gaseous or aqueous systems. Note also that Annex B of NSCV Part C Section 4 Fire Safety provides a methodology for developing equivalent solutions for fire safety.

d) Quantitative risk analysis

There are two ways of looking at the magnitude of risk within the context of this method. The first is in terms of relative risk; i.e., the risks associated with the equivalent solution should be no greater than the deemed-to-satisfy solution. The second considers risk in absolute terms; i.e., the risk associated with the equivalent solution should be acceptable in absolute terms, notwithstanding that it is more or less than the deemed-to-satisfy solution. Guidance on acceptable risk is given in the NSCV Part B Annex C.

The first approach is another way of expressing method c), except that magnitude of risk becomes the measure of equivalent performance with the deemed-to-satisfy solution. An example of its application might be in the context of the door sill height on a vessel. The increase in risk associated with the reduction of sill height on a vessel with a large freeboard (both intact and damaged) might be minimal, while the reduced risk of personal injury arising from persons that would otherwise have to negotiate a high sill may be quite significant. If this were the case, the equivalent solution of a reduced coaming height could be justified on the basis of the reduction in overall relative risk.

The second approach that relies on a quantified assessment of absolute risk is more problematical. This is another case of where the science might not yet be sufficiently advanced at this stage. Data to analyse absolute levels of risk of vessels is hard to source, and the effects on that risk of individual hazards and risk control solutions even harder to come by. The problem is compounded by the relatively rare and erratic nature of catastrophic incidents. Data trends that illustrate risk being acceptable can be destroyed overnight by a single incident such as happened with the loss of 900 people in one incident on the Estonia. While in theory, the door is open to assessment of equivalent solutions based on the quantification of absolute levels of risk; its application is probably better limited to providing support for other methods of assessment rather than being the basis for decision making.

e) Expert judgment with or without qualitative risk analysis

The last assessment method encompasses the current method of assessment most frequently used by on-site surveyors; but with some significant changes to improve reliability and consistency.

For years, attending surveyors have been presented with alternatives and non-conformances, quite often as a *fait accompli*^a, and have been required, sometimes on the spot, to determine whether they are acceptable. The surveyor has been placed in the position of the single expert arbiter to accept the arrangement as equivalent, issue an exemption, or reject it. There are frequently fundamental problems in this approach:

1. The surveyor may be unprepared and ill-equipped to make a determination;
2. The information provided is rarely adequate to assist the surveyor in making a determination; and
3. Time, commercial and resource constraints normally limit the surveyor's ability to investigate further.

^a An accomplished fact; an action which is completed before those affected by it are in a position to query or reverse it.

What should be an objective decision often ends up having an element of subjectivity. This is evidenced by the perception that there are good surveyors and bad surveyors, easy surveyors and hard surveyors. Such perceptions are indicators of a system that is unable to deliver consistent quality of outcomes. It is not surprising that there are difficulties in achieving national uniformity and mutual recognition when there can be such variability in quality even within a jurisdiction.

At this point, it is important to mention that the problems in quality stem from the system rather than from individuals. Individual surveyors working under current practices have generally been able to deliver the first objective of the standard as expressed in the Preamble to the NSCV¹²; i.e., to protect the health and safety of persons from hazards arising from the operation of commercial vessels. However, the current system is ill-equipped to deliver the third objective which is to facilitate the transfer of vessels and the recognition of crew qualifications between Australian States and Territories, and also to deliver the first objective with an increased degree of flexibility needed to accommodate new technologies; as envisaged in the Marine Safety Strategy.

Expert judgment will always be a key function of the surveyor. However, there are a number of measures that can be put in place to significantly improve the objectivity of the outcomes. These are listed as follows:

1. Expert opinion means opinion provided by experts

The equivalent solution path will require a higher degree of expertise in both the proponent and the surveyor compared to assessing a deemed-to-satisfy solution. The difference can be likened to the role of the medical specialist when compared to the general practitioner. Like the general practitioner, the proponent and/or surveyor are well equipped for day-to-day application of deemed-to-satisfy solutions. However, equivalent solutions take a greater fundamental understanding of the hazards and risks, the viability of alternatives and the professional obligations of the parties. So just like getting a medical specialist to assist in diagnosing and treating a particular malady, it may be necessary to call upon specialists in a particular field of vessel safety to establish and assess an equivalent solution.

The proponent has an obligation to ensure that any expert opinion proffered in support of an equivalent solution is in fact from an expert source. After all, the proponent is offering the opinion in the knowledge that the assessor may rely on that opinion. The proponent may, indeed, have a wealth of experience and knowledge to offer to the process that should not be discounted. This, together with an understanding of the intended vessel operation, required outcomes, the deemed-to-satisfy solution, the burden of proof of the equivalent solution and the qualitative risk management analysis may be all that is required for the proponent to be able to claim sufficient expertise. However, sometimes that will not be enough and additional expert resources will be needed to develop the solution and provide the necessary expert opinion of equivalence.

The Authority has an obligation to ensure that whoever assesses the equivalent solution has sufficient expertise, or access to sufficient expertise, to objectively consider the proposal on its merits. The individual surveyor called upon to assess an equivalent solution has an obligation to know the limits of their expertise and to seek a second more expert opinion or other remedy if they realize the topic is in a field for which they are out of their depth. Again, the surveyor can enhance their expertise by engaging in early discussions with the proponent and by referring to the NSCV to gain insight into the relevant required outcomes, deemed to satisfy solution, requirements for an equivalent solution and by applying risk management tools.

The needs of a system that can deal with equivalent solutions highlights the importance of having depth of expertise within the Authority that includes naval architects, marine engineers, shipwrights and deck officers. Failing sufficient expertise being available within the Authority, it may be necessary to seek expertise in other Authorities or engage specialist subcontractors from the private sector such as classification societies.

2. Shared responsibility for decision making

The structure of the NSCV requires that the proponent bears the initial responsibility for proving equivalence leaving the surveyor to review and verify the proposal. This ensures that the burden of determining and assessing equivalence is shared, improving the likelihood of objectivity and consistency. There are many precedents for avoiding reliance on a single expert opinion; especially in life and death or other critical situations such as are dealt with in court proceedings, medical procedures and within the cockpit of large commercial aircraft.

Shared responsibility also ensures that the proponent of an equivalent solution commits sufficient resources to prove equivalence. This helps to ensure that the surveyor has relevant information upon which to base a decision. It is not good enough for the proponent to say "This is what I want to do. What do you think?" The proponent now has to say "This is what I want to do. This is why it is equivalent. Here is support for my view. What do you think?" The cost of and time to provide this proof can be a significant part of the real cost of deviating from the deemed-to-satisfy solution that should not be borne by the Authority.

The burden of proof being on the proponent does not mean that the surveyor should not participate actively in the determination. While the NSCV has been drafted with a degree of transparency to facilitate a performance-based approach; a far better outcome will be achieved if the surveyor is consulted at an early stage to help establish agreement on the performance criteria, the nature of hazards and their associated levels of risks, the standard of proof required, and the most appropriate methods of assessment. This will help avoid the aggravation, wasted time and resources that would arise if there was disagreement on fundamental aspects of the overall approach at the time of final approval.

A proponent that comes to the table with objective proof of equivalence will be empowered by doing so. The surveyor cannot just reject the proposal off-hand. Instead the surveyor is obliged to respond to the evidence presented, and thus consider the proposal in a more objective and professional manner based on its merits.

Within the context of equivalent solutions, a surveyor can reject a non-conforming arrangement presented as a *fait accompli* and justified as an equivalent solution merely on the grounds that there is no supporting information proving equivalence. However, there is an element of discretion here. Minor non-conformances that could be expected within the tolerances of construction or that would normally be tolerated in the normal course of wear-and-tear should not be subject to the same burden of proof on the proponent.

3. The application of qualitative risk management techniques

Risk is a function of the likelihood and consequences of the hazards to which a vessel and persons on board might be exposed. Even if quantitative data on risk (see above) is not available, proponents of equivalent solutions should analyse their proposal qualitatively using risk management techniques. This provides a starting point to better identify, understand and focus on the key elements that determine and control risk. These must be addressed if the equivalent solution is to be effective. NSCV Part B Annex B set out guidelines for hazard identification, risk assessment and control of risk. NSCV Part B Annex C provides guidance on acceptable risk. AS/NZS 4360¹³ provides further information on the risk management process

The surveyor also needs to have access to methods that assist in determining objectively the standard of proof that should be applied before an equivalent should be accepted. Such a tool is currently under development. The method being investigated considers the accuracy of the assessment method or methods, the quality of the solution and the consequences of getting the

assessment wrong, as well as other factors such as whether the solution is generic or local and the application of factors of safety or other forms of redundancy.

6. DOCUMENTATION OF EQUIVALENT SOLUTIONS

Occupational Health and Safety Law places an obligation for safety information. Clause 2.4.4 of NSCV Part A provides guidance on the nature of this obligation:

A person with responsibility for the safety of a vessel should ensure that information relevant to the safety of the vessel is provided for others that may need to rely on that information in order to discharge their obligations for safety. Such information should include, but is not limited to—

- a) the purpose for which the vessel is designed;*
- b) any limitations on the use of the vessel;*
- c) special hazards that may be associated with the vessel;*
- d) testing or inspections to be carried out on the vessel;*
- e) operational and maintenance procedures necessary for the safe use of the vessel;*
- f) special knowledge, training or skills necessary for persons operating or maintaining the vessel; and*
- g) emergency procedures.*

Clause 2.7.4 of Part B of the NSCV requires that “*Decisions made under the NSCV shall be fully documented and copies of all relevant documentation shall be retained for future reference, which may include third party audit.*” This is especially important for equivalent solutions because the documentation may prove to be crucial to the ongoing safety of the vessel. This documentation may be the only record of what was intended, what was assumed and the reasons for any limitations that were imposed. Without such documentation, there is a real risk that operators, surveyors, subsequent owners and persons modifying the vessel will fail to appreciate the existence of the equivalent solution and how it was meant to work.

The first step in documenting equivalent solutions is to flag the existence of an equivalent solution; either by marking it on the certificate of survey, or by a notice permanently affixed to the vessel. This flag should also indicate whether the equivalent solution is generic or local.

In addition to the normal plans and other documentation that physically describe a solution, Clause 2.7.4 also requires the following additional documentation for an equivalent solution:

- i) details of the relevant required outcomes;*
- ii) the assessment method or methods used to establish compliance with the relevant required outcomes;*
- iii) details of any expert judgment relied upon including the extent to which the judgment was relied upon and the qualifications and experience of the expert;*
- iv) details of any tests or calculations used to determine compliance with the relevant required outcomes;*
- v) test certificates, classification certificates or other documentation from an appropriate body which verify that a solution meets an applicable standard; and*
- vi) details of any standards or other information which were relied upon.*

The process of documenting equivalent solutions is also very important if these decisions are to be mutually recognized. Quite apart from the practical considerations of knowing what one is surveying when a vessel enters the survey of another jurisdiction; brother jurisdictions need to have confidence that the approval of the equivalent solution has been objective and that it is indeed equivalent. A quality managed process requires there to be an audit trail that would allow third party review of the decision. It is a strange fact that; for a jurisdiction to be satisfied that it need not

look behind the survey of another jurisdiction, measures have to be in place that would facilitate looking behind the survey should a jurisdiction choose to.

Finally, Clause 2.7.5 of Part B requires that “*Information relevant to achieving and maintaining the safety effectiveness of the solution shall be provided to those parties responsible for the safety of the vessel*”. Again, this is likely to be particularly relevant on vessels relying upon an equivalent solution, requiring the documentation to be made available to those that must rely on it.

7. CONCLUSIONS

There is nothing particularly new about the concept of equivalent solutions and the need to be able to provide for flexibility to accommodate particular needs of stakeholders. What is new is the more transparent and systematic approach that has been incorporated within the NSCV to introduce greater objectivity into the assessment of solutions that differ from those that are deemed-to-satisfy the standard.

The implementation of a performance-based approach cannot be wholly objective because the very flexible nature of equivalent solutions means that there will never be hard and fast rules. Individuals are still required to make judgments and to use their discretion on a day to day basis. However, the principles contained in Part B Chapter 2 will help shift the process away from one with a high likelihood of subjectivity to provide improved consistency, traceability and confidence when determining and verifying an equivalent solution.

8. ACKNOWLEDGEMENTS

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