AUSTRALIAN STANDARD AS2885: A MODERN STANDARD FOR DESIGN, CONSTRUCTION, WELDING, OPERATION AND MAINTENANCE OF HIGH INTEGRITY PETROLEUM PIPELINES

by

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ABSTRACT

The suite of Standards that makes up the Australian Standard AS2885 "Pipelines – Gas and liquid petroleum" has been benchmarked against equivalent international and national Standards including ASME B31.8, CSA Z662, ISO 13623, API 1104, and ISO 13847. The benchmarking shows that AS2885 is superior in many detailed technical respects to its counterparts elsewhere, and that it better represents the current international state of the art in the design, construction, testing, operation and maintenance of petroleum pipelines. It is accepted by all of the stakeholders as the single and sufficient set of technical requirements . It uses an integral risk assessment and threat mitigation process in design and for the whole of the life of the pipeline in operation and maintenance. It has explicit requirements for the design, documentation, and approval of key processes such as prevention of external interference, control of fracture, and welding procedure qualification. And it assigns responsibility for the key processes to suitably qualified, experienced, and trained people who take responsibility for their actions in writing. Amongst other reasons that has allowed the development of a worlds best practice Standard in Australia is the relatively small and agile committee process, and the involvement of many of the key contributors to the Standard in industry sponsored research projects. This involvement has simultaneously ensured that they are abreast of the latest developments, and that they are able to incorporate those developments in the Standard as and when they happen.

1. INTRODUCTION

Our ability to design, construct and operate safe and economic pipelines is critically affected by the requirements of the Standards which are adopted. Despite the growing number of ISO Standards which are available covering aspects of petroleum pipelines, there is so far little use of these in practice, and most of the world's developed nations maintain their own national standards.

Some particular areas in which AS2885 contains features worthy of examination are: design and design factor, class location treatment, risk assessment, external interference protection, welding and non-destructive testing (especially the achievement of strength matching and the designing-out of HACC). AS2885 also breaks new ground in the management of the safe operation and maintenance of the pipeline.

The AS 2885 risk assessment process is likely to be of special interest since it requires threats to safe operation to be mitigated to ALARP levels as an integral requirement of the design, construction, operation and maintenance requirements of the Standard, rather than treating risk assessment as a separate and additional measurement process. Underpinning the whole AS 2885 approach to pipeline safety is the requirement for responsibility and accountability. The Standard requires all aspects of the high pressure pipeline industry to be undertaken by suitably qualified experienced and trained people who take responsibility for their actions in writing.

This paper is an updated version of a paper presented at the Pipe Dreamer's Conference in Yokohama in November 2002 [1]. The principal changes are the inclusion of material describing some of the changes that are expected to be introduced in a forthcoming revision of AS2885.1 which is expected to be published during 2004.

2. THE GENESIS AND DEVELOPMENT OF THE AUSTRALIAN STANDARDS FOR PIPELINES

Australia began the process of developing its own suite of pipeline Standards during the 1970s, and initially these followed well established examples from other countries such as the US and the UK. Now, after some 30 years of evolution, the suite of Australian pipeline Standards consisting of the various parts of AS2885, plus two coating Standards, has been developed into a comprehensive set of documents which provides some real advantages and improvements compared to the models upon which they were originally based.

The pipeline industry in Australia has benefited considerably from inputs of skills and practices from all around the world. Because of our small population, the number of decision makers is relatively small, and there is a receptiveness to change. The industry has been vigorous in conducting its own research and in adopting the results of research conducted elsewhere. There were, in the early days of the industry, some significant examples of problems which produced some sharp lessons, and these and other circumstances have combined to provide an environment highly conducive to the production of Standards which have undergone rapid evolution, and which have been remarked upon as a model of flexible and responsive Standards making.

The rapid development of the AS 2885 suite of standards was especially encouraged in an environment where real savings in construction and operating costs were beneficial to the Australian pipeline industry and its customers. In recent times however, the effect of economic regulation is diminishing these incentives, and this is a serious threat to ongoing development needed to maintain the advantages that the Standard currently enjoys.

3. REASONS FOR HAVING AN AUSTRALIAN STANDARD

In the face of increasing globalisation, and in view of the development of ISO Standards, there are arguments that it is an unnecessary cost and effort to develop and maintain one's own national

Standard. It is also sometimes argued that because the engineers and contractors that build major pipelines are often multi-national organisations for whom there are both effort and risk premiums in working with unfamiliar requirements, that having one's own national Standard adds to the cost of constructing pipelines.

Whilst these arguments are recognised in Australia, we do not consider there is another petroleum pipeline standard which we could adopt, and there is an overwhelming weight of opinion that the benefits of having our own national Standard outweigh any disadvantages.

It also needs to be understood that the existence of an Australian Standard does not infringe the requirements of the General Agreement on Tariffs and Trade (GATT) in that AS 2885 does not contain any requirements which have the effect of directly or indirectly restricting the use of goods or services from other countries.

Some of the benefits to Australia that arise out of having our own Standard are:

(a) the development of an Australian Standard is an act of consensus in the community interest in order to help prevent the proliferation of different requirements in different States and Territories;

(b) the Australian Standard provides a basis for ownership of the technical and safety standards to all Australian stakeholders including the public and the technical regulators;

(c) the industry has local and rapid access to the Standards Committee for training, and for the resolution of uncertainties in the intended meaning and the correction of errors;

(d) Australian conditions are often significantly different to those in the overseas countries in which petroleum pipeline technology was mainly developed. The terrain and population density conditions are different, and the small markets and long distances in this country dictate the use of different technology with an emphasis on smaller diameter high strength pipe with correspondingly thinner wall;

(e) Australian pipelines are on average significantly younger than those in Europe and North America. In the main, they have therefore utilised more modern technology with better quality materials (including coatings) and processes. For these reasons the Australian pipeline failure rates are much lower than the countries referred to above and from which most accident frequency rates derive for the purpose of risk assessment;

(f) the small number of people involved in the Australian pipeline industry and the associated regulatory organisations, together with the assistance of Standards Australia, means that the processes for changing the Australian Standard are relatively very quick compared to major overseas Standards. This situation has encouraged the rapid take up of new technology in Australia, whereas by corollary, some overseas Standards often have the effect of stifling innovation;

(g) Standards Australia and the Australian pipeline industry has committed to the review of AS2885 every five years to ensure that the Standard incorporates the latest technology;

(h) as well as the rapid take up of new technology from overseas and from industries outside the pipeline industry, the innovative environment encouraged by having our own responsive Standard has helped foster an active and ongoing program of pipeline industry research which has contributed significantly to the economy and integrity of Australian pipelines. The welding Standard, AS 2885.2, in particular has benefited from this research and has features which are in advance of comparable overseas Standards;

(i) the Standards Australia pipeline committees have used a first principles approach to the development of technical requirements. The Committee has as its catch-phrase that it needs to *understand the laws of nature* so that it can set down effective *laws of man.* Consistent with the style requirements of a Standard the rules are, wherever possible, accompanied by explanatory material in order to help the user understand the principles and intent of the Standard. This philosophy has produced what is, in the Committee's view a better standard than any that is available elsewhere;

(j) The industry has embraced the need for change and with it the need for responsible management. It has utilised a process within the Standard to ensure proper accountability for all of the decisions that are made requiring a formal approval process for all aspects of design, construction, testing, operation, and maintenance of a high pressure pipeline.

(k) because there is a recognition that the only commonality between transmission and distribution pipelines is the commodity transported, AS2885 is a specialised Standard for transmission pipelines.

In contrast to the foregoing advantages, some of the disadvantages of using a Standard or Standards from other countries are:

(a) some of the best known Standards used for international projects, especially the ASME Standards, do not in all cases have the status of a National Standard, and in particular are not necessarily accepted by the regulators in their country of origin. This means that whilst they may not be accepted in their own country as the single and sufficient set of technical requirements for a pipeline, they are often promulgated for use elsewhere as if they were. In that sense they are "export Standards";

(b) in contrast to the *laws of nature* approach used in the Australian Standard, the use of some of the international standards encourages an opposite approach. Some seem to encourage a rote learning of requirements without an understanding of their basis. We also feel that they encourage a disputatious quasi-legal approach to rule making and interpretation where the words of the standard, rather than their intent, assume an inappropriate level of importance.

(c) we are unable to exert significant influence or control over the review and processes for change in other Standards, and our experience is that it is difficult to obtain timely rulings and interpretations.

4. THE APPROACH

The fundamental approach adopted by the AS 2885 series of Standards is to ensure the protection of the general public, pipeline operating personnel and the environment, and to ensure safe operation of pipelines which carry petroleum fluids at high pressures by defining important principles for design, construction, operation and abandonment of petroleum pipelines. The principles are expressed in practical rules and guidelines for use by competent persons.

The Standards mandate minimum requirements and establish principles whereby suitably qualified experienced and trained people who take responsibility for their actions in writing can design, construct, operate, and maintain high pressure pipelines.

Because the standard is not a book of rules (which by default allows designers and operators to avoid some responsibility), the reliance by AS 2885 on "suitably qualified experienced and trained people who take responsibility for their actions" is one sense a significant strength. But it is also a potentially serious weakness, and this will be especially true if, for whatever reason, the store of "suitably qualified experienced and trained people" becomes inadequate. Recognising this, the pipeline industry strongly supports training programs in the application of the standards with the development of handbooks. Furthermore, the Standard is developing procedures for assessing the integrity of work undertaken to the standard, including design and operational auditing.

5. REPRESENTATION AND INVOLVEMENT IN THE PROCESS OF MAKING THE STANDARDS

Australia is a constitutional federation of states, and the responsibility for the licensing of petroleum pipelines falls to the State governments. This brings with it the risk that there will not be agreement between the states over the minimum and sufficient requirements for the technical regulation of pipelines. Fortunately this risk was averted by the Council of Australian Governments which agreed to adopt AS 2885 for petroleum pipelines throughout Australia to achieve uniform national pipeline construction standards as from the end of 1994.

The arrangements for representation on the main committee responsible for overseeing AS2885 are very important. The committee has structured representation, arranged and overseen by the Research and Standards Committee of the Australian Pipeline Industry Association (APIA), from:

- Owners of pipelines;
- Engineering companies specialising in the design of pipelines;
- Pipeline Constructors;
- Pipe and steel manufacturers and suppliers of other pipeline materials;
- Technical regulators from the Australian States;
- Expert technical bodies such as the Australasian Corrosion Association, the Welding Technology Institute of Australia, and the Cooperative Research Centre for Welded Structures

A very important feature of the process is the integral involvement of technical regulators. Because of this involvement they have ownership of the requirements and by this means the Standards are adopted in regulations as the single and sufficient technical requirement by the Australian States. This means that we do not have the problem that occurs in some overseas countries where the requirements of well known and widely used Standards have no regulatory status in their country of origin. Or, almost as bad, a situation where each of the jurisdictions add their own special requirements over and above the national Standard. At the risk of dwelling on the obvious, this is what we mean by the term "single and sufficient".

Another notable feature is the fact that there is significant interaction and common membership between the Standards committees and the groups which initiate and manage the APIA Pipelines Research Program . The strength and significance of that program has recently been recognised by an invitation to join with the Pipelines Research Committee International (PRC*I*) and the European Pipelines Research Group (EPRG) in the joint technical meetings held at periodic intervals for the purpose of sharing research outputs . This interaction ensures that the research is prioritised and managed to meet the needs of the industry, and is adopted in Standards as soon as the outcomes are known . In a number of cases this has been in advance of the final publication of research reports.

6. LAND PLANNING REQUIREMENTS WHICH AFFECT THE TECHNICAL REQUIREMENTS FOR PIPELINES

High pressure pipelines have an influence on the environment through which they pass and likewise, the environment affects the safe operation of pipelines. We assert that the Australian Standard, AS2885 addresses the interaction between pipelines and land use better than most, because, as we mentioned above, it relies upon the *laws of nature* as its foundation, rather than the empirical approach that is adopted by some of the rest of the world's high pressure pipeline standards. Our approach is embodied in the phrase: *"To protect people from high pressure pipelines, we must first protect the pipelines from the people."*

Our risk based design techniques, which were first introduced into the Australian Standard in 1987 recognise that land use in the vicinity of a pipeline brings with it both threats to the pipeline and consequences in the event of a pipeline failure.

AS2885 requires a structured, risk based design process that must be completed prior to construction, and then maintained and formally reviewed at regular intervals throughout the operating life of the pipeline.

Each metre along the pipeline route is examined by designers and operators to identify each threat and to eliminate it by applying mandatory levels of external interference protection measures, design change, management activity consequences, and to determine other appropriate mitigation measures that need to be applied *ab initio* and throughout the life of the pipeline. This threat and threat mitigation register becomes the baseline document for the preparation of a Safety and Operating Plan. From this document all operating and maintenance decisions flow.

The structured approach to risk assessment was introduced fully in the 1997 revision of AS 2885.1, and has had almost 6 years of practical application to both minor and major pipeline projects. It requires the designer and the operator having full knowledge of the pipeline properties, including its resistance to penetration and should it be penetrated, knowledge of its failure mode. From this knowledge protective, preventive and management procedures can be confidently developed and applied.

AS 2885.1 is currently undergoing a major revision required to address industry's request that transmission pipelines be permitted to operate with a design factor of 0.80. In additional to the revision of technical conditions to provide a basis for this changed design basis, the safety provisions are being substantially revised in the light of experience with the current revision. Factors being addressed include:

- Establishing the principle of risk assessment and management to the whole of life of a pipeline, from conception to abandonment, including environmental risk, and commercial risk (that could impact on the ability of the operator to safely operate the pipeline)
- The elimination of rupture as a credible failure mode in populated areas, with procedures to ensure that this principle is applied with integrity in situations where there is population encroachment
- A requirement for a pipeline isolation plan, with specific requirements in populated areas
- A restriction on the maximum release rates from any loss of integrity event in populated, sensitive and high rise locations.
- A basis for transparently establishing the integrity of a risk assessment
- The meaning of "accepted" risk
- Reaffirmation of a 1.25 hydrostatic test pressure factor in all locations
- Hydrostatic testing procedures for tests undertaken at 100% smys minimum
- A proposal that a design factor of 0.80 be accepted for pipeline pressure design in all locations together with a requirement that the wall thickness applied at each location will be the greater of the pressure design thickness and the thickness required to resist the load condition or identified threat at that location (ie. pressure design thickness is simply establishing the absolute minimum thickness – penetration resistance, fracture and rupture control and external loading will often take precedence in wall thickness selection).

In preparing for this revision the committee developing the Standard revision has developed some 76 issue papers addressing each component of the standard and has published these for industry review and critique on the Australian Pipeline Industry Association's web site (www.apia.asn.au) so that as broad a discussion as possible is had prior to the revision being released for formal public comment.

7. LAND PLANNING REQUIREMENTS WHICH AFFECT THE TECHNICAL REQUIREMENTS FOR PIPELINES

Once a pipeline is installed in its easement, the pipeline owner normally loses control of the land use adjacent to the easement. When changes to land use alter the balance between threats, mitigation and consequences established initially, the pipeline owner can face the very high cost of restoring the balance and ensuring that the pipeline and the public are safe. As a result of representations by the Australian pipeline industry, governments in Australia are considering the implementation of "notification zones" on either side along the length of each pipeline where planning authorities are required to notify the pipeline operator of each development proposal within the notification zone enabling the operator to review the potential impact of the development on the risk profile of the pipeline (effectively treating the pipeline as another affected landholder who must be notified of a development within its proximity).

Furthermore this will require planning authorities and land owners to consult with pipeline owners on any proposed change of land use and to develop sub-division plans, building uses and designs that minimise the influence of the changed land use on the pipeline and, if necessary, determine cost sharing arrangements between developer and pipeline owner. The Australian pipeline industry recognises that these are contentious issues. But they must be addressed if the public good is to be maximised. The aim is to provide an environment that encourages compatible development rather than a no-development practice.

8. CONFLICT BETWEEN TECHNICAL AND ECONOMIC REGULATION

Prior to 1997, Australian natural gas transmission pipelines were not subject to economic regulation. Transport charges were negotiated between pipeline owners and shippers, and as a consequence, cost savings that might result from an improved design or technological innovation were often shared between the pipeline owners and shippers. This arrangement provided incentives for both parties to use better designs and to innovate to reduce cost. A progressive AS2885 contributed to the incentive for excellence, in that it provided both rules and guidance for the implementation of improved technical performance and safety and gave the technical regulators sound technical guidance to authorise new approaches and technologies.

Unfortunately, since 1997, heavy handed cost-of-service economic regulation has been implemented in such a manner that all the benefits of cost reductions from better design and innovation are passed to the shippers. The pipeline owners now have no incentive to reduce capital and operating costs and the public is the loser, even though the latest versions of the Australian Standard, AS2885 actively promote innovation and cost reduction.

9. THE SUITE OF AUSTRALIAN STANDARDS FOR PIPELINES

The suite of Australian Standards for Pipelines – gas and liquid petroleum is:

AS2885.0 – XXXX	General (in preparation)
AS2885.1 -.1997	Design and construction
AS2885.2.- 2002	Welding
AS2885.3 – 2001	Operation and maintenance
AS2885.4 – XXXX	Offshore (in preparation – to be based upon DNV OS-F101)
AS2885.5 – 2002	Field pressure testing
AS1518 – 2002	Extruded high density polyethylene protective coatings for pipes
AS3682 – 2002	External fusion – bonded epoxy coating for steel pipes

10. SEPARATION INTO PARTS

The separation of the Standard into physically discrete components began in 1995 when the Welding standard was published to replace Section 7 of AS2885 – 1987. This was brought about by the urgent need to change the welding section at a time when the revisions of the remainder were insufficiently well advanced for publication.

There are some logistical disadvantages to the separation. People working on specialised activities in, say operations, tend to see their responsibilities as more isolated than they should, and lose familiarity with the important and indeed essential requirements of other parts of the whole Standard. Equally it is important for specialist designers to realise that when the pipeline has been constructed that it needs to be operated. This is an important long-term process and must be considered in the design and construction phase. These perceptions need to be guarded against. However, on balance, the separation is probably a good thing because it encourages more timely revision by dividing the work into manageable parts.

11. BENCHMARKING OF AS2885 AGAINST INTERNATIONAL STANDARDS

For the purposes of comparing the approach and content of AS2885 against other national Standards for petroleum, a benchmarking exercise has been conducted against several other national Standards, and against the ISO Standard ISO 13623. The comparison has been made for Parts 1, 2, and 3 of AS2885.

(a) AS2885.1 – 1997 Design and construction

(i) Scope

AS2885.1	ASME B31.8	ISO 13362	CSA Z662
• transmission pipelines only • onshore only (offshore is to be covered by Part 4, which will be based on DNV OS-F101) • all petroleum fluids	• transmission and distribution • gas only (other Standards cover other fluids) • onshore and offshore	• transmission only • all petroleum fluids • onshore and offshore	• transmission and distribution • all petroleum fluids • onshore and offshore

(ii) Involvement, ownership and usage

• managed representation of industry sectors • active participation by state technical regulators	• minimal involvement of technical regulators • USA pipelines comply with DOT rules not B31.8 • "export standard"	• not demonstrably representative of all countries and industry sectors • used by nobody?	• technical regulator involvement • Acceptance by National Regulators

(iii) Principles of risk assessment

design by threat identification and management of risk on a metre by metre basis. All threats are identified and designed out. Only those that present a residual threat are analysed for ongoing risk.	design by rule	design by rule. Default provision for risk assessment when not required by national regulator and only for areas with multi storey buildings.	non mandatory Appendix.
elimination of rupture as a credible failure mode in residential and high rise areas, together with a requirement to limit the maximum energy release rates is being considered,	design by rule (implicit assumption that reduced design factors achieve this condition)	design by rule (implicit assumption that reduced design factors achieve this condition)	design by rule (implicit assumption that reduced design factors achieve this condition)

(iv) Design of wall thickness

AS2885.1	ASME B31.8	ISO 13362	CSA Z662
pressure design thickness using design factor of 0.72 or 0.6, with 0.8 under consideration. Wall thickness is the	mandatory design factors between 0.80 and 0.40 based on location class and construction type. Division 2 (distribution)	maximum design factor of 0.83 (0.80 really) and a location factor. mandatory design factors based on location class	design factor of 0.8 and a location factor varying between 1 and 0.5. Outcome generally similar to B31.8 except

greater of the pressure design thickness or the thickness required to meet penetration or rupture resistance or other identified loads. This prevents the use of very thin small diameter pipes, and equally removes the requirement for unnecessarily thick, large diameter pipes whose pressure design thickness is sufficient to prevent puncture.	systems limited to 0.72 maximum. However, in effect, Class 1, Division 2 (design factor 0.8) probably not used in the US because of regulation	and construction type.	that use of 0.8 design factor is common

(v) Design of station piping

design to a nominated piping standard	incorporated; design factor 0.6	incorporated: design factor 0.67	incorporated: location factor 0.625

(vi) Reliability based design

Not permitted	Under consideration	permitted	permitted (limit state design)

(vii) Fracture control

• explicit requirement for fracture control plan • explicit control of propagation and initiation	specific requirements for fracture control but no documented plan	specific requirements for fracture control but no documented plan	specific requirements for fracture control but no documented plan

(viii) Design against external interference protection

Mandatory requirement with a minimum number of physical and procedural measures by location class	silent	silent	silent

(ix) Materials covered

AS2885.1	ASME B31.8	ISO 13362	CSA Z662
Steel	Steel and distribution piping including plastics	Steel	Steel and distribution piping including plastics

(x) Hydrostatic testing

• 4 hr strength test with test factor 1.25 MAOP minimum • 24 hr leak test at 1.13 MAOP • Mandatory acceptance criteria for unaccountable pressure loss • Volume-strain controlled test mandated for tests near yield	• 1.1 MAOP strength test – 2 hr min in Class 1 locations. Higher test factors in other Location classes • Leak test to demonstrate it "does not leak" – responsible and experienced judgement	• 1.25 MAOP strength test for 1 hour, 1.20 for R1 • 8 hr leak test at 1.1	• 1.25 MAOP strength test • 4 hr leak test at 1.10

(b) AS2885.2 – 2002 Welding

The benchmarking exercise for welding concentrates on the requirements for procedure qualification because this is the key ingredient for success in the welding of pipelines. It is also the prime defence against hydrogen assisted cold cracking, which is probably the most serious problem that can occur in pipeline welding. Instead of ASME B31.8, the relevant American Standard is API 1104.

(i) The purpose of qualifying the welding procedure

AS2885.1	API 1104	ISO 13847	CSA Z662
to demonstrate that production welds made in accordance with the qualified procedure will meet specified criteria	to demonstrate that test welds meeting specified criteria can be made by the procedure	not stated	not stated

(ii) Design against hydrogen assisted cold cracking (HACC)

• explicit requirement that HACC be "designed out" • normative appendix provided • appendix gives ranges of essential	no mention	optional provisions	no mention

variables where HACC is deemed to be designed out			

(iii) Number of test welds

AS2885.1	API 1104	ISO 13847	CSA Z662
explicit: number required to cover desired range of essential variables	one test weld	one test weld	one test weld

(iv) The material used for the procedure qualification test welds

same material as used for production	material from same group: • X42 and less • X46 to X60 • X65 and greater (a test weld on X65 could qualify X80)	project specific material	for greater than X56 a tolerance of 0.05 CE is allowed

(v) The test weld configuration

full scale worst case simulation if HACC not deemed to be designed out	2 nipples welded together	• simulate field conditions • certain conditions may require full length pipes • somewhat vague	not explicit

(vi) Thickness essential variable

test weld thickness plus 10%	change of wall thickness group • t < 4.8 • 4.8 < t < 19.1 • t > 19.1	• thickness minus 25% • thickness plus 50%	• thickness plus 50% for t < 10 • thickness plus 25% for t > 10

(vii) Preheat essential variable

• test weld minus 25°C • plus 75°C	• any change	• test weld minus 0°C • plus 50°C	• test weld minus 25°C • test weld plus 25 if above 200°C

(viii) Permissible variations in factors affecting HACC without need for requalification

Allowed subject to use of WTIA Technical Note 1	not provided	not provided	not provided

(ix) Detection of HACC in procedure qualification testing

• NDE at more than 24 hrs after welding • magnetic particle testing of root	no NDE on procedure qualification test	• NDE required • time delay for X80 only	• NDE required • no time delay specified

(c) AS2885.3 Operations and Maintenance

The most relevant standard against which AS2885.3 can be benchmarked is ASME B31.8 supplemented by the US Department of Transportation Pipeline Safety Regulations Part 192. The Australian Standard is a risk based document using integrity management principles. It requires individual and collective accountability. The Standard provides principles practices and guidance as to how this should be done.

Hartford Steam Boiler has reviewed the ASME B31.8 code and compared it with other codes covering a period of 65 years. The report recommended that the code be reviewed for amongst other matters the incorporation of risk based principles. (Hartford Steam Boiler GRI 00/0076)

AS2885.3 has already done this.

(i) Risk Assessment

AS2885.3	ASME B31.8	DOT Regulation 192
Metre by metre Risk Assessment	Not mandated.	Provides some elements of a formal risk process by default

(ii) Integrity Management Plan

Required and Guidance Provided	Not required New Integrity Management Supplement	Not required

(iii) Safety and Operating Plan

▪ Required and guidance provided for contents ▪ Review and Audit timetable required	Technical information provided	▪ Required through the preparation of prescriptive documents. ▪ Has an O&M Manual

(iv) Key Elements for Operations and Maintenance

▪ Commissioning procedures ▪ Integrity management ▪ Safety and operating plan Risk Based ▪ Emergency plan ▪ System integrity ▪ Threat mitigation measures ▪ Safety and environment ▪ Condition changes ▪ Repair methods ▪ Records	Provides technical advice and support to DOT requirements	▪ Class location ▪ Visual inspection ▪ Repair requirements ▪ Corrosion Prevention ▪ Monitoring ▪ Leakage surveys ▪ Written O&M Plan ▪ Operating procedures ▪ Emergency response and damage prevention procedures

12. CONCLUSIONS

On the basis of the benchmarking comparison and other information presented in this paper, it is concluded that the AS2885 suite of Australian Standards is superior in a number of very important respects to the national and international Standards with which it was compared.

The ISO Standards are not only not used by anybody: they also lack an assured basis for ensuring the representation and contribution of all of the stakeholders in all of the countries that nominally subscribe to the process of generating them.

The US Standard does not have buy-in from the regulators within its own country, and in that sense is not a consensus national Standard. It has some unofficial status as a de facto international Standard, but because of the lack of buy-in from the US regulators is an "export" Standard, although this may not be fully realised everywhere that it is in use.

The Australian Standard is focussed on onshore transmission pipelines, and as such is more specialised than the others. It is also separated into parts. These, and a number of other factors discussed in this paper, lead to it being more up to date than its counterparts, but its coverage is not so extensive.

In particular the Australian Standard has important advantages in:

- it better reflects modern thinking and the latest research and technology transfer because there is a more agile process for revision, and because many of the same people are involved in both research and in the preparation and maintenance of the Standard;

- it is accepted by all of the stakeholders as the single and sufficient set of technical requirements governing its field of application;

- the use of an integral risk assessment and threat mitigation process in design and for the whole of the life of the pipeline in operation and maintenance;

- explicit requirements for the design, documentation, and approval of key processes such as prevention of external interference, control of fracture, and welding procedure qualification; and

- the assignment of responsibility for the key processes to suitably qualified, experienced, and trained people who take responsibility for their actions in writing.

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