A PROPOSAL

for

THE USE OF

THE NEW (2007) ASME SECTION VIII DIVISION 2 CODE

IN ALBERTA

Submitted to

BOILERS & PRESSURE VESSELS TECHNICAL COUNCIL
SAFETY CODES COUNCIL

by
The B&PV Taskforce
on the new ASME Section VIII Division 2 Code

June 8, 2007

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PART - A

EXECUTIVE SUMMARY

The Taskforce recommends that the Boilers and Pressure Vessels Technical Council consider a resolution to endorse the use, in the Province of Alberta, of the new ASME Section VIII Division 2 Code, which is expected to be published on July 1, 2007. It is further recommended that the use of the Code[1] be accepted through a province-wide Variance to be issued by the Administrator of Pressure Equipment Safety under Section 38(1)[2] of the Safety Codes Act in the near term with adoption of the Code in the Pressure Equipment Safety Regulation as soon as possible. As part of the Variance, it is recommended that conditions be placed on the use of the new Code, as detailed under the Recommendations in Part D - I of this proposal.

[1] The new ASME Boiler and Pressure Vessel Code Section VIII *"Rules for Construction of Pressure Vessels"* Division 2 *"Alternative Rules"* Code will be referred to hereafter as the "Code".

[2] Section 38(1) of the Safety Codes Act provides that *"An Administrator or a safety codes officer may issue a written variance with respect to any thing, process or activity to which this Act applies if the Administrator or officer is of the opinion that the variance provides approximately equivalent or greater safety performance with respect to persons and property as that provided for by this Act"*.

PART – B

TASKFORCE MEMBERSHIP

Name	Position / Affiliated Organization
T. Robinson – Chair	Chair, Boilers and Pressure Vessels Technical Council
L. Baker	Cessco Fabrication and Engineering Ltd.
D. Bird	BP Canada Energy
G. Chabot	Cessco Fabrication and Engineering Ltd,
T. Chalifoux	ABSA the pressure equipment safety authority
A. Hantelmann	Alberta Ministry of Municipal Affairs and Housing
L. Johnston	Dacro Industries Inc.
M. Kossowan	Dacro Industries Inc.
B. Lade	Syncrude Canada Ltd.
K. Lau	Administrator, Pressure Equipment Safety
B. McKay	Shell Canada Ltd.
B. McWhirter	ABSA the pressure equipment safety authority
S. Morrison	Colt Engineering Corporation
J. Seale	Seale Engineering Ltd.

PART - C

TERMS OF REFERENCE

The Taskforce is charged to review and recommend if and how the new Code may be used in Alberta.

Further details of the mandate and establishment of the taskforce were included in the note circulated to the Technical Council membership by the Chair following the Technical Council meeting of February 10, 2006 noting that:

> *"The Boilers and Pressure Vessels Technical Council intends to create a task force to review and propose a position for Alberta's utilization of a new edition of ASME Section VIII, Division 2 Pressure Vessel Code. The new Code is currently under the review and approval process. It is anticipated that the Code will be published late in 2006. The Code changes are significant, both in content and in philosophy.*
>
> *The task force mandate would be to review the changes to the Code and to investigate the impact on safety in Alberta. The task force would be reviewing Code content to ensure that the new structure and requirements of the Code meet or exceed Alberta's current safety requirements. The task force would also review current regulatory and administrative requirements of the province to ensure that the safety of equipment is maintained throughout its life span.*
>
> *The task force will include individuals who represent; Alberta Municipal Affairs, ABSA, owner/end users and manufacturers. Expertise is required in the areas of design/engineering, fabrication, in-service inspection and pressure vessel records.*
>
> *The task force will report to the Boilers and Pressure Vessels Technical Council. The proposal generated by the task force will be used by the Safety Codes Council and Alberta Municipal Affairs to ultimately determine Alberta's position with regard to the adoption of the new Code edition."*

PART – D

RECOMMENDATIONS and OBSERVATIONS

PART D - I: RECOMMENDATIONS

The Taskforce makes the following recommendations and believes that provided the recommendations are implemented, use of the new Code will allow for equivalent level of pressure equipment safety as is presently available in Alberta:

1. Use of the Code is to be provided for with the use of a province-wide Variance (with all the provisions [part of which are discussed and detailed hereunder] to allow for a equivalent level of safety) under the Safety Codes Act as the adoption of the Code as part of the Pressure Equipment Safety Regulation will not likely be in place in time for the use of the newly published Code which is expected, in mid-2007.

2. In general, use of Part 5[3] of the Code "Design by Analysis Requirements" to over-ride provisions under Part 4 "Design by Rule Requirements" will not be allowed[4].

3. A professional engineer who submits a pressure vessel design to the Code or subsequent design submissions, including for alterations, major repairs or change of ownership, must have a acceptable track record as a pressure vessel designer and the design submission documents must provide supporting evidence (e.g., curriculum vitae with a list of previous pressure vessel designs).

4. As part of the design registration submission, the User's Design Specification shall include a program for lifetime monitoring of the pressure vessel constructed to the Code.

5. As part of the User's Design Specification of the pressure vessel, specific limits or conditions, including cyclic and other conditions of individual components or parts of the pressure vessel shall be defined to allow proper monitoring of the pressure vessel to take place during operation of the pressure vessel.

6. A Professional Engineer who certifies the User's Design Specification on behalf of the owner shall be independent of the pressure vessel manufacturer.

[3] "Part" refers to the different parts of the Code and the annexes to the respective Parts of the Code. In this case, Part 5 refers to "Design by Analysis Requirements" and all associated annexes including Annex Part 5A to Annex Part 5F of the Code.

[4] Use of Part 5 for fatigue analysis when required in accordance with an User's Design Specification is not considered as using Part 5 to over-ride requirements of Part 4 which references Part 5 for fatigue analysis

7. Professional Engineers involved in the application of the Code in the Province of Alberta, including but not limited to the certification of User's Design Specification or Manufacturer's Design Report shall meet the requirement of Section 1(2) of the Pressure Equipment Safety Regulation[5]

8. On a change of ownership of a pressure vessel constructed to the Code, the new owner shall have a Professional Engineer verify and certify the acceptability of the original User's Design Specification as well as the condition of the pressure vessel or prepare a new User's Design Specification within the limitations of the Manufacturer's Design Report and the condition of the pressure vessel.

9. An owner of a pressure vessel constructed to the Code shall have in place a Pressure Equipment Integrity Management program accepted and registered by ABSA as provided under the Pressure Equipment Safety Regulation. The Pressure Equipment Integrity Management program shall specifically address the use of the pressure vessel and the use of any pressure vessels constructed to any other standards which utilize a design factor lower than that provided for by the ASME Section I and Section VIII Division 1 Codes. As part of the Pressure Equipment Integrity Management program,

    a. operation personnel certification and training system in place and as part of the system, a procedure in place to verify that the operators of the pressure vessel have sufficient knowledge of the User's Design Specification and the Manufacturer's Design Report of the pressure vessel;
    b. verification that the operators having a clear understanding of how cyclic service is defined and monitored
    c. documentation and reporting of incidents when operation of the vessel deviates from the User's Design Specification limits as non-conformances and continual operation of the pressure vessel shall be properly justified and may be subject to regulatory approval;
    d. provisions for accurate and continual operation monitoring and record keeping to comply with the User's Design Specification and Manufacturer's Design Report limitations which need to be clearly stated and specified in the first place;
    e. maintenance of information and documentation affecting the safe use of the pressure vessel for the life of the pressure vessel and the records shall include documentation such as the User's Design Specification, Manufacturer's Design Report, fabrication documents, operation monitoring results and other records that are required to be maintained by the vessel owner[6]; and

[5] Section 1(2) of the Pressure Equipment Safety Regulation states that a "Professional Engineer means a person who is registered as a professional engineer and authorized to practice engineering in any province or territory of Canada or in any state of the United States of America".

[6] Note: Sections 41 & 42 of the Pressure Equipment Safety Regulation require that the owner must maintain "*equipment record*" and Section 1(1)(k) of the Regulation states that *"equipment record includes design information, data reports, inspection plans, and integrity assessment, repair and alteration records"*.

f. the media and system used for record keeping must be in a form that will allow the information to be retrievable and legible and the record keeping system shall be subject to internal audit.

10. An owner of a pressure vessel built to the Code shall, in the case of change of ownership of the plant, transfer to the new owner all records as required under Section 36(3) of the Pressure Equipment Safety Regulation.

11. In the case of a pressure vessel which is built to the Code and which is sold individually, not as part of a plant, the User's Design Specification and the Design Registration will be rendered void since the pressure vessel will no longer be operated as originally intended. The design of the vessel shall have to be resubmitted for registration.

12. ABSA should be asked to conduct a seminar to provide a reasonable level of knowledge of the Code. The seminar should be compulsory for ABSA technical staff involved with the new Code as well as for all certified In-service Inspectors involved with the Code. Similar to the Pressure Equipment Safety Legislation Seminar, ABSA should also make the seminar on the Code available to other pressure equipment industry personnel.

13. As part of the pressure equipment safety program delivery, ABSA may wish to

    a. consider the development and use of a new design registration application form with pertinent information on the designer as one of the specific design submission requirements;
    b. enhance the internal record keeping system to allow the provision, as a last resort, to an owner of a pressure vessel built to the Code, records respecting the pressure vessel if and when such records are not available;
    c. ensure that audits of a pressure vessel owner's Pressure Equipment Integrity Management program take into consideration the internal audits conducted by the Owner, specifically concerning the provisions highlighted under Recommendation No. 9 above;

PART D – II: OBSERVATIONS

The following five observations should be taken into consideration by all concerned, including the Boilers and Pressure Vessels Technical Council, the pressure equipment industry and ABSA:

1. Proper use of overpressure protection.
   With the decrease in design factor, the tolerance for upsets is reduced, increasing the need to ensure that the control systems are properly managed. Alberta industry will need to ensure that all overpressure protection systems are properly

managed in operation. This is in light of the fact that Alberta has experienced a number of incidents involving blockage of the relief path of pressure relief devices. Over 1200 letters were issued in late 2005 to all process pressure equipment owners/operators in the province detailing the regulatory requirements.

2. Local thin areas (LTA's) are allowed by and provided for in the Code as they are allowed for by other Sections of the ASME Boiler and Pressure Vessel Code. All LTA's must be identified and mapped and reported on the manufacturer's data report in accordance with existing Alberta requirements. ABSA should ensure this requirement is widely known to all concerned through the issuance of a new ABSA Information Bulletin and inclusion of this information in the Pressure Equipment Safety Regulation User Guide.

3. Two significantly different fatigue analysis methodologies are provided under Part 5 of the Code but it is yet to be determined which method would be more appropriate and would provide the more accurate results. Should fatigue loading be expected, analyses should probably be carried out using both methods and the more conservative result should be accepted.

4. Notwithstanding the recommendations, the Taskforce acknowledges the provisions under the Safety Codes Act whereby the Administrator may consider pressure vessel submissions for the use of the Code (e.g., including the use of Part 5 of the Code) under exceptional and fully justified circumstances and, if found acceptable, issue a site- and situation-specific Variance for the use of the Code.

5. The Boilers and Pressure Vessels Technical Council, with the help of ABSA and all concerned, should monitor the application of the Code with a view to varying the provisions made in accordance with the above recommendations based on increased experience in the use of the Code.

PART – E

HISTORY AND DISCUSSIONS

This Part is a summary of background and briefing reports received by the Boilers and Pressure Vessels Technical Council and helps to explain the subject matter but was not part of the discussion of the taskforce

PART E – I: HISTORY

A complete rewrite of the Code was commissioned by the ASME with Pressure Vessel Research Council (PVRC) heading up the development effort. The intended result would be "*a new world-class design code taking into consideration the latest developments in materials, design, fabrication, and inspection technologies*"[7].

For all of us in the field of pressure equipment safety, any improvement in pressure equipment technology and codification of the technology into standards must be welcoming news. The new Code is an exciting, interesting and bold development, the first major one of its kind in standard development to provide rules for construction of pressure vessels since the publication of the original ASME Section VIII Division 2 in 1968.

It is important that stakeholders, particularly those with the roles and responsibilities as members of the Boilers and Pressure Vessels Technical Council, have a good understanding on the proposed Code rewrite and how and if the new Code can be utilized in this Province. To this end, from the beginning of the ASME proposed rewrite early 2000, the Technical Council has reviewed a series of reports and briefing notes relative to the development of the Code. With the new Code approaching completion, the Technical Council decided to form a taskforce to review the latest draft with a view to making recommendations as to if and how the proposed new Code may be utilized in the Province of Alberta.

Manufacture and Use of ASME Section VIII Division 2 Vessels in Alberta

It is of interest to note that about half of all ASME Section VIII Division 2 pressure vessel manufacturers in Canada are located in Alberta,[8] while it is understood that Alberta manufacturers produce the bulk of Division 2 vessels built in Canada. Furthermore, a sizeable number of pressure vessels built to Div. 2, for installation in Alberta, are being manufactured overseas.

It is estimated that for any single year in the last number of years, there have been more ASME Section VIII Division 2 vessels installed in Alberta than the combined total of all such vessels installed in the rest of Canada for five to ten years. This of course, is mainly

[7] Draft "Questionnaire Regarding Development Of A New ASME Pressure Vessel Code", pp. 1, Background. PVRC Joint Task Group on Continued Modernization of Code (TGCMC)
[8] See ASME Internet web site, http://www.asme.org

due to the heavy use of such vessels in the petrochemical, refinery, and gas processing industries.

With the heavy use of ASME Section VIII Division 2 vessels in Alberta, it can be concluded that the new Code will have more significant implications to Alberta than any other jurisdictions in Canada.

PART E – II: DISCUSSION

ASME Code and Design Factors

The ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, provides "Rules for Construction of Pressure Vessels". This Code traditionally allowed for a maximum allowable design stress using a design factor of 5.0 on tensile strength and this factor was lowered in the nineteen fifties to 4.0.

In 1998, Code Cases were established to use a design factor of 3.5. The 3.5 design factor was incorporated as part of the ASME Code Section I and Section VIII, Division 1, in the 1999 addenda to the Code. The use of both the Code Cases and the 1999 addenda of the Code were extensively reviewed by the Technical Council.

ASME Section VIII, Division 2, was first published in 1968 to provide for alternative rules for construction of pressure vessels. The development of this Code was in part due to increased use of pressure vessels in high-pressure applications, particularly in petrochemical and refinery applications. Under the current ASME Section VIII Division 2 Code, with additional and more stringent design, construction, inspection, operation and other requirements, a design factor of 3.0 is used. There are a number of significant differences between the two ASME Code Divisions[9].

In both Divisions 1 and 2, a factor of 1.5 is also used on the specified yield strength of the material to determine the maximum allowable design stresses. In most cases, tensile strength instead of yield strength would be the controlling factor for room and moderate operation temperature range. At high temperature, typically, the yield strength of the material or for even higher temperature, the creep characteristic, will be the governing factors.

When the tensile strength is the governing factor, using SA516-70 (which has a minimum specified tensile strength of 70,000 psi) as an example, the maximum allowable design stress under Section VIII, Division 1, would be 20,000 psi (17,500 psi previous to the 1999 addenda or the Code Cases) and 23,300 psi under Section VIII, Division 2. At elevated temperatures when yield strength may be the controlling factor, the maximum allowable design stresses for the two Code Divisions will then be the same.

[9] "A Brief Discussion on ASME Section VIII Divisions 1 and 2 and the New Division 3" by K. Lau, a paper presented at 3rd Pressure Industry Conference, Banff, Alberta, Canada, 1999 (see http://www.absa.ca/faq/SectionVIIIcomparison.pdf)

With the change of the design factor in ASME Section VIII, Division 1, to 3.5, the differences between the maximum allowable design stresses of the two Code Divisions became smaller. It had long been speculated that the design factor of ASME Section VIII, Division 2, would move lower following the change in Section VIII, Division 1.

It should be noted that overseas standards use a variety of design factors, or at times, a range of design factors in the same standard, depending on the class of material and pressure vessel design. As an example, in the case of British Standards Institution PD5500-2000 (previously BS-5500) for "Specification for Unfired Fusion Welded Pressure Vessels", the design factors based on tensile strength range from 2.35 to 2.5 for different material bands. In the case of the China National Standard GB150-89 for "steel pressure vessels", a factor of 3.0 or higher is used.

There are also some overseas national standards that establish the maximum allowable design stresses based on yield strength only. In some of those cases, although the maximum allowable design stresses may, at times, be higher at room and moderate operation temperature conditions, there are significant additional material testing and third party involvement during material manufacturing and other considerations to ensure a reasonable level of safety is maintained. Overseas standards referred to above are essentially national standards and are not as widely used as the ASME Boiler and Pressure Vessel Code, nor are they adopted or accepted for application in Alberta.

Pressure Equipment Safety and Design Factors

There are many factors affecting pressure equipment safety. These include but are not limited to: owners' design specifications; designers' competency and thoroughness; design assumptions and details; integrity and quality systems of material manufacturers/suppliers and the actual properties of materials supplied; fabrication processes and procedures; welders' competency and welding consumables; quality of testing and examination; manufacturers' compliance to design specifications; operators' training and competency; plant operation procedure, change management and quality program; plant maintenance and integrity management; a plant's physical environment; relevant legislation and a host of other considerations.

Design Factor and the Proposed new Code

Three classes of vessels were originally proposed with *"Class 3"* pressure vessels having a "*relatively large design margin"* of 3.0 on tensile strength the same as what is in existence in Section VIII, Division 2, today and the lowest design margin of 1.875 for *"Class 1"* vessels and an intermediate factor of 2.4 for "*Class 2*" vessels. The only pressure vessel standards we know of that have a design factor below 2.35 are typically for transportation or handling (portable) purposes, generally requiring design testing as well as periodic testing and recertification that is considerably more onerous than is required for vessels built for stationary applications. When the factor of 1.875 was first introduced, there were considerable objections and the proposal was dropped. Finally, a single design factor of 2.4 has been adopted.

However, this actual design factor may actually be slightly lower than 2.4 because the factor is on minimum tensile strength at room temperature rather than at design temperature as in existing ASME Code rules. Although the difference may seem insignificant, this is a significant departure from existing philosophy and serves to further lower the design factor (or increase the allowable design stress). It should be noted that the traditional design factor of 2/3 on yield at design temperature would remain.

As a simple comparison, the maximum allowable design stress at room temperature for the same SA516-70 material under the new Code, will now be 25,300 psi (instead of 29,200 psi since the material's specified minimum yield stress of 38,000 psi governs) versus 20,000 psig (or 17,500 psi previous to the 1999 addenda or the Code Cases) under Section VIII, Division 1, and 23,300 psi under the existing Section VIII, Division 2. The increase in the maximum allowable design stress will be more significant for materials with high minimum specified yield stresses (e.g., SA517 Grade A would have the allowable maximum design stresses of 47,900 psi, 38,300 psi, 32, 800 psi and 28,750 psi respectively at room temperature under the new Code, the existing Section VIII, Division 2, the existing Section VIII, Division 1, and Section VIII, Division 1, prior to 1999, respectively).

Design by Rule and Design by Analysis

Another significant departure from existing Code philosophy is the ability for users of the proposed new Code to override Code rule requirements through design by analysis.

As noted in the ASME Section VIII, Division 1, the Code "*contains mandatory requirements, specific prohibitions, and non-mandatory guidance for construction activities. The Code does not address all aspects of these activities and those aspects which are not specifically addressed should not be considered prohibited*." In the case "*where complete details are not given, it is intended that the Manufacturer, subject to the acceptance of the Inspector, shall provide details of design and construction which will be as safe as those provided by the rules*" of the Code. But it is also stressed in the "Foreword" of all Code Sections that "*Engineering judgments must be consistent with Code philosophy and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code*". To conclude, the Code philosophy is such that requirements and details under the design rules provided in the Code cannot and must not be overruled by engineering judgments and analyses.

For the proposed new Code, it will continue to state that "*Engineering judgment must be consistent with the philosophy of this Division, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of this Division*". After saying so, provisions are made so that design analyses may be carried out to overrule mandatory requirements through the use of Code rules.

Part 5 "*Design by Analysis*" is provided specifically as an alternative to Part 4 "Design by Rule" in the proposed new Code. Thus, it is now possible to use engineering analysis to overrule requirements established as rules under "Design by Rule". As an example,

under Paragraph 4.1.5.1 for **"***Design Thickness*" under Part 4 "Design by Rule", provision is made that "*In lieu of the design by rule methods, the design thickness of the vessel part may be determined using the design-by-analysis methods of Part 5*".

Importance of Documentation and Record Keeping

With the design factor of 3.0 and the fact that these vessels are designed for specific applications, the existing Section VIII, Division 2, requires that the user prepare a "User's Design Specification" detailing the intended operating conditions and other requirements and the document must be duly certified by a Professional Engineer who is "experienced in pressure vessel design"[10]. Similarly, it is the Manufacturer's responsibility in such cases to verify that the construction of the vessel is in full compliance with the Code, taking into consideration all elements of the user's design specification. The Manufacturer, on completing the vessel, produces a "Manufacturer's Design Report" which must also be certified by a Professional Engineer experienced in pressure vessel design.

As seen above, the existing Code makes provision for a detailed and certified User's Design Specification and a Manufacturer's Design Report for each and every Section VIII, Division 2, vessel. Logically, one would assume that the user responsible for a Section VIII, Division 2, vessel would keep track of all the design and construction specifications as well as the operating conditions and history during the useful life of the vessel to ensure that the design and operating limitations of the vessel will not be exceeded. However, our experience in the province shows that this is not always the case, particularly in relation to fatigue life and operating temperature monitoring. Quite often, even when proper records are kept, the User's Design Specification and Manufacturer's Design Reports are not available in the field nor are they known to or understood by the plant personnel or field operators. The situation gets worse when ownership changes. In many cases operating history many other records are not being transferred or are simply lost.

For stationary vessels (which are under the jurisdiction of the Safety Codes Act), the proposed new Code provides under Paragraph 1.2.1.2(a) of Part 1 states that the new Code may be used to construct "*vessels to be installed at a fixed (stationary) location for a specific service where operation and maintenance control is retained during the useful life of the vessel by the user who prepares, or causes to be prepared, the User's Design Specification required by Part 2*". Similarly, the manufacturer must also prepare a "Manufacturer's Design Report". Because of the lowered design factor and the possibility that a vessel may be designed by analysis instead of by rule, these documents will have even more significance than for vessels built to the existing Section VIII, Division 2 Code.

[10] See Section VIII Division 2 Paragraph AG-301 "Certification of User's Design Specification"

Organization of the New Code

The new Code is organized completely differently from the existing Section VIII, Division 2. Requirements of the Code are divided into nine "Parts" and for each part, there will be "Normative" (mandatory) and "Informative" (non-mandatory) Annexes. The parts are:

- Part 1 General Requirements, provides the scope of this division and establishes the jurisdiction in terms of extent of coverage
- Part 2 Responsibilities and Duties, sets forth the responsibilities of the User and Manufacturer, and the duties of the Inspector
- Part 3 Materials Requirements, provides the permissible material of construction, applicable material specification and special requirements, physical properties, allowable stresses, and design fatigue curves
- Part 4 Design By Rule Requirements, provides requirements for design of vessels and components using rules
- Part 5 Design By Analysis Requirements, provides requirements for design of vessels and components using stress analysis
- Part 6 Fabrication Requirements, provides requirements governing the fabrication of vessels and parts
- Part 7 Examination and Inspection Requirements, provides requirements governing the examination of vessels and parts
- Part 8 Pressure Testing Requirements, contains pressure testing requirements
- Part 9 Pressure Vessel Overpressure Protection, contains rules for pressure relief devices

Use of the ASME Code as Handbook or Cookbook

Irrespective of the design factors used, the ASME Code Committee would endeavor to make the necessary provisions to allow for good engineering so that pressure equipment safety will not be jeopardized when all the Code rules are being followed. However, Code rules cannot be provided for all operation situations and as noted in the Forward of all ASME Code Sections, *"The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment".*

Although the intent is clearly stated in the ASME Code, historically the ASME Code has been written in a fashion that, when followed closely, a designer need not be highly trained technically to design a pressure vessel to the Code. This is still generally true today resulting in a number of designers' using the Code very much as a cookbook, more so than a handbook, without knowing fully the limitations and the basis of the Code equations and philosophy. Also, quite often, the minimum requirements stated in the Code are considered as the maximums one has to comply with. Obviously, design errors would be the common result when a designer uses this approach in designing pressure vessels. While this is not the case throughout the pressure equipment industry, neither is this an isolated problem, as evidenced by the number of design errors found by ABSA's Design Survey engineers through the design registration process.

Design Review and Designers' Responsibilities

ABSA continues to provide an admirable third-party design survey (review) function as part of the pressure equipment safety program delegated to it by the Alberta Government. Design reviews carried out in the province consistently indicate that a very significant portion (around 30%) of design submissions do not comply fully with all Code and regulation requirements.

Unlike overseas standards, the ASME Code generally does not require a separate declaration of design compliance in the data report. The requirement for a certified user's design specification and a certified manufacturer's design report should help in some respect. It is believed that full Code compliance must be met, if a lower design factor is to be used, in order to achieve a reasonable level of safety.

With the use of the new Code, it is important that ABSA, in addition to providing the third-party design survey function, must verify that the User's Design Specification and the Manufacturer's Design Report have been properly certified by professional engineers with a credible track record as pressure vessel designers.

Life Span of a Pressure Vessel

The ASME Boiler and Pressure Vessel Code is a code for new construction of boilers and pressure vessels. In-service operation is outside the scope of the Code, although it is only logical that in-service conditions would have to be considered during the design stage. With the relatively conservative design factors used in the past, equipment built to the Code is expected to provide a fairly long safe in-service period. While there is no defined life span for a pressure vessel, it is generally accepted that twenty-five years is a reasonable design limit. However, there are a large number of pressure vessels that are in service in the province that have been operated for considerably longer than twenty-five years. We do have pressure equipment built at the beginning of the last century operating in our province at the present time. With the lower design factor and with fatigue being a major consideration because of the higher stress levels, the useful lifetime of a pressure vessel will be one of the issues that needs to be addressed for safe operation of pressure vessels built to the new Code.

In-Service Operating Conditions

It is well known that plants may not necessarily be operating currently as they were originally designed to do. During the Banff Conference on pressure equipment held February 2-4, 2006, one of the speakers addressing the topic of Risk Based Inspection in the Next Decade, stated that "*Plants typically conduct Management of Change (MOC) reviews when process changes are made intentionally*". But "*Often changes are made inadvertently*". He also noted that "*(a) Most refining, mid-stream, and chemicals pressurized equipment was designed and built for an operating basis that changed long ago, (b) Most plants continuously "tweak" the process to raise throughput or process poorer quality (lower cost) feedstocks (crudes or intermediates) and (c) Over many years,*

the effect of this process creep is cumulative. An additional minor change can lead to a much greater rate of damage than previously experienced". The speaker was one of those involved in the writing of the API-579 "Fitness for Service" Standard.

The ASME Code calls for the designer to ensure that the intended operating conditions are provided for in the design[11] and generally the most severe condition of coincident pressure and temperature expected in normal operation[12] are to be provided for. However, in practice it is possible that there may be conditions during operation that a designer has not made provisions for. Furthermore, there are situations where design conditions are not necessarily made known to or observed by the operators in the field. This is particularly the case when considering the minimum-mean-metal-temperatures or the maximum allowable number of pressure or temperature cycles.

With the proposed new Code and a lowering of the design factor, to ensure the same level of safety, one would assume that there must be a better effort to ensure that the equipment will be operated within the design limits and the stated life span. In that case, we may have to introduce specific requirements for the users operating pressure vessels built to the new Code. These may include more rigorous record keeping of operation conditions, due diligence exercised to ensure proper monitoring that all design conditions are not violated, training of field operators to ensure that they are fully aware and knowledgeable of the design conditions, reporting procedures and, re-evaluation of the vessels when design conditions are exceeded, …etc.

[11] Paragraph AG-301, pp. 15, ASME Section VIII Division 2, 1999 Edition published by ASME International.
[12] Paragraph UG-21, pp. 20, ASME Section VIII Division 1, 1999 Edition published by ASME International.

PART – F
ACKNOWLEDGEMENTS

The taskforce wishes to acknowledge ABSA for providing its meeting room facility and other amenities during a series of seven meetings the taskforce held since mid 2006. The taskforce also acknowledges the use of reports and briefings prepared by Dr. K. Lau previously submitted to the Boilers and Pressure Vessels Technical Council in the preparation of Part E of this report.