ABSA
the pressure equipment safety authority

THE PRESSURE NEWS

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CAUTION

Previous issues of The Pressure News may contain information which is outdated or no longer valid. Please be cautious when using information from old articles.

WINTER IS COMING … AGAIN!

In the last year and a half, a total of 58 incidents have been reported to ABSA in which pressure equipment was damaged due to freezing. When water freezes into ice, it takes on a crystal structure which forces its molecules into a configuration where they are further apart on average than when they can move freely around in liquid form. The geometry of ice is fixed, and when there is no room to expand, the increase in volume as ice forms can exert extreme forces to the surrounding container as it is forced to take on the new geometry. The result in some cases can be an outright breach of its container, but in other cases, the container can remain intact while the forced expansion causes yielding of the material, stretching it and thinning out its walls, causing microscopic cracking, and inducing work hardening of the material which makes it more susceptible to brittle failure at low temperatures. In cases where the container is not immediately breached, repeated freezing incidents will typically lead to outright failure; in the mean time, the intact but damaged component presents an extreme hazard if it is subjected to operating conditions. Although freezing incidents are more common when winter temperatures dip to record lows, even more moderate temperatures can cause damage: all that is required is that water is exposed to temperatures just below its freezing point of 0°C for sufficient periods of time without an adequate source of heat.

Pressure equipment is generally protected from winter temperatures by means of prevention, rather than by being designed to withstand the low temperatures. Experience has shown that many incidents of freezing damage occur when heat tracing systems are relied upon to keep equipment at a temperature that will not allow water to freeze, but are not activated due to improper location of the heat sensing elements that operate them. Other common causes include deteriorated or inadequately specified thermal insulation, the inclusion of ‘dead leg’ sections in piping system layouts where water is allowed to accumulate unexpectedly, or isolation valves that are either damaged and not replaced or which are improperly closed and allow to leak fluids.

The safety risks associated with low temperature exposure are not limited only to the freezing event itself. In some cases, hazards occur during the thawing process, or when the equipment is placed into service and pressurized after the damage has occurred. In the case of ice unexpectedly forming in a “dead leg” section of piping, the blockage could cause an unexpected accumulation of pressure beyond what the equipment is designed for, which could lead to equipment failure. If a piping section is blocked with ice that is suddenly dislodged, the ice could be fired internally as a projectile, causing damage to internal surfaces, or causing an impact that could facilitate a brittle failure.

If equipment is suspected to have been affected by a freezing incident, it needs to be taken out of service immediately and subjected to a thorough inspection and integrity assessment in order to ensure that it is safe to operate. A proper inspection in such circumstances requires unique competencies, procedures, and equipment, as the resulting damage tends not to be uniformly distributed, and may not be easy to observe. Once identified, components damaged by freezing typically need to be replaced, rather than being repaired. Although ABSA is in a place to provide effective guidance while administering Alberta’s pressure equipment safety programs, Alberta legislation places the primary onus on the equipment owner to ensure that equipment is designed and operated safely and properly maintained, and it is imperative for owners to take the lead and to be proactive in ensuring that their equipment is suitably winterized and able to withstand expected cold-weather conditions. ❖

Guideline Published: Design Registration of Boilers

Boilers, particularly those found in power plants, can be large enough to fill an entire building and in such cases are often comprised of a number of modular components that are built by separate manufacturers and assembled into a complete boiler unit on site. One problem that has been seen a number of times over the years is that in cases where boilers are divided into parts built by separate code manufacturers, plans have not always been made to determine which manufacturer will take ultimate responsibility for the design of the boiler as a whole, in order to ensure that all component parts are designed to work together as a complete system.

The Pressure Equipment Safety Regulation requires that designs of power boilers intended for use in Alberta be registered by ABSA and issued a CRN ("Canadian Registration Number"). Power boilers are usually built to meet ASME Section I, which has provisions for boiler components to be manufactured separately as 'parts' by separate qualified organizations. However, ASME Section I requires that one qualified organization take responsibility for the boiler as a whole, and issue a Manufacturer's Data Report to document its construction, whereas the organizations that manufacture individual components issue Manufacturer's Partial Data Reports within their own scopes of work, and does not ascribe responsibility to them for the design of the complete unit.

The requirement for design registration given in the Pressure Equipment Safety Regulation is for a "boiler", implying that the required registration is for a whole boiler as a complete unit. Although it is a common and acceptable practice for individual part manufacturers to obtain registration of their own parts, a design surveyor in the end needs to consider the design of the complete boiler as a single system, in order to ensure that the parts are suitably designed for the service conditions and that the boiler will operate safely as a whole unit. Some boiler owners in the past have encountered significant delays when the construction of boiler parts has been subcontracted to separate qualified manufacturers, with no provision for obtaining design registration of the boiler as a whole, and no determination of which qualified manufacturer would take ultimate responsibility for construction of the boiler.

A more complete discussion of this issue has been posted to ABSA's website in the form of a guideline, entitled 'Guideline for Design Registration of Complete Boiler Unit'. It can be found by navigating to www.absa.ca, and selecting 'Design Registration', followed by 'Helpful Guidelines and Information'. ❖

Upcoming New Edition of AB-525: Overpressure Protection

Despite the provisions of adopted codes and standards, Alberta legislation requires that pressure equipment be protected from overpressure by means of a pressure relief valve meeting the requirements of the ASME code, or by other means acceptable to the Administrator. Prior to the initial publication of AB-525: Overpressure Protection Requirements for Pressure Vessels and Pressure Piping in 2013, Alberta owners intending to establish overpressure protection of their equipment by means other than a relief valve had to rely on case-by-case acceptance by Design Survey when a submission was made for registration of their piping system design. Although many such owners knew to engage in preliminary consultation with ABSA at earlier stages of their projects to ensure that their overpressure protection philosophies were adequate, frustration and misunderstandings were common in cases where these initial steps were not taken.

The first edition of AB-525 was published in 2013 after significant engagement with an industry focus group tasked with determining a reasonable set of basic requirements for common overpressure protection cases in typical applications. The group was made up of representatives of ABSA and other Canadian provincial jurisdictional organizations, Alberta pressure equipment owners, and industry experts. Since its publication, AB-525 has given owners a reliable source of initial guidance in designing their overpressure protection systems, while still leaving them the option to consult ABSA's Design Survey department in cases where their systems were more complex and not covered by the document's basic provisions.

In 2018, five years after its initial publication, a slightly modified group was reconvened to work on improvements to the document. The process started with obtaining feedback on the original edition – although some of the items that were brought forward were based on misunderstandings of code philosophies or the intent of legislation, other items covered new topics or otherwise required further investigation. After an in-person meeting and several rounds of correspondence, the outstanding items were resolved, and the direction for the revised document could be finalized.

The end result is a document that has been completely rewritten and restructured. This second edition will be based largely on the same principles as the original, but key differences will include new clarifications with respect to overpressure risk assessments, specific provisions for mixing of overpressure protection methods, and simplified provisions for pressure equipment that is protected by means of being "adequately vented" to the atmosphere through properly sized drain and vent lines.

Although a release date has not yet been set for the new document, publication is expected in the coming weeks. This year's Alberta Code Update Seminar, detailed elsewhere in this issue, will include a presentation outlining some of the changes expected in the new edition. ❖

New Designer Qualification Requirements in ASME Section VIII-1

The recently published 2021 edition of ASME Section VIII-1 includes a number of changes related to required qualifications for personnel undertaking design activities that vessel manufacturers will need to address in their quality management systems prior to it becoming mandatory on January 1, 2022. Some of the more important changes are listed below.

Paragraph U-2: 'General'

When specific supplementary (non-pressure) loadings are expected on the vessel by the end user, paragraph U-2 will now mandate that the user provide a 'Users Design Requirements Form' to specify those loads to the manufacturer, such as forms U-DR-1 and U-DR-2 provided in Nonmandatory Appendix KK, 'Guide for Preparing User's Design Requirements'. Although design falls within the scope of the manufacturer's responsibility, the onus is on the end user to understand their own use case and to communicate these required design loads to the manufacturer. This new requirement can be found in subparagraph U-2(a)(2)(-a) of the new code edition. An additional new subparagraph, U-2(b)(3), will also now require the manufacturer to ensure that personnel performing design activities are qualified in accordance with new requirements introduced in Mandatory Appendix 47, discussed below.

Mandatory Appendix 10: 'Quality Control System'

In Mandatory Appendix 10, paragraph 10-5, 'Drawings, Design Calculations, and Specification Control' now includes an additional subparagraph (c) which specifically requires manufacturers to verify computer software used for preparing code calculations or for conducting design analyses to meet code requirements. The code now requires manufacturers to ensure that generated code calculations produce correct solutions, and to verify that the mathematical models used for approaches such as finite element analysis produce behaviors that reflect to the systems being modeled, and which can be used to accurately relate to the physical problems being solved. There are also specific requirements established that procedures used for these verification be described in the manufacturer's quality control system.

New subparagraph (d) of paragraph 10-5 also requires that the manufacturer's quality control system describe the qualification requirements that are established for design personnel, along with the manufacturer's means of documenting those qualifications.

Mandatory Appendix 47: 'Requirements for Pressure Vessel Designers'

This new appendix establishes a specific requirement that manufacturers place a qualified individual in "responsible charge" of the design of each pressure vessel, and then establishes requirements with respect to qualifications of various types of individuals that can be placed in responsible charge, permitted scopes of practice, and other such related requirements. The basic requirement is established immediately by subparagraph 47-1(a): "A designer, engineer, or Certifying Engineer … designated by the Manufacturer, shall be in responsible charge of the design of a pressure vessel that is certified by that Manufacturer." These new requirements for qualification are closely related to similar requirements that were introduced in the 2019 edition of ASME Section VIII-2, and in fact Appendix 47 provides in subparagraph 47-2(d) that manufacturers can choose to follow the requirements of Section VIII-2 in lieu of the requirements introduced by Appendix 47.

In August, ABSA held a free information session to discuss these new requirements in more detail than they will be discussed at the upcoming Alberta Code Update Seminar. This session was recorded, and the recording is expected to be made available for review in the coming weeks. If you missed the session, you can access it when it is posted by creating an online learning account on ABSA's learning management system at lms.absa.ca, and signing up for 'ASME Section VIII-1 Appendix 47 Information Session'. If you would like to be better informed about these types of events in the future, please consider signing up for ABSA's 'Seminar News' email distribution list at https://www.absa.ca/subscriptions/. ❖

COVID-19 Update: Offices Remain Closed

At the beginning of July, vaccination uptake by the Alberta public was encouraging, and Alberta's general lifting of public health restrictions related to the COVID-19 pandemic was initially met with cautious optimism. One thing that has been a clear lesson since the beginning of the pandemic is to expect the unexpected, and that plans often need to be adapted to changing circumstances.

Although ABSA had previously considered a plan to largely return to "business as usual" come early September, the increasing rate of COVID-19 cases and related hospitalizations in the province necessitated the reestablishment of mandatory public health restrictions, and ABSA will be continuing with its current precautions and the associated reduction of in-person services at its office locations.

ABSA offices will remain closed to the public for walk-in traffic until early 2022, with staff continuing to work from home except as necessary for operational effectiveness. In-person examinations in Edmonton and Calgary will continue at reduced capacity, while seminars will be split between in-person and remote delivery, depending on the nature of the content; mandatory masking and physical distancing and other safety precautions will remain in place for in-person activities. ABSA is looking forward to increasing seminar and examination capacities and to reopening its offices to walk-in traffic once conditions have improved. ❖

History of Cold-Stretched Vessel Technology in Alberta

When certain ductile materials are deformed due to the application of stress, they experience a phenomenon known as strain-hardening, in which they tend to exhibit increased hardness and strength in the direction of deformation. This increased strength in the direction of the deforming load then makes them better-suited to handling similar loading configurations. When this occurs in materials like carbon steels, any advantage obtained from the increased strength is typically offset by a reduction in ductility that increases the material's susceptibility to brittle fracture; austenitic stainless steels, however, are less susceptible to strain-induced embrittlement, and such items can be designed to be loaded intentionally in order to take advantage of the increased material strength, reducing the thickness and weight required by parts that are needed to withstand a fixed load. In the case of pressure equipment, this has been applied to vessels made of austenitic stainless steels, which are subjected a hydrostatic pressure at ambient temperature in a range sufficient to induce a permanent plastic deformation and to improve the material's resistance to future pressure loads – a process known as cold stretching.

Experimentation with the use of cold-stretching technology for pressure vessel manufacture began when a company in Sweden by the name of Avesta Jerverks Aktiebolag (or simply, 'Avesta') began to investigate its use. They were awarded a patent by the end of the 1950's, and in the decades that followed, manufacturers and regulators around the world began to analyze the associated risks and to adopt rules in their adopted construction codes to allow for the use of cold-stretching fabrication methods. As interest and demand increased, the American Society of Mechanical Engineers (ASME) eventually undertook their own research, and determined that under certain conditions, such a stretching operation performed on austenitic stainless steels could reliably increase their strength, resulting in reduced material thickness requirements for comparable design conditions – with the high price of stainless steel, even a relatively small reduction in required thickness could present significant cost savings to vessel manufacturers and thus to owners, who often specified the use of stainless steel for its excellent corrosion resistance or for its ability to maintain high ductility in cryogenic conditions.

ASME first issued Code Case 2596 in 2008, which established provisions for cold-stretched austenitic stainless steel construction within the scope of Section VIII-1 of the ASME Boiler and Pressure Vessel Code. Despite that a code case facilitating its use had been published, experienced pressure equipment designers knew to recognize that code cases and interpretations are published separately and are not considered to be a part of the codes that are named in and adopted by provincial pressure equipment legislation. In the case of Alberta, owners and manufacturers interested in taking advantage of cold-stretching technology in the construction of vessels destined for the province engaged in a thorough review of the technology and of the new code case provisions with ABSA, in order to determine whether it could be safely accepted for pressure equipment constructed for use in Alberta.

The ensuing research and investigation led to the derivation of additional guidelines and requirements that could help ensure the safe use of the technology, and these were first published in Information Bulletin IB13-008, and then shortly thereafter in Information Bulletin IB13-016 when ASME Section VIII-1 incorporated the code case as Mandatory Appendix 44. With a focus on assuring the safety of equipment accepted for use in Alberta, Information Bulletin IB13-016 introduced both administrative requirements and technical requirements to manufacturers and owners taking advantage of the technology. It required users to make specific plans to operate and maintain cold-stretched vessels safely throughout their entire lifespan, particularly by requiring that plans for repairs and alterations of such vessels be incorporated into their quality control programs. It also required that such designs be registered with an Alberta Limited Design (or 'ALD') registration number in lieu of a regular CRN in order to draw special attention to them by owners and inspectors at the time of initial purchase, when they are sold or otherwise transferred between owners, or when they are subjected to repairs or alterations. It also limited the scope of cold-stretch fabrication to equipment intended for cryogenic applications, involving fluids that are understood to not have deleterious effects on austenitic stainless steels. The technical requirements of Section VIII-1 Appendix 44 were also modified, addressing some objections that were raised during the review of the available literature, with the intent of ensuring that the equipment to Appendix 44 would have a level of safety equivalent to a vessel constructed to the basic provisions of the ASME code.

Eventually, the CSA B51 Technical Committee undertook their own investigation of Appendix 44 and of the additional stipulations and requirements of ABSA's information bulletin, and then incorporated many of its requirements as new Annex K of the 2019 edition of the CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code. Incorporation of these requirements into Canada's national pressure equipment standard established a new level of harmonization between Canadian jurisdictions.

There is more to the story of the adoption of cold-stretched technology for use in Alberta – a paper providing a more complete account of the history is available on ABSA's website: Discussion on the Use of Cold Stretched Austenitic Stainless Steel Pressure Vessels in Alberta. Although ABSA's primary focus is on pressure equipment safety, ABSA has industry's interests in mind with respect to the adoption and incorporation of new technologies, and takes pride in responding promptly to its stakeholders' feedback and suggestions. The development of requirements for cold-stretched austenitic stainless steel vessels is only one of several areas in which ABSA has been proactive in ensuring the safe adoption of a new technology: similar initiatives have included the publication of AB-520, which introduced reporting requirements for finite element analyses and which was also eventually incorporated as an annex in CSA B51; the publication of AB-536, which established provisions for the continued use of "grade 91" creep-strength-enhanced ferritic steels at higher allowable stresses than currently allowed; and the more recent publication of AB-539, permitting certain types of alterations to pressure equipment to be performed using composite materials in lieu of requiring traditional welded repairs.

ABSA encourages engagement by industry, and always welcomes comments, questions, and other types of inquiries. In the case where ABSA stakeholders have regular contact with ABSA's Design Survey or Inspection departments, such inquiries can often be directed through current contacts. Technical questions and other types of initiatives that are not related to a specific project or which are otherwise of a more general nature can be directed to the Technical Advisory Group by emailing tag@absa.ca. ❖

Online Alberta Code Update Seminar

A number of codes and standards that have been adopted for use in Alberta have had new editions published so far this calendar year. In May, a new edition of the ASME B31.3 Pressure Piping Code was published, and was followed soon after by the early-July publication of the 2021 edition of the ASME Boiler and Pressure Vessel Code. This year's changes to the ASME Code cover a number of topics that designers, manufacturers, and end users need to be aware of. The new ASME Code also introduces ASME Section XIII, a reorganization and consolidation of overpressure protection requirements that were previously distributed throughout the other code sections. When new editions of codes and standards adopted by the Pressure Equipment Safety Regulation are revised, Alberta legislation provides that those newly revised editions generally become mandatory approximately one year after they are published, even if the regulation is not revised to reflect the new edition.

Each year, ABSA puts on the Alberta Code Update Seminar to inform Alberta manufacturers, owners, and related stakeholders about the most important changes that have occurred to adopted codes and standards. This year, the seminar will be delivered remotely via Microsoft Teams, on October 7. The full-day seminar starts at 8:00 AM, Mountain Daylight Time, and will include presentations to discuss changes to ASME Section VIII Divisions 1 and 2 pertaining to pressure vessels, ASME Sections I and IV pertaining to boilers, the ASME B31.3 Process Piping Code, and a brief overview of the new ASME Section XIII. Additional presentations will include a discussion of the recently published AB-539 document pertaining to alterations making use of composite wraps, the upcoming edition of AB-525 pertaining to overpressure requirements, and 'What's on the Horizon', discussing changes that are expected in the coming years in the pressure equipment industry.

This year's seminar is being provided free of charge, but space is limited, and more than two thirds of the 280 available spots have already been accounted for. The seminar will be recorded and will be made available afterwards for review by participants and by those unable to attend.

ABSA seminars are generally announced using the 'Seminars' email distribution list. If this is the first time you've heard of this year's seminar, you may want to consider signing up for 'Seminar News' under the 'Subscriptions' heading of our website, at www.absa.ca.

Online registration for the Alberta Code Update Seminar and other ABSA seminars is available at seminars.absa.ca. ❖

Documents Issued by ABSA

The following documents issued by ABSA are linked below, and available on our website at www.absa.ca.

2021-07-20 – *IB21-005: Leak Testing Components ASME B31.3*, was issued to provide guidance with respect to leak test requirements for piping system components that are not included in an initial system pressure test.

2021-08-03 – *IB21-006: Documents Issued by Alberta Municipal Affairs Governing Equipment Under Jurisdiction of the Gas Safety Discipline and the Pressure Equipment Safety Discipline* was issued to provide links to updated and new 'STANDATA' bulletins issued by Alberta Municipal Affairs with respect to pressure equipment that is subject to other related Safety Codes Act disciplines.

Other documents have been updated with editorial and other minor changes. ❖

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