WINTER 2017

BULLETIN

TECHNICAL JOURNAL OF THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

The National Board Inspection Code

2017 Edition

Introducing Part 4, Pressure Relief Devices

THE NATIONAL BOARD

COMING IN
JULY

A COMPLETELY UPDATED 2017 EDITION

OF THE *NATIONAL BOARD INSPECTION CODE* (NBIC), INCLUDING A NEW PART 4: *PRESSURE RELIEF DEVICES* – AN INTEGRATED STANDARD FOR THE INSTALLATION, INSPECTION, AND REPAIR OF PRESSURE RELIEF DEVICES.

BULLETIN
TECHNICAL JOURNAL OF THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

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On the Cover: The release of the 2017 Edition of the NBIC in July will include the new Part 4, *Pressure Relief Devices.*

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SAFETY: If Not Now, When?

BY DAVID A. DOUIN, EXECUTIVE DIRECTOR

Danger knows no constraint. That's why accidents can never be predicted.

Or can they? Inspections of equipment often reveal that a disaster is waiting to happen. Ignoring or putting off such warnings is to gamble that the problem may not be imminent. And we all know how that often works out. Or doesn't.

Figuratively speaking, adding safety to one's "bucket list" is foolish and inconsistent with professional best practices. Safety should never be a goal of the future. It is here. And it is now.

That is why we have chosen ***SAFETY: If Not Now, When?*** as the theme for the 86th National Board / ASME General Meeting, May 8 – 12, in Anchorage, Alaska.

For those who have wished for an occasion to visit Alaska, now is the time. In addition to a scenic location, this year's General Meeting will feature a generous helping of Alaskan hospitality and culture. And exciting programs.

Former lead solo pilot of the world-renowned Blue Angels and one of the country's most dynamic motivational speakers, John Foley (see page 18), will launch our Monday Opening Session with his unique perspectives on high trust and leadership. The afternoon General Session (see page 19) will complement the morning program with another lineup of quality industry speakers that will include: Michael Pischke of GE Power Services; Jon Wolf of The Zurich Services Corporation; Michael Gerhart of Miura America Co., Ltd; Minnesota Chief Boiler Inspector Joel Amato; Vincent Scarcella of CNA Risk Control; and California Principal Safety Engineer Donald Cook.

Our Monday afternoon guest program (page 20) will feature a visit with world-famous four-time Iditarod Dog Sled Race champion Martin Buser. Guests will get an up-close look at the race, the equipment, the man, and his dogs. This rare experience will be accompanied by a scarf painting session directed by one of Anchorage's local artisans (guests will keep their creations as a memento of the General Meeting).

Tuesday's guest tour will begin with a trip to the Alaska Native Heritage Center and an opportunity to visit six authentic village sites and meet with native peoples unique to the region. Lunch at the picturesque Roof at Williwaw will precede a docent tour of Alaska's rich cultural legacy housed at the beautiful Anchorage Museum at Rasmuson Center.

Wednesday's all-day outing (see page 20) will feature Alaska's majestic mountains, wilderness, and glaciers. General Meeting guests and attendees will board the Alaska Railroad and embark on an excursion along the scenic Seward Highway complete with an on-board lunch. The day will conclude with the traditional Wednesday evening banquet featuring the music of Wilson Phillips (see page 18). Sign up for all tours will take place at the National Board registration desk in the Hilton Anchorage.

While this year's General Meeting (i.e., Opening Session, General Session, member meetings, and the Wednesday banquet) will be hosted at the Hilton Anchorage, overbooking of rooms necessitates that all registrants and their guests secure their sleeping rooms at the Anchorage Marriott Downtown (see page 21). ASME meetings will take place at the William A. Egan Civic and Convention Center. All three facilities are a modest walk from one another.

The last ASME / National Board General Meeting in Anchorage took place in 1995. Although we anticipated at the time a drop in the number of attendees, the 64^{th} General Meeting saw record attendance that exists to this day. The reason: participants and guests overwhelmingly wanted to experience the 49^{th} state.

That is why I encourage you to make plans now to be with us in Anchorage. It is anticipated that sleeping rooms will be at a premium, particularly at a $159-per-evening room rate. (This rate will apply three days before the meeting and three days after.)

Understandably, it is not our intention for this year's location to overshadow the meetings conducted by ASME and the National Board, or the technical presentations, exposure to knowledgeable industry specialists and innovative ideas, and the exchange of personal experiences. However, the more industry professionals who participate, the more likely the message of safety will resonate among those we seek to protect.

And that is the reason to ask yourself: If not now, when?

See you in Anchorage!

National Board *Synopsis* Update

The National Board *Synopsis* (NB-370) is a compilation of jurisdiction laws, rules, and regulations as reported to the National Board by jurisdictional authorities. The table below notes changes by category for 2016. Jurisdictions not listed either had no changes or did not submit changes at time of printing. For more information, go to nationalboard.org under "Resources" to view the complete *Synopsis*. Data is subject to change; consult the appropriate jurisdiction for final verification.

JURISDICTION	DEPARTMENT	EMPOWERMENT	DATE OF LAW PASSAGE	OBJECTS SUBJECT TO RULES FOR CONSTRUCTION AND STAMPING	RULES FOR CONSTRUCTION AND STAMPING	INSPECTIONS REQUIRED	INSURANCE INSPECTION REQUIREMENTS	CERTIFICATE OF INSPECTION	FEES	MISC
US STATES										
Alabama	X									
Alaska	X		X		X				X	
Arizona	X		X		X					
Georgia			X		X	X		X		
Hawaii								X	X	X
Iowa	X		X		X					X
Kansas	X									
Louisiana	X				X					
Maine	X	X	X	X		X	X	X		X
Nevada	X				X	X	X			
New Hampshire			X		X					
New Jersey	X		X		X					
North Carolina			X					X		
North Dakota	X		X			X				
Oklahoma	X									
Pennsylvania	X		X		X					
Tennessee	X		X		X					
Texas			X					X	X	X
Utah	X									
West Virginia	X									
Wisconsin	X									
CANADIAN PROVINCES/TERRITORIES										
Alberta	X		X		X					
Ontario	X									
Prince Edward Island	X		X						X	
Saskatchewan			X				X			
US CITIES										
Chicago	X									
Los Angeles	X									

Steam Plant Operations

Dissolved Oxygen and Chemical Oxygen Scavenger Treatment

BY ROBERT JEWELL, ENERGY SYSTEMS CHIEF ENGINEER

Elevated levels of dissolved oxygen in a steam system can result in severe corrosion. This article addresses some of the issues regarding excessive dissolved oxygen in a steam system, its complexities, and ways to manage dissolved oxygen levels.

The article, "Correct Venting from a Boiler Feedwater Deaerator," published in the winter 2016 *BULLETIN*, lays the groundwork for this topic. It focuses on the importance of proper operation, monitoring, and efficiency of deaerators to ensure safe and effective operation, the protection of assets, and managing the costs of operations. Readers are encouraged to refer to the article as a companion piece to this one, which builds upon the topic of steam plant operations and the issues and complexities of dissolved oxygen in a steam system.

Common Points for the Introduction of Oxygen and Identification of Problem Areas

Oxygen can potentially enter steam systems in numerous ways: contained in the makeup water; introduced through leaking pump seals, pipes, or fittings; ingress from heat exchangers or condensers that operate below atmospheric pressures; and through numerous other sources.

Unless dissolved oxygen in the system is managed, it can cause oxygen pitting and corrosion throughout the system. In addition, some specific equipment that operates at elevated temperatures, such as feedwater preheaters or economizers and superheaters, can experience or be more susceptible to rapid and severe oxygen corrosion or pitting due to those higher temperatures. Elevated temperatures have been found to accelerate oxygen-related corrosion. Other forms of corrosion, such as flow-accelerated corrosion (FAC), also have been found to be accelerated by high levels of dissolved oxygen in the system.

Dissolved oxygen is highly corrosive when present in hot water. Oxygen pitting, resulting from high levels of dissolved oxygen, can penetrate deep into the metal and result in a rapid failure of feedwater piping, economizers, and boiler tubes, to mention a few. The point(s) at which oxygen corrosion occurs can vary with the type of boiler and system design, but when oxygen pitting is found to be an issue, it is frequently visible in the feedwater distribution piping and nozzles, at the steam drum waterline, and in downcomer tubes, to name a few locations. Additionally, iron oxide fouling or deposits inside the boiler may be indications of this type of corrosion. Close visual inspections of these areas may be helpful in revealing if oxygen pitting, corrosion, or iron oxide deposits are of concern.

Treatment Methods, Programs, Oxygen Scavengers, & Catalysts

Mechanical deaeration is generally employed to remove most of the dissolved oxygen from the feedwater; however, chemical oxygen scavengers are also supplemented to remove or reduce concentrations of dissolved oxygen to lower, acceptable levels.

Choosing a suitable oxygen scavenger, including some not mentioned here, requires a thorough evaluation and understanding of the overall design and operating parameters of the specific system being considered.

One commonly used chemical oxygen scavenger is sodium sulfite. With sodium sulfite, many factors affect its efficiency. Those factors include: temperature/pressure, pH, concentrations of dissolved oxygen and oxygen scavenger, location of chemical addition, residence time, and water quality – all of which are somewhat dependent on the design of the system.

Conversely, diethylhydroxylamine (DEHA), another oxygen scavenger, is not affected by temperature and may be used under somewhat different conditions or applications. The efficacy of sodium sulfite as an oxygen scavenger may also be inhibited by chelants (chelants are used in solubilizing boiler water treatment programs versus phosphate precipitation boiler water treatment programs); contaminants in the feedwater; or by other treatment chemicals, such as amines.

Some contaminants and organic treatment chemicals may also slow down the reaction time between the dissolved oxygen and the oxygen

Steam drum of a D-type high-pressure heat recovery steam generator. Close internal inspection for signs of oxygen pitting at the water line of the steam drum is a common practice.

scavenger by deactivating catalysts that are sometimes applied with sodium sulfite.

Cobalt is one common catalyst added to sodium sulfite to reduce the reaction time between the dissolved oxygen and the oxygen scavenger in order to adequately protect the pre-boiler components (those components upstream of the boiler, relatively close to the oxygen scavenger injection point), such as the deaerator, feedwater pumps, piping, and feedwater economizer; and to prevent concerning levels of dissolved oxygen from reaching the boiler. Cobalt enhances and speeds the reaction between the dissolved oxygen and the sulfite, which may be required when retention time for the reaction to occur is relatively short. A slowed reaction rate from the deactivation of the catalyst could expose pre-boiler components to elevated levels of dissolved oxygen and allow it to enter the boiler, even in the presence of excess sodium sulfite.

As previously stated, some phosphates and chelants used in boiler water treatment programs and scale inhibitors have been found to deactivate cobalt and other catalysts when concentrations are excessive. This is generally assumed to be a problem when initially filling or refilling a boiler and the dosage is elevated to bring the chemical levels back to within the prescribed parameters in a timely manner. Care should be taken to avoid excessive concentrations, with the caveat that it is important to introduce oxygen scavengers and scale or corrosion inhibitors in sufficient amounts as soon as possible upon refilling a boiler to mitigate the potential of damaging corrosion.

It is also important to note that cobalt catalyst concentrations in the boiler can differ from those of the sulfite because the cobalt is not consumed in the process. The concentrations of cobalt (or other catalysts) need to be considered to avoid precipitation in the boiler and environmental concerns regarding their concentrations in wastewater discharge.

The Benefits of Controlling Dissolved Oxygen to Acceptable Ranges

Since it may not be possible or feasible, nor in some cases desirable, to remove all dissolved oxygen from a steam system, traces of dissolved oxygen generally remain. Although high levels of dissolved oxygen can contribute to the severity of FAC, some trace amounts of dissolved oxygen can also be beneficial in mitigating corrosion. Low levels of dissolved oxygen have been found to be beneficial in the formation of protective magnetite or hematite. Significant corrosion can result unless dissolved oxygen levels are properly managed and controlled to between acceptably low and acceptably high ranges.

Managing oxygen levels can be a complex task. Engineers need to appreciate the many ways oxygen can enter a system and the various treatments for controlling dissolved oxygen. Furthermore, dissolved oxygen concentrations may vary for numerous reasons, so diligence in routinely monitoring their levels is important.

Chemical treatment programs can be complicated and identifying the correct program and the desired control parameters should not be left to a novice. A reputable water treatment company knowledgeable in this field should be consulted to identify and prescribe the correct type of treatment program for the specific system, the chemicals utilized, and residual control parameters for those chemistries.

System engineers also must be diligent in controlling chemical treatment parameters to within the prescribed low and high ranges. Furthermore, close and thorough inspections of all equipment by engineers and inspection agencies may reveal potential issues before they become problems, and can provide opportunities to improve safety, system efficiencies, and the protection of assets. ✤

Advanced Nuclear Reactors, Ventu
Modernization of the NRC – A Ne

BY WENDY WHITE, *BULLETIN* EDITOR

Image courtesy of Redseal

MEET RAY ROTHROCK.

He's a former nuclear engineer turned successful venture capitalist who advocates partnership among nuclear power innovators, the private sector, and the US Nuclear Regulatory Commission (NRC) to successfully deploy and commercialize advanced nuclear technology.

re Capitalism,and the w Way Forward ?

Rothrock is working with legislators, the NRC, and the Department of Energy (DOE) to bring about change in the overall NRC commissioning process. He believes a new way forward to tackle pressing energy challenges begins with federal leadership and regulatory reform.

Rothrock and his team caught the attention of Washington, D.C., when their research found 54 nuclear innovation startups in the US – a number he and his colleagues did not expect. Some were in national labs, others at universities, but 44 of them were privately financed by entrepreneurs, with Rothrock himself involved in two. He presented the findings to Senior Domestic Policy Advisor to the President Jason Walsh.

"We couldn't believe what we found," Rothrock told the *BULLETIN*. He sat down for an interview at the 2016 International Conference on Nuclear Energy (ICONE), where he delivered a presentation under the track, "The Future of Nuclear Power, a US Perspective" alongside prominent representatives from TerraPower, NuScale Power, US DOE, and Oak Ridge National Laboratory.

"We added up the money, listed the investors, and went to Walsh. He was blown away. We were blown away. And it started a broader conversation and more meetings at the White House, which culminated in the November 2015 White House Summit on Nuclear Energy. It was a massive success to hear the White House use the word *nuclear*."

Rothrock is trailblazing a new way forward. "As a venture capitalist, I live in a world of new," he said unvarnished.

It's apparent that "new" is his lifeblood; frames his worldview. Consider the title of his ICONE presentation: "21st Century Nuclear Innovation: New World, New Leadership, New Ways Forward."

Investing in "new" drove Rothrock's success as a venture capitalist, and "new" federal regulatory reform – coupled with nuclear innovation and venture capital – is what he projects can revitalize nuclear energy in the US *and* provide a source of clean energy.

In the following interview, Rothrock referenced the word "new" nearly a dozen times in phrases such as *new opportunities, new jobs, new lessons, new processes, new ideas,* and *embrace the new.* There are other phrases, too, that point to progress and pioneering: *lead the world; kindred souls; on the bleeding edge; long bets;* and *set a high bar.*

At first glance, the words seem idealistic, especially since they are in reference to nuclear power, which has long played the role of the redheaded stepchild within the US energy mix. But Rothrock's candid discourse makes a compelling and seemingly obvious case for change. What's more, his *actions* are what source his words.

Rothrock says there is a new generation of nuclear engineers who are developing advanced reactors and there are entrepreneurs who want to support these activities. The roadblock has been the NRC's challenging and costly process for bringing forth nuclear innovations. He cautions the US will be left behind if it doesn't act quickly: innovative US companies will turn to other energy-hungry countries that are willing to partner.

"The innovators are moving very fast, but our government is moving very slowly," he stressed. "Two companies have already left the country: TerraPower left for China and ThorCon left for Indonesia to seek assistance. The Nuclear Regulatory Commission needs modernization. It needs to be redefined."

Modernize the NRC? Many would say this is a near-impossible task. But Rothrock is unmoved. He's witnessed the rise and fall of entire industries during his career as a venture capitalist; he's personally been part of funding startups that have literally changed the world, such as tech giant Apple (a Venrock investment).

In the face of an increasingly cynical and polarized society, Rothrock turns his back and squares his shoulders. "I'm a citizen, it's my government, and I'm going to change it," he said.

A citizen changing his government. Ironic that such an original American principle has become so muted that it now rings . . . *new*.

BULLETIN Q&A WITH RAY ROTHROCK

It just might be that Rothrock and his tribe turn the whole system on its head.

BULLETIN: *You started your career as a nuclear engineer, eventually transitioning to venture capitalism. When did you see nuclear energy as a viable investment? Was it always in the back of your mind, or did a specific opportunity trigger your interest in investing in nuclear startups?*

Rothrock: What really got me back in the game was when I became a co-executive producer of *Pandora's Promise*[1] in 2012. This was huge. We pitched a seven-minute trailer to a room of billionaires and everyone wrote a check. We funded the film in an afternoon. That's the hidden enthusiasm that exists out there for the conversation.

The documentary was successful and I found many kindred souls interested in nuclear. This experience resulted in my activities on this front in the last three years – to change the way nuclear energy is regulated, developed, and put forth. Applying my Silicon Valley lessons to the nuclear industry seems obvious. As high as the mountain might appear on some days, I know that it can be conquered and we can get this done. Rachel Pritzker [President/Founder of Pritzker Innovation Fund], Ross Koningstein [Engineer and Director Emeritus, Google Inc.], and I engaged in a strategy soliciting assistance from Third Way[2] in Washington, D.C., to start the arguments. It's been a wonderful experience in American citizenship talking to folks from the White House to the DOE to the Senate to the House of Representatives.

Before the documentary, however, the following occurred.

My firm, Venrock, has a long, long history of investing in technologies that could change the world. Our founder, Laurence Rockefeller, began this process in 1938 investing in James McDonald [of McDonald Douglas], in jet engines. Think about that. So over the decades, as the firm formed up and partners joined, we were always challenged to go out to the bleeding edge and investigate.

For example, in 1989, when cold fusion was thrust upon the world, my firm asked me, because of my unique background, to investigate. As the 2000s rolled around, the Intergovernmental Panel on Climate Change (IPCC) and others began to raise the alarm of climate change. A significant piece of science like this causes firms such as Venrock to look closely. Technology solutions began to pop up and the whole venture industry suddenly had an energy group.

Venrock was no different led by me. As we investigated, we found Tri Alpha Energy[3] in 2004. We invested in it in 2005, and that investment remains today in Venrock's funds. Last summer Tri Alpha released news of containment of plasma with a new architecture, field-reversed configuration (FRC) technology.

Now, why did Venrock do this deal? If Tri Alpha works – and we know it will take a while – it will be able to generate affordable electricity without neutrons or inherent radiation, waste, and safety issues associated with fission. This is a staggering claim that, if true, would change the world. That's the sort of long bet we take at Venrock.

My investment at Transatomic Power[4] is a personal one. I retired from Venrock in 2013 after 25 successful years.

BULLETIN: *What progress has been made in regard to your concept of a new federal nuclear agency that would operate like the Food and Drug Administration (FDA)?*

Rothrock: Some of us formed up the Nuclear Innovation Alliance (NIA) in 2013. As it evolved, it began to focus on modernization of the NRC. That is what it has largely done in the last two years, and in fact, with assistance from Congress, the NIA has a thoughtful, total, and rich proposal for the NRC to consider in modernizing its regulator pathways. It's a long way from over, but there is positive momentum.

BULLETIN: *Could you explain this concept in a little more detail? For instance, what specific changes are you suggesting, and how would those changes benefit new nuclear designs and the startups/entrepreneurs behind them?*

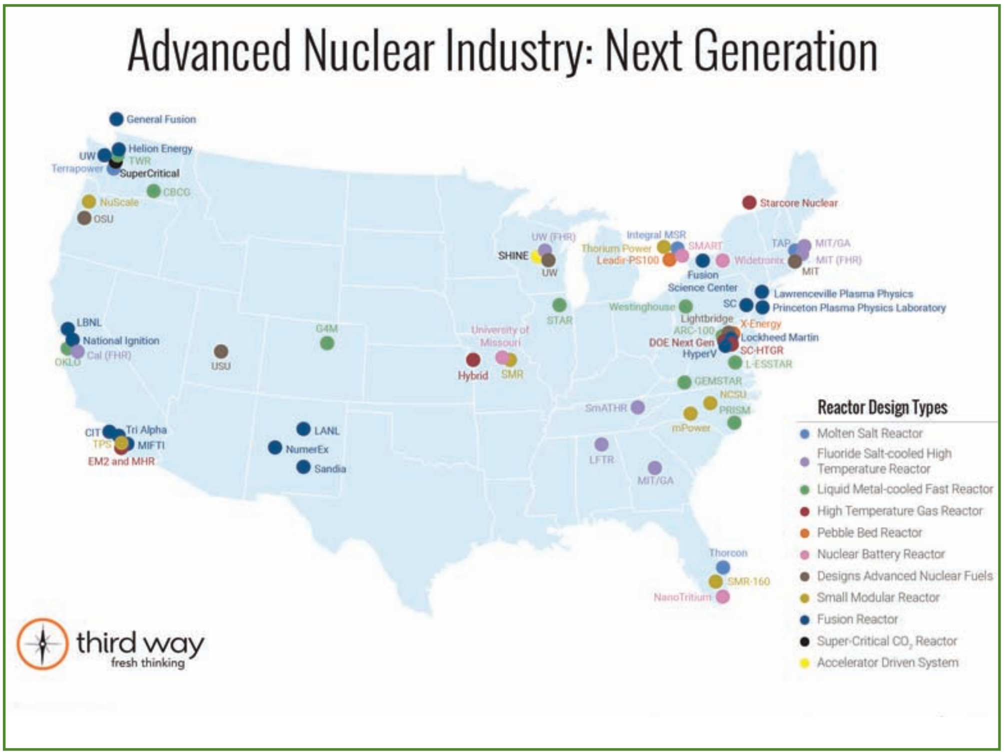


Image courtesy of Third Way

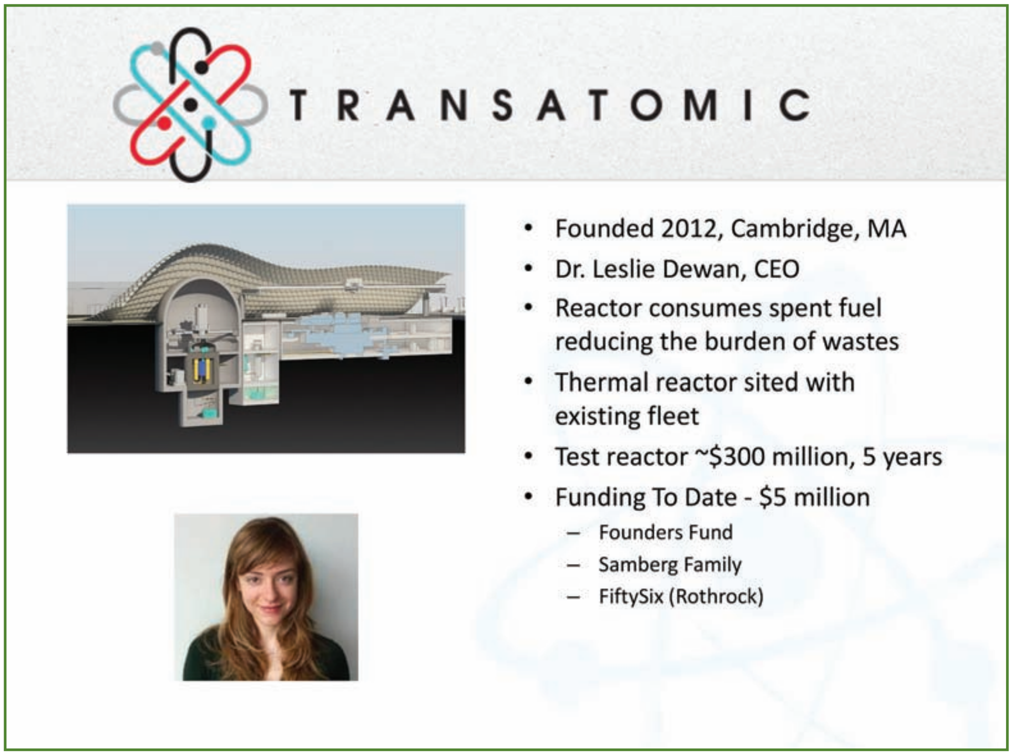
Rothrock: The old NRC process is a black box. You put in your application, have $1 billion in your bank account, answer questions, and if you are lucky, in five to 10 years you get approved. It's an "all or nothing" outcome.

The FDA, on the other hand, is a staged process with many interim updates and milestones. When interim milestones are reached, it signals that some risk of the new drug is resolved and new investors find it interesting. Each step reduces the risk on quantum amount. It still takes 10 years to get a new drug approved, and $250- to $500 million, but it's staged, known, and conclusive rather than a near-random walk.

In research for my Blue Ribbon testimony [December 3, 2015, before the Subcommittee on Energy, Committee on Science, Space and Technology, US House of Representatives], I found amazing cases where even when the NRC had reviewed some things, new reviewers could ask questions already answered (because they were new people to the process), thereby restarting a process, which is crazy and unnecessary.

Further, much of the NRC is prescriptive in its regulations. For example, you must build a containment dome. Why? Because pressurized water (lots of stored energy) needs to be contained if there is a release of that energy. Okay. But what if you don't have pressurized coolant? NRC would say today you still need to build the dome. The dome is about 30-40% of the total costs of a plant. That prescription is historical, and not based on risk analysis. The plant in which I worked, Yankee Rowe, was built in 1961 and went critical in 1962. It did not have a concrete pressure dome — it was a steel dome that did not have the capability of domes today.

To your question – a revised NRC would be beneficial in that entrepreneurs and investors will know where they stand along the way. They will know when certain risks are taken out, and they'll know what the end-game milestones are to achieve success. That doesn't exist today. As it is currently structured, startups cannot muster the resources to start the process. Dr. Jose Reyes' NuScale[5] small modular reactor (SMR) has Fluor[6] as its investor. Fluor is a multi-billion-dollar company with the balance sheet. Still, they expect to spend $1.2 billion on regulatory approval. Staggering and stifling.



When I was re-introduced to the NRC after my employment with Yankee Rowe in the 1970s, I was working at Venrock and the firm actually looked hard at investing in Dr. Reyes' NuScale technology.

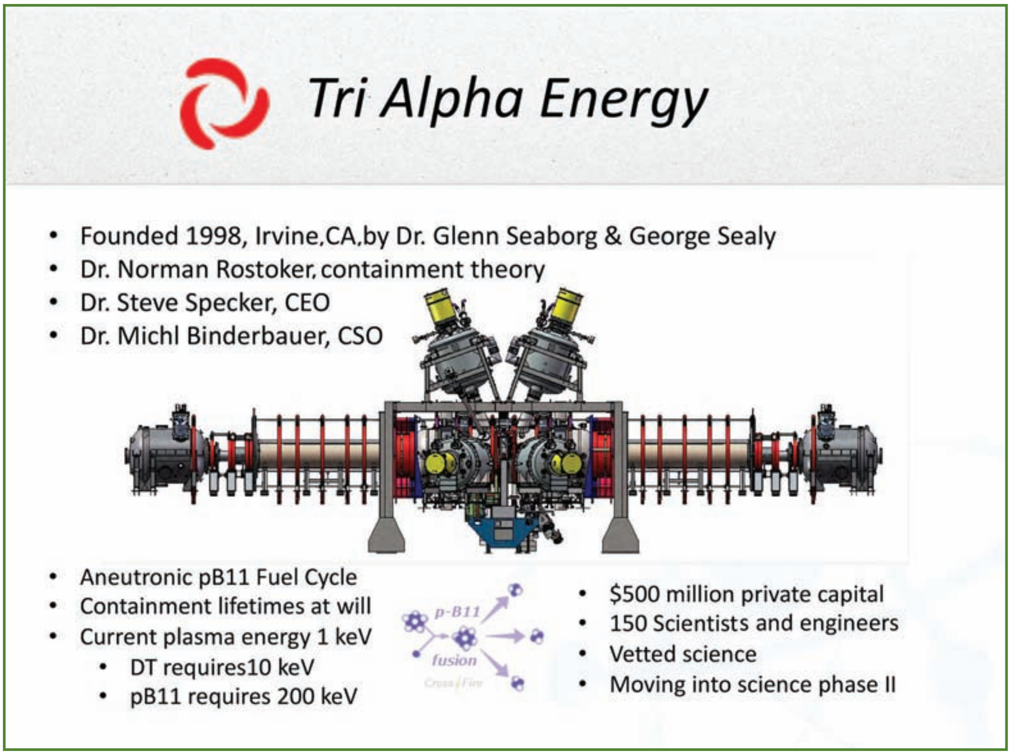
We did not invest in Dr. Jose Reyes and NuScale – not because of Jose's theories; not because of his capabilities. In my world, Dr. Reyes is a rootin'-tootin' entrepreneur, and when someone's a rootin'-tootin' entrepreneur, you've got to find reasons NOT to invest. The reason we found was the Nuclear Regulatory Commission. I was stunned, mortified [at the cost and process]. I said to NRC Chairman Stephen G. Burns, in a meeting with 500 other people, "The NRC is the gold standard for nuclear safety in the world. Nobody has died on your watch. But there's something about gold: It's heavy, it's expensive, and it's very difficult to move. We need to figure out how to use leverage to move the NRC to a new space."

BULLETIN*: When it comes to new nuclear reactors (SMRs, molten salt reactors, far-off fusion designs), what will need to change in regards to inspection and training? For example, will inspection practices need to evolve to accommodate new reactor designs? Will future inservice inspectors need to be more specialized? How extensive do you predict these types of changes will be?*

Rothrock: No doubt things will need to change. I suppose there will be a whole new level of training to come into being. This will also apply to plant operators. I don't know about the specialized part, but like anything new, when new shows up, those that manage that process need to sit back, take it in, think about it, and come up with what is required.

BULLETIN*: What are your thoughts on third-party oversight (NRC, National Board, AIAs, and jurisdictions)? Are they perceived as adding value in ensuring safety? Do you envision the third-party model as a part of the future of nuclear power?*

Rothrock: Third-party oversight is very important. I see no change in that model. My concern is if people in those organizations have enough foresight and open-mindedness to embrace the "new" rather than shut it down. I have watched whole industries be built (biotech) and others completely disrupted, all for the good of society. I hope the momentum of the current organizations simply doesn't stifle all the good that is happening. If so, we will see these companies leave the United States. That



would not be good for the US on a number of fronts — national security, energy security, and most of all, the economy.

BULLETIN*: Our reader base includes those from jurisdictional authorities, manufacturing, authorized inspection agencies, owners/users, fabricators, etc. What message would you share with this sector of the pressure equipment industry in regard to their involvement with nuclear power and its future?*

Rothrock: This time is not unlike the 1960s when nuclear was coming on-line. This offers new business, new skills, new products, and new processes that benefit all. The US has tremendous experience in all the areas you suggest. I hope they embrace the new and bring their wisdom to the table, so this time around we do it even better than we did in the 1960s. It was done wonderfully in the 1960s based on the results of what was built and operated. The world needs nuclear now more than ever. Our standards, industry agencies, and the like have a golden opportunity to set a high bar, lead the world, and make everything great in their businesses, agencies, and economy.

References

1. *Pandora's Promise* is a 2013 documentary about the nuclear power debate. The film advocates nuclear power as a relatively safe and clean energy source for carbon-free electricity. [pandoraspromise.com]
2. Third Way is a Washington, D.C.-based centrist public policy think tank founded in 2005. [thirdway.org]
3. Tri Alpha Energy is a private American company seeking to develop commercially competitive clean fusion energy. [trialphaenergy.com]
4. Transatomic Power is developing an advanced molten salt reactor that generates clean, safe, proliferation-resistant, low-cost nuclear power. [transatomicpower.com]
5. NuScale Power designs and markets small modular reactors (SMRs). See the winter 2015 *BULLETIN* for more information on NuScale and SMRs, and look for an interview with NuScale founder Dr. Jose Reyes in the summer 2017 issue of the *BULLETIN*. [nuscalepower.com]
6. Fluor is a publicly-traded engineering, procurement, construction, maintenance, and project management company who invested $30 million in NuScale in 2011. [fluor.com/client-markets/power/pages/smr-technology.aspx]

A Comparison of ASME Section VIII Requirements with API Standards for Pressure Relief Devices

BY ROBERT VIERS, SENIOR STAFF ENGINEER, PRESSURE RELIEF DEPARTMENT

It is no secret that one of the most important considerations when working with pressurized equipment is the prevention of overpressure. When it comes to safety, this is the number one priority.

Typically, overpressure protection comes in the form of one or more pressure relief devices (PRDs) installed on pressurized equipment. The *ASME Boiler and Pressure Vessel Code* (ASME Code) is the most common and widely accepted set of rules governing pressure relief devices; however, many other industry standards exist. The American Petroleum Institute (API) publishes standards for pressure relief devices and pressure relief systems that are widely used in oil refineries, petrochemical and chemical facilities, liquefied natural gas (LNG) facilities, and other industries.

When reviewing PRD standards, some obvious questions might be: "What's the difference between standards? What happens if there's a conflict between ASME Code and API standards? Which code or standard takes precedence?"

> "Overpressure protection, particularly in petrochemical and chemical industries, is a complex topic"

Although ASME Code and API standards both share the same objective – help ensure safe operation of pressurized equipment and prevent potential disaster – the two serve distinct functions in attaining that goal.

While ASME Code is adopted by most jurisdictions in the United States as law and must be adhered to, API standards are considered a "Recognized and Generally Accepted Good Engineering Practice" or "RAGAGEP." These standards go hand in hand with ASME Code and are referenced in ASME Section VIII, Division 1, Appendix M, *Installation and Operation of Pressure Vessels*. The API standards provide guidance for properly applying ASME Code, and oftentimes defer to ASME Code on specific performance requirements.

Generally, ASME Code dictates base requirements and then API builds on those requirements, with both being used together to help guarantee safe operation. For example, Section VIII, Division 1, describes specific performance requirements for devices used on unfired pressure vessels often seen in the petroleum industry. Manufacturers and assemblers of Section VIII, Division 1, PRDs must adhere to these rules to ensure that the devices function properly. While a pressure relief device can function perfectly, if it is improperly sized for or used in the wrong application, the results can still be catastrophic.

Although ASME Code does mandate that installed PRDs are of sufficient capacity to relieve an overpressure condition, the code is silent on identifying potential sources of overpressure, or on how to determine the required size and/or type of a device. API STD 520: *Sizing, Selection, and Installation of Pressure-Relieving Devices* and API STD 521: *Pressure-Relieving and Depressuring Systems* guide users on how to select the appropriate size and type of device for a given application. These standards address potential overpressure scenarios, how to determine which cases are more likely and which cases can be discounted, and how to select and configure PRDs to mitigate the most likely scenarios.

Both ASME Code and API STD 520 address installation instructions for PRDs, and rather than creating conflict between the two, the API standards build on ASME Code. STD 520 echoes

Chemical plant for production of ammonia and nitrogen fertilizer

some ASME requirements and also guides users on how to perform necessary calculations to ensure stable operation of reclosing devices. The API standards also address discharge piping requirements and calculations, with more specific consideration given to refining and petrochemical applications. Again, this serves as direction for users on how to apply the code in situations they are likely to encounter.

Some other API standards, such as API STD 526: *Flanged Steel Safety Relief Valves* and API STD 527: *Seat Tightness of Pressure Relief Valves*, describe specific requirements for PRDs. API STD 526 details requirements such as face-to-center dimensions, material requirements for valve bodies and springs, pressure and temperature limits, and backpressure limits for balanced-bellows-type valves. This standard is important in helping system designers ensure interchangeability between different valve makes and models. STD 526 also gives guidelines on valve orifice sizes and designations.

Meanwhile, API STD 527 dictates seat tightness requirements for pressure relief valves across a range of sizes, pressures, service conditions, and seat configurations. While these may seem like situations where the potential for conflicts between ASME Code and API standards could exist, the requirements in the API standards do not infringe upon or contradict ASME requirements. In fact, ASME Section VIII, Division 1, references API STD 527 for seat tightness requirements when a manufacturer's published specification (or other specification agreed to by the user) does not exist.

Overpressure protection, particularly in petrochemical and chemical industries, is a complex topic, with many different scenarios and constraints to consider when designing, constructing, and maintaining pressurized equipment. Thankfully, industry standards such as ASME Code and API standards exist and work together to guide system designers, engineers, and operators in properly sizing, selecting, and ensuring safe operation of PRDs for this extremely important function.

For more information on API standards, visit api.org/standards.

Understanding ASME Section VIII, UG-45, Nozzle Thickness Calculations

BY TIMOTHY A. GARDNER, SENIOR STAFF ENGINEER

One of the new construction (**AI**) inspector's duties specified in the *ASME Boiler and Pressure Vessel Code* (ASME Code) Section VIII, Division 1, U-2(e), is "verifying that the applicable design calculations have been made and are on file at the Manufacturer's plant at the time the Data Report is signed." Knowing what the applicable design calculations should be can be challenging in some cases. This is sometimes true of the common determination of nozzle thickness on Section VIII, Division 1, vessels.

Almost all pressure vessels are designed with one or more nozzles penetrating the shell to allow some fluid to be added to or removed from the finished vessel. Nozzles are not only a common consideration in the original construction of the vessel, but adding or changing a nozzle is a very common alteration made to existing vessels by **R** stamp holders. For these reasons, inspectors should be aware of the paragraph governing the thickness calculations of nozzles, UG-45, and understand how it is applied.

UG-45

Note Paragraph UG-45 as it appears in Section VIII (inset) before we examine its contents in detail.

It is obvious from the first sentence that the paragraph's intent is to provide a way to determine the minimum wall thickness of nozzle necks. Two situations are considered:

1) For access openings and openings used only for inspection.
2) For other nozzles.

It makes some sense that access and inspection openings would not be subjected to the additional loading from piping and equipment that other nozzles experience; therefore, the fact that different equations or requirements are given for each should not be surprising.

(15) **UG-45 NOZZLE NECK THICKNESS**

The minimum wall thickness of nozzle necks shall be determined as given below.

For access openings and openings used only for inspection:

$$t_{UG\text{-}45} = t_a$$

For other nozzles:

Determine t_b.

$$t_b = \min\left[t_{b3},\ \max\left(t_{b1},\ t_{b2}\right)\right]$$

$$t_{UG\text{-}45} = \max\left(t_a,\ t_b\right)$$

where

t_a = minimum neck thickness required for internal and external pressure using UG-27 and UG-28 (plus corrosion and threading allowance), as applicable. The effects of external forces and moments from supplemental loads (see UG-22) shall be considered. Shear stresses caused by UG-22 loadings shall not exceed 70% of the allowable tensile stress for the nozzle material.

t_{b1} = for vessels under internal pressure, the thickness (plus corrosion allowance) required for pressure (assuming E = 1.0) for the shell or head at the location where the nozzle neck or other connection attaches to the vessel but in no case less than the minimum thickness specified for the material in UG-16(b).

t_{b2} = for vessels under external pressure, the thickness (plus corrosion allowance) obtained by using the external design pressure as an equivalent internal design pressure (assuming E = 1.0) in the formula for the shell or head at the location where the nozzle neck or other connection attaches to the vessel but in no case less than the minimum thickness specified for the material in UG-16(b).

t_{b3} = the thickness given in Table UG-45 plus the thickness added for corrosion allowance.

$t_{UG\text{-}45}$ = minimum wall thickness of nozzle necks

Access/Inspection Opening Calculations

From UG-45:
For access openings and openings used only for inspection:

$$t_{UG-45} = t_a$$

Where

t_{UG-45} is the minimum nozzle wall thickness

And

t_a is the minimum neck thickness required for internal or external pressure using UG-27 or UG-28 (plus corrosion and threading allowance) respectively as applicable.

Extra loads, such as mentioned in UG-22, must be accounted for. As mentioned in the description of t_a, shear stresses caused by those extra loads must be limited to 70% of the allowable material tensile stress. Examples of possible extra loads on the nozzles would include imposed forces, such as the weight of attached piping acting perpendicular to the nozzle axis or torsional loads induced on the nozzle by piping.

Therefore, an inspector would simply look for typical thickness calculations of the cylindrical nozzle. There should also be calculations verifying the shear stress from any additional UG-22 loading in the nozzle is no greater than 70% of the nozzle material tensile strength. For example, shear stresses due to any shear force and / or torsion loadings would be calculated using typical stress analysis techniques. The combination of these shear stresses needs to be no greater than 0.70 times the nozzle material's allowable tensile stress.

Other Nozzle Calculations

Determination of the thickness of the 'other' nozzles is a bit more involved. There are two mathematical equations that are stated in place of the sentences that were formerly in the code:

$$t_{UG-45} = \max(t_a, t_b)$$

This simply means that t_{UG-45} is equal to the greater of t_a or t_b.

The t_b value is defined using the relationship:

$$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$$

This is handled similarly, but when evaluating t_b one must resolve the **max** statement nestled within the **min** statement first.

The confusing thing about this relationship is that suddenly we are dealing with three distinctly different thicknesses. (See Figure 1.) These '**b**' subscripted and numbered variables are the result of what formerly were numbered paragraphs [e.g., UG-45 (b)(2)]. These thicknesses need to be considered one at a time.

t_{b1} (for vessels under **internal** pressure) is the thickness (plus corrosion allowance) required for pressure (assuming E=1.0) for the *shell* or *head* at the location where the nozzle neck or other connection attaches to the vessel, but in no case less than the minimum thickness specified for the material in UG-16(b). This means that a thickness is being calculated using UG-27 or the appropriate head equation with the idealized assumption of E=1.0 in the equation. This value would then be compared to the value listed in UG-16(b). The maximum of these two values would be t_{b1}.

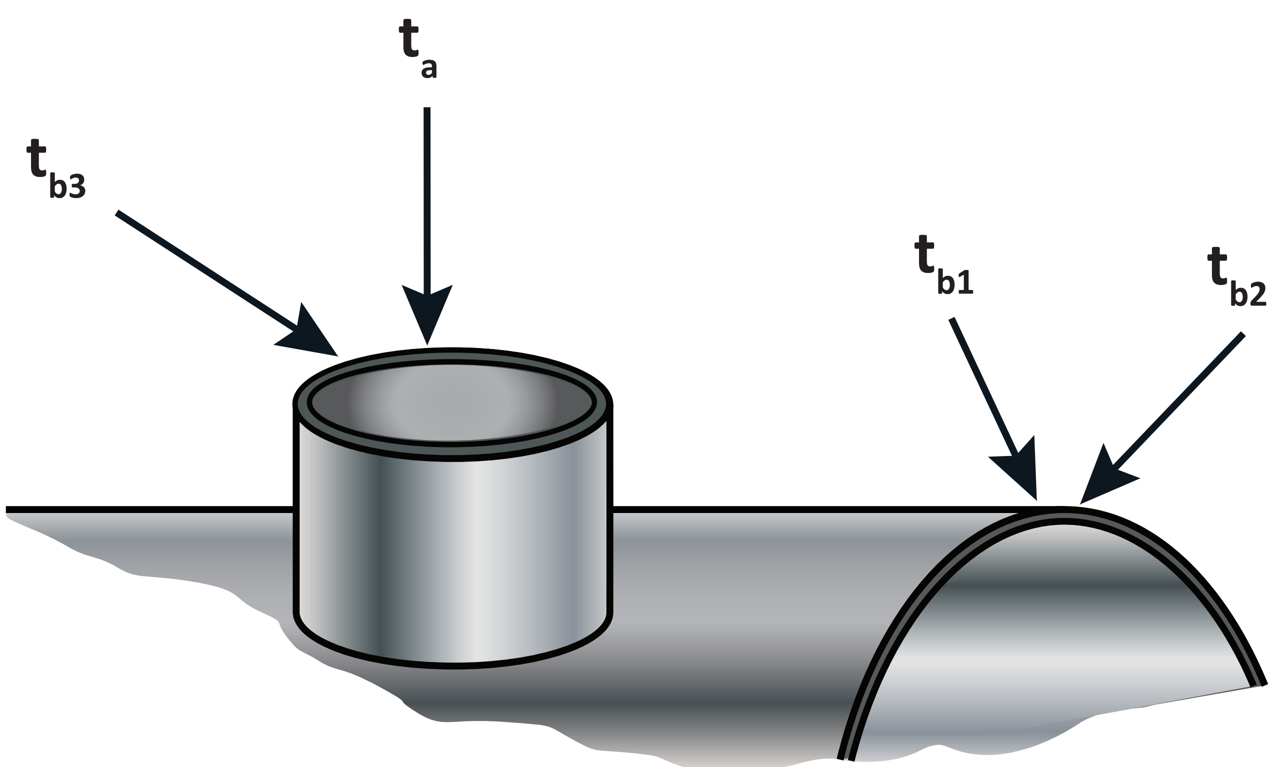
t_{b2} (for vessels under **external** pressure) is the thickness (plus corrosion allowance) obtained by using the external design pressure as an equivalent *internal* design pressure (assuming E=1.0) for the *shell* or *head* at the location where the nozzle neck or other connection attaches to the vessel, but in no case less than the minimum thickness specified for the material in UG-16(b). This means that a thickness is being calculated using UG-27 or the appropriate head equation with the idealized assumption of E=1.0 in the equation, **not using the external pressure calculating rules of UG-28.** This value would then be compared to the value listed in UG-16(b). The maximum of these two values would be t_{b2}.

t_{b3} is the thickness given in Table UG-45 plus the thickness added for corrosion allowance. Table UG-45 has a list of nozzle minimum thickness requirements for various pipe sizes. It is a table of convenience since what is required is the minimum thickness of standard schedule pipe for a particular nominal pipe size. The values in the table represent 0.875 (reflecting the 12.5% manufacturing tolerance allowed for pipe wall thickness in most pipe material specifications) times the nominal pipe thickness given in B36.10M for standard pipe schedule of various pipe sizes. All the inspector needs to confirm is that the value in the table corresponding to the proper size of pipe (or the next-highest pipe size for nozzles that are not standard pipe) has been selected.

Once the thickness values have all been determined, it is a matter of plugging the values into the comparison equation for t_b and then plugging that value into the comparison equation for t_{UG-45}. The nozzle neck minimum thickness will be the result.

By understanding the concepts in this code paragraph, an inspector should be able to easily match the individual thickness terms to the appropriate calculation and, thus, confirm that the manufacturer has applied UG-45 properly to determine the code minimum required thickness.

Figure 1: Typical Vessel Showing the Thicknesses Represented by UG-45 Terms



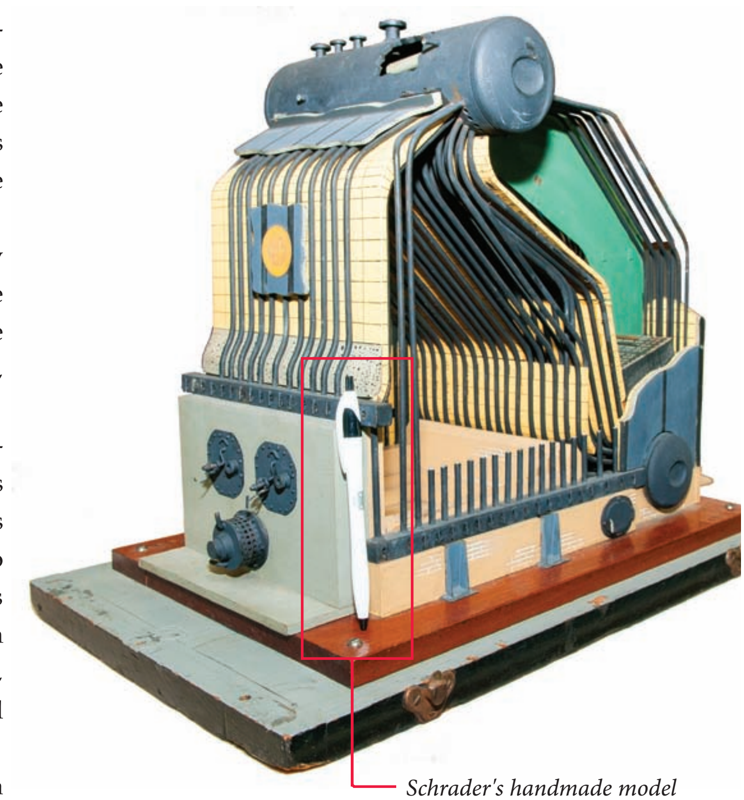
Follow-up to Summer 2014 Article, "One-of-a-Kind Boiler"

BY JOHN HOH, SENIOR STAFF ENGINEER

In the summer of 2014, CNA Insurance Companies donated a handmade model of a Babcock & Wilcox watertube boiler to the National Board, and it has been on display in public view at the National Board facilities ever since.

The detailed miniature was built by Mr. Carl F. H. Schrader in the 1940s or 1950s. At the time we received the model, the National Board attempted to locate any descendants of Mr. Schrader to learn more about him, but we were unsuccessful.

Fast-forward to 2016. I received a very nice (and unexpected) email from one of Mr. Schrader's sons. He said his daughter was searching the internet for her grandfather's name and found the *BULLETIN* article along with "how to build it" articles Mr. Schrader had written for earlier editions of *Popular Mechanics* and *Popular Science* magazines. I then received a phone call from the elder Mr. Schrader's daughter, who lives in Ohio. She hopes to soon visit the National Board to see the boiler model crafted by her father.



Schrader's handmade model boiler. The pen at the left corner gives size perspective.

It should come as no surprise that Mr. Schrader was a prolific builder and craftsman. His son said when he was young, Mr. Schrader made many of his childhood toys and built furniture, model ships, and a model streetcar he called "Desire."

After graduating from Stevens Institute in 1929 as a mechanical engineer, Mr. Schrader lived at the family home in Yonkers, New York, in the early 1930s before going to work for Babcock & Wilcox. While still at home, Mr. Schrader built the fuselage, wings, and empennage (tail assembly) of a full-scale single-seat airplane in the basement. His son recalls him describing it as a "French design low-wing monoplane." This project was inspired by Mr. Schrader's admiration of Charles Lindbergh and the dream of flight.

Not being a pilot, Mr. Schrader sold the airplane to someone who then finished the assembly. But he didn't let go of that dream of flight. He did earn his private pilot's license around 1946 in an Ercoupe aircraft. This specific aircraft is significant because it did not have rudder pedals (the rudder and ailerons were linked and operated by the control wheel). You see, Mr. Schrader had contracted polio in his legs when he was about eight years old and used leg braces and canes to walk.

Carl Schrader

Now we know more about the man who crafted the boiler model on display at the National Board; Carl F. H. Schrader was a mechanical engineer and a skilled craftsman. Carl D. Schrader, his son, stated, "My dad was quite a guy." How true.

I thank the Schrader family for providing this brief glimpse into Carl F. H. Schrader's accomplished life.

86th GENERAL MEETING ANCHORAGE, ALASKA MAY 8-12

John Foley

John Foley is a former lead solo pilot for the Blue Angels who has taken his rare experience flying in high-stakes formations to present a powerful message of trust, leadership, and thankfulness to empower people to reach their highest potential. Foley utilizes dynamic multimedia presentations showcasing daring Blue Angels flight footage to illustrate themes of high performance, teamwork, and innovation. He received a mechanical engineering degree from the US Naval Academy and was a “Top Ten Carrier Pilot” six times before becoming a Marine instructor pilot and a Blue Angel. He has a master’s degree in business management from the Stanford Graduate School of Business; one in international policy studies from Stanford University; and a third in strategic studies from the Naval War College. In 2011, he founded the Glad to Be Here Foundation®, through which 10% of his speaking fees go to charities.

Wilson Phillips

Entertainment for the Wednesday Evening Banquet showcases a blend of three unique voices performing hits from America’s pop songbook from the 1960s and beyond. The three-part harmonies of singers Carnie and Wendy Wilson and Chynna Phillips –best known as Wilson Phillips –are most recognized by the trio’s 1990 songs “Hold On,”“Release Me”and “You’re in Love.” In addition to those tunes, the group’s repertoire includes renditions of the timeless hits that gave their famous parents –Brian Wilson of the Beach Boys and John and Michelle Phillips of the Mamas and the Papas –worldwide acclaim. The California singers also perform chart-topping songs from artists Fleetwood Mac, Elton John, ABBA, and more, for a dynamic evening of radio-friendly hits delivered with impeccable vocal stylings.

The Hilton Anchorage and Anchorage Marriott Downtown

The Hilton Anchorage and Anchorage Marriott Downtown are conveniently located in the heart of downtown Anchorage, and only a 10-minute drive from Anchorage International Airport.

The Hilton Anchorage has been designated host hotel for National Board registration, the Monday Opening Session, General Session, member meetings, Wednesday Banquet, and all social receptions. Anchorage Marriott Downtown will provide sleeping rooms for registration guests. ASME meetings will take place at the William A. Egan Civic and Convention Center, located in relative proximity to both hotels. In addition, dining and shopping venues are within walking distance of both hotels and the convention center.

86th GENERAL MEETING
PRELIMINARY PROGRAM
The National Board of Boiler and Pressure Vessel Inspectors
&
ASME Boiler and Pressure Vessel Committee

Monday, May 8

Opening Session

10:15 a.m. REMARKS
John Foley, Former Blue Angels Lead Pilot and Motivational Speaker

General Session

1:00 p.m. HISTORIC INTRODUCTION OF PLATE HEAT EXCHANGER RULES INTO ASME AND NATIONAL BOARD CODES
Michael Pischke, Director, Quality Assurance
GE POWER SERVICES

1:30 p.m. *NATIONAL BOARD INSPECTION CODE* (NBIC) TOOLS FOR HISTORICAL BOILERS
Joel Amato, Minnesota Chief Boiler Inspector and
Chair of NBIC Subgroup Historical Boilers
STATE OF MINNESOTA

2:00 p.m. RULES FOR COMMISSIONED INSPECTORS
Vincent Scarcella, Zone Director
CNA RISK CONTROL

2:30 p.m. BREAK

2:45 p.m. A CENTURY AS A JURISDICTION
Donald Cook, California Principal Safety Engineer and
Chair of NBIC Main Committee
STATE OF CALIFORNIA

3:15 p.m. THE TRIAD RELATIONSHIP, MAKING HISTORICAL BOILERS SAFE
Jon Wolf, Sr. Risk Engineering Consultant Machinery Breakdown
THE ZURICH SERVICES CORPORATION

3:45 p.m. SAFER BY DESIGN: BUILDING INTRINSIC SAFETY INTO HIGH-PRESSURE STEAM BOILER PLANTS
Michael Gerhart, Sales Manager, National Corporate Accounts
MIURA AMERICA CO., LTD.

General Meeting Notices

- Attendees and guests are encouraged to dress in a business-casual style for all hotel events except the Wednesday banquet (where ties and jackets will be the evening attire).
- Distribution of any and all literature other than informational materials published by the National Board and ASME is strictly prohibited at the General Meeting.
- To obtain a preregistration discount of $45, all forms and fees must be received by April 14.
- All tour registration will take place onsite at the National Board registration desk in the Hilton Anchorage. Seating for all tours is limited.
- On-Site Registration Desk Hours at the Hilton Anchorage:

  Sunday, May 7 . . . . 9:00 a.m. - 2:00 p.m.
  Monday, May 8 . . . . 8:00 a.m. - 10:00 a.m.
  Tuesday, May 9 . . . . 8:00 a.m. - 10:00 a.m.

- General Meeting Registration is required in order to receive the special $159 room rate at the Anchorage Marriott Downtown (sleeping rooms at the Hilton Anchorage are not available).

Reminder

General Meeting details can also be found on *InfoLink!* located on the National Board website at *nationalboard.org*.

ASME Boiler and Pressure Vessel Code Meetings

- Meetings are scheduled all week at the William A. Egan Civic and Convention Center.
- Check hotel information board for locations and times.
- Meetings are open to the public.

GENERAL MEETING GUEST TOURS

NOTE: Attendees are not permitted to attend the Monday or Tuesday tours intended for designated guests. This policy is strictly enforced.

Tuesday and Wednesday tour buses will be stationed to depart and drop off at both the Hilton Anchorage and the Anchorage Marriott Downtown to accommodate all guests.

Monday, May 8

Sled Dogs and Silk Scarves, 1:00 p.m. – 5:00 p.m.

In this special National Board event, guests will meet in the penthouse (15th floor) of the Hilton Anchorage, where they will be split into two groups and take turns experiencing two very memorable activities.

The first group will meet with four-time winner of the world-famous Iditarod Dog Sled Race, Martin Buser, and a pack of his spirited dogs. Martin's energy and passion are bested only by that of his dedicated four-legged friends. As guests interact with the dogs, Martin will share stories of his special connection with them through 28 years of racing in the demanding "Last Frontier sport."

The second group will have an opportunity to explore their creative sides. In this unique activity, guests will meet with a local artisan who will walk them through the artistry of silk scarf painting. No painting skills required. Each guest will have a palette of fabric-friendly watercolor paints and a silk scarf as the canvas. The result: a personalized, glacier-inspired keepsake from an extraordinary day in Alaska.

This is an on-site indoor activity at the host hotel. Remember to bring a camera to capture a picture of Martin's playful sled dogs! Tickets are available to the first 100 participants.

Tuesday, May 9

Experience Alaska, 9:00 a.m. – 5:00 p.m.

Part of the fascination with Alaska is its past. On this "Experience Alaska" tour, guests will explore the rich history of Alaska's Native people. The tour begins at the Alaska Native Heritage Center, where visitors will experience six authentic village sites, built around a lake, that depict the history and traditions of Alaska's 11 major Native cultures and their regions.

Next, guests will be transferred to The Roof at Williwaw for an exclusive luncheon in a unique Alaskan dining facility. Attendees will enjoy the modern urban feel and cozy atmosphere of the rooftop restaurant. After a refreshing lunch, guests will spend the remainder of the afternoon taking in the sites at nearby Anchorage Museum at Rasmuson Center. There, they will experience other interesting aspects of Alaska's rich cultural legacy, past and present. A docent will guide participants through two galleries: the Alaska Gallery and the Smithsonian Arctic Studies Center. Afterward, guests can explore other areas of the museum before being transported back to the Hilton Anchorage or the Anchorage Marriott Downtown.

Comfortable walking shoes are recommended. This outing requires a moderate amount of walking. Tickets are available to the first 100 participants.

Wednesday, May 10

Alaska Railroad Adventure, 9:00 a.m. – 3:00 p.m.

(*Duration and route may change due to weather conditions.*)

All aboard! Get ready for the ride of a lifetime. Attendees and guests will gather at the historic Anchorage Depot before stepping aboard the legendary Alaska Railroad. Inside the cars, travelers will settle into comfortable seats surrounded by large windows for maximum viewing pleasure.

Breathtaking views change with every mile as the train winds and bends down the track parallel with the National Scenic Byway, arguably one of the most beautiful coastal rides in America. Visual highlights include Potter Marsh, Turnagain Arm, the Chugach Mountain Range, the Kenai Mountain Range, and prominent wildlife viewing spots along the way.

As the train chugs across the rugged landscape, travelers will enjoy lunch onboard and sip adult refreshments. Docents will be on board to share interesting facts and to point out any wildlife that comes into view. Beluga whales, Dall sheep, eagles, and glaciers are often seen along the route. This all-American railroad excursion is an exceptional way to see the Last Frontier. When guests return to the Anchorage Depot, they will understand why Alaska is a "bucket list" destination.

Please note smoking is not permitted on board. Travelers are advised to dress comfortably and have cameras on hand. Tickets are available to the first 250 participants.

GENERAL MEETING REGISTRATION

REGISTRATION FEES

Online Registration (by April 21)
Select the General Meeting Link on the top of the *nationalboard.org* home page

Phone Registration (by April 21)
To preregister by telephone using your VISA, MasterCard, or American Express, contact the National Board at 614.431.3203

Tour Registration
Register for tours onsite at the National Board registration desk in the Hilton Anchorage.

	Preregistration Pricing On or Before April 14 Save $45 off Attendee Registration	Registration Pricing After April 14
Attendee Registration	$450.00	$495.00
Additional Guest	$235.00	$235.00
Additional Banquet Ticket	$85.00	$85.00

ATTENDEE GUEST/ADDITIONAL GUEST must be a spouse/domestic partner or family member only (no professional or staff associates).

WHAT'S INCLUDED

Attendee Conference Registration

- One Guest Registration*
- Opening Session Admission
- General Session Admission
- Wednesday Outing
- One Wednesday Banquet Ticket
- Conference Gift

Attendee Guest *

- Opening Session Admission
- Monday & Tuesday Tour
- Wednesday Outing

NOTE: Wednesday Banquet Ticket not included

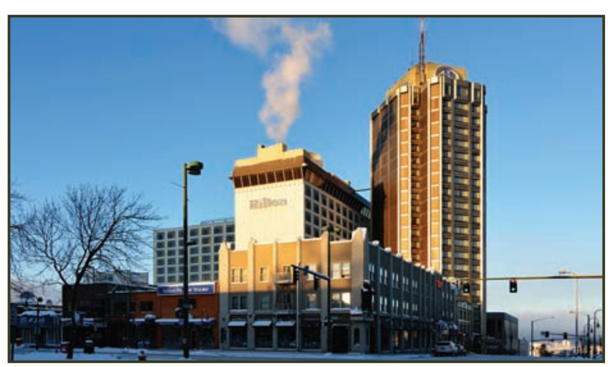
Additional Guest (16 years or older)

- Opening Session Admission
- Monday & Tuesday Tour
- Wednesday Outing
- One Wednesday Banquet Ticket

Those requiring special or handicapped facilities are asked to contact the Public Affairs Department at 614.431.3204

HOTEL RESERVATIONS

Reservations are the responsibility of attendees. **Sleeping rooms are not available at the Hilton Anchorage.** Attendees can book rooms at the Anchorage Marriott Downtown by calling 1-888-236-2427 or visiting *Infolink*! on the National Board website to access the passkey web address for online registration. To receive the $159 nightly room rate,**reference group name: National Board. Group rate reservations must be received by April 3. Rates are good for three days before and three days following this event.



** *Group rate for General Meeting registrants only.*

The Evolution of National Board Commissions and Endorsements

BY GARY SCRIBNER, MANAGER OF TECHNICAL SERVICES

Since the first National Board commission was issued in 1920, the commissions, along with the prerequisites to obtain commissions, have gone through numerous changes. Initially, inspectors performed uniform duties in code shops, but inservice or jurisdictional inspection requirements varied from jurisdiction to jurisdiction. In 1946, the National Board published the first *National Board Inspection Code* (NBIC) which established standardized requirements for inservice inspection and repairs to pressure-retaining items.

All changes to the commissioning program have been implemented to keep up with additions and revisions to the *ASME Boiler and Pressure Vessel Code* (ASME Code) and the *National Board Inspection Code*. Changes in the codes have necessitated the addition of endorsements that focus on specialized qualifications; meaning, inspectors who become certified to perform certain duties in accordance with the ASME BPV Code or the NBIC.

For example, one of the first notable changes was the addition of the **B**, **S**, **N**, **C,** and **I** endorsements in 1983. This change was in recognition of ASME N626.0, *Qualifications and Duties for Authorized Inspection Agencies, Nuclear Inspectors, and Nuclear Inspector Supervisors.*

In 1992, the National Board established the **A** endorsement, which required authorized inspection agencies (AIAs) to formally certify individuals performing duties as authorized inspectors. Following this change, ASME replaced N-626.0 with QAI-1, *Qualifications for Authorized Inspection* in 1995, which added ASME rules for the **A** and **B** endorsements.

Standardized Training

As the numbers and types of endorsements grew to meet the needs of industry, it became apparent that standardized training for the new endorsements was necessary. As a result, in 1997, the NB-263: *National Board Rules for Commissioned Inspectors* was published, providing specific experience and/or education requirements for obtaining a National Board commission and endorsements.

By 2009, the number of ASME certificate holders outside of North America was rapidly increasing, as was the number of boilers and pressure vessels requiring jurisdictional inservice inspections. Subsequently, the commissioning program and training were retooled to be more closely aligned with the specific duties of individual inspectors. On October 9, 2009, the National Board revised the commissions as follows: a New Construction/**A** Endorsement Commission was added to provide more focus for inspectors performing inspections in ASME BPV Code shops, and the scope of the traditional commission was limited to inservice, repair, and alteration inspection in accordance with the NBIC. This change allowed the National Board to provide more in-depth training to inspectors who solely performed inservice inspection, as well as those inspectors who only performed ASME BPV shop inspections.

With technology in the boiler and pressure vessel industry rapidly advancing and the ASME BPV Codes expanding to keep up with technology, it was becoming harder for inspectors to maintain their competency. Based on this need, the concept of continuing education was introduced in 2010. This resulted in a change to NB-263 to address continuing education. By the end of 2014, it became a requirement that all inspectors take an approved continuing education course prior to the renewal of the 2015 commission cards.

A New Standard: RCI-1

The National Board wanted to make sure all commissioned inspectors were kept apprised as changes occurred. On October 14, 2014, the National Board approved a complete rewrite of NB-263, *Rules for National Board Inservice and New Construction Commissioned Inspectors* that was renamed NB-263, RCI-1, *Rules for Commissioned Inspectors*, with the NB-263 designator retained for recognition. RCI-1 was published and a copy was sent to each and every commissioned inspector.

When RCI-1 was developed, it was determined that a new edition would be released every two years. As such, the 2017 RCI-1 has been completed and published, and a copy was mailed to all commissioned inspectors in October 2016.

There are several significant changes in the 2017 edition. The first was to eliminate the confusion surrounding the New Construction Commission/**A** Endorsement. The National Board wanted to make it clear that the New Construction Commission is in fact a stand-alone commission, so both terms (New Construction Commission and **A** Endorsement) have been replaced in RCI-1 with the term Authorized Inspector Commission (**AI**).

RCI-1, Rules for Commissioned Inspectors

The second change was to once again more closely mirror inspector training with the actual repair and alteration duties performed by an inspector in accordance with NBIC, Part 3. All inspectors who currently hold an **IS** commission or an $\mathbf{A_r}$ endorsement will be issued the new Repair Inspector Endorsement (**R**) on their 2017 commission cards. After July 1, 2017, applicants for the new **R** endorsement will be required to successfully complete the new Repair Inspector Course (**R**) and meet all other requirements for the endorsement outlined in the 2017 RCI-1.

Continuing education has also been updated to put more control of an individual's training back in the hands of the employer. Prior to the issuance of the 2018 National Board commission cards, all inspectors will be required to complete one continuing education course annually for each commission or endorsement they hold. These courses may be chosen by their supervisor or by the inspector from a list of qualified courses based upon individual training needs. These courses have replaced the previous continuing education "bundles" that were taken every other year. The deadlines have been adjusted accordingly so that the total time required to complete continuing education requirements in any two-year period has not changed. For more information regarding updates to National Board continuing education and commissions and endorsements, see Training Matters on page 38.

In Conclusion

Changes to RCI-1 and the commissioning program are maintained by the Committee on Qualifications for Inspections. This committee meets twice a year to discuss potential revisions to existing qualifications for inspectors, authorized inspectors, pressure equipment inspectors, and certified individuals, and also to formulate new requirements and to address interpretation requests for these procedures. The committee is comprised of a cross-section of jurisdiction members and authorized inspection agency representatives.

As has been true from the beginning, future changes to commission and endorsement programs will continue to evolve to meet the needs of industry, and with industry's input. Commissions and endorsements must stay in sync with revisions made to the ASME BPV Code and the NBIC. This is necessary for identifying the need for specialized training, developing the training, and maintaining an inspector's competency.

This ongoing evaluation of the program ensures inspectors obtain and maintain the qualifications necessary to perform safe and effective inspections of pressure-retaining equipment, thus providing the high level of safety we all strive to maintain within our industry.

For more information about NB-263, RCI-1, *Rules for Commissioned Inspectors,* visit nationalboard.org and click the "Commissions and Certifications" tab. ✤

Pressurized Hydrogen

BY JAMES R. CHILES

Picture this: inside a brightly lit lab at a university's chemistry department, a research assistant is edging along the floor. She's holding a broom out like a lance, brushy end first. There's nothing special about the broom: it's an old-fashioned straw broom, exactly like those that cleaned farmhouse floors circa 1900. To the casual visitor, nothing seems to justify this odd behavior – or her look of concern. But she has good reason for caution: after advancing a few more feet, the broom bursts into flames. She retreats to pull the fire alarm. It's not just any fire she almost walked into: this was a hydrogen-oxygen fire, virtually invisible except for a heat shimmer. This fire was extremely hot – but lacking carbon particles in the fuel mix – it radiated so little heat that a less cautious person would have walked right into it.

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Hydrogen is a gas that demands special care, particularly given that it's commonly stored at high pressure. But it also offers many new opportunities. If we treat it with the respect it deserves, we can get the good without the bad. Pressure vessel codes are ready for hydrogen, but what about users?

The Big Picture of the Hydrogen Economy

Beginning with a talk at General Motors Technical Center in 1970, the public began hearing about the Hydrogen Economy, a revolution of clean energy that was almost on the doorstep. But decades went by with no fuel cells at the dealership or in the neighborhood, only more pronouncements and prototypes.

But times are changing. Now, an infrastructure of high-pressure hydrogen is catching on, and fuel cells are probably closer to your work or home than you know. There are many reasons for the double-digit annual growth rates: this odorless gas is clean burning, yielding only water vapor; it can store and transfer renewable energy from solar cells and wind turbines that continue to grow in capacity; and it's a way for crisis-minded electricity customers to shield themselves from problems in grid-supplied power. Fuel cells can dodge many of the reliability problems that have dogged petroleum-fueled standby generators.

Let's back up and take a look at the big picture: hydrogen is one of several new ways in which pressurized energy technology could show up on the desks of pressure equipment inspectors and engineers. It could be in the form of steam that is generated from solar-thermal plants in the desert, or compressed air stored in caverns. This high-pressure air is packed away during peak production times and then tapped for use by turbine generators that feed the grid during peak-use times. The storehouse of compressed air, refilled daily, acts like a huge mechanical battery. After years of operation in Germany and Alabama, more such "Compressed Air Energy Systems" (CAES) are under construction, including a big one planned in Utah.

CAES, when scaled for leveling the peaks and valleys on big power grids, is massive. By comparison, stored energy in the form of pressurized hydrogen in tanks or cylinders is small in scale but also more widely dispersed across the landscape. These tanks feed hydrogen into compact chemical reactors called fuel cells that produce electricity, with the only exhaust being heat and water vapor. Now making rapid inroads as a substitute for emergency power at telecommunications and data centers, hydrogen fuel cells are poised to go big in vehicles and perhaps large-scale stationary generators that support the grid in times of need. Hydrogen is already powering swarms of fuel-cell forklifts in warehouses operated by Coca-Cola, Walmart, and Sysco.

Fuel cell car

So far, nearly all of the hydrogen that feeds today's heavy industry and our fuel cells is chemically extracted from natural gas. In that respect, most hydrogen has been just a clean form of fossil fuel. But advocates want to tap non-fossil sources like biogas along with solar- and wind-derived electricity that will break hydrogen from water (called electrolysis). They want to move the new and renewable gas via truck or pipe to millions of fuel cells that can use it. This is the long-discussed Hydrogen Economy.

Winds of Change

It's hard to say how far or how fast the winds of hydrogen will blow through our familiar world, but change is coming. It's driven by multiple forces, not just environmental, but also by costs and concern about stable power. Fuel-cell backup generators began to catch favorable notice among emergency-minded people when they kept the lights on at isolated facilities during Superstorm Sandy, and their popularity grows with every new storm or earthquake around the world. An industry estimate in 2014 said that 3,000 cell-tower sites in the US had either installed fuel cells for backup power, or had them on order.

South Korea has commissioned the world's largest fuel-cell generating station, at 59-MW Gyeonggi Green Energy Facility, but that record won't stand for long. And there's the car factor. Hyundai brought its first mass-produced fuel-cell car to the West Coast three years ago, and other major-brand models are on the way, encouraged by advances in fuel-cell technology and tank capacity. There are at least 15 hydrogen-gas refueling facilities for cars and trucks in California, and that's slated to go up six-fold in six years. More such fillers (literal "gas stations") are going up from New Jersey to Massachusetts.

Lined, fiber-wound pressure vessels in late-model fuel-cell cars store hydrogen at 10,000 psi, which in combination with fuel efficiency, allows them to drive at least as far as a gasoline-fueled car before refueling. Meanwhile, 15,000-psi pressure vessels for cars are on the way. That's an impressive number for consumer technology – several times higher than any gas cylinder or scuba tank a consumer might come across – and that rivals the extremely strong vessels used in chemical processing plants.

Fine. So isn't hydrogen just another news blurb on the way to some kind of energy techno-upgrade? Why the call-out for special safety awareness?

Something Different on the Machine Frontier

In my book *Inviting Disaster*, I talked about how strange the "machine frontier" can be to the unwary, and offered the example of how five people were flash-frozen by a wave of supercooled carbon dioxide liquid in Répcelak, Hungary. That was a machine frontier incident, and hydrogen is equally part of that new frontier. Recall the broom in the lab catching fire, as if from some invisible force.

It's not that hydrogen is ultra-hazardous and in a class all its own. Rather, high-pressure tanked hydrogen is a subject worthy of attention because it's *different* from the family of compressed and flammable gases that people have gotten to know. In some ways, hydrogen (being nontoxic and very buoyant) is safer than other hazardous gases. But in certain settings, it's more dangerous to people who aren't trained and prepared.

Fortunately, there are up-to-date standards and training materials for people who design and use gear for pressurized hydrogen, or who might have to fight a hydrogen fire. There's no shortage of expertise, given decades of experience handling hydrogen in industry and power plants. Those sectors value hydrogen highly for its rapid heat transfer and usefulness in petroleum refining and metal manufacturing. Because hydrogen offers so much energy per pound, NASA's Space Shuttle engines relied on it as a fuel.

"Hydrogen has been used for a long time, but now it's reaching a new audience, and one that's not familiar with it," said Nick Barilo, manager of the Hydrogen Safety Program at the Pacific Northwest National Laboratory. "We need to make sure they're up to speed."

Given that thousands and maybe millions of hydrogen pressure vessels will be showing up in businesses, electrical substations, warehouses, cars, and garages, following are a few hydrogen highlights. I hope these will underscore why healthy respect is in order.

About that broom: Pure hydrogen-oxygen fires lack the incandescent carbon particles we're familiar with in standard hydrocarbon flames like those from oil, wood, plastics, or natural gas. So hydrogen flames are not only invisible, they offer little or no advance warning in the form of radiant heat on the face and hands. In short, it's possible to stroll into a very hot hydrogen flame and not know it until one's hair is on fire.

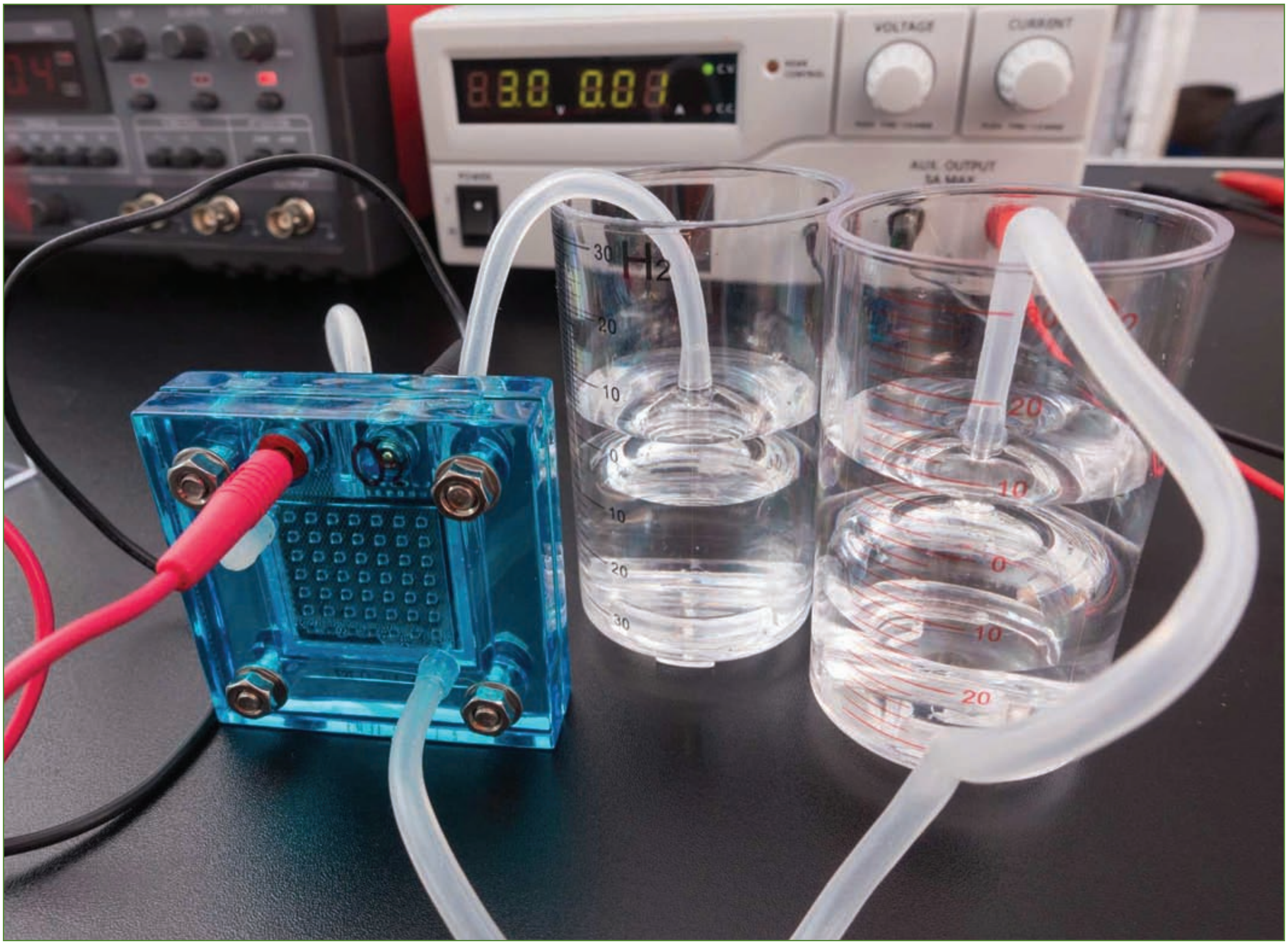
About what feeds that flame: When mixed with air, hydrogen has a very wide range of flammability. At one point on that range – about 30% of air by volume, called the stoichiometric ratio – the mix needs only an absurdly small spark to ignite. As in: a static flicker far too feeble to feel on your skin is entirely capable of triggering a hydrogen fire or, if that mix is confined, an explosion with a supersonic blast wave. And that flicker of heat can come accidentally, by using equipment and metals not suited for hydrogen.

About that equipment: Hydrogen gas in use (actually a molecule of two hydrogen atoms stuck together) is a very small and slippery customer, capable of edging its way through layers that we might think are gas-tight. "The major concern for operators is leakage and accumulation of H_2 gas," said pressure vessel consultant Francis Brown. "In addition to issues associated with sealing gases at high pressure, hydrogen gas will migrate through the vessel wall. Hydrogen storage vessels should not be located where hydrogen gas can accumulate."

Adding to the leak factor, high-pressure hydrogen will attack certain metals (including alloys of steel, titanium, and nickel) turning them brittle and, therefore, weak. And users need to watch for fatigue cracking or impact damage. Said Brown about guarding structural integrity: "Designing vessels to ASME Section VIII, Division 3, mitigates the concern."

Leaking hydrogen is odorless, invisible, and not easy for equipment to detect at the lower ranges of flammability. Why can't distributors warn our noses by adding mercaptan odorants, as we do with the natural gas piped into homes? Barilo explained that current fuel cells need very pure hydrogen and can't tolerate such contaminants. Plus, hydrogen gas is so buoyant that odorant molecules would get left behind as leaking hydrogen gas zoomed upward.

Of course, hydrogen's super-buoyant nature can be a good thing. In open air, leaking hydrogen is likely to rise and disperse before any flammable mix or ignition source can become a problem. Its low density at atmospheric pressure is why early dirigibles (like the Hindenburg) used hydrogen as a lifting gas, and why weather balloons still do. Ah – the notorious flaming Hindenburg newsreel – a reminder that the hydrogen industry wants no more disasters in the news.



Hydrogen fuel cell

In closing, here's a short list of practices to avoid, given that human nature is always on the lookout for shortcuts and cost cuts, however risky. One: fuel cell car owners – if your car is in any kind of mishap that nicks or scorches the hydrogen pressure vessel, don't plan on patching it up and using it again, or putting it on eBay. Once damaged, any fiber-wound vessel that would be plumbed to hydrogen at five tons of pressure per square inch should never be used again.

Second: telecom operators – are you meeting safety codes? Given that pressurized hydrogen tends to leak, a problem area under fire codes would be a cabinet full of cylinders next to electrical gear that isn't "classified" (rated safe) for use in flammable atmospheres, and where the setup lacks other special provisions, such as ventilation or barriers.

Another risk area to watch, said Nick Barilo, is a laboratory where assistants haven't been trained or equipped to deal with hydrogen's special demands. This example from the University of Hawaii, Manoa, in March 2016: according to the fire investigation, a researcher was severely injured when a pressure vessel filled with hydrogen and oxygen exploded, perhaps sparked by a non-compliant digital pressure gage.

Yet even with the cautions, Barilo is optimistic. "Hydrogen is going to open a lot of opportunities. Up to now our generations ran on gasoline." He recalled how gasoline fuel led to many accidents in the early years, and how it was seen as unreasonably dangerous until people understood the risks of flammable vapor and learned how to treat it with care.

The same learning curve will happen as new people handle and store hydrogen for fuel cells, Barilo said.

"Hydrogen is for the next generation. And if you understand and evaluate the risk, and then mitigate it, you'll be okay!"

2017 NBIC

NATIONAL BOARD INSPECTION CODE

PART 4
PRESSURE RELIEF DEVICES

The *National Board Inspection Code* (NBIC) has always been a valuable source of information regarding pressure relief devices (PRDs) and overpressure protection. In past Editions, this information was found within the NBIC's three Parts: Part 1, *Installation*; Part 2, *Inspection*; and Part 3, *Repairs and Alterations*.

In the upcoming 2017 Edition of the NBIC, all of the requirements and guidance relating to PRDs will be compiled into one book, Part 4, *Pressure Relief Devices*. Pressure relief device requirements are inherently different from the requirements for pressure-retaining items. Part 4 was created out of the need to integrate and emphasize this unique material.

"Usability was the primary driver for adding Part 4 to the NBIC collection," explained Tom Beirne, secretary of the NBIC Subcommittee on Pressure Relief Devices. "Users who are

Introducing a New, Integrated Standard from the National Board

responsible for overpressure protection will benefit from the functionality of having all PRD content together."

"Pressure relief devices are one of the 'last lines of defense' on a piece of pressure equipment, but sometimes they are overlooked in the code world because they are specialty items," added Joe Ball, director of the National Board Pressure Relief Department.

"As the NBIC was compiled over the years, PRD information was placed in either Part 1, 2, or 3 of the NBIC based upon relevancy. Installation concerns are in Part 1. Inspection of these items is included in Part 2. Repair requirements, although different from those for other pressure-retaining items, were in Part 3. Therefore, inspectors and users have had to flip back and forth between the three books to find what they need. Part 4 simplifies and streamlines PRD data."

Verification test of a pressure relief valve performed at the National Board Testing Laboratory -- a Part 4 activity.

Functionality for Primary PRD Users

The main users of Part 4 are those people responsible for overpressure protection who often need to understand and apply all aspects of PRD requirements. "They need to know how a pressure relief device should be installed. After they go into service, these devices must be periodically inspected to ensure continued reliability. If an inspection reveals a deficiency, a repair may be necessary. The new Part 4 addresses all of these issues in a unified format, with the benefit that everything is tied together for a PRD user," Ball said.

"And that was the goal – to consider the user of the Part 4 document as a person with multiple needs," he continued. "As an example, a user does not just install a PRD and never look at it again. Periodic inspection and in-service testing come after installation. Inservice inspection by a commissioned inspector follows procedures contained in Part 2, but ensuring the installation requirements have not been affected is one of the key points that the inspector checks, particularly if a system has been modified."

Ball explained that the portions of the previous version of Part 3 (PRD repair) were the focus of **VR** repair stamp holders, and the **VR** Repair Program quality and technical requirements are important to their work. The **VR** stamp holder's customer, however, is the user who is responsible for the installation and maintenance of the device. Ball said that knowledgeable customers want to have a thorough understanding of the repair process, even if they are not doing the repair themselves. If the user is not familiar with PRD requirements, they refer to an experienced organization, which often is a **VR** company. Many valve repair organizations also supply new PRVs, where again, they receive questions and concerns from their customers related to the application and installation of PRDs.

All of these NBIC users that have multiple PRD focuses will now have at their fingertips requirements on how to install pressure relief devices, how to inspect them (and at what frequency), what types of tests are appropriate for PRDs, and what to do if a valve needs to be repaired.

Mechanics of Part 4

While Part 4 is a new book in the NBIC collection, the format remains familiar and is similar to the other three Parts. It contains a foreword; three main sections on the installation, inspection, and repair of PRDs; and a supplement section that will contain specialized information, such as operating pressure margins, recommended repair practices, and test stand design details.

Beirne and Ball both stressed that Part 4 does not contain extensive new content or requirements. "There won't be any big surprises in Part 4," Beirne assured. "The only substantive technical changes incorporated into Part 4 were those resulting from the normal ongoing committee process, such as the new supplement on thermal fluid heaters."

Otherwise, updates include editorial fixes and standardized language; "For example, throughout the three Parts, different terminology was used in reference to PRVs: safety valve, safety relief valve, relief valve, or pressure relief valve," explained Beirne. "All of these descriptions were standardized to simply: pressure relief valve. Updating the terminology throughout the entire NBIC was a good cleanup detail."

Beirne was responsible for managing the mechanics of the new document.

"Our starting point of the first draft was copying text from the existing documents into one big document. Then the text needed transitions and introductions, which the Committee voted on. The numbering system throughout needed to be updated, and the work cascaded from there," he stated.

Once the final draft of the document was prepared and approved by the NBIC Main Committee, it went through the public review process, which started in August 2016. "Many people look over the NBIC before it goes to publication and any comments that come back from the public review are addressed by the Committee. When those comments are resolved, the NBIC goes into a publication draft."

This public review period is part of the due process requirement of the American National Standards Institute (ANSI), with which the NBIC complies. Being an ANSI standard means the document has been prepared under a process that ensures fair representation of all affected interest categories and input from the public. Most jurisdictions cannot accept standards that are not ANSI approved, and the National Board believes ANSI approval is an important part of ensuring wide acceptance and adoption of the NBIC.

Ball observed that there aren't many integrated standards similar to Part 4 in the boiler and pressure vessel industry. "We believe there is a market for it," he said. "Pressure relief specialists will look at Part 4 as a complete unit: application and installation, inspection, and then servicing PRDs."

He reported that ASME is following the same concept with a forthcoming pressure relief standard for new construction. "Every reference to overpressure protection within the *ASME Boiler and Pressure Vessel Code* will be integrated into one new document, Section XIII," Ball said, adding that ASME has approved the project and a standards committee has been appointed. Section XIII will likely be published in 2019 or 2021. Once available, the concept is that the other code Sections would reference the single Section XIII document for PRD information, just as they now reference one document for welding or NDE.

Committee Work

Compiling Part 4 involved a comprehensive review by the PRD Subcommittee of all three Parts of the NBIC over a period of approximately seven years.

"When the PRD Subcommittee looked at the PRD material as a whole, it brought the integrated application of pressure relief devices into clearer focus. A good portion of the committee's activities was related to **VR** program issues from Part 3. When we compiled everything into Part 4, the PRD requirements in Parts 1 and 2 got a very thorough review. It helped us see the big picture and caused some new business items to come forth. Because of this process, the PRD Subcommittee has taken stronger pride of ownership over the content from Parts 1 and 2 [that are now in Part 4] that had not been looked at in a while," Beirne reported.

As Part 4 was developed, the PRD Subcommittee also took into consideration input from several people who concentrate their use of the NBIC on only one Part and wanted PRD information to remain in that Part. Therefore, in the 2017 Edition, the PRD installation and inservice inspection requirements in Parts 1 and 2 will be retained in those Parts (but will also appear in Part 4). Valve repair requirements previously in Part 3 have been exclusively relocated into Part 4 and will no longer be found in Part 3.

To assist in the transition to the new document from the 2015 Edition, it is the National Board's intention to publish a cross-reference guide. More information will be forthcoming on the National Board website as the publication date of July 1, 2017, approaches.

In Conclusion

Part 4: *Pressure Relief Devices* has been a long time in the making, starting when Ball was secretary of the subcommittee in 2010 and then continuing with Beirne and the NBIC PRD Subcommittee and Main Committees in 2013.

"Tom's ran to the finish line with it," Ball observed. "He did a lot of the leg work."

"Joe helped the Committee get it to the red zone and I helped the Committee cross the goal line," Beirne joked. "In all seriousness, compiling and working through the questions and issues of the new Part 4 has been challenging. But it's been a worthwhile project for the future of the NBIC."

Both men acknowledge that the NBIC could not exist in its present form without the participation and strong support from the pressure equipment industry as expressed by the continued contributions of many different people and organizations represented in the standards writing process, along with support from National Board membership.

The *National Board Inspection Code* is a key standard for pressure equipment post-new construction activities, and the new emphasis on an integrated pressure relief device portion of the document marks the next chapter in the growth and development of the NBIC.

"What's that Handle For?"

A Primer on Lifting Devices

BY JOSEPH F. BALL, DIRECTOR, PRESSURE RELIEF DEPARTMENT

An experienced inspector took a trainee on an inspection visit into a boiler and equipment room as part of the training. When the trainee was shown one of the most important safety devices on the boiler – the boiler safety valve – the trainee asked, "What's that handle for?"

The trainer explained that it's the lifting device, to which the trainee responded, "Oh, so it's there to lift the valve up when it's being installed on the boiler!"

This, of course, is not the correct response. A new inspector might not know the purpose of a lifting device (or lift lever). This article will explore the purpose of the device, its uses and functions, and what it is NOT supposed to be used for.

100 Years of Lift Levers

The *ASME Boiler and Pressure Vessel Code* (ASME Code) states that the primary function of a lifting lever is to verify that the safety valve or safety relief valve is free to operate. It has required lifting levers on boiler safety valves dating back to the earliest days of the code itself.

The 1914 Edition of ASME Code, Section I for Power Boilers, included the provision that, "Each safety valve used on a boiler shall have a substantial lifting device, and shall have the spindle so attached that the valve disc can be lifted from its seat a distance not less than one-tenth of the nominal diameter of the valve, when there is no pressure on the boiler."

This is very similar to the requirement in the 2015 Edition which states that, "To provide a means for verifying whether it is free, each safety valve or safety relief valve shall have a substantial lifting device, which when activated will release the seating force on the disk when the valve is subjected to pressure of at least 75% of the set pressure."

Back in the day, boiler water was not treated the way modern boiler water is, where boilers are equipped with chemical feeding systems (some that operate automatically) and where simple tests performed by the boiler operator can monitor the treatment system performance.

When untreated water was used, the buildup of scale was a constant problem that affected heat transfer and efficiency, and could cause the safety valve seats to stick together. The boiler operator would periodically lift the safety valve by hand with the lifting lever to determine if the valve was stuck closed or not, which would also flush out any deposits that might have accumulated in the valve.

In the past, as part of a periodic inspection, an inspector would verify that the valve was indeed not stuck shut by performing his own test. The test did not tell him the set pressure that the valve would open at, but at least he knew it would operate.

Testing Today

Today, a recent performance test of the safety valve done by a qualified organization such as a National Board **VR** or **T/O** certificate holder is often accepted as evidence of operation, and is considered superior to the lift lever test because the actual set pressure has been verified. If users periodically perform lift lever tests themselves, they should document it in the boiler operating log, which is one sign of a well-run boiler room. If no record of a test is available, the inspector will need to see the lift lever test performed. Most of today's jurisdictional and inspection agency inspectors have rules from their employers stating inspectors should not normally operate equipment themselves, and tests of safety valves or other safety equipment should be requested from the boiler owner's personnel.

There are exceptions. Very small boilers with automatic controls, such as boilers used by dry cleaning companies, may be used in situations where no trained boiler operator or maintenance personnel are available. These inspections may not take a lot of time because internal inspections may sometimes be waived due to the low pressures and small sizes involved. However, the safety valve should always be checked, and if there is no one available to do the test, the inspector may have to instruct the user on how to do it, or actually perform it himself.

A lift lever test is simple but some precautions should be taken. As we observed from the aforementioned Section I requirement, lifting devices need to be designed to operate at only 75% of the set pressure or greater, so there should be pressure in the boiler in order for the valve to operate properly. Damage to the lifting lever and its attachment hardware can occur if the pressure is too low. The pressure also serves to flush out debris or scale that could foul the seat and cause the valve to leak when it closes (there is a risk the inspector is faced with that the valve didn't leak before the test was done). Eye and hand protection should be worn to protect from a release of steam.

When the test is done, pull the lifting lever firmly and then release it in a manner that allows the valve to "snap" closed. This will help ensure a tight reclose of the valve. Wait a few minutes for the steam and moisture to dissipate, and then check for leakage. A second test may sometimes be needed to flush out dirt or debris on the valve seat if leakage is observed.

If a boiler operates at higher pressure or its valve is larger, the person doing the test may not want to be near the valve. In this case, a rope is tied to the end of the lever so it can be pulled remotely from a few feet away. Most lift levers are provided with a hole in the end of the lever for this purpose.

If the valve does not open, this is a serious safety issue that must be corrected immediately by repairing or replacing the valve. If the valve is leaking, it will also need to be corrected because that leakage can result in deposits around the seating area that may cause the valve to stick as deposits accumulate.

Pressure Vessel Lifting Device Usage

A test using the lifting device is also commonly performed on air receiver vessels used for pneumatic equipment or tools, often found in service stations, garages, or in plants and factories. The safety valves on this equipment are very small brass valves, and most do not have an attachment for a discharge pipe. These valves sometimes have a pull ring instead of a lift lever. Removing and

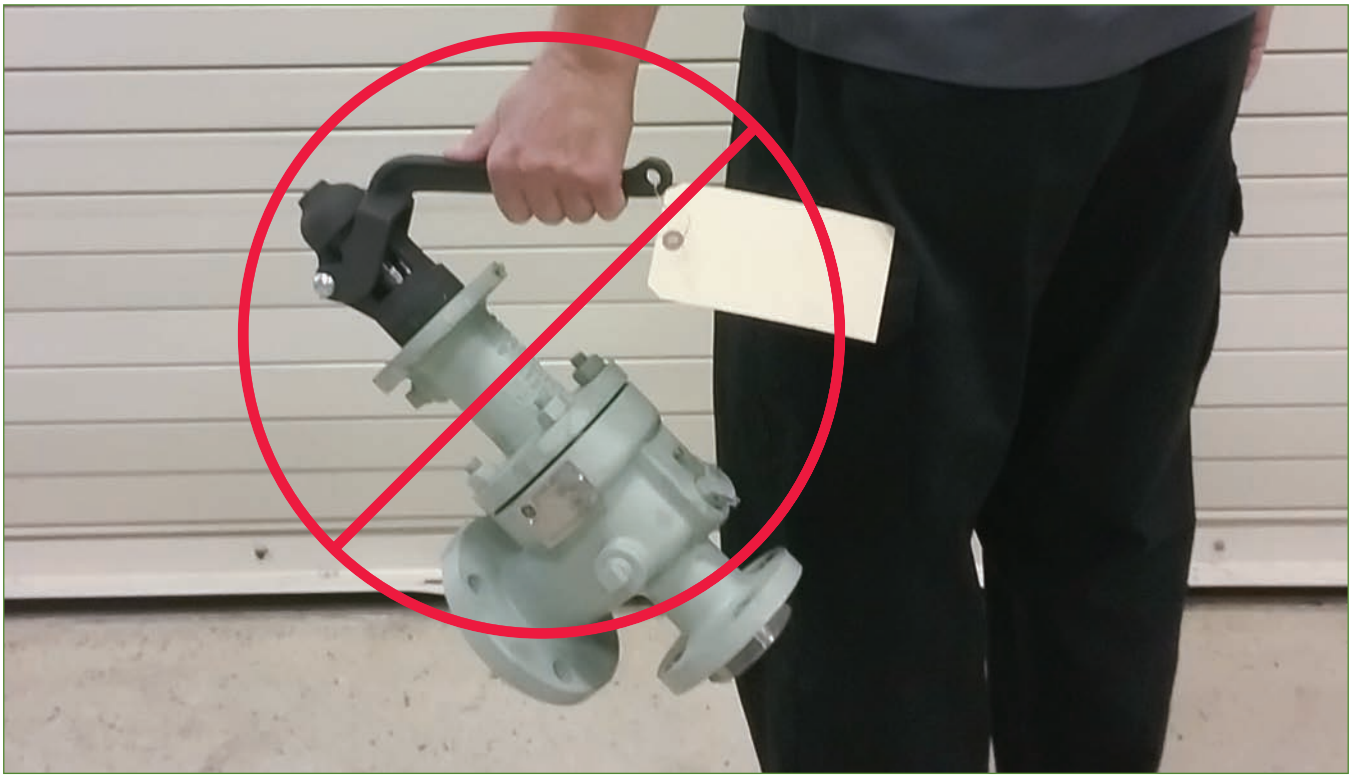
Pull ring valve

sending out these valves for a pressure test necessitates shutting down the equipment, and the test would probably cost more than a replacement valve.

The test is conducted in the same manner as above, but the small discharge holes on the valve are prone to accumulating dirt or oily residue from the compressor. As a precaution for eye safety, a shop towel can be loosely wrapped around the valve to catch any dirt or deposits that discharge when the valve is actuated. If the valve does not "pop" open, it must be immediately replaced.

Requirements for pressure relief valves on pressure vessels found in ASME Code Section VIII indicate that a valve must be supplied with a lifting device only for steam, air, and water over 140°F. The ASME Code looks at the valves in a way that tries to recognize "risk versus reward" concerns. While it could be helpful to have a lifting device for all pressure relief valves, because Section VIII valves have a wide range of service, there may be hazards associated with the fluid being discharged during the lift lever test. Therefore, for services that are commonly assumed to be safe for discharge, the lifting device is mandated. For all other services, the application of a lift device is the option of the user, and many users will choose to not install one if it is not required.

The ASME Code has also recognized that for even the basic fluids of steam, air, or hot water, there are concerns with this type of test. If an air pressure relief valve on a system used for plant instrumentation is actuated and fails to reclose, the plant could lose other safety equipment run by that air. Code Case 2203-1 indicates that a pressure relief valve that normally requires a lifting device may have the lifting device omitted, provided the user has a program to periodically remove the



Lifting or carrying the valve by the handle is not recommended.

valve from service and test it. Users are cautioned that this provision must be accepted by the jurisdiction since it is based upon in-service concerns.

The lifting device has another use that is less commonly employed. For boiler safety valves that are being tested live on the boiler (a full-pressure test using steam), there is a possibility that the valve may exhibit unstable performance if not adjusted correctly. During the adjustment process, a recommended practice is to install the lift lever after each adjustment, and attach a rope to the lever. Then if the valve fails to fully lift, or lifts and starts to chatter (a very rapid opening and closing of the valve) the rope is pulled, which puts the valve into a full steady lift. This avoids damaging the valve seat and guiding surfaces before the next adjustment is made and the test repeated. Anyone doing this work is cautioned that this testing can be very hazardous and the process must be carefully controlled.

How NOT to Use a Lifting Device

What should the lifting device *not* be used for? When I first started in the industry, I assumed one use of the lifting device might be to break the valve disk free from the seat if it didn't actuate when expected. In reality, if a situation is observed where the pressure is too high and it seems like a valve should have actuated, it is not a good idea for an inspector (or anyone else) to go on top of the boiler and break it free. Instead, the energy source should be shut down. The *National Board Inspection Code* (NBIC), Rules for Remote Emergency Shutdown Switches (NBIC Part 1, par. 2.5.3.2) exists for this purpose.

And no, lifting or carrying the valve by the "handle" is not a good idea. The design rules for lifting devices indicate they must operate at 75% of the set pressure or greater. Carrying the valve by the lift lever with no pressure present could possibly result in damage to the valve stem, the lifting device, or the valve seats. Your repair firm may be happy with the additional work and spare parts needed during the next repair cycle, but your maintenance budget number-cruncher will probably not be!

Preferred practice is that pressure relief valves be periodically pressure tested to verify freedom of performance, set pressure, and seat leakage. However, there may still be times when this is impractical, and the time-honored lifting device (the "handle") is there for the purpose of verifying freedom of operation on one of the most important safety devices on the boiler.

Note: ASME Code Section IV also requires a lifting device on all pressure relief valves. For these lower-pressure services (when compared to Section I) the lifting device must be able to actuate the valve without pressure; however, some pressure is preferable because it gives a visual indication that the valve has lifted, and the pressure will serve to flush out corrosion or scale products. ✚

New Member

Terence J. Waldbillig represents the state of Wisconsin. Mr. Waldbillig served six years in the United States Navy. He was employed with Hartford Steam Boiler Inspection and Insurance Company as an inspector from 1979 to 1997, and then with Arkright Insurance. He joined the state of Wisconsin as an inspector in 1998 and has remained with the state since that time.

In Remembrance


William Owens

Former Louisiana Chief Boiler Inspector **William Owens** passed away on October 21, 2016. Mr. Owens served in the United States Air Force and attended boiler training school. His civilian career as a boiler inspector included employment with the Hartford Steam Boiler Inspection and Insurance Company; the city of Tucson, Arizona; and with the state of Louisiana. Mr. Owens was a National Board and ASME team leader and held an **A** endorsement. He retired from the state of Louisiana in February of 2015.

Former Maine Chief Boiler Inspector **Joseph W. Emerson** died on October 21, 2016. He served as chief from 1969 until his retirement in 1980, and was selected as a National Board Honorary Member in 1981. He attended the Marine Maritime Academy and served during World War II as a Merchant Marine. He worked for the state of Maine as a boiler and elevator inspector for 25 years, and continued working as an engineer and boiler inspector into his 80s.

Members' Meeting Election Results


Joseph W. Emerson

The following business was transacted at the National Board Members' Meeting on October 4, 2016.

Donald Cook, California member, was elected Board of Trustees second vice chairman. He filled the position vacated by Michael Burns (formerly of Florida), who resigned earlier last year. Mr. Cook will hold the appointment for the remainder of the term ending in May 2018.

Four National Board members received the following awards: Peter Dodge, province of Nova Scotia, was acknowledged with a 10-year award. Steven Townsend, province of Prince Edward Island, Anthony Oda, state of Washington, and Matthew Sansone, state of New York, were recognized with five-year awards.

Cirilo Reyes

Senior Safety Engineer, Pressure Vessels, for City of Los Angeles

"When you are one of 11 children, you learn two things: how to fend for yourself and patience."

And Los Angeles Senior Safety Engineer Cirilo Reyes should know.

"I was the ninth child," he explains with a delicate smile, "which didn't result in a lot of family seniority."

The one talent each of his siblings had to learn growing up in the Philippines was how to cook. "With seven sisters and three brothers, we had to eat in shifts. That meant just about everyone took turns preparing meals every day, three times a day. Being among the youngest, I was generally expected to wash the dishes. A lot of dishes!"

Born in the capital city of Manila, Cirilo reveals that his immediate family of three brothers and seven sisters was not so different from his extended family. "One of my mother's sisters had 16 children and another had 14. A third sister had 12!"

His large family notwithstanding, the Los Angeles official enjoyed a fairly typical adolescence including playing a variety of sports. "The only difference from North America," he notes, "would be the paramilitary training that was mandatory in Philippine high schools."

While in high school, Cirilo realized that he had a head for numbers and focused on algebra, geometry, and trigonometry. And then an older brother studying engineering in college caught his little sibling's attention. The influence was such that Cirilo enrolled in the mechanical engineering curriculum when he started at the University of the Philippines in 1968. "I had always wanted to be a mechanical engineer," he offers in a noticeable Filipino accent.

Photo by Micheelle De La Vara

During Cirilo's first year in college, a relationship with a young lady whom he had known since the fifth grade evolved into a romance. "Since Josie only lived two streets away, we were pretty much friends until we went to college and became engaged," the Los Angeles official smiles. "She studied library science while I concentrated on my engineering."

Several months after graduating from the five-year program with a BS/ME, the senior safety engineer landed a position at a company manufacturing gas ranges. "I only stayed a year before going to work at the Singer Sewing Machine Company in Manila as a production supervisor overseeing the foundry and machine shop," he explains. Josie went to work at a school library.

The two were parted in 1976 when Josie's sister, who had been living in Los Angeles, petitioned to bring her three siblings to the United States as immigrants. She went back to marry Cirilo and they settled in the States.

"I had never been to the States before we arrived in 1977," he admits with a grin. "There were already 20 of Josie's relatives in the country when I arrived, and that was very fortunate for us. They were exceptionally helpful in assisting our transition into Los Angeles."

The Reyeses lived with Josie's family for several weeks before renting an apartment near her sister. With no job and the discovery that Josie was now pregnant, Cirilo was suddenly experiencing the pressure of urgently finding gainful employment.

It took him two weeks to find an assembly line position soldering record turntables.

"It was a job," Cirilo admits. "And a start."

The senior safety engineer worked the assembly line about four months before one of Josie's relatives told him about a job opening at a local hospital. The only hurdle: passing a boiler operator exam.

Having passed the test, Cirilo became the hospital's maintenance engineering boiler operator overseeing the facility's 500-HP boilers.

For three years, Cirilo watched as boiler inspectors from Hartford Steam Boiler Inspection and Insurance Company regularly came and went at the hospital. "One day I finally decided to ask an inspector how to get a job with Hartford. He replied that the company would be hiring in a couple of months and that I should send in an application."

Following the inspector's instructions, Cirilo sent an application and was invited to Hartford, Connecticut, for the purpose of interviewing for a position.

"I left the hospital after three years and started with Hartford as a boiler inspector in 1980. During that same year I passed the National Board exam," he proclaims with pride. "I received my nuclear endorsement in 1981, my **I** endorsement in 1989, my **A** endorsement in 1992, and my **B** endorsement in 1994."

The Los Angeles National Board member served with Hartford Steam Boiler Company for 26 years before retiring in 2006. Although boasting several accomplishments during his tenure, he was most proud of not having missed a day's work with Hartford.

After completing the required five years of residency, Josie and Cirilo were made naturalized US citizens in 1983.

Shortly after retiring from Hartford in 2006, Cirilo started a new chapter in his life by taking a position as boiler inspector for the city of Los Angeles. "In 2010, I was named the city's senior boiler inspector," he recalls. "Later that year, I became a member of the National Board."

The Manila native explains that he is now one of three senior city inspectors.

"Working for the city has been a great experience for me," Cirilo notes with a smile. "I was fortunate in that I made a rather easy transition from the private to public sector. The only thing I miss from my days with Hartford are the spectacular helicopter trips to the oil platforms off the Pacific coast."

Josie retired in 2010 as a library administrator for the County of Los Angeles Public Library. She and Cirilo are in the process of planning several cruises in 2017 to satisfy their wanderlust. The Reyeses have two grown daughters and four grandchildren, with another on the way.

Cirilo says there are two reasons he has no foreseeable plan to retire. Both involve his experience.

"The first is to maintain the city's high level of safety protection," he confirms. "The second is to permit the timely and seamless passage of knowledge to those who share the love of the inspection discipline."

Cirilo emphasizes he looks forward to spending more time with his grandchildren and with Josie, "the love of my life and my biggest supporter."

While Josie may be Cirilo's head cheerleader, the Los Angeles official also expresses gratification on the loving support of his extended family. All 174 of them.

Training Changes and Updates on the Horizon

BY KIMBERLY MILLER, MANAGER OF TRAINING

A new year always brings about changes, especially in the training department. Of course, there is the new schedule of instructor-led training classes and new online courses to debut, but 2017 also brings larger scale changes for the department as well as its students.

As everyone is now aware, the 2017 edition of RCI-1, *Rules for Commissioned Inspectors*, has several changes from its last issue in 2015. Two of those changes have had a direct impact on the training department. Let's review.

Continuing Education

The first and most immediate change began January 1, when the requirement for continuing education for commissioned and endorsed inspectors changed. Previously, inspectors were required to complete a group of courses (known as a continuing education bundle) every two years. Today the number of courses required has been reduced to one; however, the frequency has been increased to every year.

In response to this change, the training department has worked to reassess all online courses to ensure they meet length requirements and that the content is relevant to the scope of each credential. In addition, we have been developing new courses to add under each category (inservice inspection, nuclear inspection, etc.) of the online catalog. These new courses will be rolled out throughout the year. One major benefit of this change is inspectors and inspector supervisors will be able to select which course they would like to take for continuing education instead of being limited to what was included in the predetermined bundles. Note: under the new rules, no course may be taken as continuing education two years in a row.

A new project, which was in development prior to the 2017 publication of RCI-1, is the new online training center – now titled the Education Center. The rollout of the Education Center project was timed to correspond with the change in continuing education requirements. This entirely new system will allow students to sort the training catalog alphabetically by title or by course category; enroll in and complete online training; review a list of completed online and classroom training; print certificates from online and classroom training; and print transcripts which show a list of training and exams taken with completion dates and credentials. Courses listed in the new online training catalog are marked as "continuing education qualified" and for which commission/endorsement that qualification covers.

Repair Inspector

The second change is the introduction of the new Repair Inspector **R** endorsement. Previously, all inspectors holding an inservice (**IS**) commission were automatically approved to perform inspections on repairs and alterations. Beginning in July, those applying for the **IS** commission will be limited to inservice inspections, and the new **R** endorsement will be required of those performing repair inspections to pressure-retaining equipment.

In response to this second major change in RCI-1, the training department is currently working on a new classroom course, Repair Inspector (**R**). This is a four-day instructor-led training session covering agenda items such as duties and responsibilities; quality systems; *National Board Inspection Code* Part 3; welding fundamentals; ASME Section IX, postweld heat treatment, nondestructive examination; and repair forms. On the afternoon of the fourth day, a 50-question multiple choice exam will be administered to students. As with all endorsement exams, 70% will be the minimum score for a passing grade. Attending this training and passing the examination is one requirement in applying for the new **R** endorsement.

Beyond RCI-1

In addition to these two changes to National Board training, the Inservice Inspector Commission Course (**IC**) is also being retooled to reduce training on repairs since that information will be covered in the new Repair Inspector Course. This will allow more time to be spent covering inservice inspection, including a new Final Review Workshop which will serve as a review of the course as well as the duties and responsibilities for inservice inspection. The new version of this course will also debut after July 1. Until that time, all students attending an inservice class will be issued the **IS** commission with the **R** endorsement. Students attending the inservice course after July 1 will be required to attend the repair course if they wish to perform inspection of repairs.

The name of the New Construction Commission and Authorized Inspector Course (**A**) has been modified to match the new designation of **AI** commission – it is now the Authorized Inspector Course (**AI**). This course will again be offered six times in 2017.

Students interested in attending a National Board training course or seminar in 2017 can find the complete list of dates and full course descriptions under the TRAINING menu at nationalboard.org.

2017 Training Courses and Seminars

All training is held at the National Board Training Centers in Columbus, Ohio, unless otherwise noted. Class size is limited and availability subject to change. Check the National Board website for up-to-date availability.

COMMISSION/ENDORSEMENT COURSES

(I) Authorized Nuclear Inservice Inspector Course
Tuition: $1,600
3.5 CEUs Issued
September 11-15, 2017

(C) Authorized Nuclear Inspector (Concrete) Course
Tuition: $1,600
3.0 CEUs Issued
November 13-17, 2017

(N) Authorized Nuclear Inspector Course
Tuition: $1,600
3.1 CEUs Issued
July 10-14, 2017

(IC) Inservice Inspector Commission Course
Tuition: $3,200
8.7 CEUs Issued
March 27–April 7, 2017
July 24–August 4, 2017
September 18-29, 2017
November 6-17, 2017

(B/O) Inspector Supervisor Course
Tuition: $1,600
2.9 CEUs Issued
May 15-19, 2017
October 30–November 3, 2017

(AI) Authorized Inspector Commission Course
Tuition: $3,200
7.6 CEUs Issued
May 1-12, 2017
June 12-23, 2017
August 14-25, 2017
October 9-20, 2017
December 4-15, 2017

(R) Repair Inspector Course
Tuition: $1,300
CEUs Issued TBD
August 28-31, 2017
October 23-26, 2017

CONTINUING EDUCATION SEMINARS

(VR) Pressure Relief Valve Repair Seminar
Tuition: $1,600
Off-Site Tuition: $1,700
2.6 CEUs Issued
March 13-17, 2017
June 5-9, 2017

(RO) Boiler and Pressure Vessel Repair Seminar
Tuition: $850
Off-Site Tuition: $950
March 21-23, 2017
June 27-29, 2017
October 10-12, 2017

Code Interpretations

The *National Board Inspection Code* (NBIC) and the American Society of Mechanical Engineers' *Boiler and Pressure Vessel Code* (ASME Code) each issue responses to technical questions submitted by their respective user communities. Interpretations clarify the meaning or intent of existing rules. Section 10 of the NBIC contains an index of all approved interpretations at the time of publishing. A comprehensive index of interpretations is published online at: nationalboard.org/Index.aspx?pageID=4&ID=22

The ASME B&PVC contains an index of all approved interpretations at the time of publishing, along with the written interpretations for a given date range, at the end of each Section. All written interpretations are also published online at: cstools.asme.org/interpretations.cfm

Following are the 2015 NBIC interpretations. For more information on NBIC and ASME interpretations, refer to the websites listed above.

2015 NBIC Interpretations

- **Interpretation 15-05; Subject:** Part 3, 1.3.2 c); **Edition:** 2015
  Question: Is owner's method of verification of the installation of the Repair Nameplate acceptable per NBIC Part 3, 1.3.2 c) considering it as repair not routine repair as PWHT is involved in the repair?
  Reply: Yes (with the authorization and knowledge of the Inspector).

- **Interpretation 15-04; Subject:** Part 3, Section 3; **Edition:** 2015
  Question: Is explosion welding of plugs into leaking heat exchanger tubes considered a repair per the NBIC Part 3?
  Reply: Yes.

- **Interpretation 15-03; Subject:** Part 3, 3.2.6; **Edition:** 2015
  Question: Are fillet welded patches permitted by the NBIC for repairs or alterations to pressure-retaining items?
  Reply: Fillet welded patches are not addressed by the NBIC.

- **Interpretation 15-02; Subject:** Part 3, 5.12.2; **Edition:** 2015
  Question: When a pressure relief valve is repaired, are field labels for type/model number, capacity, CDTP, and/or BP required on the repair nameplate if the values are not changed from the original manufacturer's nameplate or stamping?
  Reply: No.

- **Interpretation 15-01; Subject:** Part 1, 3.3.4; **Edition:** 2015
  Question: Is it permissible to install boilers less than the minimum 36" clearance if recommended by the manufacturer and approved by the Jurisdiction?
  Reply: Yes, in accordance with Part 1, Section 3.3.4 a).

Host City for the 87th General Meeting

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