LIBERTY SHIPS

American shipyard workers lay down the keel of one of the 2,710 Liberty Ships built at 18 US shipyards during World War II. These humble vessels helped win the war and build a new world in the decades afterwards.
The technologies and manufacturing methodologies developed for the Liberty Ships exerted a profound influence on the maritime industry. A long chain of innovation, invention and discovery link those World War II ships to some of the most important advances in vessels, and even to the concept ships of the future, represented by the rendering of Rolls-Royce’s vision of an autonomous cargo vessel. This legacy is discussed in an article beginning on page 16 and in Viewpoint on page 20 of this issue of Surveyor.

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In June 2016, the U.S. Coast Guard (USCG) published its long-awaited Final Rule on Inspection of Towing Vessels under Title 46, Subchapter M in the Code of Federal Regulations. The product of a decade-long rulemaking process that embraced industry involvement, Subchapter M, as the Rule is known, establishes safety requirements and an inspection regime for the 5,500-plus U.S.-flag towing vessels that operate on the nation’s inland and coastal waterways and the Great Lakes.

In a letter following the Rule’s publication, the industry group American Waterways Operators (AWO), which represents the tug and barge sector, issued a letter hailing the regulation as taking safety in the towing industry to a new and historic level. When Subchapter M was submitted to the U.S. Office of Management and Budget for review, AWO President and CEO Thomas Allegretti said that, “For over a decade, AWO has strongly supported the USCG as it has worked to develop a towing vessel inspection regime. The rule will raise safety standards throughout the tugboat, towboat and barge industry, incorporating and building on the safeguards that quality companies have already put in place and ensuring that all towing vessels achieve a minimum threshold of safety.” He continued, calling the rule “a significant milestone in the industry’s quarter-century journey of continuous improvement to enhance safety and environmental stewardship.”

The development path for Subchapter M can be traced back 15 years to the public outcry following two major riverine tragedies: the first came in September 2001, when a tug struck the South Padre Island Bridge in Texas and caused the deaths of five people; the second occurred in May 2002, when a tug collided with a bridge on the Arkansas River near Webber Falls, Oklahoma, resulting in 14 deaths.

These incidents occurred in a long-simmering climate of criticism for what the press often referred to as the “free-spirited” inland waterways sector; criticism particularly focused on the areas of education, training and licensing of onboard personnel. The USCG, in fact, had been agitating for tighter controls on waterway captains and crews since a 1993 disaster in which a tug pushed a barge into an Alabama railway bridge minutes before a commuter train crossed over, causing 47 deaths.

The state of the industry at that time is reflected in the report to Congress on that disaster by the National Transportation Safety Board (NTSB), which stated that “The accident might have been avoided if the tug operator had known where he was in the fog and his relation to the bridge,” and that “The presence of marine radar and other navigational equipment, and an operator proficient in their use, may have prevented the barge from striking the bridge.” Some of the major recommendations from that report also indicate the sorry state of safety vigilance in the sector at the time. For example, the NTSB recommended that beginner towboat operators should be restricted on the size and configuration of barge tows and routes; that, for the first time, towboat operators should be required to pass simulator tests.
and written examinations each time they increased the scope of their licenses; also for the first time, operators should have to attend approved radar training courses; and that all vessels should have to carry marine radar and marine charts, instead of just a radio.

The accidents in 2001 and 2002 only seemed to confirm that the problems perceived in the previous decade had reached critical mass. Thus, it was no real surprise when the Maritime Transportation Act of 2004 reclassified towing vessels as subject to inspection, mandated the regulation of the towing industry and authorized the Secretary of the Department of Homeland Security, through the USCG, to establish requirements for a safety management system (SMS) suited to the unique characteristics and operations of the vessels.

From there, the USCG began work on a set of Federal rules to satisfy that mandate, and brought a substantial effort to bear on providing an inspection process tailored to the towing sector. This included intense consultations with industry and other stakeholders to design what became the Subchapter M rule. As part of the effort, the AWO and the USCG worked together on the 2009 Towing Vessel Bridging Program, which helped the industry prepare for the transition to the new inspection regime and its requirements.

The AWO had been pushing for quality improvement in the towing sector since 1994, when it established the Responsible Carrier Program (RCP) to bring a safety-driven code of practice to its membership. Intended to serve as a template for AWO member companies to use in developing company-specific safety programs that incorporate sound operating principles and practices not then required by law or regulation, the RCP became a condition of AWO membership in 2000. That year, the NTSB issued a report on a 1998 accident in which a towboat pushed a tow into a Mississippi River bridge in St. Louis, causing $11 million in damages. The report recommended that all towing vessels implement a safety management system.

“Thomas Allegretti, AWO President and CEO
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This proposal is an idea whose time has come,” said the AWO chairman at the time. “It would extend safety, security and environmental protection benefits to the entire towing system, while drawing on private sector and corporate resources for implementing and auditing the system.”

The RCP led directly to the SMS mindset that the USCG and the AWO called for. Its three principal parts covered management and administration, equipment and inspection, and human factors – requirements that make much of Subchapter M familiar ground to AWO members.

According to the USCG, Subchapter M creates a comprehensive safety system that includes many new requirements for design, construction, equipment and operation of towing vessels, along with compliance provisions for companies and vessels. It applies to all towboats 26 ft. or more in length (with some exceptions) and to all towboats engaged in moving dangerous or hazardous cargoes. Towboats that support salvage operations or tow recreational vessels are exempt, as are seagoing vessels of more than 300 gross tons. Certain regulations will be phased in over time, and existing vessels will have two years before having to comply with most of the requirements. It is estimated that nearly 1,100 owners and operators of towing vessels in the U.S. will be affected by the rule.

One significant provision of the new rule is that compliance can be demonstrated through the traditional inspection process or the new Towing Safety Management System (TSMS) option. Under a TSMS, owners have to implement policies and procedures, maintain operational protocols, identify and satisfy training needs, document and manage relevant data, and address the human element – and to be audited on all counts by an approved independent third party such as a classification society.

One advantage to the TSMS option has to do with modifications to a vessel or its plans after inspection. A vessel that has been inspected by the USCG, and afterwards receives modifications, must wait for a subsequent USCG inspection and approval of those modifications to begin working again. Under a TSMS, if those modifications were made in accordance with the safety management system the vessel can continue to operate, while the performance of the modifications is audited.
A
n ambitious joint industry project (JIP) now
underway seeks to develop a globally valid
off-the-shelf specification for offshore oil
and gas development projects.

The first effort of its kind, the Offshore
Standardization JIP brings together three top
Korean shipyards, international oil majors,
classification societies and leading engineering
consulting companies in a revolutionary push to
reduce costs and increase efficiencies in offshore
EPC (engineering, procurement and construction)
projects, through use of an industry-wide standard
building specification named the Integrated

The IOSS development program consists of two
JIPs, one focusing on equipment and one on bulk
material (which includes structure, piping, electrical
and instruments); their numerous tasks are divided
among working groups located in Houston, Korea,
London and Paris. Although separate efforts, the two
JIPs are interconnected through their participating
companies: the bulk material JIP works closely
with the three shipyards and has the oil majors
and engineering companies as advisors, while
the equipment JIP works closely with oil majors
and engineering companies and has the yards as
advisors, reviewing and commenting on the work
products.

This integrated effort seeks to find acceptable
common ground between the numerous individual
standards and requirements that shape offshore
projects. Many oil majors, for example, have their
own in-house safety standards and engineering
and design practices; meanwhile, industry groups in
various regions develop their own codes, standards
and recommended practices; on top of this, each
classification society has its own set of Rules for
building offshore structures. Although all these
requirements are proven, effective standards,
they reflect the particular philosophies of the
organizations that developed them and, thus, are
not in harmony with one another. Their application,
combined with design optimization, tends to
produce highly complex building specifications
unique to each project.

This complexity, in turn, introduces opportunities
for misunderstanding, miscommunication and
mistakes in construction, which end up being
rectified on the factory floor through rework
and change orders. It also tends to produce a
huge variety of similar components with slight differences, designed for very specific uses, which weighs down the manufacturing process. For example, highly engineered vessel designs developed with weight savings as the highest value tend to specify many pipe sizes and plate thicknesses, all dimensioned and formulated to exactly satisfy the unique requirements of specific locations on the vessel. Reducing these to a minimum practical number of types and sizes would save the operators money when ordering materials, allow steel makers to prepare the items in advance, and prevent ‘leftover’ materials from being discarded, as they would be applicable to future projects.

The above is an example of what the JIP categorizes as materials standardization, one of its four areas of focus, along with design, procedure and equipment. (Electrical equipment is treated under both the materials and design categories.)

Design standardization offers some significant savings opportunities as well. Consider that most FPSOs and offshore platforms end up with their own unique designs for mundane structural items like handrail systems, ladders, gratings and pipe supports, items that exist in great numbers throughout the world’s offshore equipment fleet. Likewise, cable trays and junction boxes in electrical systems provide another example of potential cost savings through mass production – a single FPSO contains more than 50,000 cable trays and 800 junction boxes. Defining satisfactory standard designs for these kinds of items, so that they are compliant with all safety and risk assessment requirements and can be used in most, if not all, offshore structures, would enable manufacturers to prefabricate and warehouse them and thereby bring the benefits of mass production to many oil and gas projects.

Procedure standardization, meanwhile, is related to documentation, certification and inspection. In many cases, inspection requirements are a point of discussion between the builder and the owner – which locations need what kind of inspection, how many of these need nondestructive testing (NDT), and so on. An accepted standard procedure covering the areas, amounts and types of inspection and NDT would save time in negotiations and add clarity to the overall production process.

In the area of equipment standardization, one of the JIP working groups is currently developing an “air compressor package” that defines functional and design requirements, materials, quality control, inspection and testing/installation and certification procedures, as well as some skid structures. This exercise highlights one of the big goals in equipment standardization, which is to use marine practice instead of offshore practice wherever applicable. So-called utility items like air compressors can be used equally well on a ship
or an offshore facility, but have different prices depending on the category under which they are ordered. One oil major made a cost comparison and found that the same compressor is almost twice as expensive when designated as offshore equipment as it is when designated for marine service.

COSTS VS. BENEFITS
The IOSS, naturally, would apply in whole only to a certain percentage of projects. The outlying projects and special cases, such as high-pressure, high-temperature wells, will need equipment that is outside the scope of the standardized specification; still, such projects will be able to benefit from its structural standards, which will streamline construction of the supporting platform or vessel.

A further benefit of the IOSS comes through familiarity - as a document well-known to both builder and client, it would help both parties proceed with a clear understanding of all expectations from the start of the project. In the shipyard, just the elimination of rework and change orders will save much time and energy and conserve raw materials. In the offices of the oil majors and engineering companies, the standardized specification will shorten the design spiral and reduce the work-hours spent in engineering design and analysis. Over time, widespread use of the IOSS could generate an enormous cumulative savings of manpower, brain power, materials and energy - a truly incalculable wealth of potential that could be applied toward future problems and solutions. Through these long-term energy savings, the IOSS could, in a sense, represent one of the single biggest footprint reductions from the offshore energy sector to date.

Since economics is among the main drivers of the JIP, one important part of the project is validation of its standardizations through a cost-benefit analysis. The working group now undertaking this task is looking at the IOSS in terms of materials costs, construction costs and indirect expenses. One interesting result of the analysis is that, in cases involving a reduction in the variety of piping and plate sizes, the overall material cost becomes slightly higher, due mainly to the upsizing that occurs when creating large groups of average characteristics.

The steelweight increase due to materials standardization is currently estimated at one to two percent, but the cost of that increase is well countered by other savings.

For example, reducing the variety of structural sizes can increase productivity by simplifying the overall task and allowing materials to be used in multiple locations on the vessel. This also reduces waste by creating compatibility between projects - when one job is finished the builder can return unused materials to the stockroom because they will be applicable to another. Currently, leftovers
are losses, commonly discarded because they are specifically made for the project at hand.

Further, the benefits of uniting simplification and standardization include intangible cost savings as well, through better project management, reduced error and elimination of unnecessary procurement and time delays due to change orders. Simply by improving the understanding between client and builder, a standardized specification would significantly reduce the number of change orders and thereby the amount of waste; typically in an offshore project, change orders cause previously procured materials and structure to be discarded.

Taking all this into account, the current cost-benefit analysis concludes that, despite the weight increase, the IOSS could drop the overall construction cost of a vessel by 10 to 15 percent - an early estimate but very encouraging. Equipment costs, meanwhile, are currently expected to drop by some 30 percent.

‘Mutual understanding becomes better when there is a standard to follow,’ says Howard Fireman, ABS Senior Vice President and Chief Technology Officer. ‘We have seen many cases of builders misunderstanding an owner’s unique standards and requirements, leading to significant change orders during construction or during the project. The simplified, standardized project specification we are developing through the JIP will eliminate a lot of that, and provide an effective way of reducing costs, increasing predictability and making the construction process more effective and reliable, without compromising safety or quality.”

**FIRST FRUITS OF LONG LABOR**

Phase One of the Offshore Standardization JIP was completed in early 2016 with delivery of eight proposed standard specifications. These outcomes are planned to be four guidance notes related to structures, piping, electrical and instruments. Among the topics they address are:

**Structure**
- Requirement for Welding Procedure Qualifications
- Inspection Requirement for Outfitting Structures

**Piping**
- Carbon Pipe and Fitting
- Duplex Piping and Fitting
- Bolting Material

**Electrical and Instrument**
- Cable Trays
- Junction Box
- Instrument Tubing Design Specification

So far, eight proposed standard specifications have been reviewed and commented on by the operators and engineering companies.
“Sustainability” is one of today’s most heavily merchandised terms, applied to every sphere of activity from agriculture to chemical processing to shipping. At the same time, there is no universal definition for what ‘sustainability’ is, what its goals are and how those goals should be achieved, which has made it a rather elastic term often defined according to the agenda of the particular person or group promoting it. As a result, many believe that ‘sustainability’ is an empty buzzword, while many others say it only seems that way because it’s an important but unfocused concept like ‘liberty’ or ‘justice’.

The most common definition for sustainability is derived from a 1987 report entitled Our Common Future (or, the Brundtland Report), for the United Nations’ World Commission on Environment and Development, which said “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
The report adds that sustainability “contains within it two key concepts: the concept of needs, in particular the essential needs of the world’s poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.”

Getting deeper into its mechanics, the Bruntland Report describes it as “a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.”

Spurred by this melding of ecology, economics, social consciousness and political action, the idea of sustainable development evolved into today’s amorphous concept of sustainability, which at times appears to be something of an intersection between philosophy, policy and theology – witness the Earth Charter, published in 2000 after a 13-year development path, which speaks of “a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace.”

Some of the various definitions take the form of compact manifestos, presciently noted in a 1995 article entitled Methods of defining ‘Sustainability’:

“Sustainability criteria act as constraints on untoward forms of development. They are premised on the belief that humanity will only succeed in a cosmic sense if it finds a way to meet human needs, while at the same time maintaining the integrity of biological systems, accounting for the loss of natural resources from the economy, working social equity, regenerating human settlements and conserving natural capital.”

A year later, in a work building on the Bruntland Report, the Real World Coalition stated, “The environment must be protected...to preserve essential ecosystem functions and to provide for the well-being of future generations; environmental and economic policy must be integrated; the goal of policy should be an improvement in the overall quality of life, not just income growth; poverty must be ended and resources distributed more equally; and all sections of society must be involved in decision making.”

There is even a lighter side to the wide world of sustainability definitions, as in the Alice-in-Wonderland wording of The New Palgrave Dictionary of Economics (2008): sustainability “concerns the specification of a set of actions to be taken by present persons that will not diminish the prospects of future persons to enjoy levels of consumption, wealth, utility, or welfare comparable to those enjoyed by present persons. Sustainability grows out of a need for intertemporal
ethical rules when one generation can determine the endowment of natural and constructed capital that will be passed on to all subsequent generations. Economic models of sustainability seek axiomatic guidance for the selection of rules regarding natural resource use. Ecologists approach sustainability from a related - though not identical - ethical stance:

And sometimes you're no longer sure what's being talked about. 'Sustainability economics' represents "a broad interpretation of ecological economics where environmental and ecological variables and issues are basic but part of a multidimensional perspective. Social, cultural, health-related and monetary/financial aspects have to be integrated into the analysis" (Understanding Sustainability Economics (2008))

With so many definitions bouncing around, there is good ground for confusion. Adding to it is that sustainability, in all its elasticity, is a pillar idea in environmentalism and, particularly, the ‘climate industry’, as well as a foundation stone of the expanding political reality they have been constructing for some years. This has given rise to a widespread tendency to characterize sustainability as being all about ecology and carbon - understandably, as those are its chief bullet points, but an error nonetheless.

There is a fairly recent interpretation of sustainability in play that is having a positive impact in both industry and society. For nearly a decade, leading companies in and out of the maritime sector have been viewing sustainability through the lens of corporate social responsibility, defining it via action as a kind of byword for good stewardship - general responsible behavior, whether toward resources, people, business or the environment.

The highest-profile sustainability efforts in the maritime community are, naturally, those operational aspects that come under the mandates of environmental regulation, such as energy efficiency, emissions reduction and ballast water management. Beyond this, however, some companies interpret good stewardship to include support of the poor communities in developing countries that generate the natural products – like wood, chocolate, coffee, cotton and fruit – on which so much international trade depends. This is often done through programs of social welfare, charity and humanitarianism, to provide the basics of healthy development like education, clean water and protections against exploitation (through membership in such global programs as Fair Trade and the Rainforest Alliance).

Helping the people at the foundation of world trade is one way of fostering sustainability in industry. Further up the line, another trend is to
force good stewardship in the supply chain, demanding that suppliers meet the client’s standards of responsible behavior.

One industry leader working to merge sustainability and industrial activity is the AP Moller-Maersk Group, a $40-billion conglomerate that works in 130 countries and operates one of the planet’s biggest shipping companies. Former Group CEO Nils Andersen states in the company’s sustainability report that Maersk “is a global company with great strength and vast outreach. We have the ability – and the responsibility – to do things right and to contribute to a more sustainable future. We do this by taking responsibility for the adverse impacts of our business and by seeking to enhance the positive aspects.” In addition to the requisite environmental practices, the company has since 2009 been using its power to fight corruption, promote transparent business practices, and protect human rights. “Maersk can be a force for positive change,” Andersen has said, “by sharing our knowledge on trade and the potential trade holds in creating economic growth and development opportunities for society.”

Few companies are big enough to force broad change in their supply chain; most have to be content with a personal pursuit of excellence and serving as an example of simultaneously “doing good and doing well.” In this, much good guidance for the maritime industry can be derived from the IMO document *A Concept of a Sustainable Maritime Transportation System*. The set of goals and actions under this vision include: development of a safety culture; better education and training in maritime professions; encouragement of environmental stewardship; support for seafarers; pursuit of energy efficiency; improvement of maritime traffic support and advisory systems; enhancement of maritime security; and enforcement of transparency in business.

The strange thing in all this is that as a matter of legislatively forced practice, sustainability may actually ‘mean’ everything that is said about it, and that companies, in order to survive the sustainability culture, just have to choose their own definition and run with it. With that in mind, a basic formulation of what sustainability could mean for maritime industry practice can be found in the IMO document’s guiding thoughts: “In order to provide a seamless and reliable service in the most efficient manner, the Maritime Transportation System must deliver safe, secure, efficient and reliable transport of goods across the world, while minimizing pollution, maximizing energy efficiency and ensuring resource conservation.”
The offshore oil & natural gas sector prides itself on a long history of innovation and daring achievements in pursuit of nature’s subsea energy treasury. Thanks to the ceaseless efforts of three generations of explorers, engineers and developers in pushing the limits of industrial capability and productivity, offshore sources now supply some 30 percent of the world’s energy needs. As offshore production steadily increases in importance to the global energy mix, the inheritors of this tradition continue to press the outward boundaries of technology. One of the barriers being crossed today is the challenge of producing from high-pressure, high-temperature (HP/HT) offshore wells.

The designation HP/HT has been around for decades, and nowadays is usually applied to wells having pressures more than 15,000 psi and temperatures above 176.7°C (350°F). Onshore, oil and gas developers have been producing from wells with HP/HT characteristics since 1952, and the first HP/HT standard, which addressed flanges, was published in 1957. With such collective experience, the industry’s challenge today is not about figuring out how to handle the HP/HT problem itself, but about how to ‘marinize’, or safely move offshore, its already proven solutions.

That’s why offshore operators and equipment makers say the lower end of the HP/HT spectrum does not require revolutionary developments, but merely an extrapolation of existing technologies. It is also why HP/HT wells are already in progress in several places around the world, and why HP/HT development has gained traction over the last decade among countries coping with declining national reserves. In 2014, for example, U.K. Chancellor George Osborne proposed a series of tax allowances to encourage development of HP/HT field clusters in the U.K. North Sea. One
concrete result of that initiative was seen in 2016 when Maersk Oil announced the start of drilling on the first of six HP/HT wells in the Culzean field offshore Aberdeen, Scotland.

“We do not see a paradigm shift with new design concepts – rather, the gap between 15 ksi technology and 20 ksi technology is more an extension of existing technology,” says Jim Raney, Director of Engineering and Technology for Anadarko Petroleum Corporation, and a leader in the effort to develop engineering standards for the HP/HT environment. “The experienced service providers working on this equipment are going back to the basics with a 15-ksi design and making the walls thicker, and/or using higher-strength materials to take the 20-ksi load. Reliability is critical in the offshore environment, and extending current technology reduces the risk of designing, manufacturing and installing 20 ksi equipment,” he says. “The people in the oil and natural gas industry have proven incredibly resourceful over the years when it comes to developing and implementing new technologies that enable us to do things more safely, more efficiently and in a more environmentally compatible manner.”

That resourcefulness was pushed to the limit when a number of projects drove the onshore industry towards 20 ksi in the mid-1970s and 25 ksi in the early 1980s; several of those reservoirs were not only in the 25 to 30 ksi range, but also contained a high amount of sour gas (having a very corrosive, high sulfur content). Such wells would be challenging even today, but back then were truly excursions into the unknown, requiring groundbreaking engineering and the use of new alloys. Economically marginalized by the industry depression of the 1980s and 1990s, HP/HT prospects became again a subject of interest amid rising oil prices and high demand in the early 2000s. Today, onshore projects are looking toward the 30 ksi barrier and beyond.
API convened a team of industry experts in 2004 to begin developing a recommended practice for offshore HP/HT equipment. This opened a development trail that culminated with the 2013 release of the first API standard on the subject, entitled Protocol for Verification and Validation of High-pressure High-temperature Equipment and usually referred to as PERISK-I (short for its official designation API TR PERISK-I).

In a presentation at the 2014 Offshore Technology Conference in Houston, FMC Technologies Emerging Technologies Director Brian Skeels, noted that the document “looked at HP/HT holistically, as a single entity (well) from the reservoir face to the pipeline” and took a systems engineering approach to the problem of defining functional requirements for HP/HT projects. The document provided the procedures and processes for equipment design and outlined the follow-up work program for the various API subcommittees tasked with developing standards for each equipment type.

PERISK-1 is the guiding document for the 14 subcommittees now working on HP/HT standards for each individual piece of offshore well equipment. In 2015, the first of those standards was released, API 17 TR8, entitled High-pressure, High-temperature Design Guidelines. Developed specifically for subsea trees (although it has been applied to a variety of equipment), the standard focuses on equipment in direct contact with HP/HT fluids, provides a first-version design flowchart that maps out three paths toward achieving design verification of equipment for the 20 ksi domain, and accounts for overlaps between the various design codes covering well pressures ranging from 15,000 to 25,000 psi.

The API 17 TR8 developers are now working out the details of its second edition, which they hope to publish in the first quarter of 2017. “We are addressing the more thorny technical issues we couldn’t resolve in time for issuance of the first edition – the industry was clamoring for it and couldn’t wait any longer,” says Skeels, who is the 17 TR8 Task Group Chairman.

Commenting on the HP/HT standards development track earlier this year, the U.S. Bureau of Safety and Environmental Enforcement (BSEE), the regulatory authority for oil and gas development of the U.S. outer continental shelf, said it recognizes the collective effort that the industry has put into API 17 TR8 and believes it to be “one of the best available guidance documents for the construction of HP/HT oil field equipment at this time.”

In an effort to add clarity to the situation, BSEE recently released a step-by-step guide for operators looking to develop HP/HT equipment. The document, Guidance on Obtaining BSEE Approval to Implement a High Pressure and/or High Temperature Project in the Conceptual and Final DWOP (deepwater operations plan), outlines the acceptance criteria BSEE will use to review and approve HP/HT equipment in the offshore continental shelf of the United States.

Currently, without standardized formulae and methodologies for satisfying HP/HT requirements, all designs for HP/HT equipment are being approved through rigorous first-principles engineering analyses.
and guidance from API 17 standards. Data accumulated as these projects go forward will be used to improve HP/HT standards until they are as highly evolved as those presently in place for well-established project types and reservoir conditions. Given that standards improve with operational experience, it will likely be years before that goal is reached.

Meanwhile, new HP/HT equipment, HP/HT standards and the BSEE requirements for HP/HT projects continue to evolve in parallel - a familiar path forward for frontier technologies. In the time since API 17 TR8 was released, 30 new HP/HT equipment standards have been published, four more are presently in development and four subcommittees are engaged in revision on several others.

API standards are produced by subject matter experts from across the oil and gas industry who volunteer their time to work for the common good. Hundreds have enlisted in the effort to develop HP/HT standards. Although it is a lengthy and challenging exercise, it is, overall, an optimistic one as well. Participants expect that a comprehensive set of HP/HT standards will lead to equipment standardization, which, by shortening the manufacturing timeline, will both reduce project costs and facilitate development of future resources. There is vision in this to develop off-the-shelf solutions for at least 80 percent of all modules and systems common to HP/HT projects.

“There is neither enough time nor enough dollars for each company to have its own proprietary HP/HT design,” says Raney, who chaired the development of PERISK-1 and now chairs a subcommittee developing HP/HT standards for subsea blowout preventers. “The cost of technology development is driving industry toward ‘standardization’ of 20 ksi equipment and a single fit-for-service design that all companies could purchase. There are potentially enormous synergies for the vendors in having a single HP/HT design for multiple customers,” he says. “The benefits to industry of HP/HT standards are only now beginning to surface.”

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**API AT-A-GLANCE**

Founded in 1919, API is the leading U.S. trade association for oilfield equipment and operations since 1924, when it published a standard for pipe sizes, threads, and couplings. API publishes its standards in the form of Specifications, Standards, Technical Reports and Bulletins.

Today, API maintains nearly 700 standards, some 240 of which address exploration and production activities.

Adherence to API standards is voluntary, until a standard is incorporated into official regulations. Today:

- 96 API standards are referenced by BSEE in the Code of Federal Regulations
- A total of 130 API standards are referenced by the U.S. Government
- 240 API standards are referenced by state governments
- 225 API standards are referenced in regulations globally

API has six committees developing standards:

- Committee on Standardization of Oilfield Equipment and Materials (CSOEM)
- Drilling and Production Operations
- Committee on Refinery Equipment
- Pipeline Standards Committee
- Safety and Fire Protection Committee
- Committee on Petroleum Measurement

Currently, some 7,000 subject matter experts from the oil and gas industry volunteer their time in the various API subcommittees.

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September 2016 marked a small but important anniversary in merchant shipping: 75 years since the launch of the first Liberty Ship during World War II. It is noteworthy because the Liberty Ship can be considered the great-grandfather of the modern merchant fleet, in the sense that it pioneered the manufacturing techniques, the welding science and the standardization philosophies affecting just about every commercial ship afloat.

Officially designated vessel type EC2-S-C1, the Liberty Ship was a 10,000-dwt freighter, the main part of a huge fleet designed to carry desperately-needed supplies and materiel to the Allied forces fighting in Europe and the Pacific. The idea behind them was simple: build more than the enemy could sink. In what became history's biggest shipbuilding program, the U.S. Maritime Commission launched a total of 2,710 Liberty Ships from 18 shipyards between 1941 and 1945, along with 531 'Victory' class ships (a larger, faster freighter type), 521 'T2' class tankers and a much smaller number of other designs.

Conceived as expendable instruments of war with a life expectancy of two trips across the Atlantic, the Liberties instead displayed great durability and ended up delivering some two-thirds of all Allied cargoes, at the Herculean rate of 6,000 tons per hour. Then, in the post-war world, the Liberty story spun out in some very interesting threads that helped shape the future of an entire industry.

The first major industrial impact of the emergency shipbuilding program was to change the way ships are constructed and establish welding as the shipbuilding technology of the future. Up to that time, even steel hulls were built on the logic of their wooden and iron forbears: a keel was laid, ribs were raised and shell plating was riveted in place. Because riveting was a slow process, the Maritime Commission took a calculated risk and adopted welding as the only way to meet its need for rapid, high-volume deliveries, and industry grudgingly accepted the decision. A few welded ships had been built before the war, but most builders still considered the technology unproven, and many opted for a hybrid approach that produced welded hulls with a mixture of riveted frames, seams and deckhouses – an inelegant solution, but it worked.

The revolution in ship construction came when industrialist Henry Kaiser got into the game. Although he had never built a ship, he reasoned that modern manufacturing methods could be applied to any product, including one shaped like a ship. Introducing what later generations would call 'Group Technology', Kaiser brought assembly line logic into what had been an artisanal industry. He assembled ships from prefabricated, all-welded modules – the first time ever that such had been done – and organized his shipyards according to manufacturing needs and product flow rather than to the types of work being performed.
For example, the down-hand welding technique (holding the torch below the waist and letting the weld flow by gravity) was by far the easiest to teach unskilled workers, so the workflow and parts to be assembled into ships were organized to accommodate it: forepeaks were built sideways, sides were built lying flat, deckhouses were built upside down, and bottoms, bulkheads and decks were built as discrete units. The method was considered strange and the whole process was ridiculed by many, but it worked. The Liberty Ship project brought revolutionary advances to shipbuilding that, in terms of manufacturing logic, organization and quality control, remain with us today.

Kaiser’s yards performed with astoundingly great efficiency, completing vessels in two-thirds the time of the other yards and at 25 percent lower costs. It is estimated that the 821 Liberty Ships he built saved the Government more than $226M (almost $3B today).

Despite the success of Kaiser’s methods, after the war U.S. shipbuilders rejected his assembly-line approach and returned to traditional construction methods – setting their ultimate demise in motion. Meanwhile, Kaiser’s model got a warmer reception across the Pacific, where American shipowner Daniel Ludwig had leased a Japanese naval shipyard to build large tankers for his company, National Bulk Carriers. In 1951, Ludwig brought in Elmer Hann, formerly Kaiser’s General Superintendent, to run the facility. Hann taught his Japanese colleagues Group Technology methods, and his belief that a modern shipyard’s success rested on having college-educated middle managers who knew shipbuilding and understood the importance of data analysis – in particular, the Statistical Quality Control methods invented by American engineer W.E. Deming. One of Hann’s students, Dr. Hisashi Shinto, became the acknowledged father of Japanese shipbuilding. Expanding on what he learned from Hann and Deming, he worked with Japanese-owned yards to develop a constantly self-improving ship construction system founded on basic Kaiser logic, enhanced through statistical process control, which quickly made shipbuilding a pillar of Japan’s post-war reconstruction. By 1964, Japan was building 40 percent of the world’s merchant ships and remained the number one shipbuilding nation for 40 years. The methods developed in its shipyards were copied around the world and are the foundation of today’s standard shipbuilding practices.

Although welding ultimately proved to be the way forward for ship construction, it did not attain that recognition seamlessly. A number of Liberty Ships and T2 tankers suffered sudden, mysterious, extensive and even destructive fractures, some involving loss of life, which led to outraged allegations against the shipbuilders of everything from carelessness to fraud. By 1944, it was estimated that some 12.5 percent of the Liberty fleet had weld defects and that one ship in every 30 had suffered major fractures. This led the Secretary of the Navy to appoint a “Board to investigate the design and methods of construction of welded steel merchant vessels” to solve the mystery. The Board, made up of technical personnel from the Coast Guard, the Navy’s Bureau of Ships, the Maritime Commission (which led the emergency shipbuilding program) and ABS (the classification authority for the entire war-built merchant fleet), convened a nearly two-year program of data collection and laboratory analyses that involved some of the best engineering minds in the country. The understanding of fracture mechanics, so important to industry today, began during this work.

Eventually, the causes of the problem were identified and solutions developed, and by 1946 the fracture problem had virtually disappeared. Even so, the Board members realized that the true understanding of the behavior of ships at sea was only just beginning. Before it disbanded, the Board recommended the establishment of a permanent committee to continue its work, whose duty would be “to investigate and study problems pertaining to the structure of ships, in order to improve design details, materials and methods of fabrication used in the construction of ships.”
This led to the founding of the U.S. Ship Structure Committee, which since 1946 has been a leading force in identifying and tackling future marine engineering challenges.

If the Ship Structure Committee (SSC) can be considered as part of the Liberty Ship legacy, then so can its work, including the spark of the rational ship design revolution.

In a 1959 report, the SSC concluded that achieving a better understanding of loads (the forces a ship experiences at sea) was key to establishing “rational, less empirical design procedures.” That report, A Long-Range Research Program in Ship Structural Design, kicked off a research program that ran throughout the 1960s and led to the first true understanding of the loads and responses of ships in service. One of its stated goals was to develop a theoretical basis for analyzing new designs.

The report introduced rational ship design as the means by which: the functions and requirements for a hull structure can be explicitly stated at the outset of the project; all loads expected in service can be determined and combined; structural members can be arranged in the most efficient manner to resist those loads; and adequate, but not excessive, scantlings can be determined using a minimum of purely empirical factors. Ultimately, the rational ship design movement brought computer-aided design and engineering into the maritime world and led development of the analytical technologies that marine and offshore engineering depend on today. This technology thread connects the ancient history of the Liberty Ship to the futuristic vessels of tomorrow.

The Liberty Ship also left its mark on the business side of shipping. After the war, the United States sold 781 Liberty Ships and 399 T2 tankers into commercial service; most of them went to U.S. allies, sold under extremely favorable terms in order to jump-start the rebuilding of their merchant fleets. The modern merchant fleets of Greece and Italy, for example, grew out of 100-ship lots sold to those countries in 1946. Able to access virtually all ports, the Liberty Ship became not only the backbone of the global dry bulk trade, but also sparked a revolution in the business of shipping. Greek shipping legend George P. Livanos once remarked to Surveyor magazine that, “through the Liberties, Greeks were exposed to new world financing and American banks learned that shipping finance could be secure and profitable.”

The vessels also helped shipowners modernize their operations. Italian shipping patriarch Giuseppe d’Amico, whose company Fratelli d’Amico Armatori began its post-war buildup with four Liberties and two T2 tankers, once told this magazine that the Liberty Ships were a “double gift” to shipowners, for the favorable financing and for the effect the vessels had on the shipping business.

“The Liberty Ships were absolutely modern vessels filled with rational concepts; such ships did not exist in the mercantile world before the war,” d’Amico said. “With its simplified technology, the Liberty was an enormous advance for us. Studying the rationalized technology of the Liberties, we learned to change our ways of working and improve our methods. It was the start of the professional evolution of the Italian shipowners – and of the crews, too, from whom the ships required higher-level skills.”

Further, the growth of ABS as an international organization began with the Liberties, when it had to open offices in ports around the world to support the ships, because all had been built to ABS Rules and, under the sale terms, had to be maintained in ABS class.

As the Liberties entered the last phase of their commercial lives in the early 1960s, they brought one more gift to the shipping industry, at least by inspiration. Of the 2,710 Liberty Ships built, 2,580 were virtually identical from stem to stern. The standardized design was highly prized across the industry: owners knew their characteristics before purchase, charterers knew their capabilities before hire, and crews and stevedores knew their vessels
before ever stepping aboard. The maritime industry desired a modern replacement but did not believe mass production of ships could be done commercially. In response, a marine consultant named George T.R. Campbell developed a methodology that effectively resurrected Liberty-type series shipbuilding in a commercial format.

Campbell did this by developing his own standard-design vessel, which he branded Freedom, and worked with the IHI shipyard in Japan to optimize procurement, production and unit pricing. Through project supervision by his company GTR Campbell International (GTRC), he was able to guarantee owners consistent pricing over a long string of ships, as long as they did not ask for design changes or ‘extras’ or otherwise interfere with the building process. The ship was technologically innovative and priced attractively and, as a result, became the best-selling ship design in maritime history - 176 Freedom series ships were built over the next decade, and established series shipbuilding as a viable, economical commercial practice.

Although conceived as short-life vessels whose only value was in numbers, the Liberty Ships instead left a broad and far-reaching legacy that touches even the present day. Those wishing to personally appreciate that legacy are in luck, because two functional Liberty Ships remain, restored to their wartime condition (but with the guns deactivated) and open to the public: the traveling museums John Brown, docked in Baltimore, and Jeremiah O’Brien, whose home port is San Francisco. Lovingly tended by volunteers, with operations and upkeep funded solely by ticket sales and donations, the vessels are maintained in seaworthy condition and take the public out on cruises several times a year. The Jeremiah O’Brien even made it across the Atlantic for the 50th anniversary celebrations at Normandy in 1994 – the only American ship that had been present at the invasion to do so. Together these ships hold the ends of a long thread of service in war and in peace, to remind and inspire and, with silent nobility, help the present understand the past so as to build the future.

Museums are places where objects tell stories, and even the best museums are made better when your guide is a living witness to the history on display, whose personal recollections enhance the tales the objects try to tell.

One such person is 90-year-old Angelo Demattei, a docent for the San Francisco-based SS Jeremiah O’Brien, one of the last two seaworthy Liberty Ships. The other is the SS John Brown, which sails out of Baltimore. Today the ships are floating museums, memorials to the huge merchant fleet built to support the Allied armies of World War II, whose vessels served in peace as well as they served in war - the Liberty Ships and T-2 tankers in particular formed the backbone of the world’s postwar commercial fleet, helping many shattered nations recover and rebuild.

A World War II merchant marine veteran, Demattei sailed to Okinawa to support the invasion of Japan in a convoy of 31 merchant ships accompanied by six Navy destroyer escorts. On your tour he may tell you of their two submarine ‘contacts’ during that voyage, and the destroyers passing through the convoy dropping depth charges left and right. He may tell you how they arrived at Okinawa on 12 August, right in the middle of a series of Kamikaze attacks, which continued for two days beyond the end of the war on 14 August. He may even share the moment on 16 September when, standing on deck, he witnessed the ship next to them strike a mine.

The experiences he shares will briefly raise the ghosts sleeping in the silent steel and pass along a moment of appreciation for the service and sacrifice that are the foundations of freedom.

Should you be in San Francisco or Baltimore, take a moment to visit these ships and hear their stories. It will be a memorable experience, and will help preserve the vessels for future generations – the museums are supported only through ticket sales and donations.
The future, as such, doesn’t come into being overnight. Tomorrow is constantly being shaped today, through cultivation of new ideas and technologies and the evolution of existing ones. That is why, to be effective, classification must be simultaneously forward-thinking and traditionally-minded: forward-thinking in order to keep pace with developing technologies, and traditionally-minded in order to do so without compromising its safety mission.

The two mindsets may seem mutually exclusive, but they are not. Both are informed by the past and build on it. With that in mind, I wish to draw attention to a special anniversary for the maritime industry that passed by with little fanfare – 75 years since the launch of the first Liberty Ship in September 1941. The date is worthy of commemoration because the Liberty Ships helped shape several important aspects of the modern maritime industry.
“LIBERTY SHIPS WERE STANDARDIZED DRY CARGO VESSELS THAT KEPT THE ALLIED ARMIES OF WORLD WAR II SUPPLIED WITH EVERYTHING FROM FOOD AND MEDICINE TO AIRPLANES AND TANKS; VICTORY WOULD NOT HAVE BEEN POSSIBLE WITHOUT THEM.”

Liberty Ships were standardized dry cargo vessels that kept the Allied armies of World War II supplied with everything from food and medicine to airplanes and tanks; victory would not have been possible without them. Under the exigencies of war, they had to be built with great speed and in great numbers - a total of 2,710 were launched between 1941 and 1945. To achieve this production rate, ships had to be constructed in a totally new way, which meant introducing two major new technologies simultaneously: the Liberties would be the first all-welded ships, and the first assembled from prefabricated modules according to modern mass-production methods.

This presented a complex challenge to the industry and to ABS as the classification authority, because shipping had little to no prior experience with these technologies. Previously, every ship was seen as a one-off project, built by hand from the ground up using logic and logistics that were, essentially, ancient. Now they not only had to be built under a new methodology, they also had to be built quickly and with precision so as to be seaworthy and reliable.

It took a future-oriented outlook tempered by knowledge and experience - from all parties involved - to resolve the issues raised by this shipbuilding revolution. The manufacturing solutions developed for the Liberties still exert an impact on shipbuilding today, at the same time, critical structural problems produced by the welding process were exposed and resolved, which established welding as the ship construction method of the future. After the war, many Liberties entered commercial service, where they proved the merits of standardization and series-built ships.

Today, the rapid development and application of cyber technologies to shipping has introduced a revolution of similar scope and impact. Big data is enabling industry to know, understand and do more regarding vessel operations, while the growing interconnectedness of the Internet of Things is dramatically increasing the ability to remotely monitor, maintain and control maritime assets. New communications capabilities are redefining the ship-to-shore interface and the responsibilities of seagoing and shoreside staff, while the industry itself is becoming increasingly dependent on integrated systems on-board and ashore and the effectiveness of the data transfer technologies they employ. And, as all this is happening, evolving abilities to accumulate and analyze operational data are enabling the successful development and application of goal-based safety standards.

The cyber revolution is even more challenging than the manufacturing revolution because it occurs in an arena that is intangible, but produces very real problems in the physical world. One example of this is software compatibility - no one yet has a full understanding of how the various software programs within complex systems interact, yet ‘software conflict’ can disable an entire industrial operation. Another example is cyber security, where threats and problems evolve as quickly as the solutions. What links the past and present challenges is the attitude with which they must be tackled: a willingness to explore the future combined with an adherence to the hard-won lessons of the past.

The people who designed the Liberty Ships could not have foreseen where their work would lead. They had a problem to solve and they did so. Their solutions led to new problems and new solutions and ultimately spun out a long thread of innovation and achievement that helped bring about some of the technologies and practices fundamental to the shipping world of today. Not a bad record for vessels originally thought to be short-life ships whose only value was in numbers. The fact that they helped shape the future of an industry should encourage everyone engaged in technology development today to drive onwards, despite the challenges and the pushback, because every advance, no matter how small, is a link in the chain that draws tomorrow out of today.