

# **Review of Selected Standards in Support of Valuation Guidelines Development**

**March 2019**

AL Cooke



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AL Cooke<sup>1</sup>

March 2019

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the U.S. Department of Energy  
under Contract DE-AC05-76RL0 1830

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## **Abstract**

This report reviews a set of standards in support of a U.S. Department of Energy Grid Modernization Laboratory Consortium (GMLC) project—Valuation Framework Development (GMLC1.2.4). The purpose of the review is to determine whether established business processes used by other industries or in other settings with the electric utility industry provide insight into whether the process defined in GMLC1.2.4 can be codified by some industry group or body, and whether the framework for valuing grid technologies, investments, or policies could be formulated using language leading to valuation analyses that would be auditable, transparent, repeatable, internally consistent, and extensible. Eight sets of standards widely used in United States and international business and industry that share the attributes of the GMLC-proposed Valuation Framework are reviewed for commonalities and lessons learned from application of the existing standards to help identify potential process or success factors applicable to the development of Valuation Guidelines. The reviewed standards generally embody efforts to accomplish threshold-setting objectives, as do the proposed Valuation Guidelines, based on fundamental principles used to enable the standards to achieve their objectives. Successful outcomes of using the eight sets of standards and associated lessons learned that are relevant to the proposed standardization of Valuation Guidelines are highlighted and provide insight into whether Valuation Guidelines would lend themselves to being codified in language that would improve the credibility, transparency, and overall acceptance of the grid valuation effort.





# Summary

This report reviews a set of standards in support of a U.S. Department of Energy (DOE) GMLC project titled “Valuation Framework Development” or GMLC1.2.4. The review attempts to test the hypothesis as to whether business processes as defined in GMLC1.2.4 may lend themselves toward codification in specific language akin to standards language. The scope of the GMLC1.2.4 project has been to define a process or framework for valuing grid technologies or grid investments or policies that would be auditable and would comply with the principles of being transparent, repeatable, internally consistent, and extensible.

## Purpose of Review

The specific purpose of this standards review for the GMLC 1.2.4 Valuation Framework Development project is to address two questions: (1) do standards exist, albeit in different industries, that successfully codified and standardized processes similar to the kind of valuation process proposed in GMLC 1.2.4; and (2) if yes, what are some of the lessons learned from the review that could be useful for directing future work toward standardizing a valuation process?

The review undertook a brief analysis of eight sets of standards widely used in business and industry in the United States and internationally to set guidelines or establish thresholds for accuracy, transparency, consistency, repeatability, quality, and/or extensibility. The standards share attributes with the Valuation Framework being proposed by the GMLC.

The standards reviewed are the Generally Accepted Accounting Principles (GAAP); International Organization for Standardization (ISO) 9000 series; ISO 14040 series; aviation checklists; medical checklists; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standard 202-2013; North American Electric Reliability Corporation (NERC) bulk electric system reliability standards; and the Rhode Island (RI) benefit-cost analysis framework (framework).

## Commonalities of Standards and Valuation Guidelines

The standards reviewed share the goals and purposes of the proposed Valuation Framework, as described below.

### Consistent Methodology

The purpose of most of the standards is to outline a framework requiring use of consistent methods, laying out minimum requirements, and in some cases pointing to the need for data from reputable sources. The intent is to reduce, if not eliminate, the opportunity for organizations to produce results that further a narrow, special interest, and/or, to ensure that the organizations do not overlook key steps in the process. Another intent with several standards is to identify the minimum steps needed for success.

- GAAP’s purpose is to ensure that accurate financial reports following appropriate processes are prepared for the use of stakeholders, such as investors, who require accurate and unbiased financial information that can be compared to the financial information of other entities.
- ISO 9000 focuses on data-driven decision-making, quality management practices, including consistent management tools and practices, timely and accurate records management, and a planning

process that considers stakeholders (suppliers, contractors, customers, employees, etc.) and the full range of impacts.

- The ISO 14040 series, and in particular ISO 14044, lays out a consistent framework for the analysis of environmental impacts. ISO 14044 addresses a need recognized historically when organizations made conflicting claims backed up by their “home-grown” analyses.
- Checklists—aviation and medical—exist to lay out the minimum expected steps to ensure nothing critical is overlooked.
- NERC standards set minimum thresholds for planning and operations activities on the bulk electric system, thus ensuring that specific details are not overlooked, and necessary steps are taken.
- ASHRAE 202-2013 explicitly states their standard represents the minimum acceptable commissioning process (though it seems like more a best practice).
- The RI Framework includes a benefit-cost analysis step listing benefits and costs to be analyzed as well as a policy framework identifying the specific areas that must be addressed at some level.

## Industry Stakeholder-Developed Standards

Issues faced by industry participants can be successfully addressed by standards developed by the industry as a means of self-regulation.

- GAAP standards or rules are developed by the Financial Accounting Standards Board (FASB), but the process includes significant amounts of stakeholder input and one of the mechanisms for initiating a standard development/update process is a stakeholder request or recommendation.
- ISO standards are also developed by committees composed of member representatives who are experts in the committee’s subject area. For example, ISO 9000 is developed by member representatives who have quality management expertise. Standards must be approved by a membership ballot.
- NERC’s reliability standards are developed by drafting teams composed of industry participants and require approval by a ballot body drawn from industry participants. The initiating step—a standard authorization request—can be submitted by any industry stakeholder (including but not limited to NERC committees, subgroups or staff).
- ASHRAE 202-2013 is developed and maintained by a standard committee composed of the ASHRAE membership, and the process of updating the standard is generally started when a stakeholder submits a change proposal.
- The RI Framework was developed through a stakeholder process, and the working group came up with a unanimous, consensus-based proposal. (The utility regulator set it up to be a stakeholder process.)

## Principles Used to Meet Objectives

The reviewed standards generally embody efforts to accomplish objectives (i.e., establish thresholds for accuracy, transparency, consistency, repeatability, quality, and/or extensibility) that are very similar to the objectives of the Valuation Guidelines. The following list is a summary of the main principles used to enable the standards to achieve their objectives:

- Process orientation: The various standards focus on process, including:

- Minimum expected steps: The standards outline a minimum set of steps needed to accomplish the goals set forth by the standards, to either prevent steps from being forgotten and / or to ensure all participants undertake the same (or very similar) set of minimum expected steps.
- Documentation: Accurate records management and being able to document completion of the minimum steps were required steps.
- Stakeholders or stakeholders' perspectives are represented: Some of the standards exist largely to address stakeholders' needs and perspectives, and all the standards ensure that the organizations following the standards are focused not on their own narrow interests but on the stakeholders they serve. Similarly, the standards address "stakeholder seams" where stakeholder groups that might not otherwise communicate are brought together to communicate and resolve issues.
- Culture change is acknowledged: In some cases, such as the ISO standards, an explicit goal of the standard is to present a vision of the culture for the organization; in other cases, such as the two types of checklists, a step included in many examples is a group huddle, which can be culture changing insofar as the participants are directed to communicate and empowered to question one another to ensure all minimum steps are taken; and in still other cases, such as the NERC standards, it is not clear whether the original intent was culture changing but the implementation of the standard and its result was culture changing for at least a portion of the industry.

## Successful Outcomes of Standards

The following section is illustrative of the fact that the reviewed standards are successful.

GAAP has tackled some difficult issues, like the true market value of an investment versus the book value and the treatment of off-balance-sheet items such as special purpose entities. Both issues had constituencies that resisted strongly—including by asking Congress for legislative relief. FASB can succeed at this in part because the governing board is independent from the various stakeholder groups.

ISO 9000 successfully puts the focus on customer needs and quality management systems. In the most recent year for which statistics are available, over a million entities certified under ISO 9001 worldwide—39,000 of which were in North America.

ISO 14044 is a credibility-building analysis insofar as it lays out a process for evaluating environmental impacts which, when paired with what is called Type III environmental declarations, can be used to credibly establish that the entity has subjected their product to an environmental assessment.

Aviation checklists are simply a key factor in aviation safety. The speed at which change propagates through aviation checklists is impressive. A book, *The Checklist Manifesto* by Atul Gawande, recounts the story of a crash and the lessons learned. It took a matter of months to complete the crash investigation, but about 10 months after the first crash, another was averted because the crew had an updated checklist that reflected lessons learned.

Medical checklists have been demonstrated to be capable of helping hospitals all but eliminate errors caused by skipping or forgetting the simple steps like washing hands or washing the patient's skin at the point of incision. Both medical and aviation checklists are potential culture changers insofar as they empower all participants to serve as backstops to other participants, and in both cases, they empower subordinate staff like the first officer or a nurse to question the lead (pilot or doctor) to ensure that all important issues have been addressed.

ASHRAE's Commissioning Standard has been demonstrated to help the building industry deliver buildings that meet the advertised criteria and needs of the building occupants. It also responds to the needs of the utility industry and others who operate energy efficiency programs. Before commissioning became somewhat common, there were failures to deliver in the efficiency realm, and commissioning helps to deliver and to protect the credibility of the efficiency program. The decision-making rests with the committee that controls the standard. There is at least one opportunity for public comment, and ASHRAE addresses all negative comments to the extent possible. The model is structured to get fairly wide public comment without creating an unwieldy structure. *The ASHRAE model for setting and updating the standards is a model that should be considered for the Valuation Framework.*

NERC Reliability Standards are successful stakeholder-driven standards that have been shown to yield successes relative to historical results, such as the decreasing transmission outage trend for the past 5 years and decreasing rates of protection system misoperations over the past 5 years. The standards themselves are developed by stakeholders and stakeholder approval via a ballot body is a required step.

The RI Framework is new enough that identifying a specific success resulting from the standard is not possible. However, the RI regulator that set up the process in their order accepting the stakeholder report stated at least some surprise that the process was able to achieve unanimous consensus on all but one issue.

## **Lessons Learned and Their Relevance to Valuation Guidelines**

This review noted the following aspects of standards development that pose possible challenges to a process such as the development of Valuation Guidelines:

- Opposing stakeholder interests: While it is not clear why there would be stakeholder opposition to the development of Valuation Guidelines, the challenge that FASB faced illustrates the difficulties that can be posed if powerful interests oppose a standard. FASB had the backing of the Securities and Exchange Commission (SEC) to assist their cause. DOE can provide support, though it would not have the same force as the regulatory support provided by the SEC. Obtaining buy-in from key stakeholder groups such as the National Association of Regulatory Utility Commissioners, National Association of State Energy Officials, state legislative organizations, as well as the trade associations and consultancies could similarly be helpful.
- Culture change/stakeholder resistance: Within any organization there tends to be people in positions of authority who will resist a tool that empowers others to ask questions. While the culture-change aspect of aviation or medical checklists gains a portion of its effectiveness by empowering people, e.g., empowering a nurse to ask if all the minimum steps have been taken, not everyone will welcome such empowerment.
- Speed of assimilation: As noted in the discussion of aviation and medical checklists, having a single, central entity that supports the process can make it possible for a standard to become widely used relatively quickly. In industries that have fractured authority structures, assimilation can take longer. In the electric industry in which each state and the District of Columbia have their own industry regulators, ensuring a speedy assimilation of the Valuation Guidelines will be a key challenge.
- Brevity/attention span/work overload: A strength of the aviation (and possibly medical) checklist is the focus on the “killer” items that the team cannot overlook, and the brevity of the checklist—the crew can complete the checklist quickly before they are interrupted by other tasks or communications with the tower. Similarly, while some utility personnel across the United States may have opposed the NERC reliability standards initially, the specificity of the individual requirements may have been welcomed by others simply because the standards made the steps clear. Following this model requires

identifying discrete breakpoints to make the Valuation Framework a tool that can be used to assist the analyst when dealing with interruptions and workload, and not as something that adds to the workload.

- Staging of development: At least two standards illustrate potential paths for staging. Initially, FASB was able to establish a standard for off-balance sheet accounting at a minimal level and later, when conditions changed, FASB strengthened the standard. NERC standards started as voluntary criteria. When conditions changed, NERC undertook a process to codify their criteria as voluntary standards which, when conditions changed again, became mandatory. From these two examples, it seems that a positive direction for Valuation Guidelines might be simply to start the process and codify the strongest set of guidelines that can be codified.

## **Considerations for Development of Valuation Guidelines**

The standards reviewed in this report provide valuable insight into whether Valuation Guidelines would lend themselves to being codified to improve the credibility, transparency, and overall acceptance of the valuation effort. In short, the standards reviewed in this report pursue similar sets of objectives. The standards are largely stakeholder-developed and are either written explicitly in standards language or in language that is similar in nature.

It therefore appears feasible that the Valuation Guidelines would be codifiable in language not unlike that used for standards. The question now becomes ‘are DOE and industry sufficiently interested to launch such an effort?’ A second question is how should the effort should be structured and governed? As evidenced by ASHRAE and ISO, it is possible to structure and govern a standards approval process within a nongovernmental organization. As evidenced by NERC and FASB (i.e., GAAP), it is also possible to structure and govern processes within a framework ultimately overseen and/or championed by a governmental entity.



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## Acronyms and Abbreviations

AICPA	American Institute of Certified Public Accountants
AMF	Advanced Metering Functionality
ANSI	American National Standards Institute
AQAP	Allied Quality Assurance Procedure
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
BCA	Benefit-Cost Analysis
BES	bulk electric system
BOT	Board of Trustees
BSI	British Standards Institute
CDC	The U.S. Centers for Disease Control and Prevention
CLABSI	Central Line-Associated Bloodstream Infections
DIS	Draft International Standard
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
EPD	environmental product declaration
ERO	Electric Reliability Organization
FAA	Federal Aviation Administration
FAF	Financial Accounting Foundation
FASB	Financial Accounting Standards Board
FDIS	Final Draft International Standard
FERC	Federal Energy Regulatory Commission
GAAP	Generally Accepted Accounting Principles
GASB	Governmental Accounting Standards Board
GMLC	Grid Modernization Laboratory Consortium
GMP	Grid Modernization Plan
GSA	General Services Administration
IASB	International Accounting Standards Board
ICU	Intensive-Care Unit
IFRS	International Financial Reporting Standards
ISO	International Organization for Standardization
LCA	life-cycle assessment
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NERC	North American Electric Reliability Corporation
NIST	National Institute of Standards and Technology
PASA	Procedures for ASHRAE Standards Actions

PST	Power Sector Transformation
PUC	Public Utilities Commission
RI	Rhode Island
SAR	Standard Authorization Request
SDG&E	San Diego Gas & Electric
SEC	Securities and Exchange Commission
SOP	standard operating procedure
SPC	Standard Project Committee
SPM	Standard Processes Manual
SPE	special purpose entity
UK	United Kingdom
UL	Underwriters Laboratory
VRF	violation risk factor
VSL	violation severity level
WECC	Western Electricity Coordinating Council
WHO	World Health Organization

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# 1.0 Introduction

This report reviews a set of standards in support of a U.S. DOE GMLC project titled “Valuation Framework Development” (or GMLC1.2.4). The review attempts to test the hypothesis about whether business processes as defined in GMLC1.2.4 may lend themselves to codification using language akin to that used for standards. The scope of the GMLC1.2.4 project has been to define a process or framework for valuing grid technologies, investments, or policies that would be auditable and would comply with the principles of being transparent, repeatable, internally consistent, and extensible.

The purpose of the standards review is to address two questions: (1) do standards exist, albeit in different industries, that successfully codify and standardize processes similar to the kind of valuation process proposed under GMLC 1.2.4; and (2) if yes, what lessons learned from the review could be useful for directing future work toward codifying a valuation process?

## 1.1 The Valuation Framework

The GMLC is a consortium of the DOE’s National Laboratories working together to address issues associated with the ongoing modernization of the national electric power grid. The GMLC1.2.4 project team is composed of staff from several National Laboratories, the National Association of Regulatory Utility Commissioners, and SRA International, Inc. The project team is working with a stakeholder advisory group comprised of industry, regulators, and other organizations.

Under GMLC1.2.4, the Valuation Framework is being developed as a tool to provide a transparent, logically consistent, and extensible process designed to be audited by a third party. A valuation study is an assessment of the value of a course of action, whether it is an investment in new generation, a potential implementation of a new demand-side management program, or development of compensation methods for distributed generation such as rooftop solar. GMLC1.2.4 is attempting to address a need to facilitate the creation of clear, transparent, and repeatable methodologies and practices to generate valuation studies that produce results that are easier to compare and interpret.

As the Valuation Framework has been developed, it has become apparent—especially from stakeholder feedback—that its potential improvement of valuations may be more in its defining of a process that ensures deliberate consideration of key decision-maker (and other stakeholder) decision criteria and information needs, and in helping ensure that the methods and tools employed are indeed consistent with the metrics required.

Originally, it was anticipated that the framework development would focus on assisting analysts in choosing from among various models and tools and maintaining consistency between the selection of key metrics and the methods and tools, including assembling resources—catalogs, lists, bibliographies, etc.—that enumerated and characterized/described the available tools and models. As this view has evolved more toward developing an appropriate *process* than optimizing model selection, the project team also reassessed the aspirational goal toward developing what might be called Generally Accepted Valuation Principles, akin to the Generally Accepted Accounting Principles used in the financial and accounting industry.

To that end, the project team has identified some other industries’ standards (some of which are electric power-related) that have sought to establish requirements for a process, to ensure accuracy, completeness and consistency in performing a function. This report reviews the process requirements of these examples

from other industries that have similar open-ended problem spaces and attempts to apply them to the valuation process.

## **1.2 Report Contents and Organization**

This report reviews eight existing standards in the electric utility and other industries and examines the requirements of the standards to explore if and how the requirements of these standards might inform the development of the valuation process guidelines. The ensuing sections describe the scope, methods, and structure of the following standards<sup>1</sup> that are relevant to the power system Valuation Guidelines:

- Generally Accepted Accounting Principles
- requirements for quality assurance (ISO 9000 series)
- environmental life-cycle assessment (ISO 14040 series)
- aviation checklists
- medical checklists
- ASHRAE building/facility Commissioning Standard
- bulk electric system reliability standards
- Rhode Island's Benefit-Cost Framework.

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<sup>1</sup> Some items on the list might not appear to be standards, e.g., the medical and aviation checklists. However, checklists function like standards, i.e., they present lists of requirements and the checklist user is expected to follow or comply with the requirements. Thus, the items reviewed herein are generically referred to as standards.



## 2.0 Standards: Description, Accomplishment, Administration

Eight standards related to electric utility and other industries that address open-ended problem spaces, as do the Valuation Guidelines, are presented in the following sections.

### 2.1 Generally Accepted Accounting Principles

GAAP encompasses standards that determine how financial statements are prepared. Financial statements are a critical part of the financial system, bridging the gap between the corporate world and the financial community. As such, financial statements need to be clear and communicate accurate and unbiased information about the company (or governmental agency) to those who are contemplating making investments, i.e., either buying stocks or bonds or otherwise investing in the company. Financial statements include information about a company's financial position, the results of their operations, and disclosures of information.

GAAP accounting standards determine how the financial statements are prepared, and cover

- recognition – or identification of the items that should be recognized in the financial statements (e.g., revenues, expenses, etc.)
- measurement – or determining the amounts of each item that should be reported
- presentation – or describing how the items should be aggregated, including line items, subtotals, and totals, and
- disclosure – or including specific information that is most important to those who use the financial statement to both supplement and explain amounts reported in the statements (FAF 2018a).

#### 2.1.1 Need for GAAP

As noted in the preceding description of GAAP, the financial community needs clear and unbiased information. What we call GAAP today is developed and maintained by the FASB and the Governmental Accounting Standards Board (GASB). FASB and GASB are the standards-setting bodies. As such, FASB and GASB are charged (by their parent organization, the Financial Accounting Foundation [FAF]) with setting rules governing accounting in the United States—the rules we know as GAAP.

The FAF and FASB came into being after the publication in 1972 of what is generally known as the Wheat Report—named after the report committee chairman of the American Institute of Certified Public Accountants (AICPA), which commissioned the report (Eccles and Rogers 2014; AICPA 1972). Leading up to the commission of the Wheat Report in the latter half of the 1960s, was a situation where the combination of “the rapid expansion of accounting firms, the new issue boom, the development of increasingly complex and innovative business practices, and the corporate merger movement” had led to something akin to a crisis of confidence in the accounting profession (AICPA 1972). The Wheat Report was commissioned in response to the perception that the then-prevailing process for the development of accounting standards was dominated by major accounting firms, and the process was not transparent. This engendered concern that the process was not sufficiently unbiased and independent to serve the interests of the capital markets and investors who relied on financial reports (Eccles and Rogers 2014).

In 1973, the AICPA empowered the FASB, replacing the AICPA's existing standard-setting body (the Accounting Principles Board), to establish the accounting principles (Large 1979). Also in 1973, the SEC issued a statement in which they recognized the FASB as a standards-setting entity and lent considerable

credibility to FASB. The SEC was established by the U.S. Congress in 1934 to be the authority for the preparation of financial statements and accounting and auditing in general. The 1973 SEC statement noted that the SEC had looked to standards-setting bodies with substantial authoritative support in the private sector to provide leadership in these areas. The SEC further noted that financial statements prepared following any guidance other than that of just such a standards-setting body should be presumed to be misleading and that “footnote or other disclosure would not avoid this presumption” (SEC 1973). The SEC stated they believed the FASB had the substantial authoritative support required to be a standards-setting body. The SEC further stated that any standards and practices contrary to the FASB promulgations would be considered to not have authoritative support and therefore be presumed to be misleading (Large 1979). Thus, the FASB came into being and received the backing of the SEC to be a standards-setting body.

### **2.1.2 How Has FASB and the Use of GAAP Improved the Quality of Work?**

FASB improved the quality of accounting standards by introducing and maintaining more of a clear independence from the accounting firms to which the GAAP provides guidance. The FAF (and its standards-setting bodies) is a private organization. FASB members serve full time and are required to sever connections with their employers prior to joining the board (Large 1979; FASB 2018). Board members are appointed by the FAF Board of Trustees for 5-year terms and may serve up to 10 years. The Board comprises members with different backgrounds including stakeholder organizations (financial statement preparers and statement users), academics, public and private organizations, regulators, and other governmental agencies (FASB 2018). Thus, FASB was able to more directly address difficult issues such as fair market value than would an entity that was more closely tied to key stakeholders.

In a relatively recent change that adds to the independence of the FASB, funding now comes from fees collected from public market equity issuers and investment company issuers. This relatively new funding mechanism was established pursuant to the Sarbanes-Oxley Act of 2002 (FAF 2018b).

While the term GAAP includes the word “principles” in its name, GAAP includes some fairly specific rules. While there is disagreement about whether GAAP is too rule-oriented and should be more principle-oriented, specific rules remove ambiguity, which makes the life of auditors and accountants a little easier.

### **2.1.3 Significant Successes**

Though it might seem a little odd given the macro-economic outcomes the nation experienced with the 2008 recession, the redefinition of fair market value is an important success story. It had been evolving as early as 1993 when FASB issued a pronouncement that securities and loans must be carried on books, not at historic cost, but at market value. Many argued against so-called “mark-to-market” accounting. For example, a short-term downturn in a market makes an asset less valuable on the book but doesn’t reflect its long-term value, or mark-to-market punishes the owners of assets for conditions beyond their control. Nonetheless, mark-to-market accounting made it easier to uncover the risky investments held by banks and other entities that led to the 2008 recession than if those same entities were able to report their assets at purchase cost. A 2006 FASB pronouncement provided clearer guidance on mark-to-market accounting needing to be based on objective market value, not subjective worth. The response in the “market” was such that even as Congress was creating emergency stabilization legislation in 2008 there was a provision allowing the SEC to suspend mark-to-market accounting. In response, the SEC and FASB issued a joint press release clarifying that in cases where there is no real market for a security or investment, that firms were permitted to use other valuation methods to mark the investment to market – but firms were not allowed to book the investments at historical costs or otherwise hide the fact that the investments were

impaired (Mundstock 2009). But, GAAP requiring banks and securities owners to carry securities and loans on their financial statement at market value went a long way toward facilitating the discovery of the risky investments that caused the 2008 recession.<sup>1</sup>

Fair market value is only one of the contentious issues FASB has addressed. Another relates to how items are shown on the books, versus off-balance sheet items. Enron provides a well-known example of a company using off-balance sheet items to pump-up reported revenues. The Enron collapse that led to the demise of the Arthur Andersen accounting firm was, in part, related to the threshold for outside investment in special purpose entities (SPEs). At the time there was a 3 percent threshold. If outside investment was less than the 3-percent threshold, the SPEs that led to Enron's financial collapse would, per the rules, have been consolidated into Enron's financial statements and the financial markets would have been able to see the risks faced by Enron. This incident, however, includes mixed results for FASB and GAAP. First, after the fact, it was determined that Enron violated the existing FASB standard for off-balance sheet activity and in fact the SPEs should have been consolidated into the Enron balance sheet. This meant there was no failure of GAAP but rather a bad-faith implementation by Enron and Andersen (Litan 2002). A separate fact of the matter was that the threshold was too low, and FASB knew this, but the securitization industry had come to rely on its ability to manipulate these rules and the pushback against FASB's prior efforts to increase this threshold led the FASB to abandon the effort. However, after the Enron financial collapse, FASB's critics changed their stance on this and FASB enacted a succession of reforms, including revising the SPE threshold up to 10 percent and requiring disclosure of guarantees. So, while the Enron collapse might be viewed as a failure, it was not a failure of GAAP per se. It is also as much or more of a reflection of the balance of power FASB works within/against than a compelling need to revise the standard (Litan 2002).

FASB is also fairly responsive to constituent needs. Because of the growing influence of multinational corporations there is a growing need to have convergence between U.S. GAAP and international accounting standards. In 2014, FASB and the International Accounting Standards Board (IASB) converged their guidance on recognizing revenue in contracts with customers. The IASB is responsible for the International Financial Reporting Standards (IFRSs). The convergence is important to ensure the consistency of revenue reporting in the United States and elsewhere in the world as well as to improve the comparability of companies' financial statements for companies reporting under GAAP and IFRSs (FASB 2014).

#### **2.1.4 Administration of and Updates to GAAP**

Updates or new standards are essentially driven by either events or requests for standards or revisions. The time it takes to make a change, and the nature and extent of the research and outreach activities performed prior to the change varies with the magnitude of the change. Some processes, such as the mark-to-market or revenue reporting will face greater stakeholder pushback than other processes, and as a result will take longer.

As outlined in the *Rules and Procedures* (FASB 2013), when the FASB identifies a reporting issue based on stakeholder requests or recommendations or through other means, FASB

- has the staff prepare an analysis of the issues and decides whether to add them to a technical agenda
- deliberates at one or more public meetings the various issues the staff identified and analyzed

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<sup>1</sup> Mundstock added a postscript to the end of his paper stating that FASB later reversed course and relaxed the rules for mark-to-market reporting. This relaxation was not researched further in the preparation of this paper, but merits notice as a caveat for the success story presented herein.

- issues an Exposure Draft, i.e., a draft of proposed provisions, and solicits stakeholder input
- holds a public roundtable meeting about the Exposure Draft, if necessary
- redeliberates the proposed provisions at one or more public meetings (after the staff have analyzed all the comment letters, roundtable discussion, and other information gathered during the due process activities), taking into consideration the input received
- issues an Accounting Standards Update.

Each amendment includes a timeline for the effective date of the amendment, and during the interim period FASB works on educating stakeholders about the amendment (FASB 2019).

## 2.1.5 Key GAAP Features Relevant to Valuation Guidelines

Successful example of use of consistent guidelines: GAAP is appropriate to the Valuation Guidelines insofar as GAAP strives specifically to achieve financial reports that are accurate, repeatable, and that follow consistent guidelines. This statement could also be used to describe the GMLC1.2.4 objective for the Valuation Guidelines. GAAP starts with the end user in sight, namely the entire purpose of GAAP is to provide meaningful information to users of financial statements. It should be noted that this end user is not the entity whose financial results are being audited. This end user is the person/entity who uses the financial reports for purposes such as making investment decisions. Similarly, the Valuation Guidelines have in mind the end users of valuation reports—the stakeholders who look for valuation studies to be accurate reflections of the value of proposed investments in the electric power grid.

FASB, through GAAP, has successfully developed standards addressing important valuation issues that have strong and politically powerful constituencies. Examples include the mark-to-market and off-balance-sheet issues discussed in Section 2.1.3. Part of the reason for this success is the independence of the FASB from stakeholders; another part is the strong support provided by the SEC—with its legislative mandates. At the outset, Valuation Guidelines would not have the benefits of legislatively mandated backing like GAAP. However, the Valuation Guidelines could be overseen by an independent body such as the FASB if a mechanism were developed for funding such a body, and it would not be unreasonable to believe that some utility regulators, other governmental entities, and other stakeholders could be identified who would support the effort. Obtaining buy-in from key stakeholder groups such as the National Association of Regulatory Utility Commissioners, National Association of State Energy Officials, state legislative organizations, as well as the trade associations and consultancies could be helpful.

Possible model for setting standards: To update standards or issue new standards, the FASB requires a majority vote of the Board. The FASB has been accused by some as being too slow, but given the power of the entities with which FASB works and the possible disruption FASB could cause with overly aggressive moves, it is easy to see why the FASB moves deliberately and carefully. While consensus might not be possible for the FASB for all the contentious items that come before it, it has a decision-making process that can and does move standards forward.

## 2.2 ISO 9000 Series

The International Organization for Standardization (ISO) 9000 series is a set of standards geared toward helping businesses or governmental entities be more efficient and improve their customer satisfaction through a quality improvement process. The ISO 9000 series is composed of four standards (ISO 2019a):

- ISO 9000<sup>2</sup> describes fundamental concepts and principles. The current version is dated 2015.
- ISO 9001 outlines quality management system requirements and discusses the approach and principles. It also provides the requirements against which an entity would be audited if they seek ISO 9000 series certification. The current version is dated 2015.
- ISO 9002 provides guidance to clauses 4 through 10 in ISO 9001 to aid users in applying the quality management system of ISO 9001 and in understanding the intent of the ISO 9001 requirements. The current version is dated 2016.
- ISO 9004 provides guidance to help an organization achieve continued improvement, including a self-assessment tool. The current version is dated 2018.

For purposes of discussion in this document, the ISO 9000 series will simply be referred to as ISO 9000.

### **2.2.1 Need for ISO 9000**

Articles discussing the history of ISO 9000 point to the North Atlantic Treaty Organization (NATO) Allied Quality Assurance Procedures (AQAPs). In the 1950s and into the 1960s, NATO was concerned about equipment supplies for defending Europe in the case of a naval blockade that prevented resupply from North America. NATO spent several years searching for a way to assure that quality and dependable sources of material and equipment would exist in the event that their primary sources were cut off. In 1969, a NATO committee named AC 250 published the AQAPs, which listed 20 criteria for a quality management system (Hendra 2017).

The next major milestone appears to have come in the United Kingdom (UK) where the Procurement Directorate for the Ministry of Defense adopted the AQAPs as Defense Standards 05-21/24 (Hendra 2017). Also underway in the UK were efforts at implementing quality assurance in industries beyond defense industries. The British Standards Institute (BSI) published a set of standards in 1974 to shift the burden of inspection from buyers/vendors to suppliers, through third-party assessments. Ultimately, this led in 1979 to publication of a common standard for all industries—BS 5750. This standard turned out to be identical to Defense Standard 05-21/24, perhaps not coincidentally because the head of BSI in 1979 was the same person who had implemented the NATO standard at the UK Ministry of Defense (Hendra 2017; CABEM 2017).

In 1982, a paper was produced pointing to management deficiencies as the root cause of the UK's failure to produce quality products for world markets. It introduced the concept of certification of a company's quality management system by an independent third party. The intent was to relieve purchasers of the burden of having to assess the company's quality management system, and to replace it with a system designed to instill customer confidence.

In the United States, the Food & Drug Administration used the AQAPs as a quality assurance mechanism for medical product devices, putting them into Chapter 820 of the Code of Federal Regulations in 1980 (Hendra 2017).

The UK white paper popularized the need for quality management systems in the United States. Ultimately, the BS 5750 became ISO 9000:1987—the first version of the ISO 9000 (CABEM 2017).

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<sup>2</sup> The ISO convention for standards is to follow the standard number with a date, e.g., ISO 9001:2015, denoting the version of the standard.

### **2.2.2 Use of ISO 9000**

ISO 9000 is used worldwide. The most current numbers available show 1,058,504 ISO 9001 certificates being issued in 2017. Of these, 38,000 were issued in North America. By far, the largest number—513,000—were issued in East Asia and the Pacific, and Europe came in second with 389,000 certificates (ISO 2018b).

In online success stories related to ISO 9000, it is often noted that businesses or government entities require their suppliers to be ISO 9000 certified. Thus, not only do the suppliers use ISO 9000 as a mechanism for demonstrating the existence of a quality management system, but some purchasers require and/or expect the same. As noted in Section 2.2.1, ISO 9000 can relieve purchasers of the requirement to perform all quality assurance work.

### **2.2.3 How Has the Use of the ISO 9000 Series Improved the Quality of Work?**

In the previously outlined history of the need for standards, ISO 9000 came into being to provide customers with an assurance that the producer with ISO 9000 certification would be a reliable supplier. The success of the ISO 9000 arises from causing firms to focus on the following quality management principles:

- customer focus
- leadership
- engagement of people
- process approach
- improvement
- evidence-based decision-making
- relationship management (ASQ 2018).

The quality principles include numerous components. Leadership, for example, includes setting a vision, challenging goals, modeling the organizational values, and others. Engagement of people includes ensuring that the people's abilities are used and valued, that people are empowered and given opportunities to participate in open discussion of problems and issues, and others (ASQ 2018). The point is that the ISO 9000 standards and certification focus the organization on what the customer wants (quality products delivered reliably and on time), having the organization's leadership engaged and leading with a focus on people, engaging the people, and working on improvement.

### **2.2.4 Significant Successes**

Internet search results for terms like ISO 9000 “success stories” or “case studies” focus heavily on the marketing efforts of consultants who want to help companies qualify for ISO 9000 certification, to help said companies with their marketing and sales efforts. Note that this is not intended to be a strike against ISO 9000, but rather, it is to say if you view ISO 9000 from a supplier perspective it seems to be quite successful. For example, the National Institute of Standards and Technology published a blog highlighting U.S. manufacturer success stories where manufacturer's sales, revenues, and/or workforce grew significantly because of ISO 9000 certification (Lagas 2016). Several papers appear on the Internet focusing on the sales success and positive revenue impact for firms that have ISO 9000 certification (see for example Javorcik and Sawada 2018). There are customers that require ISO 9000 certification, so if an organization desires to be a supplier to those customers the organization will seek certification. However, as noted by Hendra 2017, this would be consistent with the end-result sought by the UK government in the 1980s.

Viewed from a purchaser perspective, ISO 9000 also seems successful. While it is a bit harder to find examples of success stories focused on metrics important to purchasers, they do exist. One example that illustrates how success was achieved is Gaishin Manufacturing, a manufacturer of precision products for industries ranging from aerospace to lawn care. Located in Michigan, the company wanted to expand their customer base. To win new business, many customers required ISO 9001 certification. Gaishin was able to achieve their certification which led to positive sales results, notably retaining a vehicle safety component manufacturer that represented 2 to 3 percent of their annual sales. They also achieved a 40% decrease in customer claims related to quality and improved their on-time delivery by over 20% (MMTC undated).

## **2.2.5 Administration of the ISO 9000 Series**

Administration of the ISO 9000 series involves standards maintenance, setting and reviewing standards, and certification with the series. Each standard is maintained by a technical committee, referred to herein as the “responsible committee.”

### **2.2.5.1 Maintenance Responsibility**

The ISO 9000 series is maintained by ISO Technical Committee 176 – Quality Management and Quality Assurance. The individual ISO 9000 standard is maintained by Subcommittee 1, Concepts and Terminology. ISO 9001, 9002, and 9004 are maintained by Subcommittee 2, Quality Systems.

All ISO standards are reviewed every 5 years (ISO 2018a). For new standards, generally an industry group or sector will communicate a need for a new standard to its national ISO member, who will then communicate a request for a new standard (ISO Update 2018).

### **2.2.5.2 Standard Setting and Review**

The stages of creating or updating a standard are as follows:

- Proposal stage – A new work proposal is put to the responsible committee for a vote. This stage is required for a new standard but can be skipped for existing standards. For a new standard, this stage would include checking to ensure there are no issues with copyrights, patents, or conformity.<sup>3</sup> The proposal stage also asks whether a new standard is really needed under the ISO global relevance policy.
- Preparation stage – Usually a working group is set up by the responsible committee to prepare a draft. The working group will draft and revise the standard, circulating it within the working group until they believe they have developed the best draft that they can. At this point the draft is forwarded to the responsible committee.

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<sup>3</sup> Conformity is a key subject area. A conformity assessment is a demonstration undertaken by a supplier or manufacturer (i.e., a first party), a user or purchaser (i.e., a second party) or an independent body (i.e., a third party) to show that requirements have been met. ISO Directives require that any standard that contains requirements goes through a process related to conformity. The requirements’ language must meet a “neutrality principle” such that first, second, or third parties can assess the conformity. The ISO has a Committee on Conformity Assessment (CASCO), and one of their tasks is to work with Technical Committees and subcommittees who are writing standards (ISO 2019b). The ISO documentation related to conformity notes that one of the biggest obstacles to international trade is test procedures in one country not being accepted in other countries, so the ISO emphasizes the need for conformity to be consistent and replicable in countries around the world. The ISO has a document *Conformity assessment for standards writers: Do’s and Don’ts* (ISO 2016).

- Committee stage – The draft is circulated to the committee for comment and vote. Within the committee, the standard can be revised multiple times before consensus is reached on the technical content. This stage is optional, and ISO rules specify the conditions under which this stage can be skipped.
- Enquiry stage – The Draft International Standard (DIS) is submitted to the ISO Central Secretariat and is then circulated to all ISO members who have 12 weeks to comment and vote on the draft. The DIS is approved if two-thirds of the participating members of the committee vote in favor of the DIS and not more than one-quarter of the total votes cast are negative.
- Approval stage – If the DIS is approved during the Enquiry stage, it can go straight to publication. However, if the DIS is substantially revised or has technical changes based on comments received, a Final DIS (FDIS) stage is required. The FDIS is sent to the Central Secretariat, then sent to all ISO members for a 2-month voting period to determine if the standard is suitable for publication. The FDIS is approved if two-thirds of the participating members of the committee vote in favor of the DIS and not more than one-quarter of the total votes cast are negative.
- Publication stage – The standard is submitted for publication. At this stage, only editorial corrections are made to the final text, and the committee secretaries and project leaders have a 2-week sign-off period (ISO 2018c).

### **2.2.5.3 Certification with ISO 9000**

The American National Standards Institute (ANSI) is the sole U.S. representative and dues-paying member of the ISO, and a founding member (ANSI 2018b). The ANSI – American Society for Quality National Accreditation Board LLC (ANAB) issues accreditation for ISO 9001 certification bodies, or those entities that can certify organizations as meeting ISO 9001 criteria (ANAB 2018). Within the U.S. several entities have accreditation for ISO 9001 certification.

Certification under ISO 9000 is on a 3-year cycle and must be renewed before the existing certification expires.

### **2.2.6 Key ISO 9000 Features Relevant to Valuation Guidelines**

Focus on culture: ISO 9000 focuses on culture. While parts of the ISO 9000 series focus on empowering employees and improving delivery time and quality of the product, a major focus is on delivering a product that customers can count on for quality, and the engagement of management is emphasized in this process. It can be argued that part of the need for a Valuation Framework stems from organizational cultures focused on the organization's own self-interest and developing a culture that is more outward-looking toward the stakeholders, who compose the customer base for valuation studies, would be a change for the better.

Focus on customer: The ISO 9000 series' customer focus is relevant to the Valuation Guidelines' emphasis on stakeholder involvement. (As noted in Section 2.1.5 the stakeholders can be regarded as the "customers" for the valuation studies.) Even with the focus one sees on the Internet surrounding ISO 9000 certification as a marketing attribute, an organization's adherence to the ISO 9000 principles provides a much stronger assurance to their customers that the organization will maintain a focus on quality improvement than could be expected otherwise. In this respect, ISO 9000 is similar to GAAP—both are standards that force an organization to pay attention to the needs of the customer.



## 2.3 ISO 14040 Series – Life-Cycle Assessment

The ISO 14040 series provides guidance for performing Life-Cycle Assessments (LCAs), or assessments of the environmental impacts of a process, at each stage of the process, throughout the entire life cycle. The LCA covers every stage, from the extraction and processing of raw materials to the end of the life of the product when the product is recycled and/or sent to a landfill. The LCA is an environmental management tool, and the results can be used as input to other management processes, such as identifying opportunities for improving or lessening environmental impacts or in marketing.

The ISO 14040 series is part of the greater ISO 14000 family of tools for environmental management. This family includes the 14020 series, which includes provisions for environmental labeling and declarations. The ISO 14040 series includes the following:

- ISO 14040 covers the principles and framework for the LCA. The current version is dated 2006 and was last reviewed and confirmed in 2016.
- ISO 14044 specifies the requirements and guidelines for performing an LCA, requirements and guidelines for performing a life-cycle inventory analysis, the life-cycle impact analysis and interpretation, reporting, a critical review of the LCA, and the limitations of the LCA and other elements. The current version is dated 2006 and was last reviewed and confirmed in 2016 and amended in 2017.
- ISO 14045 describes the principles, requirements, and guidelines for an eco-efficiency assessment of product systems. The current version is dated 2012.
- ISO 14046 describes the principles, requirements, and guidelines for assessing the water footprint assessment. The current version is dated 2014.
- ISO 14047 provides examples of applying ISO 14044 “to impact assessment situations.” The current version is dated 2012.
- ISO 14048 describes the documentation requirements for clear and unambiguous documentation of the LCA and life-cycle inventory analysis. The current version is dated 2002 and was last reviewed and confirmed in 2013.
- ISO 14049 provides examples of applying ISO 14044 “to goal and scope definition and inventory analysis.” The current version is dated 2012 (ISO 2018d).

Although the ISO 14040 series (referred to herein as simply ISO 14040) addresses issues beyond just the LCA, this review focuses mainly on ISO 14044.

### 2.3.1 Need for the Standard

The need for the standard stems from a general, increasing awareness of environmental problems, and a more specific need for an agreed-upon mechanism for analyzing environmental impacts. Official descriptions of the need for the standard point to increasing awareness of the need for environmental protection. ISO 14040 talks not only about the need for environmental protection but about the increased interest in the impacts associated with products.

Papers found on the Internet date this growing awareness to the 1960s and the publication of documents such as *The Limits to Growth* (Meadows et al. 1972). The Coca-Cola Company is credited for laying the groundwork for the current LCA methodologies. In a 1969 Coca-Cola study, the company examined the relative environmental impacts of different beverage containers to determine which had the lowest

environmental releases. The company quantified many items such as raw materials and fuels used (SAIC 2006).

In the 1970s, fears of resource depletion—in particular oil depletion—precipitated the performance of several LCAs by large energy companies and by the DOE. During this period the U.S. Environmental Protection Agency (EPA) became interested and the assumptions and techniques used were reviewed by EPA and industry representatives, with one result being the evolution of reasonable methodologies (SAIC 2006). As the fuel crisis was gradually resolved, interest in LCA dwindled in the United States. In the late 1980s, the Green Movement in Europe rekindled interest, focusing on recycling and emissions (Dantes undated). Also in the later 1980s, solid waste disposal issues came to the forefront—an issue brought to the national consciousness with the story of a garbage barge that floated around the high seas because no ports would accept it (Hunt and Franklin 1996). The early 1990s brought a back-and-forth battle of LCAs between the American Paper Institute, the National Association of Diaper Services, and Proctor & Gamble where the first study found disposable diapers to be preferable to cloth diapers, the second study concluded the opposite, and the third reversed the conclusion to favor disposable diapers again (Dantes undated). At about this same time, either coincidentally or not (the document does not indicate a relationship), a statement by 11 U.S. State Attorneys General denounced the use of LCAs in marketing until uniform methods were developed. This action and pressure from environmental groups led to the ISO development of LCA standards (SAIC 2006).

### **2.3.2 Use of ISO 14040**

Because there is no certification for ISO 14040, the ISO survey does not provide statistics. However, ISO 14040 is an integral part of companies' or entities' using Type III environmental declarations under ISO 14025. A Type III environmental declaration is described as “quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards, but not excluding additional environmental information” (ISO 2012). The Underwriters Laboratory (UL) website notes an environmental product declaration (EPD) can be developed after an LCA has been performed. UL certifies EPD reports and has a UL LLC-trademarked label for certified products. However, UL notes that certification does not mean a product has met any environmental performance criteria. Rather, it means the product has been through a process to quantify its environmental impacts (UL 2018).

There is an international EPD system. Currently, it contains over 900 EPDs for a range of products in 43 countries (EPD 2018).

ISO 14040 is, as noted, part of the greater ISO 14000 family of environmental management standards. In 2017, worldwide, 363,000 entities were certified under ISO 14001, the standard within the family of standards to which an entity can be certified. This is up 5 percent from 2016. Over the 2008–2017 period, the growth in certifications averaged 8 percent per year (ISO 2018b).

In 2017, the industrial sectors that had the most certifications for ISO 14001 were

- basic metal and fabricated metal products
- electrical and optical equipment
- construction
- wholesale and retail trade.

Each of the four sectors listed above represented 9 percent or more of the certifications and construction represented 19 percent. Electricity supply represented 1 percent of the certifications.

### **2.3.3 How Has the Use of ISO 14040 Improved the Quality of Work?**

The ISO 14040 series, and in particular ISO 14044, provides a consistent method for assessing environmental impacts. This gives entities a tool for assessing and potentially reducing their environmental footprint by comparing alternative sources of materials, alternative methods of production, and alternatives for how recyclable they choose to make their product. This is especially true in cases where the entity using ISO 14044 chooses to also use the other environmental standards, such as ISO 14046 and others geared toward addressing greenhouse gases.

For maximum value, a key to ISO 14044 is pairing it with other standards such as the labeling standard or ISO 14001 so it is not just a calculation of impact, but it is also a transformation of the culture of the company.

### **2.3.4 Significant Successes**

ISO 14044 and the 14040 family in general provide what the aforementioned 11 U.S. State Attorneys General wanted—an agreed-upon set of guidelines for assessing environmental impacts. ISO 14044 has received worldwide acceptance.

### **2.3.5 Administration of ISO 14044**

ISO/TC (Technical Committee) 207 – Environmental Management administers ISO 14040. In particular, Subcommittee 5 – Life Cycle Assessment oversees ISO 14040, 14044, 14045, 14046, 14047, 14048, and 14049.

For a description of how the ISO creates and updates standards, please refer to Section 2.2.5.2.

### **2.3.6 Certification of EPDs**

As was the case with ISO 9000, ANSI has developed a list of accredited certification bodies for verifying or validating EPDs (ANSI 2018a).

### **2.3.7 Key ISO 14040 Series Features Relevant to Valuation Guidelines**

Consistent guidelines: ISO 14044 introduced a consistent set of guidelines for assessing an organization's environmental impacts. As discussed in Section 2.3.1, before ISO 14044 there really were no widely accepted guidelines, and organizations were free to specify the scope and depth of their environmental assessment to suit their own self-interests. By providing a common set of guidelines for organizations to follow, ISO 14044 puts environmental assessments on a more level plane.

Use with other certification/validation: The pairing of ISO 14044 with EPD certification offers a mechanism for organizations to potentially benefit in the marketplace. Arguably, an organization performing ISO 14044 analyses is a positive step, and the added benefit of an EPD certification provides an additional avenue for an organization to benefit. The EPD verification and validation is a potential model for third-party review. The EPD verification reviews the LCA and related analyses to ensure the analyses conform to the guidance and use inputs from sources seen as meeting credibility thresholds. A similar process might be of interest in the Valuation Guidelines.

## 2.4 Aviation Checklists

The aviation industry uses checklists extensively for performing maintenance on aircraft, preparing aircraft for flight, packing the cargo area, and securing doors, and in the cockpit for situations ranging from the routine to the extraordinary or emergency. This discussion mainly focuses on cockpit checklists or the checklists used by the pilot(s) and copilot(s) in the cockpit.

Cockpit checklists are used to ensure critical tasks are undertaken in the appropriate sequence (when applicable) and in the appropriate manner. In the cockpit on a typical flight, the cockpit crew are required to make large numbers of “routine flight controls and switch actions” and to frequently check gauges and other instruments to keep track of aircraft functions, systems, and configurations, not to mention keeping track of the flight path and ensuring other cockpit crew are performing their duties as needed (Dismukes and Berman 2010).

There are two main types of checklists: those for normal or routine activities—known as standard operating procedures (SOPs)—and those for abnormal or emergency situations (EASA 2012). Routine activities or SOPs are tasks such as checking fuel gauges, system functionality, and the position of flaps, etc., prior to takeoff. Normal or SOP checklists would be used any time the configuration of the plane needs to be changed as a part of a normal, everyday flight. Emergency checklists cover the steps to take to save the plane and passengers if systems or equipment (e.g., the engines) stop working in flight.

In a recent article, Boeing points to several types of checklists:

- procedural – to cover long, complex, or critical tasks that get performed only occasionally
- preparation – a list of steps to ensure all variables are performed; Boeing’s illustrative examples of preparation checklists include shopping lists or lists made up in preparation for a trip
- problem-solving – “multiple-point, question type checklists used for troubleshooting”
- prevention – a checklist to address errors in high-hazard areas that can cause injury or death to workers or people in surrounding areas or destruction of property (Higgins and Boorman 2016).

### 2.4.1 Need for the Standard

Planes are extremely complicated machines. Because they are machines, although they are well maintained, there will be equipment failures. There is also the possibility for human failure. Checklists are cognitive aids designed to address the last fact, the possibility for human failure. Higgins and Boorman (2016) state the Boeing objective is to move their “effective incident rate to zero.”

The first checklist was prepared following the crash of a Boeing plane in 1935. Boeing was demonstrating the plane they expected to be the next generation of a military long-range bomber. According to all accounts, the demonstration was a formality and Boeing was expected to be awarded the contract over their competitors, Martin and Douglas. Army brass and manufacturer executives watched as the Boeing plane took off, climbed to 300 feet, stalled, turned on one wing and then crashed. Douglas received the contract. The investigation revealed the pilot—one of the military’s best test pilots—did not unlock the wind gust-lock, making the elevators inoperable. Later, when the demonstrations had to be re-run, Boeing re-entered. However, in the elapsed time between the accident and the re-run, Boeing had developed normal operations checklists. Boeing won, and ultimately over 12,000 of the B-17 (“Flying Fortress”) planes were sold (Higgins and Boorman 2016).

What had happened in 1935 was that the new plane had become too complicated for pilots to fly without the cognitive aids ultimately provided by the checklists. Checklists are now mandated by the U.S. Federal Aviation Administration (FAA) and other regulators around the world.

## 2.4.2 Use of Aviation Checklists

All airlines in the United States are required to have approved procedures readily usable in the cockpit of each aircraft. Flight crew are required to follow the procedures when operating the aircraft (FAA 2011, Section 121.315).

## 2.4.3 How Has the Use of Aviation Checklists Improved the Quality of Work?

Aviation checklists have several beneficial impacts that improve the quality of work:

- Focusing on “killer” items. The Boeing philosophy, as reported by Gawande (2009), is that attention span issues dictate checklists be short. At any pause point<sup>4</sup> the checklist needs to be completed in 60 to 90 seconds. This means focusing sharply on the important or in the case of an airplane, the killer items, and leaving off those things every pilot does every time such as calling the tower.
- Dealing with task overload. Checklists can help with task overload in several ways, particularly if people, like pilots, are accustomed to grabbing a checklist when problems arise.
  - Reminder of what is most important. Gawande (2009) recounts a story of a checklist where the first item on the checklist for engine restarting was “fly the plane.” This might sound strange, but on a flight such as United Airlines Flight 811<sup>5</sup> when the pilot is dealing with multiple crises—decompression and a non-functioning oxygen system, a disabled engine and another engine that is burning, and damage to the outer-edge wing flaps—a reminder to “fly the plane” might be a needed reminder about what is most important.
  - Help with prioritizing what to address first. In a case like Flight 811, it might be obvious that descending to an altitude where everyone, including the cockpit crew can breathe, is the priority. In other cases, the priority might not be as clear, and a question-directed checklist can help figure out how to address problems in the correct order.
  - Help with overcoming common ways of dealing with task overload. Murphy discusses three inappropriate ways pilots respond to task overload,<sup>6</sup> all of which are deadly in the cockpit, and common for everyday working professionals:
    - Shut down. Some people simply stop working when faced with an overload of tasks and distractions.
    - Compartmentalization. Some divide the overload of tasks into compartments and address the compartments one at a time, ignoring the others.
    - Channeling. Some focus literally on one thing to the exclusion of all else (Murphy 2000).

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<sup>4</sup> Pause points are those points at which a checklist should be used. They might be when starting a new task or when transitioning from one task, say takeoff and communicating with the tower, to the next task of leveling off at flight altitude and being handed off from the tower to the next air traffic controller.

<sup>5</sup> Flight 811 had just left Honolulu International Airport when a cargo door failure caused explosive decompression in the passenger cabin resulting in passengers being killed when they were ejected from the cabin. See: [https://en.wikipedia.org/wiki/United\\_Airlines\\_Flight\\_811](https://en.wikipedia.org/wiki/United_Airlines_Flight_811)

<sup>6</sup> Murphy calls it Task Saturation in *Business Is Combat* (Murphy 2000).

- Combating cultural issues at the airline/pressures to “deliver.” There is evidence that a contributing factor in crashes and incidents include cultural or delivery pressure leading to what some have called “get-there-it is,” which can lead to shortcutting the pre-flight inspections and checklists.
- Cockpit culture change. The use of the checklist in the cockpit can be empowering to the first officer (and others). In the cockpit the pilot is in charge, and evidence from flight recorders indicates that pressure from the pilot has been a contributing factor in crashes. Thus, there is a view that the checklist is to be a tool whereby the first officer or other can be/are empowered to question the pilot.
  - Crew members serve as cross-checkers for each other; if a crew member notices a step has been skipped, they are empowered to bring that to the pilot’s attention.
  - Crew member(s) monitor each other. Simply monitoring conditions is important and the pilot not flying the plane is often the monitoring pilot, whose job it is to monitor with and without the use of the checklists.
- Speed of checklist change. One impressive point is the speed at which the review of incidents leads to a solution that in turn leads to changes being made in the checklists in every commercial airline’s cockpit.
  - Gawande (2009) recounts the story of a January 2008 crash just short of the runway at Heathrow Airport (no fatalities). The investigators could not definitively identify the cause of the crash, but suspected ice had formed in the fuel lines, blocking fuel flow to the engines.  
  
 From the time the crash investigators issued a bulletin, it took Boeing two weeks to design and test (using in flight simulators) a new checklist and send it out to every owner of a Boeing aircraft. Within about a month of the recommendations becoming available, every pilot had a new checklist. In November 2008 a Delta Air Lines flight encountered the same thing—i.e., an “uncommanded rollback” of an engine. Because they had a checklist, the pilot and crew knew what to do and landed safely. Investigators later found it was ice.
  - Gawande (2009) wrote this story from the perspective of a medical professional advocating the use of checklists in his profession. He also recounted an analogous medical story. A study examined what happened after nine major treatment discoveries. The researchers found it took on average 17 years to adopt the new treatment procedures for at least half of American patients.

#### **2.4.4 Significant Successes**

The prevention of crashes such as the 2008 Delta Airlines flight illustrates the type of success the airline industry strives for with checklists—giving pilots the tools they need to keep planes safely in the air.

#### **2.4.5 Administration of Aviation Checklists**

The FAA requires checklists to be in the cockpit. Airplane manufacturers such as Boeing and Airbus are the primary authors of checklists in the airline industry and the airlines customize checklists somewhat to account for their own practices. The FAA has an approval process for approving the manuals and checklists that pilots are required to have when in the cockpit of a plane.

##### **2.4.5.1 Standard Setting and Review**

When an incident occurs, for example the ice formation in fuel lines noted in Section 2.4.3, the FAA sends out advisory letters and/or orders, and the manufacturers and airlines respond by updating checklists.

If an airline manufacturer develops a new plane, they also develop the full suite of checklists and manuals for that plane.

### **2.4.5.2 Certification with Checklists**

Pilots train in the use of checklists. With both SOP and emergency checklists, pilots are trained to memorize checklists such that when a checklist is pulled out and used it can often be used in the manner of “do the action” then “challenge” to ensure it was done, as opposed to “read-do” wherein the non-flying pilot reads the checklist and the flying pilot does it.

## **2.4.6 Key Aviation Checklist Features Relevant to Valuation Guidelines**

Checklist design: Brief, hitting only killer items. Gawande (2009) includes a story of his visit to Boeing to talk with Daniel Boorman, Boeing’s eminent expert on checklists. To illustrate the checklist Boeing created to deal with the type of incident suffered by Flight 811, Boorman took Gawande to the flight simulator. By the time they started to taxi in the simulator, they had already completed three checklists—an initial cockpit check with four items, before starting the engines another checklist with six items which included a prompt asking if they had completed a taxi and takeoff briefing, and one other checklist with five items to determine whether they needed to go through de-icing and had taken the brakes off. The point is that the checklists are designed to be short, to the point, and they can be completed quickly before an interruption occurs.

Speed: The speed at which a key addition propagates throughout the industry is impressive. This seems like an important feature: having one central entity with a high-level purview that can perceive such needs and ensure the need is reflected in revised guidelines.

Avoiding overlooked steps: As a machine—or process—becomes much more complex, even obvious basic steps or checks may be overlooked. This is particularly true in environments where interruptions are common—like in a cockpit or at the desk of a valuation analyst—and where dealing with the interruption can take long enough that a person can literally “forget where they were,” think they finished the task, but in reality had left it incomplete or had not even started it. The Valuation Guidelines’ requirements to align decision-maker objectives, performance metrics, stakeholder concerns, and selection of models and tools may seem elementary, but the need for checklists validates that enumerating the requirements for a proper valuation assessment will improve the quality of a valuation study.

## **2.5 Medical Checklists**

Medical checklists are checklists designed to cover the minimally expected steps in patient care procedures—from routine bedside actions to operating room protocols—to minimize the possibility of negative outcomes.

### **2.5.1 Need for Medical Checklists**

In 2001, a specialist at Johns Hopkins Hospital came up with a checklist for tackling a potential checklist task—central-line<sup>7</sup> infections (Gawande 2009). The procedures for preventing central-line infections—a.k.a., central-line-associated bloodstream infections or CLASBI—were well-known and understood.

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<sup>7</sup> A central line is a catheter placed in a large vein, typically in the neck, chest, or groin. The catheter is used for administering drugs or fluids, or for obtaining blood (CDC 2018a).

However, simple steps were often overlooked or forgotten—like washing hands; cleaning the patient’s skin; wearing a mask; donning sterile gloves, hat, and gown; and putting a sterile dressing over the insertion site. The John’s Hopkins Hospital checklist experiment showed amazing results during a short 10-day test (infections went from 11 percent to zero), so much so, the researcher doubted the results and re-ran it for 15 months. Only two infections occurred during that period (Gawande 2009). In 2003, the researcher was approached by the Michigan Health and Hospital Association about testing his checklist in Michigan hospitals. When the results were presented in December 2006, the study showed sustained reductions of 66 percent in CLASBI rates in the 103 intensive-care units that reported results (Pronovost et al. 2006). It was estimated that 80,000 central-line infections occurred each year in the United States with up to 28,000 deaths (Pronovost et al. 2006), meaning the results of what was called the Keystone Initiative were anything but academic.

So, major reason checklists are needed in the medical profession is to ensure the simple steps are not overlooked. The medical profession is highly specialized. For example, an emergency procedure for a heart attack involves multiple specialists but given the gravity of the situation, the time to assemble the required team and get everyone briefed, scrubbed, and in the operating theater is short. Thus, following a checklist can literally save lives by ensuring the minimum expected steps like washing hands, cleaning the patient’s skin, and wearing a mask are not overlooked.

Checklists are also needed to combat task overload in medical professionals. The magnitude of the potential problem is staggering if one considers the number of diseases officially recognized (plus those not recognized but known to exist), the number of potential treatments including the number of drugs and procedures, and the limitations of the systems used. At the time Gawande wrote his book *The Checklist Manifesto* (2009), the World Health Organization recognized over 13,000 diseases. There were over 6,000 drugs in existence for addressing these diseases and over 4,000 medical and surgical procedures (Gawande 2009).

Dealing with this level of complexity would be impossible for anyone. Then, add in the distractions that go along with being a doctor in a modern hospital in the United States, namely, alarms going off; the person in the bed next to your patient suddenly crashing with the attendant scene that follows when the crash cart and multiple doctors and nurses arrive to revive the person; people calling, paging, and texting you to ask for help (Gawande 2009). With doctors and others focused on complex questions such as diagnosing the problem and identifying the appropriate procedure, it is not hard to understand why simple steps can be overlooked. Checklists are a tool to help deal with complexity by ensuring the simple things get done.

It should be noted the cost of mistakes can be enormous, including of course the harm done to patients and their families. Noted earlier in this section were the number of lives saved. It also includes the costs of correcting mistakes—recovery from a central-line infection can include lengthy stays in the intensive-care unit. The Keystone Initiative was estimated to save \$175 million dollars (Gawande 2007). The cost can also include malpractice-related costs and potential damage to the reputation of doctors and medical facilities.

## **2.5.2 Use of Medical Checklists**

Medical checklists are relatively new to the medical profession. In a sense, the nursing profession has used checklists for quite some time, though they weren’t called checklists. They were called things like medical timing charts, care plans, and just charts for keeping track of vital signs.



As already discussed, the Johns Hopkins Hospital developed a CLASBI checklist. The Centers for Disease Control and Prevention (CDC) CLASBI prevention website presents several different checklists including their own (CDC 2018b).

The World Health Organization (WHO) Safe Surgery Checklist is used around the world (WHO 2018a). Because it is used in places like the United States, Canada, Norway, and other nations that have modern hospital facilities as well as in developing countries that have medical facilities that might be called rudimentary, results have varied. In their initial 2007/2008 pilot program with eight hospitals in Canada, India, Jordan, New Zealand, the Philippines, Tanzania, the UK, and the United States, the average rate of inpatient complications fell from 11 percent to 7 percent, and inpatient death rates fell from 1.5 to 0.8 percent. More recent studies in Norway, Liberia, Iran, and the Netherlands also found statistically significant reductions in surgical complications (WHO, 2018b).

The WHO and Ariadne Labs have also developed a Safe Childbirth Checklist. While initial response is positive in a collaborative project, the uptake by various professionals involved in childbirth around the world implies the WHO may need to work on it more to be as successful with it as they appear to be with the Safe Surgery Checklist. (WHO 2018c).

Essentially, there is no requirement for hospitals to use checklists, nor is there a national standard-setting organization in the United States. The closest that the United States comes to having a national requirement for a checklist is what is called the Universal Protocol. While there are no specific requirements for a checklist, some facilities have likely included the requirements of the Universal Protocol in a checklist (Haynes 2018). The Universal Protocol is required of all facilities accredited by the Joint Commission.<sup>8</sup> It requires a pre-procedure verification process, surgical site marking, and a surgical “time-out” immediately before starting the procedure to verify the correct patient, correct procedure, and that the correct equipment, instruments, and implants are available (Dillon 2008). The Universal Protocol is designed to prevent the horrors of incorrect surgery—procedures performed on the wrong person, surgery performed on the wrong leg, or arm or eye, and nightmare situations such as amputation of the wrong leg.

### **2.5.3 How Has the Use of Medical Checklists Improved the Quality of Work?**

While some detractors fear checklists will turn medical professionals into robots just checking boxes, others believe they free-up medical professionals to focus on more important tasks. This is because checklists are good for mindless things like “wash your hands,” and these are things you shouldn’t spend time thinking about (Gawande 2009).

The WHO Safe Surgery Checklist includes a “time-out” similar to the Universal Protocol. In the Safe Surgery Checklist this is so all team members can introduce themselves, to confirm the patient’s name, the procedure and where the incision will be made, to ask whether the patient was given an antibiotic prophylaxis within the hour, to discuss anticipated or possible critical events, to discuss any issues or concerns or whether there are patient-specific concerns like allergies (WHO 2018a). This time-out, like the Universal Protocol time-out, has prevented many mistakes. Even more, the pre-operation preparation enables better preparation (e.g., if the potential for accidentally causing massive bleeding exists, arranging beforehand for a ready source of blood) and gives the team members an opportunity to think before the

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<sup>8</sup> The Joint Commission was founded in 1951, and the name was originally the Joint Commission on Accreditation of Hospitals. The name was changed in the late 1980s to the Joint Commission on Accreditation of Healthcare Organizations to reflect expansion of the organization’s scope of activities. In 2007, the name was shortened to the Joint Commission (Joint Commission 2019).

operation so they are better prepared to move quickly if one of the possible critical events occurs (Gawande 2009).

## **2.5.4 Significant Successes**

The CLASBI story is significant. The CDC estimated in 2011 that intensive-care units had reduced CLASBI by 58 percent compared to 2001, saving many lives given their estimate that one in four people die of CLASBI (CDC 2011). The associated stories such as the checklist test in Michigan are equally if not more amazing success stories. Given that some hospitals in the initial study reached a percentage rate of zero (0%) infections, all but eliminating CLASBI seems like it is possible.

The WHO Safe Surgery Checklist has had considerable success, in some cases reducing the percentage of patients with complications by amounts exceeding 10 percent.

As with aviation checklists, medical checklists have the potential for changing culture for the better. In a checklist culture, a nurse or an anesthesiologist is more likely to feel empowered to call a time-out and ask a question about procedures on the checklist that have been omitted than if there is no checklist culture.

## **2.5.5 Administration of Medical Checklists**

As noted earlier, there is no entity that has the authority specifically to order or to approve checklists. Thus, checklist development and use are entirely up to each medical facility.

### **2.5.5.1 Standard Setting, Review, and Maintenance Responsibility**

Maintenance is also up to each individual medical facility. In conducting research for this report, it was noted the WHO Safe Surgery Checklist still has a 2009 date on it—the date it was released widely after the pilot test. It was confirmed the WHO checklist has not been updated, a fact however, that is likely to be more of an institutional constraint (e.g., funding source issues) than because the checklist has been found to be perfect. Note however the WHO checklist was always intended to be tailored by the institutions using it (Haynes 2018).

### **2.5.5.2 Certification with Checklists**

Other than the Universal Protocol discussed earlier, there is no certification process for the development and use of checklists.

## **2.5.6 Key Medical Checklist Features Relevant to Valuation Guidelines**

Focus on minimum steps: Some medical procedures are so routine that one could almost “do it in one’s sleep,” and therein lies the problem: when staff do the procedure on “autopilot,” important steps may be forgotten (e.g., hand washing). The discipline of enforcing a checklist has prevented such lapses in the quality of care. The checklist also makes explicit and clear the minimum expected steps. This is relevant to the Valuation Guidelines because analysts can also operate on autopilot, and when they fail to explicitly examine some of the nuanced assumptions or the choice of models or metrics, etc., they can unintentionally subvert the valuation process by making it less transparent and/or failing to address the decision-makers’ true valuation criteria.

Peer review and empowerment: A related feature is the cross-check function where medical professionals are all responsible for the checklist and they are empowered to ask one another whether a step has been overlooked. In an environment where employees do not feel empowered to question a team leader (like the doctor), it is easy to envision worst-case scenarios, such as the case where team members recognize steps are being skipped that can lead to negative outcomes and yet team members remain silent due to fear or apathy.

## **2.6 ASHRAE Commissioning Standard**

The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standard 202-2013, *Commissioning Process for Buildings and Systems* (referred to hereinafter as the Commissioning Standard) lays out a quality assurance program to ensure that building systems function as intended (ASHRAE 2013). The ASHRAE standard documents what ASHRAE terms “the minimum acceptable commissioning practice for buildings and systems” (ASHRAE 2013). It can be applied to new and to remodeled buildings. The process includes numerous steps, starting at project inception. The Commissioning Standard lays out a “framework for developing design documents, specifications, procedures, documentation, and reports” (ASHRAE 2018a).

### **2.6.1 Need for Commissioning Standards**

The need for Commissioning Standards grew out of a confluence of major factors. First was a recognition that buildings, especially large and complicated structures like the John Hancock Building in Boston, Massachusetts, and the Kansas City Hyatt, cannot simply be expected to operate correctly (U.S. House of Representatives 1984). The second was a burgeoning energy conservation/energy efficiency effort on the part of electric utilities in the United States. From the outset, utility programs (at least in some parts of the country) invested in post-implementation evaluations of the programs they operated, and they identified performance gaps, one of which was that buildings did not operate as efficiently as expected. Commissioning was seen and developed as a strategy for correcting this shortcoming in efficiency programs (see for example, Piette and Nordman 1995).

### **2.6.2 Use of the Commissioning Standard**

Several organizations, including ASHRAE, Building Commissioning Certification Board, Association of Energy Engineers, AABC Commissioning Group, and others offer certification in the fundamental principles of building commissioning. (It is not clear that all the building commissioning groups use the ASHRAE Commissioning Standard, as opposed to their own standard.) Building commissioning is an important segment of the building construction and retrofit market place, although a Washington State University document on commissioning stated that it was not standard practice (WSU 2005).

### **2.6.3 How Has the Use of the Commissioning Standard Improved the Quality of Work?**

If included from project inception, the commissioning process offers a built-in quality assurance program. Once construction begins, the commissioning would verify what is being constructed against specifications. If issues were uncovered, the construction process might be modified, and if no issues were uncovered, construction would continue. As systems are completed, commissioning tests the systems individually and in concert with other systems to ensure everything operates as expected. One perpetual source of problems to be addressed by commissioning comes at the seams—at the points where

the different professions' domains meet or at the point where one building stage ends and another begins<sup>9</sup> (Akin et al. 2004). Seams coordination is a key aspect of quality assurance. For example, ASHRAE cites examples where already-constructed walls (interior or exterior) had to be breached and rebuilt because the architects had not considered the physical clearances needed to transport and install the heating, ventilation, and air-conditioning systems in the mechanical room when the building was designed. This is relevant to the Valuation Framework, where, for example, the guidelines require early identification and involvement of stakeholders, instead of waiting until the valuation study is complete before bringing in the stakeholders to review it.

There are three main ways commissioning is performed—commissioning, retrocommissioning, and recommissioning (ASHRAE 2013):

- Commissioning is a process that occurs with new construction. As noted, it is the verifying, testing, and documenting of all systems and assemblies to ensure the result meets the owner's project requirements.
- Retrocommissioning applies the commissioning process to an existing building that was not previously commissioned.
- Recommissioning applies the commissioning process to a building that was previously commissioned to ensure that the facilities and assemblies are operated and maintained to maintain the services intended over the life of the facility.

## **2.6.4 Significant Successes**

Guided by the Commissioning Standards developed by ASHRAE and/or by others, performance of retrocommissioning has helped numerous entities achieve the energy savings originally intended from their buildings but that had not fully materialized previously. For example, a Marriott International Hotel in San Diego participated in a utility-sponsored retrocommissioning program and the commissioning contractor was able to identify over \$270,000 in annual energy cost savings. The project cost the hotel nearly \$392,000, but with the utility incentives the payback period was under a year. Improvements identified included eliminating unnecessary simultaneous operation of heating and cooling, reducing fan speeds, re-enabling a demand-controlled ventilation system in the parking garage, and others (SDG&E undated).

The website cited in the San Diego Gas & Electric (SDG&E) end note, the California Commissioning Collaborative site, gives several examples of retrocommissioning success stories. They also provide stories about the use of metering-based commissioning and testing in existing buildings to improve the performance of buildings.

New construction commissioning in New York (also listed on the California Commissioning Collaborative site) for Baruch College in Lower Manhattan provides an example of the type of success that new building commissioning can provide. The commissioning team identified several issues, including among others, incorrect sequencing in the air-handling control systems, missing smoke detectors on supply and return valves, and "impediments to the emergency generator operating system" (NYSERDA undated). As illustrated by the list of issues uncovered and resolved through the commissioning process, energy efficiency is not the only benefit of commissioning.

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<sup>9</sup> Gawande (2009) discusses how checklists used by the construction management team also address the seams issues.

## **2.6.5 Administration of the ASHRAE Commissioning Standard**

Administration of the ASHRAE Commissioning Standard involves addressing maintenance and certification needs.

### **2.6.5.1 Maintenance Responsibility**

ASHRAE's Standing Project Committee 202, Cognizant Technical Committee 7.9, Building Commissioning oversees maintaining the standard. According to the ASHRAE Continuous Maintenance Procedures, a new version of the standard must be published within 5 years of the date of the last version. Because Standard 202-2013 is maintained under the continuous maintenance procedures by the Project Standing Committee, a change proposal can trigger a revision to the standard. There is a clear process for submitting recommendations for change, and there are clear and near-term deadlines for studying stakeholder change proposals:

- A committee member or a member of the public can submit a change proposal at any time.
- ASHRAE staff will review the proposal to ensure it is a change to the most current published version of the standard.
- The staff then forward the proposal to the standing committee chair.
- The proposal can either be accepted for public review without modification, or with modification, or it can be accepted for further study or rejected. The response to the proposer must explain any of the responses except "accepted without modification."
- If a proposed change is accepted for study, the study shall be completed within 7 months of selecting that option. Upon completing the study, the committee must either approve the proposal with or without modifications or reject the proposal.
- If the proposal is approved by the project committee, with or without modification, it is then sent out for public review in accordance with Procedures for ASHRAE Standards Actions (PASA) (ASHRAE 2018c).

According to PASA, the project committee votes for changes to the standard and, to receive approval, must receive at least a two-thirds majority of those voting. A quorum is considered one-half of the project committee voting members. There are many rules surrounding voting and going through all the rules in detail is beyond the scope of this report. Those casting negative votes will be requested to provide input about the reason(s) for their negative votes, and the results will be held in abeyance until the committee can attempt to resolve the comments and put the proposal back out to the project committee to give committee members an opportunity to change their votes (ASHRAE 2018b).

Once the project committee approves the proposed standard revision, it is sent out to the public for comment. Once the comment period closes, the project committee will review the comments and try to resolve all negative public review comments, and each commenter will be notified about the disposition of their comment(s). After the review of public comments, the project committee may make changes to the proposal or vote to recommend approval of the standard. If there are no public comments, the original vote on the standard review draft stands. If changes are made, all substantive changes must be approved by the project committee. The committee may determine a full public review of the revised proposal is required as well (ASHRAE 2018c).

ASHRAE's process is ANSI approved, and "PASA is ASHRAE's contract with ANSI" (ASHRAE 2018c).

### **2.6.5.2 Certification with ASHRAE Commissioning Standard**

As noted in Section 2.6.2, professionals can be/are certified as commissioning professionals by ASHRAE and other organizations. When a commissioning professional works on a building project, it could be under any number of programs or governmental requirements. For example, the General Services Administration (GSA) maintains a building commissioning program/requirement for new buildings (GSA 2017).

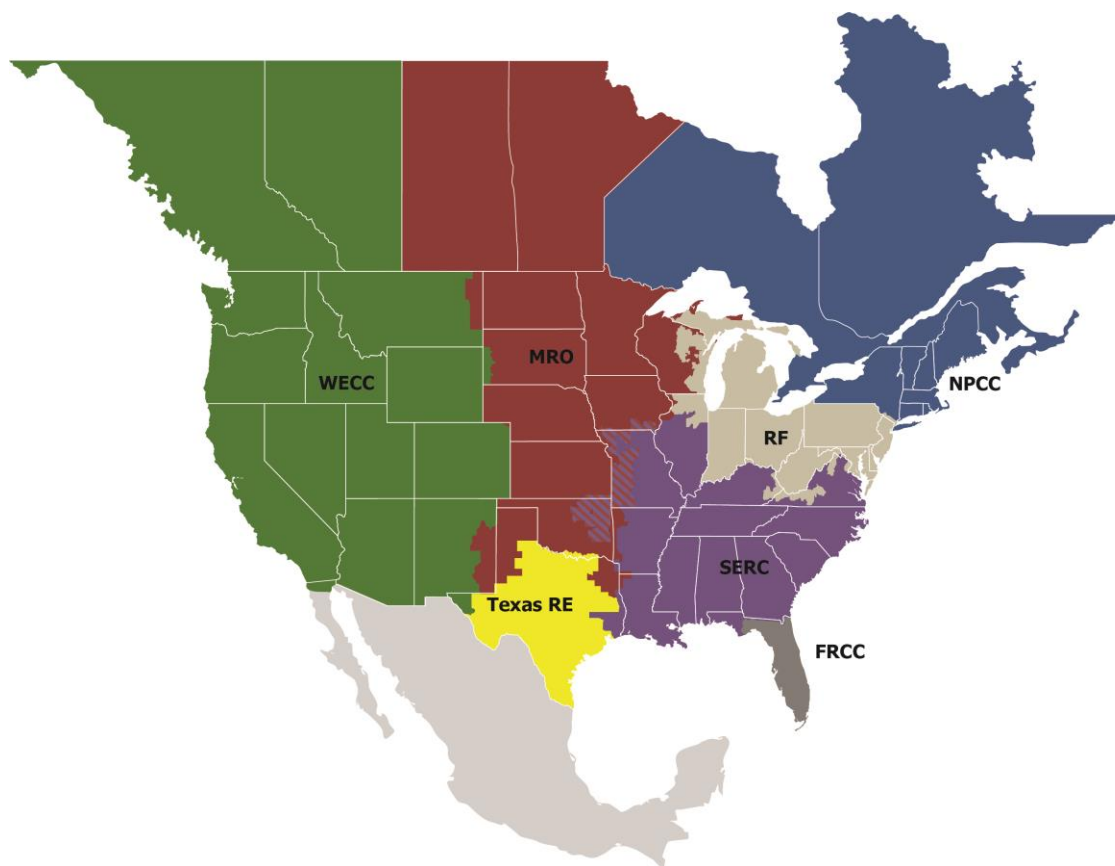
### **2.6.6 Key ASHRAE Commissioning Standard Features Relevant to Valuation Guidelines**

Addressed need for minimum quality control steps: In developing the Commissioning Standard, ASHRAE responded to a very clear need. In the electric utility space, commissioning responded to a need to ensure that energy efficiency programs achieved the energy savings “advertised” by the program. In other words, energy efficiency programs analyzed the energy savings that could be achieved if a system upgrade was made, and if the savings did not materialize because the system was not installed or operated correctly, it did not reflect well on the energy efficiency program—either in terms of benefit-cost analyses or in terms of public perception. Thus, in the late 1980s and early 1990s, building commissioning became an often-heard buzzword. The fairly widespread (i.e., beyond just ASHRAE) nature of commissioning programs and certifications is a testament to the fact that it responds directly to a need.

ASHRAE administration process as possible model for Valuation Guidelines: The ASHRAE process for approving a standard revision is an interesting model. As a consensus standard, the Standard Project Committee (SPC) responsible for developing or revising a standard must have balanced, industry-wide membership. A proposed standard must be approved by a majority of the SPC, and reasons for any negative votes by SPC members must be raised with the entire SPC. While a standard does not need to be approved by a public ballot, a standard or proposed revision to a standard must be posted for public comment, and the ASHRAE SPC must address all comments received. This is a high bar, but not impossibly high, because ASHRAE has successfully developed dozens of standards. The approval process for ASHRAE standards is a model that should be examined closely. A caveat might be that new Valuation Guidelines might be subject to a large number of proposed changes, at least initially, so it may be desirable to put revision on a schedule for the first couple of rounds, then possibly put it on a continuous maintenance review standing.

## **2.7 NERC Electric Reliability Standards**

NERC reliability standards define minimum requirements for planning and operating the bulk electric systems (BESs) to achieve and maintain minimum reliability criteria. NERC reliability standards are mandatory. NERC is the Electric Reliability Organization (ERO) that has overall responsibility for setting standards, monitoring compliance, and enforcing compliance. The Federal Energy Regulatory Commission (FERC) has oversight authority in the United States. NERC has delegated authority to seven Regional Entities to monitor and enforce compliance with reliability standards within their geographic/BES footprints. Figure 2.1 shows a map of the NERC Regional Entities copied from a NERC webpage entitled *Key Players* (NERC 2017b). NERC works with the Regional Entities and with other stakeholders to identify the need for standards or requirements within standards.



**Figure 2.1.** Map of NERC Regional Entities Geographic Areas (Source: NERC 2017b)

Reliability standards apply to a wide range of entities in the United States, Canada, and Baja California North (Mexico). The standards are broken down by function—balancing authority, distribution provider, generation owner, generation operator, planning authority/planning coordinator, reliability coordinator, resource planner, reserve sharing group, frequency reserve sharing group, regulation reserve sharing group, transmission owner, transmission operator, transmission planner, and transmission service provider. Each utility, generation owner, distribution provider, etc.,<sup>10</sup> that is subject to the NERC reliability standards is required to fill out an organization registration and certification that specifies which functional areas apply to them. Unlike other areas of the electric industry in the United States where some entities such as municipal utilities might not be regulated by FERC or state regulatory authorities, all entities are subject to NERC reliability standards if they meet the definition of one or more function. Based on the applicability section of each standard and the functional registration of each entity, NERC and the Regional Entities can determine which standards apply. Each entity registered with NERC is accountable for meeting the standards and/or individual requirements within standards that apply to it (NERC 2018).

<sup>10</sup> NERC standards are intended to address the bulk electric system. Thus, anyone who owns, operates, plans for, or is otherwise operationally involved with generation, transmission, and to a lesser extent, distribution assets is either subject to or potentially subject to NERC reliability standards. These can be corporations (i.e., investor-owned utilities or independent power producers or merchant generators, etc.), municipalities, cooperatives, and others. Thus, finding a single word to refer to all such entities is difficult, so the word “entity” was selected. Except in situations where all words are capitalized, the word entity will be used in lower case to distinguish it from Regional Entities.

As noted, the interconnected electric grids that fall under NERC’s purview include Canada and a portion of Mexico. The following discussion focuses on authorities in the United States and does not attempt to extend the discussion to cover the authorities within Canada or Mexico.

### **2.7.1 Need for Electric Reliability Standards**

NERC standards have at least partially existed since the mid-1960s. NERC and nine regional reliability organizations<sup>11</sup> came into being because of a major blackout in 1965. NERC was originally the National Electric Reliability Council, and the original NERC “standards” were not standards as such but guidelines, policies, and criteria. (National was changed to North American in 1981.) The original NERC guidelines, policies, and criteria were voluntary steps adopted by the industry to promote planning, maintenance, and operation practices designed to make the BES more reliable. In 2006, NERC became the North American Reliability Corporation (NERC 2017a).

In the late 1990s, NERC embarked on an effort to translate their policies, guidelines, and criteria into standards. At that time, NERC was responding to changes such as the opening of wholesale markets to competition and open-access at the retail level, and began efforts to make standards mandatory and enforceable to deal with the impacts these changes were having on the planning and operation of the BES (Hilt 2018). The original set of standards, known as Version 0 standards, were, at least in theory, the same as the existing policies, guidelines, and criteria—they were just restated as standards. The Version 0 standards became effective in 2005, though in the United States the standards remained voluntary (Taylor 2009). A key part of the need was illustrated on August 14, 2003, when a major northeast blackout occurred. Following the blackout, when the Energy Policy Act of 2005 (EPACT 2005) was passed by the U.S. Congress, it included provisions calling for the establishment of one ERO to be overseen by FERC (Hilt 2018). The ERO would have the responsibility to set and enforce mandatory reliability standards. After passage of EPACT 2005, FERC announced a process seeking an ERO, for which NERC applied. FERC ultimately selected NERC to be the ERO<sup>12</sup> (Taylor 2009).

Pursuant to EPACT 2005, FERC granted NERC the legal authority to enforce reliability standards with all users, owners, and operators of the bulk power system in the United States. Compliance with those standards is mandatory and enforceable in the United States. If a U.S. power company is found to be non-compliant with NERC reliability standards, enforcement actions include NERC-overseen rectification of the non-compliant company's issues, and fines levied on a sliding scale, proportional to the company's degree of noncompliance.

Avoidance of major power outages can be said to be the underlying need for the reliability standards.<sup>13</sup>

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<sup>11</sup> The original regional reliability organizations differ from the current set of regional entities, although some of the original regional reliability organizations, e.g., the Western Electricity Coordinating Council, evolved to become Regional Entities participating in the current NERC program.

<sup>12</sup> Note that FERC’s processes for selecting the ERO, selecting/approving the selection of Regional Entities, and approving NERC standards should not be misconstrued as “rubber stamps.” In the approval of Version 0 standards, FERC approved some entirely, rejected some entirely, and approved some partially, while sending the rest to NERC with comments for improvements.

<sup>13</sup> The original formation of NERC and the Regional Entities has been directly linked to power outages. While no sources reviewed for this report made a direct link between the east coast outage and EPACT 2005, the timing seems to be more than coincidental.



## **2.7.2 Use of Electric Reliability Standards**

All entities subject to reliability standards must comply with all requirements that apply to the functions for which the entity is registered. (NERC 2018a). Entities registered as balancing authorities are audited every 2 years. Entities registered under other functions are audited less frequently. All entities are required to self-certify compliance, or noncompliance, with standards annually. Additionally, the Regional Entities can and do conduct spot checks, as well as follow up on tips or third-party reports of non-compliance issues. Auditing of compliance is performed by Regional Entities for the entities within their footprint. For example, transmission-owners or balancing authorities in California are audited by the Western Electricity Coordinating Council (WECC). Because Regional Entities may vary somewhat in their approach to compliance enforcement, this discussion focuses on WECC.

NERC and WECC have done a great deal of outreach to educate and assist entities in complying with standards. After the initial functional registrations and installation of the Regional Entities under FERC/NERC, most of the regional outreach has been performed or at least coordinated by the WECC. Several outreach and/or training opportunities can be found on the WECC website:

- Reliability and Security Workshop
- Compliance Open Webinars
- Human Performance Conferences (appears to be annual conferences)
- Grid Training and Education (WECC 2018b)
- Compliance Users Groups and other compliance assistance (WECC 2018a).

The WECC Compliance Users Group was set up relatively early in the era of mandatory compliance enforcement. The Compliance Users Group, as the name implies, was about the users. It was a collaborative effort between the users—i.e., entities who were expected to comply with standards—and the WECC compliance staff to provide a forum where users could solicit presentations and information about the topics of concern to the users and where WECC compliance staff could provide information to users about subject areas they considered problematic. For example, at one Compliance Users Group meeting in Seattle, Washington, the WECC auditors presented a session on the checklists the auditors used to audit compliance with standards. At another Compliance Users Group meeting, the agenda included a focus on the standard requiring maintenance of protection system equipment and testing of equipment—one of the standards for which WECC auditors were finding the largest numbers of non-compliance issues and one of the standards entities were finding most difficult to comply with.

WECC promotes what it calls a “culture of compliance.” The culture of compliance is instilled in entities at least in part through audits and spot checks (WECC 2017). Part of the audit process when WECC (and other Regional Entity) auditors are onsite is to get a feel for the culture of the entity being audited. Auditors will meet with a wide range of people from top management to the workers performing the work to get a feel for whether an entity has a culture that says compliance is valued and necessary (RF et al. 2018).

## **2.7.3 How Has the Use of Electric Reliability Standards Improved the Quality of Work?**

A big part of the early work for entities was developing processes for documenting compliance. Using the protection standard requiring maintenance and testing of protection equipment as an example: when the auditors showed up onsite they expected to see a box of papers showing a schedule for and the history of testing and/or maintenance for each relay, associated communication equipment and backup batteries, and any other associated equipment. The documentation also needed to state how and/or why the particular schedule was established for each piece of equipment (manufacturer specifications or other rationale).

Maintaining this level of documentation was new for some if not most entities. While the paperwork in and of itself does nothing for reliability per se, it does improve the quality insofar as it is now possible to determine that every piece of equipment was tested and maintained on a schedule specific to the equipment.

The effort of focusing on a culture of compliance is a major key for improvement. Many entities prior to 2005 would have said essentially “we don’t need mandatory standards because we voluntarily comply.” To an unknown and unknowable extent, this would have been true, but not always.

While most entities would have proclaimed they had a culture of compliance prior to implementation of mandatory standards, the fact that auditors looked for evidence of such compliance during audits, and the desire to avoid fines for noncompliance, as well as the fact that Regional Entities can do spot checks, all combined to instill a greater culture of compliance. Another factor working toward instilling a culture of compliance was the knowledge that when setting fines for noncompliance with standards, NERC and Regional Entities would look unfavorably on repeat violations of the same standard and on entities that establish a track record of standards violations in general.

## **2.7.4 Significant Successes**

NERC’s *State of Reliability 2018* report (2018c) lists several successes. The items listed below were highlighted in the main findings. Note that much of the success is relative to historical results.

- BES resilience improved during Hurricanes Harvey and Irma, when measured in terms of recovery time and effort levels.
- There was no loss of load in 2017 due to cyber or physical security events. This was despite the continually evolving threats. (These areas remain priorities.)
- Transmission outages showed a decreasing trend for the last 5 years, including outages caused by failed protection equipment, failed substation equipment, or human error. (These areas continue to be major contributors to outage severity.)
- Protection misoperation rates declined for the fifth consecutive year, though misoperation remains a high priority.

## **2.7.5 Administration of Electric Reliability Standards**

The administration of electric reliability standards involves maintenance, the setting and review of said standards, and certification with the standards.

### **2.7.5.1 Maintenance Responsibility**

In the United States, FERC has the overall responsibility for the approval of BES reliability standards. NERC, as the ERO, is responsible for the development of national standards. Regional Entities can establish standards in areas where the regional stakeholders believe there is a need to go beyond the NERC standards. For this report, the focus is on the national or NERC standards.

### 2.7.5.2 Standard Setting and Review

While NERC is responsible for developing standards, much of the work of developing standards is performed by the industry. NERC has a nine-step process for standards development, outlined in the Standard Processes Manual (SPM; NERC 2013) and summarized here.

1. Initiate a Standard Authorization Request (SAR): The SAR is a form used to document a proposed project for a new or a modified reliability standard. Any entity or individual can submit a SAR, including stakeholders and NERC committees or subgroups or staff. NERC requires applicants to submit sufficient information to justify and document the request. If there is sufficient justification and information provided, the Standards Committee will review the SAR and can accept, reject, remand it to the requestor, or delay action if other approaches might be possible. If the SAR has insufficient information, the Standards Committee can also post a SAR for stakeholder comment to collect feedback to support the proposed project. If a SAR is accepted, it is added to the list of approved projects and assigned a priority relative to the other projects in the development process (NERC 2013).
2. Post the SAR for a formal or informal comment period: When the Standards Committee initiates a new project, the SAR is posted for comments. The Standards Committee also appoints a drafting team to work with NERC staff to consider stakeholders' written views and objections.<sup>14</sup> For a new standard, the comment period is a formal comment period, which means all issues raised must be addressed, and an effort must be made to resolve all objections. At this stage, if there is insufficient support for a standard, a SAR can be rejected.

When the Standards Committee is ready to develop a new or revised standard, it appoints a drafting team if a team was not appointed to develop the SAR. At least one NERC staff member is assigned to each team to serve as a resource, helping as an advisor, facilitator, project manager, or with legal, technical or regulatory expertise. The NERC staff person does not have voting rights on the drafting team—the team members have final authority over the technical details of the standard (NERC 2013).

3. Develop preliminary draft of the standard, the implementation plan, violation risk factors (VRFs)<sup>15</sup> and violation severity levels (VSLs)<sup>16</sup>: Once constituted, the drafting team develops a project schedule for developing or revising the proposed standard. Then the drafting team develops a first draft of the standard, including all required elements as described in NERC's SPM. The team also drafts an implementation plan to identify factors to consider, proposed effective dates, and other related aspects of implementation, and VRFs and VSLs.

Drafting teams are encouraged to seek informal feedback to gather information from stakeholders before the draft reaches the stage of "final draft." Information collected shall be publicly posted. Note that informal feedback does not require formal responses, but drafting teams are encouraged to summarize their responses and how the comments were used.

4. Obtain Standard Committee approval: NERC staff coordinate a review of the elements of the draft to ensure they are within the scope of the SAR, are clear and enforceable, and whether they meet

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<sup>14</sup> There may already be an ad hoc team in place that can be used to refine a SAR.

<sup>15</sup> VRF refers to the risk to the BES if a requirement of a standard is violated. It can be a high risk meaning essentially the BES faces unacceptable risks in the case of violations. A medium risk is one not likely to lead to BES instability, separation, or cascading failures. A low risk requirement is administrative in nature.

<sup>16</sup> VSLs range from "lower" to "severe," and quantify how severe a violation of a requirement of a standard is. For example a lower risk results when a violation stems from missing a minor element of a requirement, but the performance of the stakeholder results in almost meeting the full intent of the requirement. A lower risk VSL is often a paperwork shortfall. An extreme VSL on the other hand essentially means that the violation is severe enough that the result does not meet the intent of the requirement.

NERC's Benchmark for Excellent Standards and other criteria for publication. If an element of the draft does not meet the specified criteria, the Standards Committee can remand the draft back to the drafting team. If the draft meets the criteria, the Standards Committee shall authorize posting it for a formal ballot, and the VRFs and VSLs for a non-binding poll (NERC 2013).

5. Conduct the formal comment period and ballot: The formal comment period for a standard shall be at least 45 days long. The purpose is to solicit specific feedback. If stakeholders disagree with some aspect of the draft they are encouraged to explain their reasons for disagreeing, and if possible, to propose alternative language that would make it acceptable to them. During the comment period, a ballot pool is established, and the ballot of the standard takes place. The ballot pool comes from the Registered Ballot Body. When the standard is posted for comment, NERC staff also post the notice of the ballot. Any member of the Registered Ballot Body may join the ballot pool but must do so before the ballot window opens. The ballot window and non-binding poll take place during the last 10 calendar days of the 45-day comment period, with provisions for dealing with windows ending on a non-business day. The ballot window can be extended if necessary to achieve a quorum (NERC 2013).

Step 5 can be repeated if significant changes to the draft are required due to the comments received.

6. Post responses to comments: The drafting team must respond in writing to all comments submitted on any posted version of the draft standard prior to the final ballot. If the drafting team determines that significant changes are required and an additional ballot is needed, the team is not required to respond in writing to all comments. If a stakeholder suggests revisions to the draft that improve the quality, clarity or enforceability of the standard, the drafting team can choose to make such revisions, communicate this decision to stakeholders—in effect stating that significant revisions are required—and post the revised standard for another 45-day comment period (i.e., repeat Step 5). When doing so, the drafting team also is not required to respond in writing to the comments on the previous draft.
7. Conduct the final ballot: When the drafting team reaches the point at which it is not making substantive changes from the previous ballot and has made a good faith effort to address all objections, the team shall conduct the “final ballot.” In the final ballot, votes are counted “by exception only,” meaning that the ballot pool members’ votes remain the same as in the previous ballot unless they indicate a revision. Approval of a reliability standard must meet quorum requirements and achieve a minimum weighted voting segment approval of two-thirds (NERC 2013).

The two-thirds approval requirement seems like a high bar but as of this writing, NERC had yet to have a required standard development process that simply could not get stakeholder approval (Rueckert 2019). There are procedures for when a case arises where stakeholder support for a standard under development falls short of the two-thirds threshold. NERC's SPM indicates that the Standards Committee could choose to abandon the project, return it to informal development, or continue efforts to address objections and re-ballot the standard (NERC 2013). NERC has a backstop procedure if FERC (or their Canadian or Mexican counterparts) directs NERC to issue a new or revised standard, but the standard lacks sufficient support among stakeholders for approval. Section 321 of NERC's *Rules of Procedure* addresses such a case (NERC 2018b). As of this writing, one potential standard did require a second final ballot process but was passed by the stakeholders, and no standards have needed to be dealt with through the backstop process. While it is possible that the existence of the backstop has had an influence on balloting, this review found no direct evidence of this having happened.

8. Submit the standard and implementation plan to the NERC Board of Trustees for adoption and approval: There is no limit to the number of times a standard can be balloted to result in a standard that is clear and enforceable, though the Standards Committee has authority to conclude the process if it is clear that a drafting team cannot develop a standard that meets the NERC criteria and achieves the requisite approval percentages. If a standard is approved, it is posted on the NERC website and

presented to the Board of Trustees (BOT) by NERC management for adoption. Note that the BOT can either adopt or reject a standard but cannot modify the proposed standard.

9. Submit the BOT-approved documents to applicable government authorities for approval. If the BOT adopts a standard, it is then submitted to FERC for approval (NERC 2013).

For a standard to be enforceable, it must be approved by its ballot body, adopted by the NERC BOT, and approved by FERC. Thus, a large part of the work of and responsibility for developing standards rests with the stakeholders given that they make up the drafting team and the ballot body for standards.

When a standard is replaced by a revised standard or otherwise superseded by a new standard, the outdated standard is retired. Such will be noted in the implementation plan for the new standard, and the ballot body vote shall be considered as approval to retire the outdated standard (NERC 2013).

Standards, the definition of terms, interpretations, even the SPM from which much of this discussion is drawn, go through a version of the process with the same or in some cases lesser levels of formality, e.g., relaxation of the requirement to respond in writing to all comments.<sup>17</sup>

### **2.7.5.3 Certification with Electric Reliability Standards**

Registered entities are subject to audit and other mechanisms to determine compliance. This process was discussed in Section 2.7.2.

### **2.7.6 Key Electricity Reliability Standard Features Relevant to Valuation Guidelines**

Example of industry stakeholders successfully setting standards: The NERC standards are an example of the industry working together to develop standards. As noted in Section 2.7.1, the industry has been developing criteria and policies since the mid-1960s to promote the reliable operation of the BES, and the Version 0 reliability standards were a codification as standards of the guidelines, policies, and criteria developed by the industry. It can be reasonably asserted that prior to the era of mandatory standards the industry had voluntarily worked together to develop a system that improved the state of reliability. This implies that the industry could similarly work together to develop standards in other subject areas, such as promoting consistent valuation practices. It should further be noted that even in the era of mandatory standards, industry stakeholders continue to work together on drafting teams to develop the standards, and standards cannot go into effect unless they are approved by a ballot body composed of stakeholders.

Example of stakeholder interaction: Some NERC standards require at least minimal collaboration between stakeholders. While this report is not a discussion of individual standards or requirements of standards, in some cases standards explicitly require exchanges of data or planning documents with other affected stakeholders such as neighboring balancing authorities or planning authorities.

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<sup>17</sup> The Final Ballot period closed for revisions to the SPM on October 2, 2018. There is currently a version that received a weighted approval sufficient for ballot body approval, and the final version is available with a TBD date at: [https://www.nerc.com/pa/Stand/Pages/Revisions-to-the-NERC-Standard-Processes-Manual-\(SPM\).aspx](https://www.nerc.com/pa/Stand/Pages/Revisions-to-the-NERC-Standard-Processes-Manual-(SPM).aspx)

## 2.8 Rhode Island Benefit-Cost Framework

The Rhode Island Public Utilities Commission (PUC) developed guidance to be used in evaluating future rate cases. In Rhode Island, the General Assembly created the Renewable Energy Growth Program to continue the development of renewable-energy distributed generation in the territory of the electric distribution company serving the state (RI Gen Law 2014a). The Renewable Energy Growth Program statute calls for the distribution company to annually file tariffs designed to provide multi-year streams of performance-based incentives designed to provide the types and levels of incentives needed to achieve the intended goals of the General Assembly (RI Gen Law 2014b). The statute also provides a series of factors that the PUC should consider when reviewing the tariffs proposed by the distribution utility. To implement the Renewable Energy Growth Program and to review the tariffs files pursuant to the program, the PUC adopted goals, updated rate design principles, and developed a benefit-cost framework through a collaborative process. The statute applies specifically to the Narragansett Electric Company doing business as National Grid (hereinafter National Grid) (RI PUC 2017a).

The RI benefit-cost framework (framework) is an example of the type of process envisioned in the GMLC Valuation Guidelines project and is discussed in this section of the report. The RI Framework was developed by a facilitated stakeholder process. The working group of stakeholders and facilitators/mediators held seven day-long meetings and multiple conference calls. The result was a report documenting unanimous consensus on goals for the electric system, the costs and benefits to be accounted for, and a set of rate design and cost recovery strategies and principles. Consensus was reached on all but one issue related to implementation strategies for future rates (RI PUC 2017b).

### 2.8.1 Need for the Standard

As early as 2013 the PUC had been considering whether various National Grid programs provided the incentives needed to promote desired policies and objectives, in particular a modernized electric system. Additionally, in 2014 state legislation was signed creating the Renewable Energy Growth Program, under which the PUC was charged with the task of reviewing tariff proposals filed by National Grid. In compliance with the legislation, the PUC opened a docket to consider rate design issues. During the proceeding, National Grid filed a new rate design proposal. During the regulatory proceeding it became apparent that there were significant disagreements related to the factors the PUC was directed by the legislation to use when evaluating tariff proposals. The PUC recognized that it could not make decisions about which costs and benefits needed to be included in a proposal every time a proposal comes before the PUC. Thus, Docket 4600 was opened to investigate major points of disagreement, and in particular, the benefits and costs of distributed energy resources (RI PUC 2017b).

Docket 4600 was designed as a stakeholder process. The goal was to find consensus around a set of questions. Specifically, the PUC needed to understand and desired to find consensus around the following (RI Stakeholders, 2017):

- The costs and benefits applicable to any or all programs
  - How can each cost and benefit be identified?
  - Do they align with state policies?
- The level at which each cost and benefit should be quantified
  - Where do they impact the distribution system?
  - Where do they impact cost allocation and rates?
- The best way(s) to measure the costs and benefits at the identified levels.

## **2.8.2 Use of the RI Framework**

The PUC guidance is that all parties submitting tariff proposals will address the consistency of the proposal with the goals included in the guidance document. In the guidance document the PUC made clear that this applies to all tariff proposals. Proposals that are continuations of existing tariffs should at least reference the guidance, while new rate design proposals as well as any case proposing new programs or capital investments must reference the goals, rate design principles, and the RI Framework (RI PUC 2017a).

In 2017, National Grid filed an application to change their base electric distribution rates. Part of the filing related to National Grid's proposed Power Sector Transformation (PST) plans were segregated for consideration in a separate proceeding, though the cost implications of the PST planning remained with the rate case. In the PST filing, National Grid did reference the RI Framework. In particular, National Grid discussed the eight goals for the electric system, affirming that their plan furthers the goals. National Grid also referenced the RI Framework, stating "where appropriate" they used the Benefit-Cost Analysis (BCA) to analyze proposed investments, but that the BCA was not appropriate for all investments. For some, National Grid believed a "best-fit/least-cost" approach<sup>18</sup> was the appropriate methodology (National Grid 2018a).

PUC staff filed testimony noting that the National Grid analyses did not use the RI BCA for some capital projects and disagreeing with this decision. A PUC consultant filed testimony noting National Grid proposed several important foundational investments but did so without an overarching Grid Modernization Plan (GMP) (National Grid 2018b).

The National Grid rate proceeding concluded with a Settlement Agreement, which includes references to the Docket 4600 BCA. The Settlement Agreement includes a requirement for National Grid to file a GMP. This will include an updated Advanced Metering Functionality (AMF) business case using the RI BCA. The agreement also calls for National Grid to work with a stakeholder advisory group to develop the GMP and the AMF business case as well as other aspects of National Grid's PST plans. Finally, there was a clause calling for National Grid to report on their progress, developing benefit-cost metrics related to the energy system, customers, and society using the RI Framework (National Grid 2018c).

## **2.8.3 How Has the Use of the RI Framework Improved the Quality of Work?**

As noted in Section 2.8.2, the RI Framework will be used for developing metrics—in other words, it provides an agreed-upon template within which the stakeholders can work. Because the RI Framework garnered significant levels of consensus among members of the working group, logically when National Grid and the PST advisory group undertake future work the path to agreement on benefits and costs should be less contentious. However, the RI Framework is new, and the implementation of the Settlement Agreement represents the first use of the RI Framework.

## **2.8.4 Significant Successes**

The fact that stakeholders were able to assemble a BCA framework is a significant success. The BCA framework was largely a consensus report (it included one non-consensus item), developed through a facilitated stakeholder process. This fact, in and of itself, is a significant success. In their order adopting

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<sup>18</sup> National Grid had used a best-fit/least-cost methodology based on a U.S. Department of Energy, Office of Electricity Delivery & Energy Reliability report entitled *Modern Distribution Grid, Decision Guide*, Vol. III (June 28, 2017).

the framework set out by the stakeholders, the PUC said the process exceeded their expectations, and that at the outset it had not been clear that the process would be able to reach consensus and whether the report might be essentially a list of the issues without agreement (RI PUC 2017b).

## **2.8.5 Administration of the RI Framework**

Administration of the RI Framework includes addressing framework maintenance needs, setting and reviewing related standards, and certification with the framework.

### **2.8.5.1 Maintenance Responsibility**

Maintenance of the RI Framework is the responsibility of the PUC. The PUC, in their order accepting the working group report, stated their understanding that the RI Framework still has work to be done before it is completed. Further, the PUC intends to integrate the RI Framework into a unified methodology to guide decisions (RI PUC 2017b).

### **2.8.5.2 Standard Setting and Review**

Thus far, the development of the standard has been a process directed by the PUC but with a large stakeholder component. Docket 4600 was designed to be a stakeholder process, and the stakeholders were able to develop a largely consensus report. The stakeholder report included recommendations for future stakeholder involvement, but it will be up to the PUC to determine the extent to which future standard-setting work and review will be performed by the PUC and how much will be performed by stakeholders. The PUC asked the Division of Public Utilities and Carriers to perform the immediate follow up work of developing specific mechanisms for populating missing data and two other steps, and took it upon themselves to develop the guidance document posted on the Docket No. 4600 web page on October 27, 2017 (RI PUC, 2017b).

### **2.8.5.3 Certification with the RI Framework**

The PUC stated that National Grid should use the RI Framework in their (now recently concluded) rate proposal. However, the RI Framework is not a bright line denoting what will be accepted or rejected. In other words, a proposal with a negative BCA result could in the end be approved because of other aspects, such as the benefit to the grid or the positive impact on state energy goals. That said, the PUC expects National Grid to use the RI Framework at least as a starting point for analyzing proposals (RI PUC 2017a).

## **2.8.6 Key RI Framework Features Relevant to Valuation Guidelines**

Example of successful stakeholder development of standard: The RI Framework is an example of a guideline for performing analyses very much in the same vein as the Valuation Guidelines and is developed by stakeholders. Thus, the RI Framework stands as an example of the results that can be achieved using a stakeholder process.



## 3.0 Conclusions

This standards review for the GMLC 1.2.4 Valuation Framework Development project addressed two questions:

- Do standards exist, albeit in different industries, that successfully codified and standardized processes similar to the kind of valuation process proposed in GMLC 1.2.4?
- If yes, what lessons learned could be useful for directing future work toward standardizing a valuation process?

The review undertook a brief analysis of eight sets of standards widely used in business and industry in the United States to set guidelines or establish thresholds for accuracy, transparency, consistency, repeatability, quality, and/or extensibility. The standards reviewed were GAAP, the ISO 9000 series, ISO 14040 series, aviation checklists, medical checklists, ASHRAE Standard 202-2013, NERC BES reliability standards, and the RI BCA framework.

### 3.1 Stakeholder-Developed Industry Standards

With the possible exception of the GAAP, the reviewed standards were developed by teams of stakeholders. The GAAP was developed by an independent standards board, but the development process involved significant stakeholder involvement starting with opportunities for stakeholders to suggest a needed standard and extending to the ability to comment on and provide input to the process.

The standards explicitly developed by industry stakeholders use processes that include voting processes for the broader body of stakeholders to vote on the proposed standards.

Most of the standards reviewed in this report have defined processes for the review and updating of standards, or elimination of standards that have either been superseded or that are no longer needed. The ASHRAE standard is approved by a vote of the members of the committee that developed the standards, while ISO standards are approved by votes of the membership and NERC standards are approved by votes of a ballot body assembled for the standard project.

Because ASHRAE standards are approved by the ASHRAE committee that develops the standard, the process seems less onerous than the NERC process that requires approval by a “ballot body,” or the ISO process that requires a vote of the membership. NERC has thus far been able to develop all required standards, so the difference may be immaterial. NERC has procedures for addressing final votes that fail to achieve requisite stakeholder support for passage, including a backstop procedure for cases in which FERC has directed NERC to develop a standard. It is unclear whether the backstop’s existence has been a factor to date.

### 3.2 Principles Used to Meet the Objectives

The standards generally embodied efforts to accomplish objectives (i.e., establish thresholds for accuracy, transparency, consistency, repeatability, quality, and/or extensibility) that are very similar to the objectives of the Valuation Guidelines. The following list summarizes the main principles used to enable the standards to achieve their objectives.

- Process orientation: The various standards focus on process, including the following:

- Minimum expected steps: The standards outline a minimum set of steps needed to accomplish the goals set out by the standards, in some cases to prevent steps from being forgotten and in other cases to ensure all participants undertake the same set of minimum expected steps.
- Documentation: Accurate records management and being able to document completion of the minimum steps were required steps.
- Stakeholders are involved, or their perspectives are represented: Some of the standards exist largely to address stakeholders' needs and perspectives, and all the standards exist to ensure that the organizations following the standards are focused not on their own narrow interests but on the stakeholders they serve. Similarly, the standards address "stakeholder seams" at which different stakeholder groups that might not otherwise communicate are brought together to communicate and jointly resolve issues.
- Culture change is acknowledged: In some cases, such as the ISO standards, an explicit goal of the standard is to present a vision of the culture for the organization; in other cases, such as the two types of checklists, a step included in many examples is a group huddle which can be culture changing insofar as the participants are directed to communicate and are empowered to question one another to ensure all minimum steps are taken; and in still other cases, such as the NERC standards, it is not clear whether the original intent was to change the culture but the implementation has been culture changing.

### 3.3 Successful Outcomes of the Standards

The following outcomes of standards illustrate how the reviewed standards have been successful.

- GAAP has tackled some difficult issues, like the true market value of an investment versus the book value and the treatment of off-balance-sheet items such as SPEs. Both issues had constituencies that opposed standards strenuously—including, in at least one case, by asking Congress for legislative relief. FASB can succeed at this in part because the governing board is independent from the various stakeholder groups.
- ISO 9000 successfully puts the focus on customer needs and quality management systems. In the most recent year for which statistics are available, over a million entities certified under ISO 9001 worldwide—39,000 of which were in North America.
- ISO 14044 is a credibility-building analysis insofar as it lays out a process for evaluating environmental impacts which, when paired with what is called Type III environmental declarations, can be used to credibly establish that the entity has subjected their product to an environmental assessment.
- Aviation checklists are a key factor in aviation safety. The speed at which change propagates through aviation checklists is impressive. A book, *The Checklist Manifesto* by Atul Gawande (2009) recounts the story of a crash and the lessons learned. It took a matter of months to complete the crash investigation, and about 10 months after the first crash, another was averted because the crew had an updated checklist.
- Medical checklists have been demonstrated to be capable of helping hospitals eliminate errors caused by skipping or forgetting simple steps like washing hands or washing the patient's skin at the point of incision. Both medical and aviation checklists are potential culture changers insofar as they empower all participants to serve as backstops to other participants, and in both cases, they empower subordinates like the first officer or a nurse to question the lead (pilot or doctor) to ensure that all important issues have been addressed.

- ASHRAE's Commissioning Standard has been demonstrated to help the building industry deliver buildings that meet the advertised criteria and needs of the building occupants. It also responds to the needs of the utility industry and others who operate energy efficiency programs. Before commissioning became somewhat common, there were failures to deliver in the efficiency realm, and commissioning helps deliver and protect the credibility of the efficiency program. Decision-making rests with the committee that controls the standard. There is at least one opportunity for public comment, and ASHRAE addresses all negative comments to the extent possible. The model is structured to get fairly wide public comment without creating an unwieldy structure. The ASHRAE model for setting and updating the standards is a model that should be considered for the Valuation Framework.
- NERC reliability standards are successful stakeholder-driven standards that have been shown to yield successes relative to historical results, such as a decreasing transmission outage trend for the past 5 years and decreasing rates of protection system misoperations over the past 4 years. The standards themselves are developed by stakeholders, and stakeholder approval via a ballot body is a required step.
- The RI Framework is new enough that identifying a specific success resulting from the standard is not possible. However, the RI regulator that set up the process in their order accepting the stakeholder report stated at least some surprise that the process was able to achieve unanimous consensus on all but one issue.

### 3.4 Lessons Learned and Their Relevance to Valuation Guidelines

The review noted the following aspects of standards development that pose possible challenges to a process such as the development of Valuation Guidelines.

- Oposing stakeholder interests: While it is not clear why there would be stakeholder opposition to the development of Valuation Guidelines, the struggles that FASB faced in establishing standards to address issues such as the establishment of a market value for assets illustrates the challenge that can be posed if powerful interests oppose a standard. FASB had the full backing of the SEC to assist their cause. DOE can provide some support, but it would not be of the same strong regulatory stature as that provided by the SEC. Obtaining buy-in from key stakeholder groups such as the National Association of Regulatory Utility Commissioners, National Association of State Energy Officials, state legislative organizations, as well as trade associations and consultancies could similarly be helpful.
- Culture change/stakeholder resistance: Within any organization there tend to be people in positions of authority who resist a tool that empowers others to ask questions. While the culture-change aspect of aviation or medical checklists gains a portion of its effectiveness by empowering people, e.g., empowering a nurse to ask if all the minimum steps have been taken, not everyone will welcome such empowerment.
- Speed of assimilation: As noted in the discussion of aviation and medical checklists, having a single, central entity that supports the process can make it possible for a standard to become widely used relatively quickly. In industries that have fractured authority structures, assimilation can take longer. In the electric industry in which each state and the District of Columbia have their own industry regulators, ensuring a speedy assimilation of the Valuation Guidelines will be a key challenge.
- Brevity/attention span/work overload: One strength of aviation (and possibly medical) checklists is the focus on the “killer” items that the team cannot overlook. The strength of the checklist comes in part through the brevity of the checklist—the crew can complete the checklist quickly before they are interrupted by other tasks or communications with the tower. Similarly, while some utility personnel

across the United States may have opposed the NERC reliability standards initially, the specificity of the individual requirements may have been welcomed by others, simply because the standards made the steps clearer. Following this model requires identifying discrete breakpoints, or killer items, to make the Valuation Framework a tool that can be used to assist the analyst with dealing with interruptions and workload, and not as something that adds to the workload.

- Staging of development: At least two standards illustrate potential paths for staging. With the GAAP standard related to off-balance sheet accounting, FASB was able to establish a standard at a minimal level, which, when conditions changed, they were able to strengthen. NERC standards started as voluntary criteria. Later in response to changing conditions NERC undertook a process of codifying their criteria as voluntary standards, which when conditions changed again, became mandatory standards. Based on these two examples, it seems that a positive direction for Valuation Guidelines might be to start the process and codify the strongest set of Valuation Guidelines that can be codified.

### **3.5 Considerations for Standards Development of Valuation Guidelines**

The standards reviewed in this report provide valuable insight into whether Valuation Guidelines would lend themselves to being codified by some industry group in language that would improve the credibility, transparency, and overall acceptance of the valuation effort. In short, the standards reviewed in this report pursue a very similar set of objectives. The standards are largely stakeholder-developed and are either written explicitly in standards language or in language that is similar in nature.

It therefore appears feasible that the Valuation Guidelines would be codifiable by some industry body. The question now becomes, is there sufficient interest by DOE and on the part of the industry to launch such an effort? A second question is how should the effort be structured and governed? As evidenced by ASHRAE and ISO, it is possible to structure and govern a standards approval process within a nongovernmental organization. As evidenced by NERC and GAAP, it is also possible to structure and govern processes within a framework ultimately overseen and/or championed by a governmental entity.

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