FROM RESEARCH RESULTS TO PUBLISHED CODES AND STANDARDS - ESTABLISHING CODE REQUIREMENTS FOR NFPA 55 BULK HYDROGEN SYSTEMS SEPARATION DISTANCES

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ABSTRACT

Performing research in the interest of providing relevant safety requirements is a valuable and essential endeavor, but translating research results into enforceable requirements adopted into codes and standards, a process sometimes referred to as *codification*, can be a separate and challenging task. This paper discusses the process utilized to successfully translate research results related to bulk gaseous hydrogen storage separation (or stand-off) distances into code requirements in NFPA 55: *Storage, Use and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks* and NFPA 2: *Hydrogen Technologies*. The process utilized can be summarized as follows: First, the technical committees for the documents to be revised were engaged to confirm that the codification process was endorsed by the committee. Then a sub-committee referred to as a *task group* was formed. A chair must be elected or appointed. The chair should be a generalist with code enforcement or application experience. The task group was populated with several voting members of each technical committee. By having voting members as part of the task group, the group becomes empowered and uniquely different from any other code proposal generating body. The task group was also populated with technical experts as needed but primarily the experts needed are the researchers involved. Once properly populated and empowered, the task group must actively engage its members. The researchers must educate the code makers on the methods and limitations of their work and the code makers must take the research results and fill the gaps as needed to build consensus and create enforceable code language and generate a code change proposal that will be accepted. While this process seems simple, there are pitfalls along the way that can impede or nullify the desired end result – changes to codes and standards. A few of these pitfalls include: wrong task group membership, task group not empowered, task group not supported, in-person meetings not possible, consensus not achieved. This paper focuses on the process used and how pitfalls can be avoided for future efforts.

INTRODUCTION

This paper describes methods endorsed by the National Fire Protection Association (NFPA) that were utilized successfully to codify research results into enforceable code requirements in the 2010 edition of NFPA 55: *Storage, Use and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks.* The codification of the results of technical research can be nearly as daunting and time consuming as performing the original research, yet in the case of research related to the development of safety standards, the public benefit that motivated the original research project may not achieved without it. So while the research project may be complete once the results are documented, peer reviewed, published and vetted through the scientific community, the overall goal of improving safety for the public might not be achieved until the results are codified.

This paper utilizes the cited NFPA 55 example as a "case-study" in the application of the process described and is not intended as a statement of support for NFPA 55 (although the author certainly does). Rather, the intent is to describe the process utilized by the separation distance proponents to codify the research results so that other researchers and public safety officials may benefit from both an understanding of the process and its potential pitfalls.

SCIENTIFIC RESEARCH PROCESS

The research process is frequently complete upon publication of a technical paper that has been subjected to the proper peer review and sometimes publication in a technical journal. If the desired end result is for the results to be interpreted and applied to public safety codes and standards, then additional work may be required as part of the code making process.

CODE MAKING PROCESS

NFPA codes and standards are created by Technical Committees as described in the NFPA Directory [1]. The membership of NFPA Technical Committees is controlled to assure that representative interest categories are proportionate. NFPA Technical Committees develop text for their respective documents by achieving consensus among voting members and acting on submitted code change proposals. Code change proposals with highly technical substantiation statements, such as those frequently generated by codifying research results, take time to both process and comprehend. Engaging the actual NFPA Technical Committee directly may not be the most efficient way to process proposals with complex substantiation documentation. For this type of effort formation of a task group may be warranted.

Figure 1 illustrates a simple representation of a typical code making process. This process works best when the technical committee can hear a complete proposal with

Figure 1

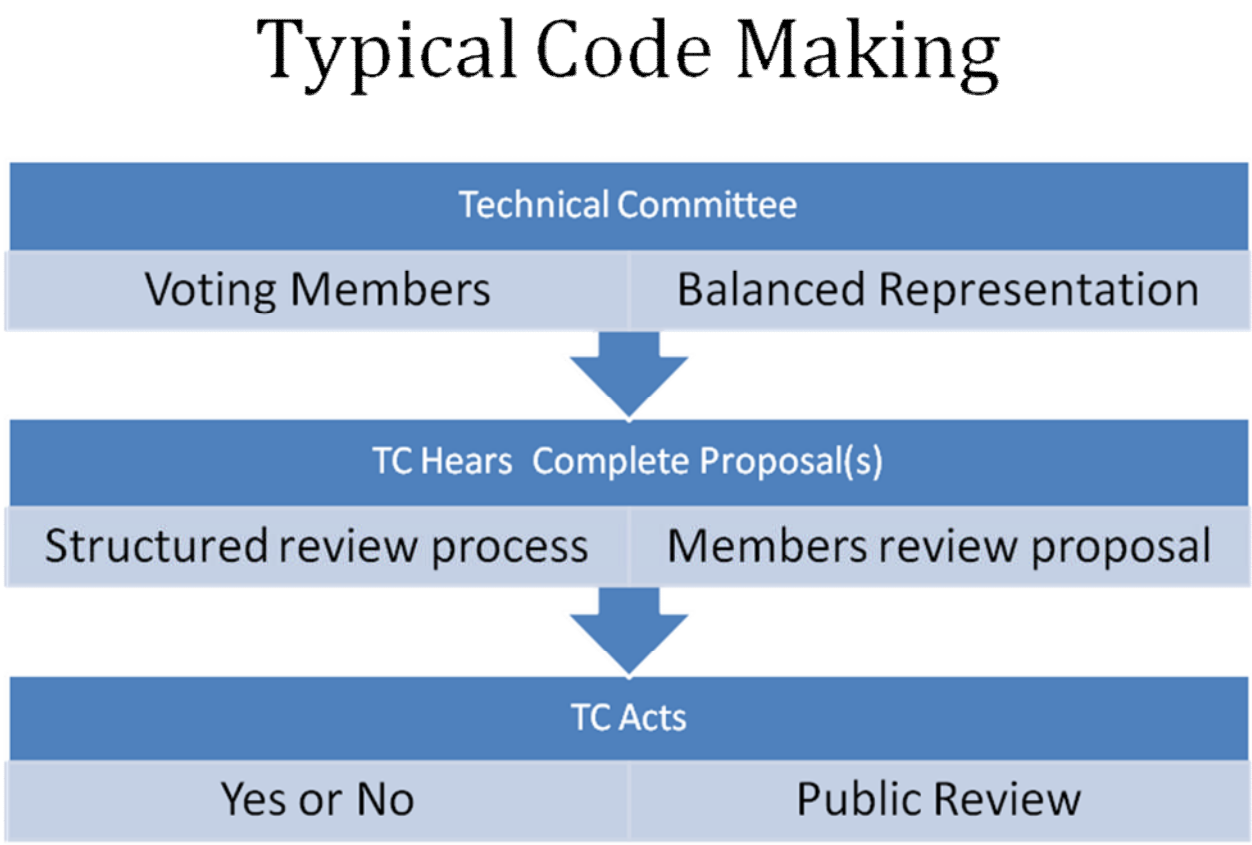
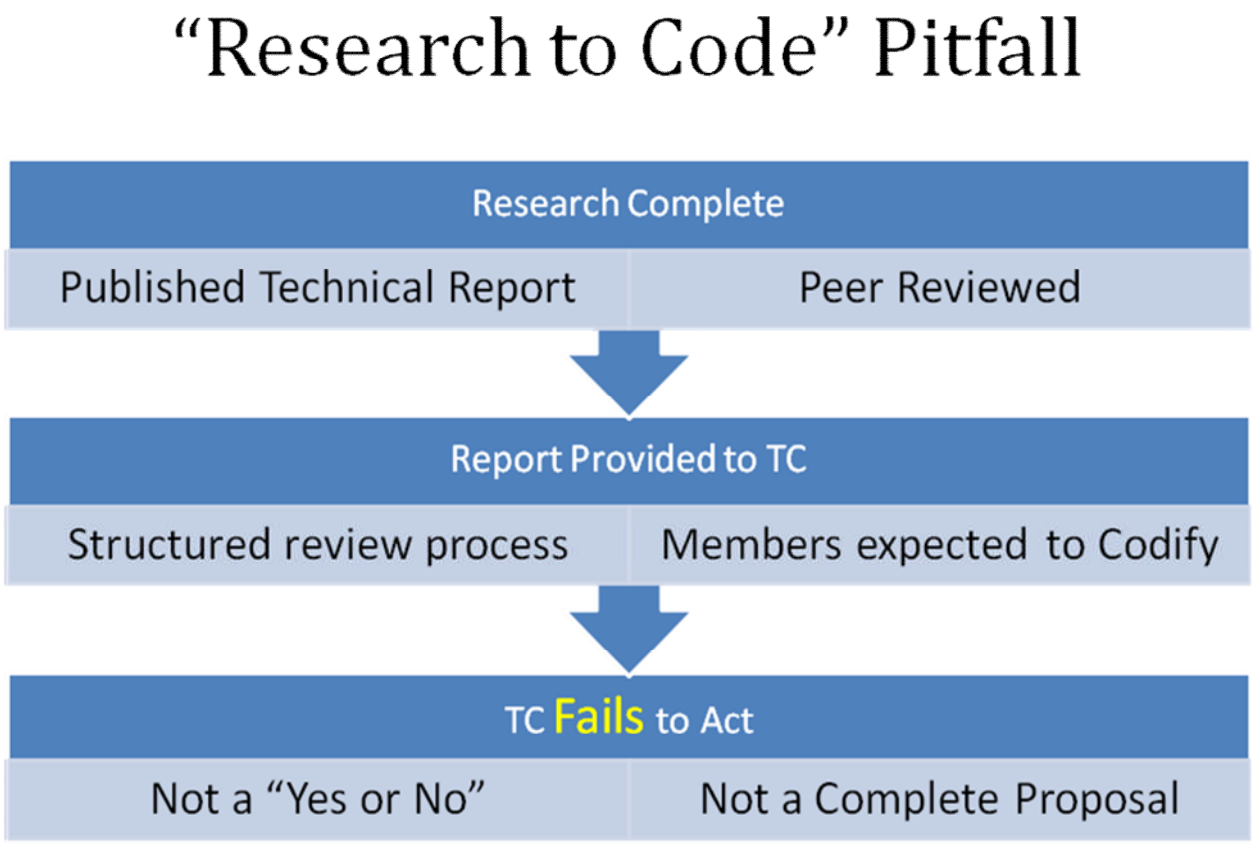


Figure 2



NFPA Technical Committees respond well to complete proposals. An over simplified explanation of a complete proposal is "replace X with Y" along with a well explained basis statement providing the substantiation for the proposed change. The TC members can then read the material and establish their voting positions – typically in support or opposition to the proposal. When a proposal is incomplete or non-existent (such as when non-codified research results are presented to the TC) the committee may fail to act or reject material that is worthwhile but not yet complete. Creating a complete proposal from research results can be effectively accomplished utilizing a sub-committee called a Task Group.

NFPA TASK GROUP PROCESS

NFPA procedures allow the formation of a *task group* to deal with specific situations. Such a task group concept was successfully utilized to codify research results related to bulk gaseous hydrogen (GH2) storage systems separation distances. The NFPA Directory Section 1.3.4 contains administrative instruction for the development of NFPA documents and defines a task group as: *An ad hoc group appointed to address a specific topic or problem.* The function and limitations of a task group are described in Section 3.1.3.4 of the NFPA Directory as follows[1]: *A Technical Committee or Technical Correlating Committee may create Task Groups to address a specific topic or problem. The Task Group shall be appointed and discharged by the Chair. Persons serving on a Task Group need*

[1] The acronyms appearing in the actual NFPA Directory citation have been expanded by the author for the reader's convenience.

not be Members of the Technical Committee or Technical Correlating Committee. Such a group need not be balanced by interest. The Task Group shall forward recommendations along with a report of underlying issues to the Technical Committee or Technical Correlating Committee for action. Task Group reports shall not be submitted in the name of the Task Group as proposals, comments, Tentative Interim Amendments, or Formal Interpretations. This charging language allows flexibility in task group membership yet enables the endorsement that comes from having members of the target code Technical Committee as members of the task group. In the case of the separation distances task group, the single proposal generated was submitted to the Technical Committee by a member of the task group and defended before the committee by multiple members of the task group.

IDENTIFY NEED AND GOAL FOR TASK GROUP

The current separation distances for bulk GH2 storage systems listed in NFPA 55 - 2005 edition, Table 10.3.2.2.1, contain minimum separation distances that were in question because the numerical values in the table lack a clear, documented basis. For this reason the NFPA 55 Technical Committee was approached to query them as to the origin of the existing values. The Technical Committee opinion was that although the distances in the existing table were felt to be generally reasonable and had not resulted in an unacceptable loss history, the basis for the values was not documented and improving that situation was a worthwhile effort. Therefore the Technical Committee authorized the formation of a Task Group to investigate the basis of the existing separation distances and validate or revise them as needed. The following scope statement for the task group was developed by the NFPA 55 Technical Committee: *Validate or revise the existing prescriptive hydrogen separation distances in NFPA 55 using new research and investigate use of risk-informed processes.* An additional goal of the task group was to prepare sufficient explanatory material for permanent retention in the Annex to NFPA 55 so that the methodology utilized could be repeated or revised by others should the need arise in the future.

APPOINT TASK GROUP MEMBERS

Once a task group is authorized and the scope statement established, selecting its contributing members is crucial to achieve success. There are no upper or lower limits on task group size but to be effective between 6-10 members is recommended. There must be enough members to spread out the work load, but not so many that meeting coordination and consensus building suffers. There are several key membership categories that are recommended.

Voting Technical Committee Members – The NFPA process allows (but does not require) several members of the Technical Committee to be members of a task group. This component of task group membership is critical to success for the simple reason that their endorsement of the task group results carries considerable benefit at the subsequent Technical Committee meeting where consensus among the Technical Committee members must be achieved to attain successful implementation.

Industry Experts – Additional expertise in the area of practical implementation should be sought. These members will assure that requirements are relevant to and representative of actual current field conditions.

Contributing Researchers – The contributing researchers are vital members of the task group. The primary job of the researchers during the task group process is to educate and communicate the results and limitation of the research to the task group. This task is easier to accomplish within a small(er) task group than within a larger Technical Committee. Participation of the contributing researchers also allows the task group the flexibility to directly impact the direction of the research and possibly to investigate alternatives. This iterative process is often beneficial to the end result and made easier if the original researchers are direct participants in task group proceedings.

Code Experts – This category of individual is key to successfully transforming results into code proposals with proper basis statements. Ideally this expertise comes from the Technical Committee membership but that is not required. A code expert is a person well versed in preparing and defending successful code change proposals. These individuals must also be well versed in the applicable regulatory flowdown of how documents are enforced and where the target document is located within that regulatory flowdown. Many code change proposals suffer from a lack of complete understanding of how specific requirements are implemented in the regulatory flowdown of code requirements. This problem can be exacerbated in highly complex proposals, making participation of a code expert critical.

Other experts – This category allows flexibility to include and individual with valuable expertise to be included. In the case of the separation distances task group expertise in the area of risk informed decision making processes was required.

ENGAGE TASK GROUP MEMBERS

Once the membership of the task group is established, the tasks required to get the work done must be identified and a schedule developed. Flexibility is key to success here. In the case of separation distance the gap between the research results and enforceable code text was significant and the path to ultimate resolution was not initially clear. There were many intermediate steps that were initially unknown to task group members. The method used to identify and address them was to clearly describe the research results to the task group members and then identify the incremental steps necessary to achieve the desired end goal.

For the goal of this paper, the actual methods employed to get the work done are less important than the actual creation and membership of the task group, therefore the details of the separation distance task group for NFPA 55 will not be discussed except in general terms.

Travel to in person meetings is important. Most meetings can be telephone/internet virtual meetings, but occasional in person meetings are much more productive and efficient. These meetings are costly and therefore must be well planned and managed.

The task group must meet frequently. Meetings should be held not less than monthly until completion. Task team members usually have other duties and the selected meeting frequency needs to reflect the relative importance of getting the specific task completed.

Generate Complete Proposals For Code Changes

This was the end goal for the NFPA 55 separation distances task group and something similar should be the end goal for any task group. Preparing an administratively complete change proposal is not a simple task. Success or failure of the group will ride on the completeness and quality of this step.

An administratively complete proposal will contain all needed code changes in the proper format along with detailed basis statements. Proposals that arrive in this form make acting on them easier for the Technical Committee because there is little need to fill gaps between the research results and the proposed code text. When a Technical Committee receives proposals that are complete, they can easily vote *yes* or *no* or make minor adjustments as needed. Regardless, the end result of a proposal prepared by a properly constituted task group is usually a good outcome.

DEFEND PROPOSALS TO TECHNICAL COMMITTEE

The work of the task group does not stop with generation of a complete change proposal. The Technical Committee must be convinced of its validity and benefit. In the case of the NFPA 55 separation distances, the original researchers involved gave presentations providing an overview of the research methods, assumptions, limitations and results. In addition to the technical information, the

code experts involved in the task group gave a detailed explanation of the codification of the research results and the resultant proposed code text and bases statements. This is an important step because the Technical Committee members initially agreed that the task group was needed and assigned some of their members to address the issue. Therefore this step is the final report on the task group efforts. Technical Committees typically have in-person meetings so travel will be required for the task group members to defend the proposal(s) to the Technical Committee.

DEFEND PROPOSALS TO PUBLIC

In addition to defending the change proposals to the Technical Committee, the task group may also need to defend the proposal and the research upon which it is based to the public. Within the NFPA process this step is accomplished in the Technical Committee Report on Proposals and Report on Comments processes.

CONCLUSION

- Simply presenting research results to NFPA technical committees is not enough.
- Establishment of a Task Group is a valuable approach.
- Membership of the task group assigned is key.
- Select a chair who comprehends the technical argument and has overall code knowledge.
- Have frequent telecons
- Produce complete proposals.
- Defend the proposals to the Technical Committee
- Defend the proposals to the public.

REFERENCES

1. National Fire Protection Association, *NFPA Directory*, 2008 Edition, NFPA, Quincy MA.
2. NFPA 55, *Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*, National Fire Protection Association, 2005 edition, Quincy MA.