Safety and Codes and Standards
Summary of Annual Merit Review Safety and Codes and Standards Subprogram

Summary of Reviewer Comments on Safety and Codes and Standards Subprogram:

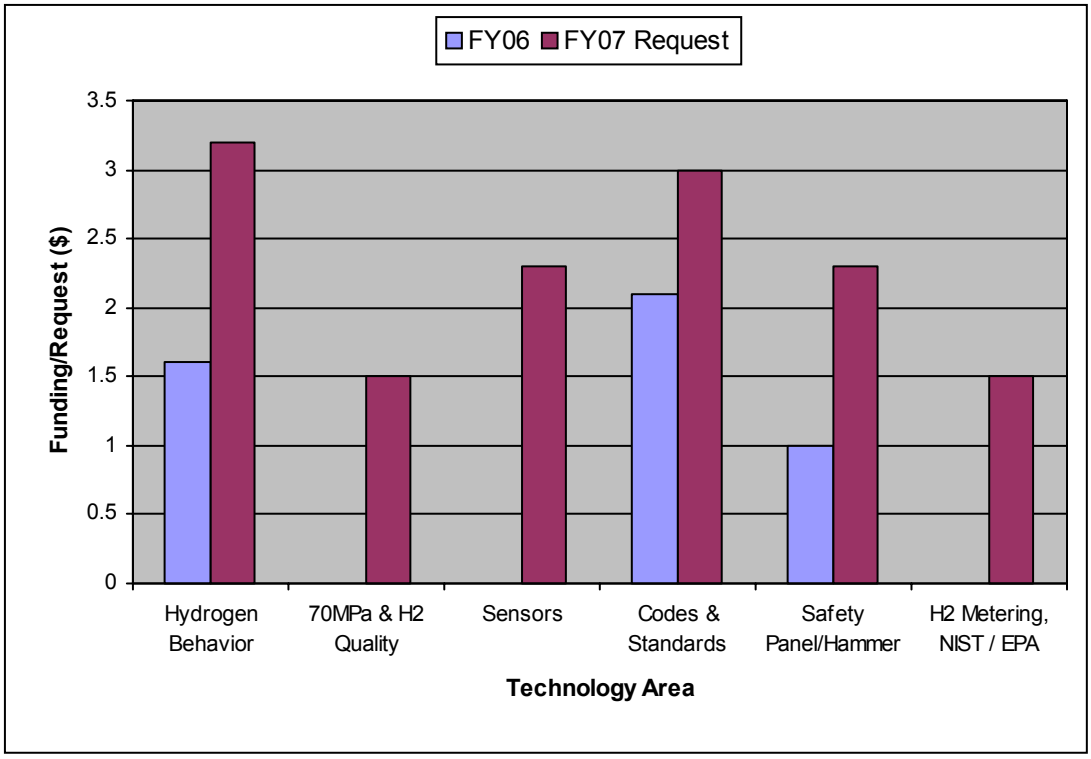
In general, Safety and Codes and Standards Subprogram reviewers stated that projects were productive and successful, especially given their levels of funding. The Reviewers were impressed by the breadth of activities and the ongoing commitment to safety, codes, standards and information-sharing activities. They stressed that successes in this subprogram touch every other DOE hydrogen-related activity by fostering acceptance, collaboration and communication with critical stakeholders and consumers.

Reviewers stressed the importance of continuing efforts in critical areas such as hydrogen fuel quality, risk assessment and materials research, gaps in hydrogen codes and standards and regulation coordination efforts, but lamented the limited budget. Suggestions for maximizing progress included leveraging the efforts of universities, standards organizations, national labs and industry. International consensus on codes and standards is very important, but there was some uncertainty about the effectiveness of the GTR activities.

Five safety projects were reviewed. The Hydrogen Codes and Standards work was praised for its clear objectives, well designed National Template and broad access and interaction with global stakeholders, SDOs and CDOs. Reviewers mentioned that the funding seemed inadequate to meet the Project's goals and timeline. Research and Development for Hydrogen Safety, Codes and Standards, is focused on hydrogen behavior, materials research and risk assessment to support the development of technically sound codes and standards and was praised for impressive industry/SDO/CDO coordination. Some reviewers thought there was room for more coordination but cautioned against developing a quantifiable risk assessment tool, lest it be misapplied by courts. The Global Technical Regulations work was praised for the dialogue fostered with other countries, particularly Japan. However, there was concern about the mission and direction of the project, as well as the lack of demonstrable progress. The Incident Reporting Database was thought to be an effective tool for sharing lessons learned and was progressing quite rapidly, given the low funding. Some concern was expressed about lack of mechanisms to ensure that information was extracted. Finally, the Safety Panel was regarded as strong in concept and in qualified membership. Fostering the collaboration and communication of safety experts has helped to promote and ensure safety across hydrogen-related projects. Some concern about lack of focus was expressed, as well as the difficulty in translating the safety panel's recommendations to commercial settings.

Safety and Codes and Standards Funding:

Safety and Codes and Standards funding includes international activities as well as national development and coordination among several agencies. A large number of reviewers expressed concern over funding gaps and were concerned that lack of funds would delay future activities. The recently issued National Academies' report recommends additional funding for safety, codes and standards and to increase public awareness of hydrogen safety issues to facilitate the commercialization of hydrogen technologies.



Majority of Reviewer Comments and Recommendations:

Subprogram scores were average to high, with an overall average of 3.3. As in 2005, the lower scores reflected dissatisfaction with the progress and direction of the Global Technical Regulations activities at Los Alamos National Laboratory. Reviewers also indicated that the Safety Panel has a range of high quality representatives but the Panel should evaluate its mission and strategy to maximize its effectiveness.

There was continuing distress about low or reduced funding for the Safety and Codes and Standards subprograms, due to budget cuts and Congressionally-directed projects. The low funding could jeopardize overall DOE objectives and commitment to the Hydrogen Fuel Initiative.

Recommendations included:

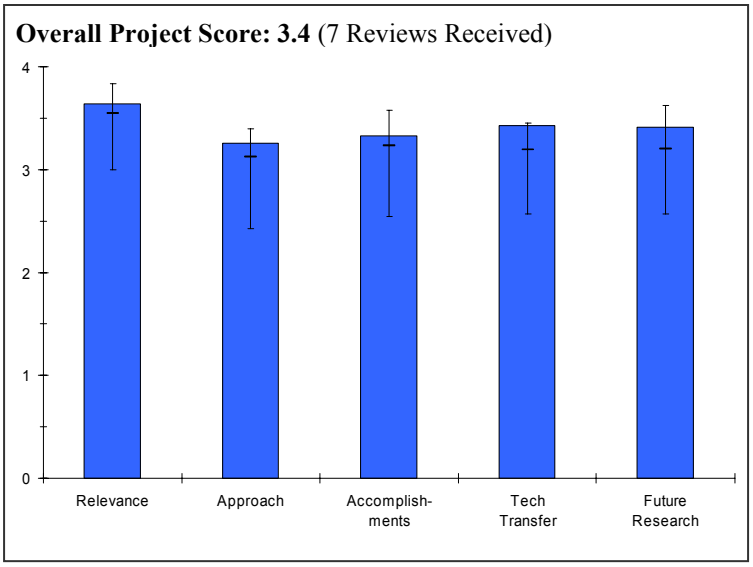
- More R&D is needed to fill in the gaps in hydrogen codes and standards; more focus should be made on following the roadmaps presented by the Codes and Standards Technology Team.
- Safety needs to be highlighted and tracked during the DOE demo program. Recommend DOE consider ways of focusing safety as an absolute.
- Inclusivity and international collaboration are strong elements of the DOE Hydrogen Safety strategy, but there is potential for redundancy and diluting efficiency. The Subprogram must continue to work to ensure communication and efficient collaboration on the range of safety activities.

Project # SA-01: Hydrogen Codes and Standards

Jim Ohi; NREL

Brief Summary of Project

In this project, the National Renewable Energy Laboratory is working on hydrogen codes and standards to expedite hydrogen infrastructure development, coordinate such development activities for the Hydrogen Program, and incorporate hydrogen safety considerations into existing and proposed national and international codes and standards. This will be accomplished by bringing together experts to address key issues, coordinating collaborative national and international efforts between government and industry, and by serving as the central point of contact for up-to-date information on codes and standards activities.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.6** for its relevance to DOE objectives.

- As the presenter noted, there is considerable need to focus on the research needed to support and develop consensus standards. Greater emphasis should be placed on furthering these efforts.
- This project's support of the codes and standards efforts is important to provide overall direction.
- It is absolutely necessary that safety be maintained throughout the R&D and that affordable, uniform codes and standards be developed.
- Without codes & standards, there will not be a hydrogen economy.
- Codes and standards are a must and an enabler for the hydrogen economy to develop.
- This project is a rational approach to addressing the President's Hydrogen Fuel Initiative.

Question 2: Approach to performing the research and development

This project was rated **3.3** on its approach.

- Being inclusive is good, but the effort may be spread too thin given the resources. The various coordinating committees and widespread partnerships such as that with the NHA may be creating redundancy and diluting efficacy. Future efforts should consider focusing on those gaps that are best addressed by government R&D.
- Need better prioritization between focus areas to identify key codes and standards to be developed, while understanding the technology gaps restricting their development.
- The project has a well defined road map to address a complicated overlap of responsibilities.
- Coordination through national and international organizations is excellent. The move of the C&S development effort to a private sector manager may or may not have a positive impact.
- Should make clear in the National Template that SAE has responsibility for storage systems as part of Containers. SAE does all vehicle standards (and has contributors from all of the global OEMs). Grounding of refueling stations is a red herring. If the station is built properly, there is no grounding issue. NextEnergy's design with grounding pipes, etc., should not set design criteria, for example. Other installations have been implemented successfully in current retail locations.
- The National Template has enabled a complex system of codes and standards to be effectively managed.
- The approach being followed is sound and has the support of industry.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.3** based on accomplishments.

- In areas where concise focus was applied, the most meaningful and measurable progress was achieved. A good example is in fuel quality. These efforts have more value than some of the general overarching and widespread coordination activities which are not resulting in meaningful progress.
- Information on website is good.
- The project has had some notable successes. The HIPOC team is a good example where a need was identified and a means to fix implemented.
- Accomplishments relative to funding that has been available is excellent. It is unfortunate that more funding has not been available to accelerate national and international efforts.
- H_2 quality work definition has been well done. Alignment of all interested parties is in place. 70 MPa work plan also important and in place. Performance based standards are the goal. NREL's web-based hydrogen bibliographic database will be useful to the H_2 industry. Good job.
- Energy company participation in the spec development process will enable cost consideration to be factored into the specs.
- The accomplishments in the model code area are as good as can be expected considering it is a consensus process with a number of competing agendas.
- The accomplishments in the product standards area are in step with the progress within the industry.
- The progress on a hydrogen fuel standard and applicable test and sampling methods are critical path and need to be accelerated to keep pace with other activities and meet the DOE stated goals.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.4** for technology transfer and collaboration.

- Greater emphasis should be placed on transferring the R&D to the standards/code language, particularly in the non-vehicle codes. This program would benefit from greater participation of the technical researchers such as SNL participating directly in the TAG or standards committees. There is a disconnect between the implementing or user groups such as code officials and safety engineers and SAE and the high level coordinating effort from select industry and technical experts.
- Need better collaboration with other projects and institutes. Much work applicable has been accomplished in other projects but has not been integrated in this project.
- The project interfaces with a wide variety of industry, government, and standards organizations. An improvement could be advertising the efforts more widely.
- All appropriate (and even peripheral) SDOs and CDOs are involved. Stakeholders are well covered.
- NREL is doing a good job coordinating and following all the diverse groups involved in this effort.
- Collaboration with OEMs, energy companies, FC providers, national labs, C & S groups has enabled gaps to be identified and closed.
- Collaboration in this area is excellent. The automotive, fuel cell, specialty gas, energy and safety industries are engaged, focused and cooperating.
- The information transfer methodology is also excellent and appears to be world class. The information is easily and readily available in real time.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.4** for proposed future work.

- Proposed work is focused, and if completed, answers near term needs that will advance the state of the industry.
- Future work proposed shows no prioritization and therefore advancements will be slow. Focus is on "in the Woods" work instead of high need areas and focused developments efforts.
- The project has some important objectives for this forthcoming year. This was clearly communicated in the presentation.

- Plans to transition this work to a private contractor could be a marginally positive to very negative move. This change will be highly dependant on the contractor selected and their motives for taking the task. Would like to see a test plan for H_2 quality and prioritization of codes and standards to be developed.
- Great plans need to be funded.
- Future plans are aggressive and focus on the critical areas.
- The proposed research matches the stated industries needs and is current. This project has demonstrated the ability and willingness to adjust and redirect activities as the developments dictate within budgetary constraints.

Strengths and weaknesses

Strengths
- Great coordination w/NHA/FC C&S coordinating committees good getting ICC and NFPA to talk.
- The PI clearly is knowledgeable in this area. He has developed a comprehensive plan.
- Partnerships and interactions with stakeholders, SDOs, CDOs; both nationally and internationally.
- Work on H_2 quality has been very important in bringing the area out as an issue to discuss.
- National Template, active participation of energy companies in spec development process, and DOE coordination of a complex system of code and standard development are strengths.
- The industry, national lab and SDO/CDO collaboration is the key strength. The focus on performance based solutions over the historical proscriptive methodology has allowed rapid advancement in several areas.
- An equally important strength is the project leader's patience with industry members who are aggressively pushing to complete the various initiatives to maintain the DOE schedule and contain costs. Much of this friction is due to the funding not matching the schedule and work load.

Weaknesses
- Project needs better focused direction in specific C&S development specifically in the SAE / vehicle area and fueling station areas. Need more coordination with industry.
- The funding appears to be inadequate to address all of the needs in this area. The project is in a position to influence, but not direct the activities of standards organizations. These organizations often have conflicting interests.
- The biggest weakness is that many of the standards should have been developed already, so this effort started out behind schedule. Unfortunately, funding limitations have caused this and are generally out of the control of HFCIT.
- Lack of funding has pushed back the timeline.
- The weakness is the lack of funds for applied research to resolve outstanding, critical path items. Paths need to be identified that will generate the required data at a greater rate and for less money. However, this weakness is out of control of the project and, for that matter, the DOE leadership.

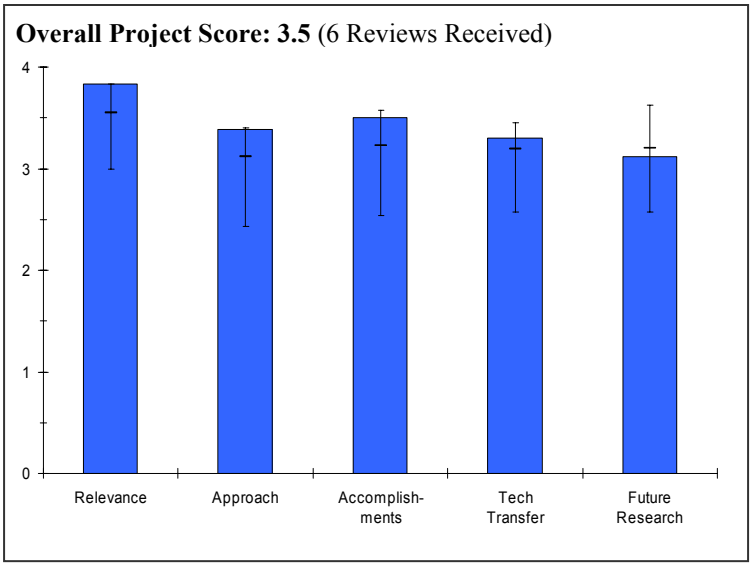
Specific recommendations and additions or deletions to the work scope

- Template development seems to be completed with little additional development per year. This suggests little to no further effort is required. Needs to integrate with other projects in delivery, tank validation, storage, etc.
- Additional funding that can spur additional industry and standard organization support.
- Presentation of fuel quality R&D should have included an overview of the test plan.
- Note that on the National Template, SAE responsibility for Vehicle Containers includes Storage Systems. Drive to consensus on grounding "issues," and gather viewpoints of all OEMs (global).
- Project scope is appropriate.
- Increases in funding for hydrogen quality and high pressure vehicle fueling.

Project # SA-02: Research and Development for Hydrogen Safety, Codes and Standards

Chris Moen; SNL

Brief Summary of Project



This project contains two major elements that address 1) risk assessment and consequence analysis of unintended hydrogen releases, and 2) compatibility of hydrogen with engineering materials. The purpose of the hydrogen safety scenario element is to develop a scientific basis for evaluating credible safety scenarios, providing technical data to codes and standards developers. Safety scenarios are used to map unknowns in the codes and standards decision making process into R&D on hydrogen behavior in engineered systems. Sandia National Laboratories (SNL) is developing benchmark experiments and a defensible analysis strategy for risk assessment of hydrogen systems, including experimentation and modeling to understand the fluid mechanics and dispersion of hydrogen for different leak rate regimes. The purpose of the materials compatibility element is to create a Technical Reference to guide material selection and methods of construction in codes and standards development for the hydrogen economy infrastructure. Material testing is being conducted to fill information gaps identified during the literature search. Material systems include pressure vessel steels (stationary storage and transportation of hydrogen gas), pipeline steels (hydrogen gas transportation), stainless steels (ancillary components in the storage, distribution, and consumption of hydrogen gas such as piping, pressure relief devices, and valves), aluminum alloys (hydrogen gas storage vessels on vehicles), copper alloys (high-pressure hydrogen seals), and composite systems.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.8** for its relevance to DOE objectives.

- Objectives are good; execution may need to be revised
- This project is directly answering critical identified priority needs and is addressing clear technical barriers.
- This project will supply some of the basic research building blocks on which industry can build.
- Understanding H_2 compatibility with materials is critical to assuring safety.
- Important topics to support data based standards.
- This project is a rational approach to addressing the President's Hydrogen Fuel Initiative.

Question 2: Approach to performing the research and development

This project was rated **3.4** on its approach.

- Material work is good, need to evaluate existing H_2 plume data. Much data already exists; it seems this hasn't been integrated into current work.
- Need much better direction on how to address risk.
- Risk analysis work is technically sound. There are opportunities for improvement if the work includes more coordination and input from code officials and/or regulators depending on the application. Risk analysis is difficult in larger multi-component/ complex systems for which unexpected incidences occur and are difficult to incorporate into risk assessment.

- Several barriers were described in the presentation, along with the project team's ability to overcome those barriers. The approach for the basic technical research appears sound. The approach for other areas, such as risk assessment is less clear.
- SNL's materials expertise is being well utilized on this project. Their knowledge has enabled timely adjustment of test procedures and understanding of research data.
- Good idea to look for gaps in material compatibilities for hydrogen embrittlement.
- The approach to generating the data is excellent.
- The intent to generate a risk assessment methodology raises serious concerns. Anything that quantifies a qualitative concept, such as safety, and is used in the public venue may be misapplied and end up as a litigation tool with personal injury lawyers.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.5** based on accomplishments.

- Material progress good.
- H_2 plume and risk work and accomplishments seem less than anticipated with existing data and risk information available.
- Program is providing technically sound and detailed answers for each of the topics being investigated.
- It's not clear how risk assessment will be done considering variation of possible construction techniques amongst vendors.
- Adjusting priorities to meet the needs of ASME is appropriate.
- Great accomplishments-very important work. The most important discovery is regarding the duplex steels investigation.
- The technical accomplishments on material properties are outstanding.
- The accomplishments on hydrogen flame characteristics are also outstanding.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.3** for technology transfer and collaboration.

- Need better collaboration between SNL and others doing material testing.
- Other labs have flame plume & hazard data; need better collaboration.
- Some collaboration has been described, such as with ASME. It was not clear if the project is working with organizations such as NFPA that are establishing setback distances. This collaboration could identify additional areas for testing.
- Immediate Web publication of chapters assures information is available in a most timely manner.
- Impressive industry/Codes and Standards coordination.
- The collaboration on high pressure materials with ASME and CGA is very good.
- The collaboration on the pure science of flame characteristics is very good.
- The collaboration on the applied science of flame characteristics is directly supportive of the model codes effort.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.1** for proposed future work.

- Need better plan to get most data to ASME.
- Need better use of existing data from places other than SNL (H_2 plume and risk).
- Need better collaboration to determine risk approach using existing/previous examples.
- An impressive list has been provided for next year's work. It's not clear how this work is selected or prioritized.
- Prioritization of future work is generally good. More work is needed to establish an acceptable risk level.
- Important areas of research.
- The plans for generating the applied science on hydrogen flame characteristics are excellent.

- The plans for work on metals exposed to "pure hydrogen" at storage pressure are also excellent. However, it is hoped that this work would also address the potential effects of the impurities expected in a fuel grade hydrogen.
- The plans on generating a "risk analysis" methodology are of concern. However, this may be an issue with semantics.

Strengths and weaknesses

Strengths
- Great capabilities for material testing.
- This project is doing basic, fundamental research that will support all other programs. In particular, the materials work is critical to the safety of multiple other projects. It is difficult to obtain funding for this in industry, so DOE support is important. This is one of the few areas providing that information.
- SNL's materials expertise is this projects greatest asset.
- Excellent R&D activity. Making important technical discoveries regarding materials compatibility & risk assessment.
- The strengths of the flame research are that it addresses the pure and applied science needs (mechanisms and real world applications like set back distances).
- The strength of the materials research is that it addresses the pure science needs (mechanisms).

Weaknesses
- Need better collaboration outside the project in all parts of project.
- It's not clear how work is selected and prioritized. It would be helpful to understand this process to make sure that the most important research work is being done to aid the hydrogen industry. This work could also be better publicized to maximize value of that information.
- I am not convinced that "no greater" risk is adequate. Introduction of a new technology, such as this, would be set back significantly if there were an "equal" accident.
- No gauge of the impact that the work done in this area has on the codes and standards.
- The weaknesses of the materials research is in the applied science area. These materials will be subjected to a fuel grade hydrogen. This means impurities. Are there additional issues associated with the impurities?

Specific recommendations and additions or deletions to the work scope

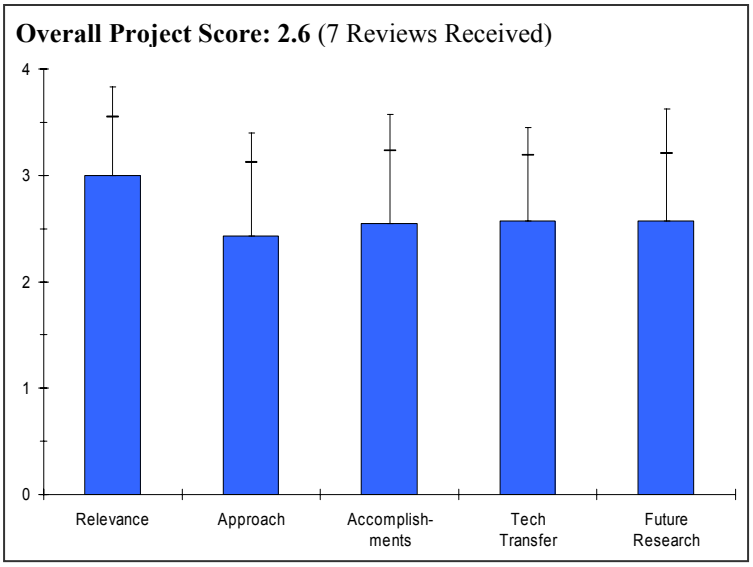
- Need approved test matrix to meet ASME needs.
- May be able to reduce H_2 plume R/D or eliminate based on previous work completed outside SNL.
- Need firm risk assessment directions.
- Providing the basic research data appears to be where this project can add the most value. Keep the project focused in those areas.
- Need to reexamine the allowable risk level and programmatic impacts of a potential accident.
- Recommend reviewing the influence that the data generated from the R&D work / risk assessment has had on the relevant codes and standards. It would be good also to survey the Standards industry, specifically ASME, ASTM & SAE regarding materials use for stationary & mobile uses of hydrogen.
- Do some applied research at the transmission and lower storage pressures on metals with a fuel grade hydrogen.
- Evaluate composite materials at all transmission and storage pressures on pure and fuel grade hydrogen.
- Evaluate various plastics and polymers at building and appliance pressures on pure and fuel grade hydrogen.
- Attempt to engage this researcher as a voting member in the various technical committees on hydrogen in the model and design code activities (ICC, NFPA, and ASME).
- Publish suitable test methods through the appropriate SDO (ASTM).
- Publish the combined results in a government manual, readily available to the public. Example that could be followed would be the US Bureau of Mines report and NASA NSS 1740.16.

Project # SA-03: International Projects: Global Technical Regulations

Cathy Padro; LANL

Brief Summary of Project

This Los Alamos National Laboratory (LANL) project provides technical support for the EPA/DOT/DOE joint effort in the development of global technical regulations for hydrogen and fuel cell vehicles. Working collaboratively with DOT/NHTSA (principally), LANL participates in the global effort to develop performance-based standards and regulations for hydrogen vehicles. This project also provides technical support to the International Partnership for the Hydrogen Economy and its efforts related to regulations, codes and standards.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.0** for its relevance to DOE objectives.

- The concept behind the effort has merit. This project however does very little to support the President's Hydrogen Fuel Initiative.
- It will be helpful to the hydrogen industry to have common design standards throughout the world.
- Important to assist in the coordination activities in GTR process.
- GTRs are a necessary stretch goal.
- This project shows good alignment to the goals of the MYPP to ensure alignment with the UN/GTR process and to ensure the appropriate U.S. influence in the GTR process.
- This project is a rational approach to addressing the President's Hydrogen Fuel Initiative.

Question 2: Approach to performing the research and development

This project was rated **2.4** on its approach.

- The approach does not facilitate US leadership. It prevents the representing bodies for the US from being able to actively engage and lead in the necessary work under the GTR process. The effort does not seem to effectively engage industry or create a mechanism for DOT to better represent US interests.
- The presentation doesn't show how the barriers to progress listed will be addressed.
- Not very clear how the DOE will use R&D to assist in the GTR process.
- Active participation in the European and Japanese code and standards development is a must.
- Continue to ensure that DOT has the appropriate information to take to the UN/GTR process.
- Good progress overall. Need to keep in mind that DOT/NHTSA has responsibility for vehicle safety and EPA has responsibility for emissions. The two responsibilities do not overlap, so there is no need for "coordination" by DOE between the two. Monitoring among the two is OK. Work to ensure that the three active bodies (Japan, US, and EU) are all proceeding along the same path without unfair advantages gained by any one region.
- The approach appears sound. However, the apparent preference for European initiated product standards with regards to hydrogen over domestic product standards is surprising. It might be expected that the domestic, performance, based standards generated by North American industry would be championed as the basis of international product standards. It is also surprising that of the international standards organizations, ISO would seem to be given preference over other international SDOs, which are more frequently adopted, who are working in this venue (e.g. ASME, ASTM, SAE)

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **2.5** based on accomplishments.

- No new information was presented. No technical accomplishment that met the needs of EPA and DOT were presented, and it is not clear that the work is responsive to the stated needs.
- The project has shown progress. It's not clear how this progress compares to overall objectives of the program. A timeline showing activities out to 2010 would be helpful.
- No measurable accomplishments in report.
- Key contacts have been made and key meetings have been attended.
- Progress has improved for this project this year including the GTR development process proposal.
- Clearly understanding European and Japanese direction and regulations with respect to hydrogen related codes and standards is critical.
- Facilitating DOT interactions and participation in GTR process is good.
- The progress of this process seems to be limited to a minimal organization tree in which the US is not listed as leading in any activity. This passive position seems to be in conflict to the President's goals. Additionally, a summary of the key 'hot items' based on a preliminary review of the Japanese regulations which was published seven months ago should be available.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **2.6** for technology transfer and collaboration.

- This project should focus heavily on tech transfer/collaboration and support for DOT and EPA yet fails to do so.
- It was not clear from the presentation how collaboration within the US would be handled to support US position on final GTRs.
- Interfaces at the international level have been established which should allow US data and standards to be part of the GTR process.
- Close collaboration with DOT and other codes and standards bodies is essential to the success of this project.
- The collaboration on this project appears to need some attention. The response to a query from the previous years review was disappointing.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.6** for proposed future work.

- The presenter did not enumerate any real specifics or details for which to evaluate the value of the proposed future research.
- It's not clear what approaches will be used to overcome the barriers listed on the first slide. For example, what can overcome the barrier to US industry participation?
- Not very clear how the DOE will be assisting the GTR process to bring the US/ German and Japanese contingents together.
- This is a long term process and constancy of purpose will be necessary to stay the long course.
- The proposed future research is sketchy. This is probably due to the dysfunctional nature of the GTR process and bureaucratic inertia.

Strengths and weaknesses

Strengths

- The initial structure is in place to build upon.
- US will have a place at the table as GTRs are developed.
- P.I. knowledge of the key issues is very good.
- Good working relationships with the codes and standards community.
- Difficult mission and DOE & LANL have done a good job balancing all the players.
- The interfacing with the various members states involved in the GTR process.

Weaknesses

- There do not seem to be clear goals for success. This might be a difficult area for specific goals, but some effort should be applied to do so.
- Need to work on putting together a clearer presentation on activities. Not a lot of movement from this activity in the GTR. Not a clear understanding regarding how budget was spent.
- This project has been lumped into a general fund which could make it too easy to slip away in future years.
- Direct role in UN/GTR process lies with DOT, not DOE.
- I think LANL understands the current GTR process and recognizes current bumps along the road, but to reiterate, the EU directive E1HP that has moved through Parliament and now at the European Commission is the biggest issue right now. It is too regulatory and not sufficiently performance based. DOE/LANL should work with the Japanese and ensure that a set of GTRs results that benefit everyone equally.
- The weaknesses with this project are the lack of detailing activities.

Specific recommendations and additions or deletions to the work scope

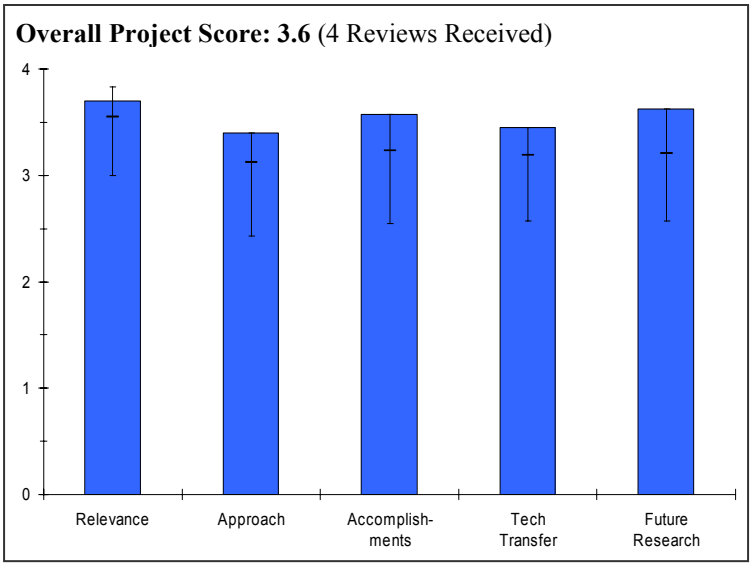
- This project should be considered for deletion. The Performing organization is not addressing the specific requirements of the Federal agencies being supported, and may in fact be impeding progress.
- Inquire with NHTSA on how to better support them with data, organizing meetings to bring consensus together. Better utilize funding to support NHTSA activities.
- Recommend the project be broken out and receive separate funding.
- Ensure appropriate codes and standards information is advocated by DOT in the GTR process.
- Make sure that the E1HP proposals are monitored and get global OEM input on how best to do the GTR; probably NOT using E1HP as the model. Keep in mind that what appears to be "lack of sustained domestic industry support at international technical committees" listed as a barrier is somewhat misleading. All the OEMs are global companies and input to the GTR process occurs at many levels and in many forums. Just a mind-set shift needed when discussing and presenting DOE work in this area. It might be worth briefing the C&STT on some of the ancillary activities, such as the funding for BP's station in Beijing, supporting the Olympics. What are we learning, etc.
- The objectives of DOE are unclear in this area. From this report, it appears that a lot of money is being spent to support minimal activity. It is understood that this project covers other administrative tasks not discussed. The lack of definition on the other tasks skews the perception of the accomplishments of this project. Rescope this task to address the administrative tasks, including GTR's, and relaxing the requirement for peer review may be justified.

Project # SA-04: H_2 Incident Reporting and Best Practices Database

Bruce Kinzey; PNNL

Brief Summary of Project

The objectives of this project are to: 1) Establish a web-based system for open sharing of lessons learned from hydrogen incidents and near misses, and provide a confidential tool for reporting any occurrence of same; and 2) Provide a Hydrogen Safety Best Practices document to enable widespread benefit from the wealth of knowledge and experience already attained in industry, aerospace and elsewhere.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.7** for its relevance to DOE objectives.

- Incident reporting and best practices databases will be helpful in disseminating safety information and identifying gaps in codes and standards activities.
- This project is a rational approach to addressing the President's Hydrogen Fuel Initiative. Applied correctly, this Initiative could improve consumer safety across the board. Applied incorrectly or out of context, the results from this activity may hinder the transition to hydrogen as a transportation fuel.
- Everyone's experience must be shared. This could be one of the greatest resources for the Program.
- This project (database) is highly important for communicating lessons learned in and out of the Hydrogen program.

Question 2: Approach to performing the research and development

This project was rated **3.4** on its approach.

- Databases are well designed.
- The approach appears sound but is missing one relevant component. The approach is to generate two public databases. The first is of industrial and commercial best practices. The second is of industrial and commercial hydrogen incidents. A similar activity should have been concurrently conducted on other commercial transportation fuels (petroleum, natural gas, etc) as points of reference and comparison.
- I am not convinced that the team has done everything necessary to get all organizations willing to share information. Consider searching out more organizations that have established H_2 related procedures and compare to further develop best practices.
- Approach is fairly solid, though it is not clear if voluntary input will capture all important issues.
- Sanitizing process may help to promote usage once those inputting information become more comfortable with it.
- No process currently to verify accuracy of input.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.6** based on accomplishments.

- Databases well designed, easily searchable, and already populated with existing data.
- The project has made very significant progress in a number of areas which meet the goals proposed and support complimentary projects.
- Considering the short timeframe of this project, progress has been excellent.

- Incident database has just launched.
- Project has only been running for approximately 6 months
- Pulling information from several databases.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.5** for technology transfer and collaboration.

- Not clear whether enough contacts are established to collect all incidents, also there may be some liability issues. Suggest establishing contacts with NTSB, PHMSA, and NHTSA incident reporting systems.
- The project consisted of drawing information from the H_2 safety review panel, privately submitted reports, and probably public news sources. The review panel is a diverse group drawn from government and industry. This in of itself demonstrates close coordination.
- Cooperation received so far is very good, but results next year will be a better indicator.
- Working closely with the Hydrogen Safety Review Panel.
- Participation from other organizations is voluntary.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.6** for proposed future work.

- Continued enhancement and data collection recommended. Useful tool for safety planning.
- The further work plans generally address the objectives stated for this program. However, at the risk of scope creep, the lack of objective benchmarking of similar industries begets the question of how to interpret the information. Safety and acceptable risk are subjective by nature. Reference points are necessary for objective evaluation.
- Plans for future work are very good.
- Future work appears to be very relevant towards capturing lessons learned with respect to hydrogen incidents.

Strengths and weaknesses

Strengths
- The strengths of this project lie in the diversity and experience of the research panel and the extensive media sources in this country.
- Greatest asset is Web based sharing of information.
- This is a valuable tool for communicating incident related lessons learned.
- In a short period of time the project has come on line and information is being captured.

Weaknesses
- The weaknesses are the lack of reference to safety incidents in similar industries resulting in the potential to misapply the collected data to support a political agenda (i.e. Hydrogen is too dangerous, natural gas is safer, and gasoline is safer...) And the need to depend on voluntary reports on hydrogen incidents.
- Lack of process/procedure to maximize input from external organizations.
- Participation by those having incidents is voluntary.

Specific recommendations and additions or deletions to the work scope

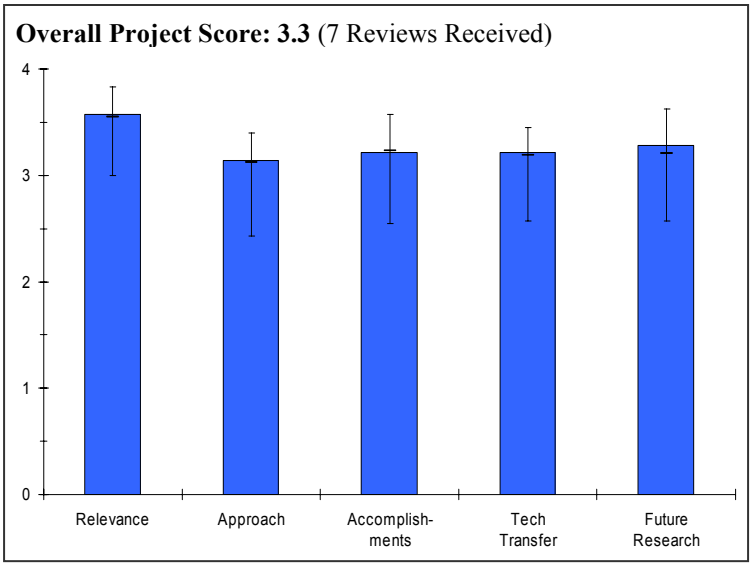
- Funding should continue to maintain and enhance data collection.
- A potential source of relevant information on hydrogen, natural gas and petroleum incidents might be OSHA. Many industrial and commercial incidents need to be reported in detail to OSHA.
- An additional barrier is the reluctance of an organization to share information on an incident or near miss, because it might reflect badly on them. Motivating all organizations to share all information will be difficult but important. Conduct a stakeholder workshop to bring out concerns of sharing information and addressing those concerns that might be beneficial.
- Continue to look for new sources of data to populate the database.
- Develop a process to protect input and non-sanitized information from FOIA requests.

Project # SA-05: Hydrogen Safety Review Panel

Steven Weiner; PNNL

Brief Summary of Project

The Hydrogen Safety Review Panel supports the DOE Hydrogen Safety Program, focusing on the development and implementation of practices and procedures that will help ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE projects. Bringing together a broad cross-section of industrial, government and academic expertise, the panel provides guidance and review of safety plans for project teams, conducts safety review site visits and telephone interviews and helps capture best practices and lessons learned for the benefit of the Hydrogen Program as a whole.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.6** for its relevance to DOE objectives.

- Safety is a must and the Safety Panel supports the mandate.
- Some day the technology may be sufficiently mature that this activity is no longer needed, but we are not there yet.
- This project is a rational approach to addressing the President's Hydrogen Fuel Initiative. Applied correctly, this initiative could improve consumer safety across the board. Applied incorrectly or out of context, the results from this activity may hinder the transition to hydrogen as a transportation fuel.
- Integrating safety into funded projects is extremely important, as any incidents causing injury or death in the DOE funded programs would have a negative impact on deployment of a hydrogen economy.
- Project strongly supports DOE goals and President's initiative and goals of the Hydrogen program.

Question 2: Approach to performing the research and development

This project was rated **3.1** on its approach.

- The approach to putting the Panel together should be revisited. Greater utility and benefit might occur if more independent specialists and experts were engaged beyond the industry experts. The board would then serve as a more effective third party review and sounding board. In too many cases the safety specialists from the industries performing the work are part of the panel. Oversights may be repeated both by the industry team and the safety review panel. The loss of FM global as a member is pretty severe.
- Site visits, phone audits and the two new Websites help with developing a safety culture.
- Reviewing safety plans and providing good examples is valuable to the community.
- The approach appears sound but is missing one relevant component. The approach is reviewing industrial best practices and applying them to commercial practice. A similar activity should have been concurrently conducted on other commercial transportation fuels (petroleum, natural gas, etc) as points of reference and comparison.
- Panel of experts is diverse and about the right size.
- It seems that some of the activities of this panel are duplicated by the NREL effort in the demo program. Both groups are collecting safety data. At least in the demo program, criteria for reporting leaks are set the by the reporting party, so how is the safety panel going to avoid a comparison of apples and oranges as they review incidents?

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.2** based on accomplishments.

- The project has produced some useable results and continues to make progress. However some of the accomplishments continue to highlight prior shortcomings of the effort.
- Seven on site reviews is a step in creating a safety culture.
- Progress is somewhat dependent on the willingness of others to cooperate, which appears to be good.
- The project has made very significant progress in a number of areas which meet the goals proposed and support complimentary projects.
- Panel has conducted a good number of safety reviews, and site visits, and apparently each funded project is required to submit safety plans for review to the panel of experts.
- Team has made very good progress in addressing multiple barriers with respect to hydrogen safety.
- It is important that lessons learned are communicated within the Hydrogen program.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.2** for technology transfer and collaboration.

- Improvements to the team are necessary. The project is interacting with the DOE projects.
- Outreach with two new Websites is broad.
- This is really (and should be) a technology pass through project. The more the information can be shared the better it will be for the Program.
- The project consisted of a diverse review panel drawn from government and industry which generated a DOE data base on a number of items. This in of itself demonstrates close coordination.
- Unclear whether this project interacts with others directly or if this might be accomplished through another avenue.
- Not clear what the end result is. Need to answer the "So What?" question. Clearly the interactions with the PNNL Hydrogen Safety Program are important. But, is there a clearly articulated vision? What will result from the questionnaires, telephone interviews, etc.? How will best practices be rolled out? For example, under Equipment Maintenance and Sensor Calibration, the accomplishment contains nothing new.
- Great collaboration is apparent within the team in order to accomplish the amount of activities they have.
- Helping DOE to integrate safety planning into the Hydrogen Program.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.3** for proposed future work.

- Additional planned site audits and safety review will help ensure a focus on safety.
- Continuing this activity is very important.
- The further work plans generally address the objectives stated for this program. However, at the risk of scope creep, the lack of objective benchmarking of similar industries begets the question of how to interpret the information. Safety and acceptable risk are subjective by nature. Reference points are necessary for objective evaluation.
- Proposals listed under "Responses to 2005 Reviewer's Comments" should be implemented.

Strengths and weaknesses

Strengths

- On site safety audits, phone audits, and the two new Websites (incident reporting and best practices) help focus on a safety culture.
- Sharing of information.
- The strengths of this project lie in the diversity and experience of the Panel.

- Good overall effort and training for guidance for emergency responders. Review of safety plans for small groups new to H_2 is valuable.
- High level of expertise of team members.
- Diverse background of team members.

Weaknesses

- Safety was not a key take away at either the Plenary Session or the lunch addresses. The PI mentioned an audit was not completed due to a lack of funding - not a good message.
- The weaknesses are the lack of reference to safety practices in similar industries resulting in the potential to misapply the collected data to support a political agenda (i.e. Hydrogen is too dangerous, natural gas is safer, and gasoline is safer...)
- An annual report should be published and distributed throughout the program so that lessons learned can feed into future improved safety plans in each program area.
- Very important that the panel members are there to ensure safe use of hydrogen, not to look for opportunities for consulting contracts. Should not be sensationalizing H_2 risks any more than is done for gasoline or anything else. The accomplishments reported this year in many areas are really standard operating procedures that apply to any potentially hazardous process. Can the panel do more than that?

Specific recommendations and additions or deletions to the work scope

- Recommend safety be highlighted at the Plenary or a luncheon. May want an Award for best safety improvement. Lack of funding should not be mentioned at a public meeting.
- Generate similar databases on safety practices from other similar industries.