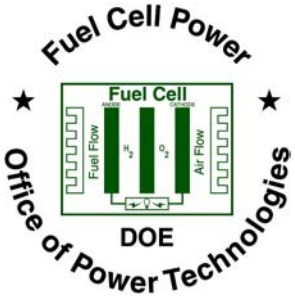
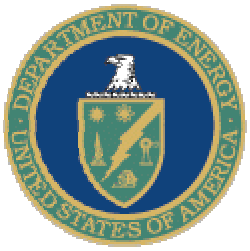
Fuel Cells Summit V Summary and Results

May 30-31, 2001
Adelphi, Maryland





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FOREWORD

Fuel Cells Summit V is the fifth in a series of working meetings sponsored by the U.S. Department of Energy, Office of Power Technologies (the Summits originated in the Office of Building Technologies, State and Community Programs, but the responsibility for this program has since been transferred to OPT). The goal of the Summits is to support a receptive institutional and regulatory environment for fuel cell technologies. The Summit series provides a forum for representatives from industry, codes and standards organizations, governmental agencies (federal, state and local), and other interested parties to learn from each other about codes and standards affecting fuel cell implementation, and to cooperatively address the related needs identified for facilitating the technology's movement into the marketplace.

This summary report documents the presentations, discussions and results of the Summit. As the proceedings were not electronically recorded, the contents herein were produced from notes taken by various attendees and materials provided by presenters. To minimize risk of misinterpretation or misrepresentation, only a minimal attempt has been made to edit statements or discussion for purposes of clarity and continuity. However, the statements and text contained herein are not literal transcriptions and therefore cannot be treated as such. Undoubtedly some of the discussion and nuances of points made during the meeting have been lost in the translation. On the other hand, as this document has been compiled from multiple note takers and circulated for comment to Summit attendees, the authors believe it fairly captures the spirit and content of the meeting.

The authors wish to thank the various presenters for their individual contributions, as well as all of the attendees for their cooperative attitude and lively participation.

Any remaining inaccuracies in the text are the sole responsibility of the authors. The views expressed herein do not necessarily reflect the positions of the U.S. Department of Energy or any of its contractors.

Table of Contents **Page**

1. DAY ONE PRESENTATIONS AND DISCUSSIONS

1.A. Welcome and Introduction

Mr. Ronald Fiskum, Office of Power Technologies, U.S. Department of Energy
Dr. Mike Davis, Avista Corporation

Mr. Fiskum welcomed everyone to the Summit and noted the importance of building codes and standards in facilitating the deployment of fuel cells and other distributed generation technologies into the market. This meeting, the fifth Fuel Cells Summit, continues to be an important component of the Office of Power Technologies (OPT) fuel cells program. Mr. Fiskum next introduced Dr. Mike Davis, CEO of Avista Labs and former Assistant Secretary of the Office of Energy Efficiency and Renewable Energy.

Dr. Davis indicated that he has had the benefit of both public and private sector experience in the energy arena and discussed the need for patience in this effort. It will take a long time to successfully get fuel cells into the market, make a profit, and create a sustainable business. In addition to improving the technology itself, fuel cell developers must spend a lot of effort on codes, licensing, and education to achieve mass-market commercialization.

Fuel cells will benefit from earlier efforts to open markets for new power generation technology. There was a time when there were no independent power producers, and when it was impossible to bring a new technology to market and site it in a utility service territory. PURPA (Public Utilities Regulatory Policies Act of 1978) changed things. Solar energy developers also paved the way for opening transmission access.

Fuel cell systems consist of three main components -- fuel processing, the fuel cell itself, and power conditioning equipment. Of these three, power conditioning is the easiest aspect to deal with as the technology and the utility interfaces do not distinguish between generation sources. More work must be directed toward fuel cells and fuel processing

The central utility model works well in some respects; it offers guaranteed return, but limited profit and prices. Today, the "time to market" is a key issue affecting the central utility because it takes a long time to start earning on the very large investments. Also, there is much more environmental pressure now than in the past. But customer demands present the biggest change in the utility market. Utilities must be able to deliver goods and services to meet special needs. The digital economy demands clean power and reliable service. Fuel cells have traits that can meet these needs.

Dr. Davis stressed that it will be critical for the industry to set reasonable expectations and reduce the chance that expectations will get ahead of the industry's ability to deliver. He hopes many fuel cell companies succeed, and that they work together to deal with critical issues that could inhibit success of the entire industry, such as safety. For instance, piping hydrogen around a building could present problems. Again, this calls for the need for standards, codes, licensing, and education. It is important to avoid the mistakes made by the solar industry in the past. (This point was particularly stressed by a

U.S. Senator on a recent visit to the Avista facilities.) However, it is also important that the standards are broad and flexible. Individual firms should not try to gain market advantage by attempting to set specific standards that only they can meet, as these will turn out to be detrimental to the industry as a whole.

Potentially, there is a huge global market for fuel cells -- both inside and outside the grid. But there is a long way to go before this market can be realized. The industry must find the most profitable applications. For example, in the solar industry, the size of the systems (in terms of overall watts necessary) declined over time until the solar module itself only contributed a fourth of the total system cost. In the fuel cells arena, companies will need to gain experience in the most profitable niche markets before they can tackle the larger residential and transportation applications.

Best components make the best systems. In an automobile, there are an impressive number of components and the integrator of these makes the most money, but integration is also very difficult. Everyone has a different idea about how to make a fuel cell. Avista has focused on developing certain components where they perceive a relative advantage. For instance, power electronics are very important. Fuel processors also need improvement and Avista is focusing on improving those.

When we think about the future and the issue of licensing a fuel cell for use in a house, many questions arise. For example – who obtains the permit? We need to think about the amount of time and education needed to clear the hurdles of building inspectors. When Dr. Davis owned his own mechanical contracting business in the Denver area, he had to maintain contracting licenses in over 20 different jurisdictions, adding time and cost. Although contractor licensing is a separate issue from building codes and standards, similar time delays and costs will result if the industry is not prepared for them. Codes and standards is not the most glamorous aspect of fuel cell development, but it is an extremely important one.

1.B. Status Report on the Fuel Cell Industry

Mr. Robert Rose, U.S. Fuel Cells Council

The U.S. Fuel Cells Council (USFCC) is a three-year-old organization open to any company or entity supporting the agenda of getting fuel cells into the market. Currently, there are 80 members. The USFCC works hard to make sure the industry advances a common agenda.

It is an industry that is just beginning, just on the cusp of becoming a commercial industry. In 2002, some members may start taking orders. In 2003, they could be offering commercial sales on commercial terms.

Recent activity includes:

- A lot of activity in buses – several dozen (perhaps as many as 100) new fuel cell buses have been put into service.
- A new buy-down program, a joint activity of DOE and the Defense Department will offer a fuel cell subsidy.
- Ballard Power Corp. will be making a $14M sale of fuel cells to Honda (1kW units.)
- Ze-Tek recorded some fuel cell sales and committed to building two production plants in the U.S. and one in Germany. (In order to get costs down, you need to develop the capability to produce in quantity.)
- Dupont reorganized and started a fuel cell group, including substantial hydrogen activity.
- The Bush administration is showing some support for fuel cells, e.g., Congressional support, possibility of tax credits, some federal R&D. There is also some interest on the part of States, maybe including fleets.
- The California Fuel Cell Partnership continues to grow.
- GM reports some good endurance testing results.
- Joint Ventures abound. The industry is internationalizing before fuel cells are even commercial (this is fairly unusual).
- Fuel cell companies are not depending on the government for supporting development. This is good.
- The first markets are likely to be high value markets; e.g., particular niches for specialized technologies with fairly high price tags.

Market Drivers for fuel cells include:

- Environmental benefits – fuel cells are highly efficient and have relatively low emissions.
- The general trend towards distributed generation in this country and the world.
- The modularity of fuel cells, which leads to a highly reliable energy source.

- Their output of "high value" energy. Poor power quality costs the nation between $150 and $450 million per year. "The most expensive kilowatt is the one you can't get." Fuel cells are reliable to "six nines," i.e., 99.9999% reliability.

On the automotive front --

- GM and Toyota have joined the California Fuel Cell Partnership. There have been quite a few vehicle demos – cars and buses (Mr. Rose showed many photos) and expect to have more than 70 by 2003.

- Fuel cells are being considered for specialty vehicles – fork lifts, bicycles, mining locomotives (mining vehicles are considered a high value market and the current technology isn't very good, requiring long extension cords).

- Remaining issues for automotive applications include fuel choice, cost, heat rejection, and performance issues like startup time and range. Major automotive application is still a longer-term proposition.

Stationary power side --

- The residential market is desperate for fuel cell attributes and we do not have enough product to supply demand.

- California situation is heightening interest. Fuel cells will be assured a place in CA.

- High tech growth requires high quality power.

Commercial buildings market --

- If fuel cells can come down the cost curve, there is a substantial market. The current market generally consists of users more concerned with power reliability than cost.

- There are lots of good ongoing demonstrations. The primary issues for fuel cells are cost, availability, competition from microturbines, and entrenched technologies.

Residential buildings --

- Those involved with codes and standards are very interested in fuel cells.

- There has been some recent patent activity in methane, propane, and natural gas fuels.

Portables --

- The Ballard/Coleman launch is a good development.
- The U.S. Fuel Cell Council is examining DOT fuel regulations.
- H Power made a sale of real fuel cells, 12,300 10kW units to the Energy Co-Opportunity, a consortium of rural electric cooperatives.
- Packaging is improving.

R&D --

- There is quite a bit of funding at Federal level and Congressional support (more than $175 million in FY2001).

1.C. Status Report on Institutional Issues and Responses to Them

Mr. David Conover, National Evaluation Service, Inc.

Mr. Conover's PowerPoint presentation is quite lengthy and detailed, containing many points and data not repeated here, The reader should consult Appendix A to view the main presentation and Appendix B for the background memo, "Status of Codes and Standards and Identification of Additional Needs to Support their Enhancement, Further Development, Deployment, and Use." Unlike similar presentations in past Summits, this presentation attempted to also address portable and vehicular applications and issues. This is difficult because codes and standards affecting portable, vehicular and stationary applications will be different and there is a number of other implementation issues that are unique to each application. What follows below are a few highlights.

Codes and Standards can support the implementation of fuel cells; they should not be seen as simply barriers to be overcome or roadblocks to successful deployment. The ideal situation is uniformity in the acceptance and application of fuel cell design, installation, operation, and use including a supportive service infrastructure. One key role that codes and standards play is to protect the market against unsafe products.

Different applications will call into play different codes and standards. For stationary applications, integration of the system with the building is a particular focus. For portable applications, acceptance for use in and around the built environment is key. For mobile applications, the means of refueling and refueling infrastructure takes prominence along with the location of the fuel cell vehicle and any unique on-board fuel supply in relation to buildings and structures.

The simple fact that a code or standard exists does not mean that it has been adopted in all jurisdictions. It will take a number of years after a code or standard is developed for it to be adopted and those responsible for its enforcement as well as those having to satisfy the code or standard to become fully aware of the requirements.

1.D. Presentation of Real World Experiences with Code Officials and Fuel Cell Installations

Timothy Hillman, Pacific Northwest National Laboratory

This study was conducted in the Tri-Cities area of Washington State, which includes five separate jurisdictions (3 cities and 2 counties). The survey included Building Officials, Fire Marshals, and Electrical Inspectors. The purpose was to assess the relative level of preparedness of local code officials for reviewing and approving stationary fuel cell installations.

One key point that the study identified was that code officials generally have no pre-existing knowledge of fuel cells. They do not have the resources to track technologies coming down the pike, so even though some may have heard of fuel cells they generally were not familiar with their operation or application.

The officials who participated in the study brought up three major issues: (1) fuel supply and storage systems, (2) utility interconnect, and (3) fire fighter intervention. The code officials seem to have no particular concerns regarding hydrogen, as long as components like automatic shut off valves, clearances around storage tanks, signage to indicate what is there, etc., are sufficient to ensure safe operation. For interconnection with the utility grid, local utilities will have different requirements and the code inspectors will need to know that the installation meets utility specifications. One issue is "islanding," which occurs when power is shut off to a portion of the grid but a fuel cell inside that portion is still live and continues to supply power to the wires. This is a particular concern for firefighters; they must be informed through signage or other means that a fuel cell is on the premises and therefore the electric wires may still be live.

Another important issue is that manufacturers will specify how a fuel cell is to be correctly installed in accordance with safety and other requirements. Will there be licensed installers besides manufacturers? Manufacturers will ease things by providing complete wiring schematics to their systems.

Code officials are not that concerned with the processes inside the fuel cell; they prefer to think of it as a black box, although it will be necessary to have the "box" tested and listed or some other means employed to verify that the "box" meets accepted and adopted safety criteria. Their main attention will be on the connections to this black box, i.e., fuel inputs and exhaust outputs, electric outputs, switching systems for energizing or de-energizing the circuit, etc.

For the code officials surveyed in this study, the favored means of getting information from the manufacturers to the code officials were conferences and field guides, then manufacturers' representatives and videos, followed by several other approaches. In general, computer-based information was seen as less desirable as many code officials still do not use computers to a large extent.

1.E. Lunch with Speaker

Dr. William Parks, Associate Deputy Assistant Secretary, Office of Power Technologies, U.S. Department of Energy

Dr. Parks of the Office of Power Technologies graciously took the spot of the original guest lunch speaker, as Dr. Robert Dixon was unable to attend. As Director of the Distributed Energy Resources Task Force, Dr. Parks presented on the directions of DOE activity in this area and how the Fuel Cells Summits fit into the larger DOE picture. His comments were not recorded for purposes of reporting here but his presentation slides are included in Appendix A.

1.F. Group Discussion

Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

This session was designed to discuss the issues brought forward earlier in the day as well as to introduce any others that Summit participants thought should be put on the table. What follows is the mixture of comments, questions and ensuing discussion.

Lead-Off Question: *What are the main issues confronting deployment of fuel cells right now?*

Stationary fuel cells and separation of the reformer from the black box; the connectivity between these two black boxes is a main issue. Where is the fuel coming from?

There are three main components of the system that must be interconnected. Are there standards needed to address their interconnection? Is a reformer standard needed to allow for approval of this device as a separate component when outside an assembled fuel cell or matched set of components? If the assemblage of fuel cell components is not matched and tested by the manufacturer, the components would need to be tested and listed separately and code provisions made available to ensure their safe connection and installation. Where the manufacturer has an overall matched set of components that are to be installed as a single assembly, and has them approved that way, pursuant to Z21.83, which does address individual components as well as the assembly, then the entire assembly can be tested, listed and approved.

Also, if hydrogen is being produced by the unit and stored for later use, the building could be considered a hazardous production facility, changing its use group with respect to building codes and consequently imposing a number of other design and construction considerations. There is a need to determine whether this is an issue. CSA was approached some time ago to see if they could approve hydrogen storage facilities. It was suggested that since LNG is stored it can't be too different from hydrogen. Are there limits on inventory that put you in different classifications? => Yes, NFPA 50A and 850B cover liquid and gaseous hydrogen storage; however, there is no standard for the facilities or equipment that would "manufacture" hydrogen.

Who is addressing ten years down the road, when somebody makes a mistake and causes an accident? Who will be responsible? This question suggests that the entire industry needs to work together to address the identified issues, rather than allow a portion of the industry to move forward without considering necessary issues and causing a safety concern due to lack of attention to those issues.

Can we transport portable systems on aircraft? The USFCC is working on this, but it will require change in DOT and IATA regulations. Minimum time to resolution will be 9 months.

For stationary applications in multifamily buildings, the building may be considered a utility and have to be rezoned. This is determined by whether the building is selling the power to its tenants at a profit.

What about standards for earthquake or tornado (i.e., natural disaster) survivability? The stationary unit must shut down safely in the case of an emergency. This is something different than requiring the unit to operate through an emergency, supplying continuous power. (This issue was not discussed, as it would relate to portable and transportation systems and their fueling infrastructure.)

Are smaller fuel cells (appliances) to be treated differently than other systems? => Yes, there is currently a stopgap measure in place (Z21.83, soon to be renamed), but in terms of safety requirements there's not a lot of difference, mostly related to manuals and other things to help the homeowner. (The statement above could be controversial as "smaller" and "a lot" are not defined. A fuel cell is a fuel cell regardless of size. The only difference to date in the codes and standards world is that for units above 50 kW there is an installation standard, and for smaller units the manufacturers installation instructions are the only guide other than all units up to 1000 kW will have to meet Z21.83 or equivalent.)

What about repairs down the road? We're going to need standards for parts interchangeability, encompassing a) replacing the same part from the same manufacturer; b) replacing the same part but from a different manufacturer; and c) substituting a new replacement technology down the road.

Replacement or repair of a piece of equipment is not going to be exempt from mechanical codes and it will have to be shown that the repair is not significantly modifying the operation of the system, as this would typically void the manufacturer's warranty and bring other problems, and make the modifier liable for them. In effect, the repaired fuel cell will have to show that it continues to meet code after the repair or retrofit, hence the need for tested and listed replacement parts such as a fuel cell stack. This will also require education and factory training of the repair force. NFPA 853 talks about who can perform servicing, what training is required to be certified, etc.

Is there anything covering breach of the separator, which could cause potentially explosive conditions? Also, what about air bleed into the system as a means of

controlling CO concentrations? => Yes, NFPA 853 covers these issues. Additionally, Z21.83 requires shutdown in a passive and inert state. This is usually done with nitrogen but other ways are possible.

ANSI Z21.83 addresses open flames; what about catalytic technologies that do not employ combustion? That section is currently being modified to accommodate non-combustion. NFPA 853 may talk about this; where they don't have an open flame, Z21.83 covers.

What about reverse power controls on interconnection? These controls monitor voltage and scale the system back to prevent back feeding the grid. Right now everyone seems to be developing their own system for this purpose. Is a standard needed so that utilities can pre-approve? => There are standards for utility companies for reverse power relays; however, no one is aware of any inverters that have this capability. Generally, it is done through a dual backup system

Is there an issue with odorants in the gas or lack thereof in hydrogen? What you do with the extract, sulfur or whatever from the deodorizer? Is there a code that addresses the use of de-odorized gas? => The leakage rate is limited and there are ventilation requirements in Z21.83, but this is an indirect standard in that it does not specifically address odorants. A separate ventilation system is needed to vent any escaping hydrogen to the outside of the building; natural ventilation is not acceptable. Maybe don't need two fans, though. One well-designed fan might work

One of the training needs identified in the Tri-Cities study was a checklist for design and commissioning. Is this needed? NFPA 853 does address some of this.

Are small residential units going to be covered under NFPA 853, which right now only covers stationary fuel cells over 50 kW in capacity? Eventually.

Any safety codes covering fabrication of sulfur traps? ANSI Z21.83 and NFPA 853

Would it be worthwhile for someone to sift through NFPA 853 and Z21.83 and extract salient features for consumption by this more general audience?

1.G. Expert Panel Discussion

For the sake of clarity, applications (i.e., Stationary, Portable, and Mobile) were handled consecutively in the discussion.

Stationary Applications

Mr. Todd Strothers (TS), CSA: I recommend everyone get a copy of Z21.83 and NFPA 853 and understand all of it before you get to the production stage to make sure you will be in compliance; you can have a pre-assessment done by CSA or UL.

Mr. Guy Tomberlin (GT), City of Fairfax: These are "appliances" in the eyes of the code official. The location on the premises, identifying the components, then getting qualified, certified installers are a good idea but not in the code right now. To take this through a site plan, a lot of this has already been developed, the guidelines we have to go by are pretty much contained in Z21.83; having qualified installers will certainly ease things. The more qualifying documentation you offer to the code official the better off you are going to be.

Comment: You are also going to need NFPA 853 as well, which tells you how to install.

GT: A lot of things haven't been adopted by individual states (e.g. there may be a number of standards and other documents that are under development or have been published) but remember it may take time before they are adopted by state and local government into their rules and regulations.

Comment: There aren't references to the model codes in many instances.

GT: This is only pertaining to units > 50kW. Still, there is a need to get NFPA 853 adopted into the model codes.

Mr. Timothy Bernadowski (TB), Dominion Virginia Power: A lot of work is still in draft form and we need to make sure the work keeps moving because no state is going to reference anything that is still in draft form. Just because model codes exist, that doesn't necessarily help. You need adoption and implementation of them as well. We need to recognize that we are dealing with two bodies – one that implements the codes and another, like the state utility commission that regulates utility grid issues.

We also need some sort of acceptance testing for installed systems by the utility on grid and interconnect issues, overall for initial installation as well as for later modification. We need standardized testing methodologies to make sure the installed system does what it is supposed to do.

There are other peripheral issues such as zoning and environmental requirements. For example, in Virginia there is a difference between emergency power and normal power installations. If it is a normal installation, there has to be leakage detection for the underground fuel supply tank associated with the installation.

Fuel cells are not unique. Or, at least selling them that way marks them for special attention by approving officials. He recommends calling the fuel cell an onsite generator.

Mr. Chris Fennell (CF), National Association of Home Builders Research Center: What is the impact on the actual construction site? Homebuilders don't sell fuel cells, they sell homes. At what point is the fuel cell installed? Does it require a specialist to complete the installation? How is installation going to affect the overall construction process? You may really only have one opportunity for getting fuel cells into the residential construction market, if the process isn't handled properly the first time you

may cause a lot of damage to fuel cells' reputation that will take years to repair (e.g. if the initial installations have problems in approval and/or subsequent operation and servicing).

Mr. Harry Jones (HJ), Underwriters Laboratories: In reference to the "black box" – it would be nice to have standardized connections to waste water, electricity, etc., to minimize any special approvals required. If mistakes occur and installations aren't well carried out, local code language may be the result. Primarily, you want to simplify the construction and installation process as much as possible.

Monitor the standards making process. There are many ways to address risk, but there are some ways that might put undue pressure on the manufacturers. Manufacturers must recognize that they have to keep code committees informed so that the committees don't write something that is out of date with the technology. Keep them informed!

Manufacturers putting temporary equipment out in the field should make sure that the authority having jurisdiction will approve equipment beyond these prototypes.

The manufacturers should assign responsibility to someone to track feedback from the field, problems encountered, etc., to head off issues further down the road.

Mr. Alan Mace (AM), Idatech: A manufacturer can't always afford to get products listed when you know the products will be changing soon, because the effort will be wasted (e.g., testing and listing can be expensive propositions that are not necessarily cost effective on a technology that changes rapidly in the early stages of development). So you need to work with the local code officials or else we're hampering the industry. We've actually gotten a "bye" on many of our installations; that is, they don't require strict adherence to all kinds of standards for installations that are specifically considered temporary. The code officials are more concerned with the fuel rather than the black box. Fire marshals are really the primary disciplines that take a look at our installations. A Eugene, Oregon fire marshal required an additional $30,000 in safety related devices and siting considerations for the installation of a methanol tank associated with the fuel cell. There's also a lot of disparities between urban and rural code officials and what is the best means to reach them (many don't even have computers).

CF: Residential fuel cell sizing – the PATH project – Partnership for Advancing Technology in Housing - is assisting with a fuel cell installation and much of that work might be of interest to the people here. It's designed to provide information to the construction industry as to the kinds of hoops they'll have to jump through in order to install these.

Would a builder and a homeowner be content to consider the fuel cell a black box, not knowing what was inside, similar to the code officials? Maybe we should use the same method as was recently done with the code officials to solicit their opinions.

GT: Frequently there are concessions to the manufacturer – if you can prove you've met the "spirit and intent" of the overriding code, inspectors will often approve the installation. Also, nationally recognized listing agency approval is what we look for. We're book/tech kinds of people and like to have documentation. Establish "level of equivalency" where the code does not yet exist.

Use community opinion to overcome some of the barriers. If there's concern on the part of the public, the inspector might look at things a little differently.

Question: *Can something be done regarding the qualifications of the installers? Codes don't mention this.*

CF: Who is the installer? A plumber, electrician, other? There has to be enough availability of that talent so as not to be a restriction.

TB: As far as interconnection requirements, we require signoff by a licensed electrician and approval according to manufacturer's instructions.

GT: We'd like to get this incorporated into the code (installer certification).

Comment: *We're fearful that the code will drive the construction standard.*

GT: The code official's primary job is public health and safety; if you have demonstrated compliance with intent, they should approve it.

Comment: *Licensed and bonded installers are sort of the responsibility of the manufacturer. It shouldn't be a code issue.*

AM: The European directive system is effective (the "CE mark"). It defines safety and allows the manufacturer a lot of leeway in meeting requirements, e.g., low-voltage, emc.

TS: These are tricky to get a handle on what you want to do, however. What tests, how long, how much? Also, some countries might have standards on top of these – additional requirements. There are some political differences between EU countries. With the U.S. system, it's more prescriptive but more clear cut.

AM: We think the issue of CE marking is coming to the U.S., driven by requirements to meet the European market.

Question: *What do each of you see as the biggest obstacle to fuel cell deployment?*

HJ: Marketing people deciding what they want to build and then getting it certified.

GT: Not really any barriers, as long as you install correctly.

TS: Don't think there are obstacles from the Test Lab perspectives for stationary units. It's more the issue of cost; perhaps incorporating the true cost of fuels into all technologies will make fuel cells more competitive.

TB: I don't think there are any drop-dead barriers.

CF: 1) The winner is going to be the company who makes the process as transparent as possible; 2) builders will build what buyers will buy, there needs to be a market.

AM: Time – trying to refine the technology to meet all the requirements on it.

Question: To list a new product, what's the cycle time?

TS: 1-6 months, depending on the manufacturer's schedule and whether the product passes all of the tests. You could break the system up into parts and have them certified separately. Also, talk to component manufacturers and ensure that the components they supply to the fuel cell have been certified; if you're using other parts that aren't certified, this will delay your certification.

Question: How pressing is the need for annual test ratings and labeling for consumers (e.g., such as done by NIST for heat pumps)? Should we consider an ASHRAE standard for seasonal ratings?

Portable Applications

TS: Portable units would not be certified under Z21.83, but CSA is currently writing a standard and hopes to have it ready this year (by September, it's in draft form right now).

Comment: Transport of the fuel supply and storage of the fuel supply once it reaches its destination needs to be addressed with DOT and whoever else.

GT: ICC developed a definition of portable. But taking a portable unit and affixing it to a fixed fuel supply (e.g., a natural gas pipe), does this change its status as portable? It's currently a gray area. Mainly it is an issue for ventilation.

HJ: Household use may trigger Consumer Product Safety Commission issues, at least to monitor how they're being used. Fire code is probably the only code that will affect portables.

Question: The definition seems restrictive, are you planning to modify the definition to include vehicles plugging into the grid?

GT: No, we're really looking at appliances; vehicular application is completely different.

HJ: There are indoor use issues that will be associated with units intended for indoor use.

Transportation Applications

Mr. Tony Androsky (TA), Society for Automotive Engineers: The Society for Automotive Engineers (SAE) covers much more than automotive applications and actually writes more standards for aerospace applications than for automotive. SAE also covers locomotive, heavy trucks, forklifts, and others.

Vehicles are an international product and there is a need to ensure that all of the components and systems work together, no matter where they come from. We're initially looking at bus use safety and performance standards and need to address these right away. Another large potential application is in airport vehicles; currently the Dallas/Ft. Worth Airport cannot provide the amount of energy needed to charge these vehicles for the level of service being demanded of them.

The core of our engineering community is currently focused on internal combustion engine technology; we need to change that somehow. The bottom line here will be the cost/kW compared to what the internal combustion engine can do.

Refueling infrastructures are going to be a major issue. Right now, the more proactive automobile manufacturers are considering the option of converting their dealerships into refueling stations for hydrogen vehicles, just to ensure there is somewhere to refuel these vehicles.

There are a number of post-crash safety issues that need to be addressed so that volunteer fire forces, emergency medical technicians and others know how to tell what vehicle has what inside of it and how to deal with it. These people aren't always professional emergency responders and may be confronted with very complex fuel systems. SAE is in collaboration with IAC and ISO, and with groups like the NHA to deal with these issues.

There's going to have to be a lot of cutting edge information going to the design engineers, inspectors and service technicians; somehow they're going to have to be certified on these vehicles. If they don't buy in to the new systems, there will be a lot of broken stuff out there.

Question: What are the issues the insurance industry brings up?

TA: Don't really know but we have been approached by the Transatlantic Consortium about refueling of buses.

Question: Is infrastructure or fuel reformation capability driving the fuel choice currently being researched by the manufacturers?

TA: Both of these are drivers. Direct methanol fuel is being considered by some manufacturers. Energy distribution network has been brought up a lot. The California Air Quality Control board is considering CNG, putting in fuel supply.

Question: How about hybrid systems – Solid Oxide with microturbine? NFPA 37 standard covers turbines, but there isn't a microturbine standard (according to Mr. Conover). NFPA 37 was written for gas turbines of a much larger capacity but currently they could be considered within the scope of that standard.

Question: What about parking garages?

TA: Underground garages, aboveground, everything needs to be looked at. Resulting codes are probably going to be specific to every fuel type. It is hard to retrofit residential garages to add more ventilation and existing ventilation systems, and construction of public garages may not be satisfactory to accommodate potential hydrogen events.

Question: What about driving a fuel cell vehicle into a tunnel?

TA: That's a DOT issue.

Question: Are there going to be emissions inspection stations similar to what we have for current vehicles?

TA: Presumably there will be some sort of safety inspection.

Other infrastructure issues:

- Hydrogen production
- Service stations

Hydrogen generators – regulations are drafted, not published.

2. DAY TWO IDENTIFICATION OF ACTIONS

Much of the discussion during the first day was captured on flip charts, and where needs for cooperative action could be discerned, were identified as such. These newly articulated needs were next added to a table of needs previously assembled by Mr. Conover in preparation for the Summit (the resulting table is included in Appendix 3.B.)

Summit attendees broke into four working groups the entire morning of the second day to identify actions that could be undertaken to address as many of these needs for which ideas could be generated. The different working groups were defined by topical area, including Stationary/Residential, Stationary/Commercial, Portable, and Mobile applications. Following lunch, a spokesperson for each group presented the resulting set of actions identified during the morning.

Following is a summary table of the actions identified by each group, along with the parties responsible for participating in each action where they were identified. Full presentations and notes from the breakout sessions are included in Appendix 3.E.

Actions Table from Fuel Cells Summit V, May 31, 2001

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
Stationary/ Residential	No known standards exist for hydrogen piping. What type of material should be used for piping hydrogen at the pressures that are required by the fuel cell?	Check with Dave Conover to see if there is any applicable code or standard in place. If not, pursue development of one.	Not identified
	Piping connections need to be designed such that they would meet existing standards	Manufacturers should consider aiding the permitting process for an inspector in the field	NA
	Education agenda items are being developed for code officials, should we also be compiling points similar to the one above to be shared with manufacturers?	The list of issues identified at the Summit could be forwarded to the different manufacturers for feedback on some of the concerns and solicit additional comments/concerns from them.	Not identified
	Manufacturers will be installing initial units, but what will happen years down the road when thousands units are being sold/resold on the market? Will there be licensed installers, or will many be installed by relatively unskilled labor?	Should there be a federally mandated program to require that installers be certified by a state or federal agency? How much of this responsibility should we place on the manufacturers?	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Will there be certified mechanics to work on these units in the field? Who will be responsible for the maintenance and upkeep of the unit? The homeowner? Will new home owners know what to do with an existing unit? What if the technology doesn't pan out? What steps will be taken to appropriately dispose of/recycle the unit, components, fuel?	Need to maintain contact with manufacturers to ensure that they properly consider and address the long term issues	Not identified
	Education issues exist on many levels, and not just with code officials. A lot needs to be done with the general public creating awareness and a general understanding of the technology. Increasing public awareness will aid market penetration of the new technology.	Anne-Marie Borbely has already begun an education campaign for code officials about fuel cells and other DER technologies. Manufacturers can help with input and in generating materials for this ongoing activity.	Anne-Marie Borbely
Stationary – Commercial	*What is the impact of the fuel cell on the construction process? Specialty contractors?*	Modifications to rooftop cranes to allow for extra weight of FC units relative to current RTUs. The incremental cost of these changes at the time of construction would be minimal. Flue/ventilation requirements could be quite different for fuel cells.	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	During the product development cycle the prototype may not be listable since the product is in flux – need opportunities to install prototypes without being listed	The semiconductor industry has experience with hydrogen-consuming equipment and their use in buildings. This equipment typically has a short life cycle.	Valerie Harris (City Public Service, San Antonio TX) will provide further information concerning other industries methods for managing this issue.
	There is a need for a consistent listing requirement between North America, EU, and Asia.	Track the progress of IEC TC 105 that is trying to address this issue. ANSI Z21.83 is being considered for safety requirements and NFPA 853 is being considered for installation requirements. USFCC has a C&S working group and disseminates information concerning the progress of C&S. Information is available to members on the USFCC website (http://www.usfcc.com/).	Andy Skok U.S. Fuel Cells Council
	Presentations and videos for code officials on the technology and how to inspect and approve installations	Need outreach not only to code officials and customers but also utility commissions, environmental commissions, legislators, customers, schools. Communication methods can also include training seminars, workshops, training CDs, test site visits and demos, newsletters.	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Attend and present at meetings of model code organizations (ICC, IAEI, BOCA, SBCCI, ICBO, NFPA)	Get contact information for each of the organizations.	Terrence Moore, DEM, Fairfax, VA. Conover is writing an article for IAEI magazine and one has been written in the NFPA Journal on fuel cells. Conover will also present information on fuel cells at educational sessions he is giving in 2001 at BOCA/ICBO and SBCCI annual meetings.
	Develop standards for verifying or testing as-installed performance, which may be required for interconnection to the utility. The requirements for verifying as-installed performance can vary depending on the capacity of the unit, interconnection voltage, line PQ etc. Having some sort of as-installed test standard that recognizes these needs could avoid unnecessary testing or simplify testing of as-installed equipment	Expand the scope of the item to include items beyond interconnection. Many of the issues are addressed by existing standards. Develop a recommended practice for commissioning associated with or included in ASME PTC50 or NFPA 853.	TBD
	Standard operational data communication protocol across technologies, manufacturers, countries.	No specific action at this time	Honeywell
	Hybrid systems	Should be done through ANSI Z21.83 and IEC TC 105	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
		Develop/create a "political" process/forum/advocacy group to facilitate the "technical solutions" to meet power, energy, and infrastructure needs	Andy Skok will work on a proposal
Portable	Basis for designation of a fuel cell as stationary, portable, or vehicular - definition needed for battery substitutes.(remove cord and plug connection) May not be the case in scenarios.	A fuel cell generator of electricity, which is not fixed in place. A portable fuel cell appliance utilizes a cord and plug connection to a grid-isolated load and has an integral fuel supply.	Drafted at Summit by Breakout Session attendees
		Expand definition scope to include non-cord connected products i.e. laptop, flashlight	Harry Jones, JG to address with the ICC Ad Hoc Hydrogen Comm. in Golden, CO 06/04-5
		18.1 Occupancy (Code) 18.2 Container (Standard)	Beth Hock to verify
		Add "non-reversible" to definition ?	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
		What about: - Micro fuel cells - Fire Codes – Stockpiling fuel - Quick disconnect to fuel tank ? OK but not to utility fuel line	Not identified
	Indoor use (Confined Spaces) - work is being done by CSA 3.01 to address oxygen depletion, hydrogen emissions - limit power output/fuel supply of FC to intrinsic levels - toxicity - other indoor emissions issues i.e. MEOH, Propane etc.) Impact - Confined Space (Boat, house, RV's, aircraft) what standard will apply (ask T. Strothers) - Fuel storage technology (NaBH4, NH3…) - H2 Gaseous fuel Detection – Will H2 be odorized ? detection.	- Identify CSA limits - FC Council determine issues other than home/garage, commercial bldgs (Requires research) Make sure product standards insure full range of confined space issues including O2 depletion, H2 emissions, multiple appliance use.	Todd Strothers Fuel Cell Council Portable Group Not identified
	Education/Consumer Awareness - Literature, product search - USFCC Working Group (Web Site) - Educating Manufacturers - Educating Regulators - Educating Consumers	Status report at FC 6	Not identified

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Interchangeability of Components - Disposal/Recycling (Options and opportunities) - MF lifetime ownership - Product life cycle - Study hazards - Certification of replacement components (e.g., stack)	Expand the scope of the CSA to include other FC technologies	Not identified
	Testing Protocols (Standards for operating range – performance	- Verify whether ASME PTC 50 covers portable Do we need performance standards ?	ask D. Conover/B. Wichert Conover response: My understanding is that ASME PTC 50 covers all fuel cells and associated components from fuel input to electric, heat and other outputs. Ask the USFCC WG regarding portable
	Transport of fuel supply - DOT - Fuel type	Update from portable WG for FC Summit 6 (RMES report)	
	Marking and labeling (misuse of appliance) – beyond standard (CSA) requirements. Product liability. Misuse of appliance.	Review and participate in the development of CSA 3.01. Encourage CSA to action and identify gaps. Review CSA standard at FC Summit 6	
	Reversible fuel cell appliances		

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
Mobile/ Vehicular	Basis for designation of a fuel cell as stationary, portable, or vehicular	*IEC TC-105 Working Group #1 should handle this. Dave Conover will communicate with Kelvin Hecht and Steve Kazubski of the US TAG to ensure these three terms are addressed:* Stationary Fuel Cell Portable Fuel Cell Vehicular / Mobile Fuel Cell	Dave Conover, to be accomplished ASAP. Conover 6/23/01 update: E-mail on this topic sent to Kelvin and Steve; item resolution assumed to be underway.
	Safety related to hydrogen production	SAE has a Fuel Cell Standards Working Group on Safety, covering all aspects of vehicular safety for fuel cell vehicles, led by Glenn Scheffler.	SAE, Jane Hock
		On-Board Reformer design criteria is addressed by SSAE J2579 under the SAE Working Group. Jane Hock will convey this concern to the SAE Fuel Cell Standards Working Group at the next meeting on June 12.	SAE, Jane Hock

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
		Vehicle crash response is covered by SAE J2578 under the SAE Safety Working Group. Jane Hock will follow up.	SAE, Jane Hock
	Identification of necessary safety concerns for each type of fuel cell and how to address them	List out safety issues associated with each fuel and storage scenario and I.D. who is working on each one of them. SAE has developed a list of safety issues, available on their web site. NHA and ISO TC-197 are also working on these issues. SAE has liaison agreements with NHA and ISO TC-197. ICC is also working on some of these issues. Dave Howell will work with PNGV to explore the task to compile a list of all these safety scenarios and keep it up to date.	Dave Howell

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Ventilation needs for all parking garages *How combustible liquids and flammable gases can co-exist in the same interior spaces or be stored on the same site?*	Being researched by ICC for Fuel Cell Safety Standards Work by Dr. Swain in Florida applies to residential garages. Additional work on public/commercial garages and tunnels may be necessary. DOT and NHTSA may need to be involved. Jane Hock will convey this concern to the SAE Fuel Cell Standards Working Group at the next SAE meeting on June 12, 2001.	Jane Hock
	Standardization of data	The following proposed SAE standards address these issues: Fuel Cell System Performance Testing Fuel Processor Subsystem System Performance Testing Fuel Cell Stack Subsystem Performance Testing ASME PTC-50 also addresses fuel cell system efficiency performance. Jane Hock will bring this to the attention of SAE. Bob Wichert will bring this to the attention of ASME.	SAE, Jane Hock ASME, Bob Wichert

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Basis for the acceptability of fuel cell vehicle storage, fueling, and use within the current building infrastructure	ICC ad hoc hydrogen working group is addressing this issue.	ICC ad hoc hydrogen working group
	Need to address reforming on board or off site and issues associated with each	See hydrogen production above	
	Operational guidelines for consumers and distributors	Education/Training	SAE/Industry/OEM/Component Manufacturers
	How to address hydrogen safety	Covered previously	
	Servicing and maintenance protocols are being explored by SAE in cooperation with the Service Technicians Society (STS)	Covered by SAE	Covered by SAE
	Need to integrate fuel cell technology into airline support applications	Covered by SAE	SAE, Jane Hock
	Need to integrate fuel cell technology into portable power applications.	Fuel Cell Manufacturers should work with various temporary power markets	Manufacturers
	Need to identify regulatory barriers to fuel cell utilization	Fuel Cell Manufacturers should work on this issue.	Manufacturers
	Need to compete against gearhead mentality regarding IC engine competition	Fuel Cell Manufacturers should educate appropriate audiences.	Manufacturers
	Need energy efficiency message to drive application of fuel cells	Develop education package	DOE, Fuel Cell Manufacturers, NGOs, Associations, EPA
	EMTs need help dealing with increased issues associated with use of fuel cells and related fuels	Covered by SAE action item above	SAE

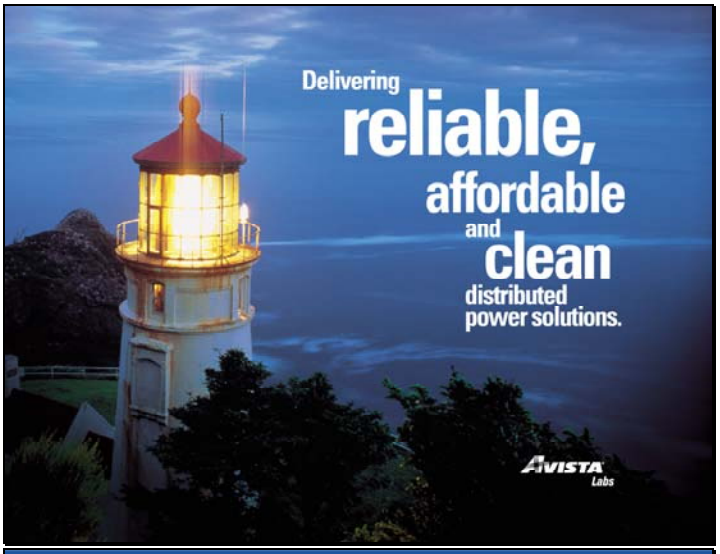
Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Service technicians need to be educated, in place and certified	Add qualified service technicians to operational guidelines above	Manufacturers, SAE, Jane Hock
	Aircraft in process inspectors need to be trained in fuel cell technology	Add qualified service technicians to operational guidelines above	Manufacturers, SAE
	Auto Inspectors / mobile platform inspectors	Add qualified service technicians to operational guidelines above	Manufacturers, SAE
	What do commercial insurance carriers need?	Being accomplished by SAE in cooperation with insurance liability industry	SAE Working Group, Jane Hock
	SAE has started a dialogue with the Performance Review Institute (PRI) for potential mobile unit certification	No action required	
	Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility facility-need to review use group iss	ICC is studying this issue ASAP	ICC ad hoc hydrogen working group
	SAE has relationship with transit standards consortium for standards for bus applications	Continue relationship	SAE, Transit Standards Forum
	Federal transit authority – bus standards on safety, but also performance	Continue this work	FTA
	Refueling stations may be a big issue (OEMS considering getting involved in distribution of fuel)	Inform ICC of the possibility of dealerships becoming fueling stations for hydrogen or otherwise	ICC, Guy Tomberlin
	SAE is doing a lot in codes and standards	Continue this effort	SAE

Application	Issue Description	Suggested Actions to Address	Responsible Party(ies)
	Need hydrogen infrastructure	This is a market issue. DOE OPT (Carol Hammel) is assessing what needs to be done and developing a plan for what the infrastructure should be.	DOE (Carol Hammel), manufacturers, etc
	Need to address parking garages?	See ICC item above	
	What about tunnels? (DOT and NITSA need to address this)	See ICC item above	
	Will state vehicle inspectors need to inspect fuel cell related components?	See educational item above	
	What about passive ventilation of enclosed spaces for hydrogen safety?	See ICC item above	
	NFPA Building Codes	Review NFPA Building, Mechanical, Electrical, Plumbing, and other new NFPA building codes to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.	Manufacturers
	National Building Code of Canada, Administered by the National Research Council of Canada	Review National Building Code of Canada to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.	Manufacturers
	Utility Company or Federal refueling stations may not be required to follow building codes	Utility companies and Federal facilities will have to review their requirements	Utility companies and Federal facilities.

3. APPENDICES

3.A. Presentations

Slide 1



Slide 2

Avista Labs

Welcome to Avista Labs!

Avista Labs

- Incorporated in 1995
- Headquartered in Spokane, Washington
- IP: 2 Patents; 230 claims
  - ✓Modular PEM fuel cell
  - ✓Control electronics
- Design, Develop and Market
  - ✓Fuel cell systems
  - ✓Related components
- Moved into new building in 2000
  - 22,800 square feet
  - ✓Office Space
  - ✓Test Facilities
  - ✓Machine Shop
  - ✓R&D Labs

Slide 3

Avista Labs

Electricity & Fuel

Production, Sale, Delivery & Use

At Avista Labs, electricity is more than a commodity business

Specialization

On site electricity solutions bring availability, reliability and quality cleanly and affordably to the point of use

Value Proposition

Point of use specific
Custom solutions using standard components

On-Site Electricity

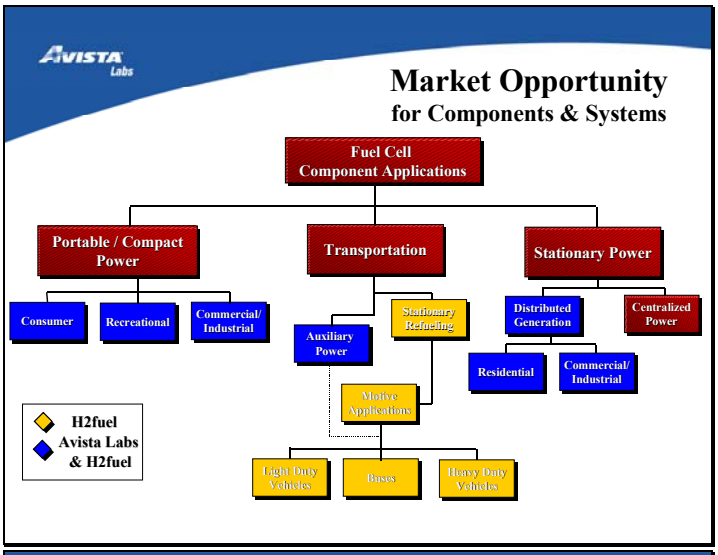
Generation
Storage
Distribution
↓
Quality

99.999% Reliable
5.3 minutes off-line per year

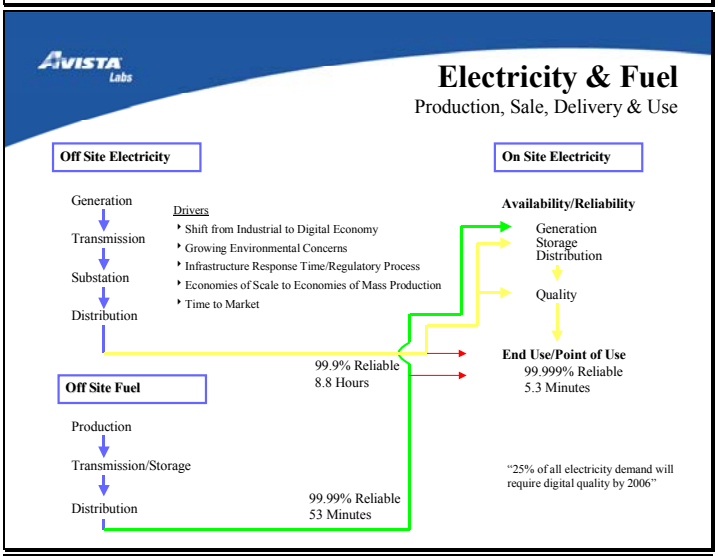
End User

"25% of all electricity demand will require digital quality by 2006"

Slide 4



Slide 5



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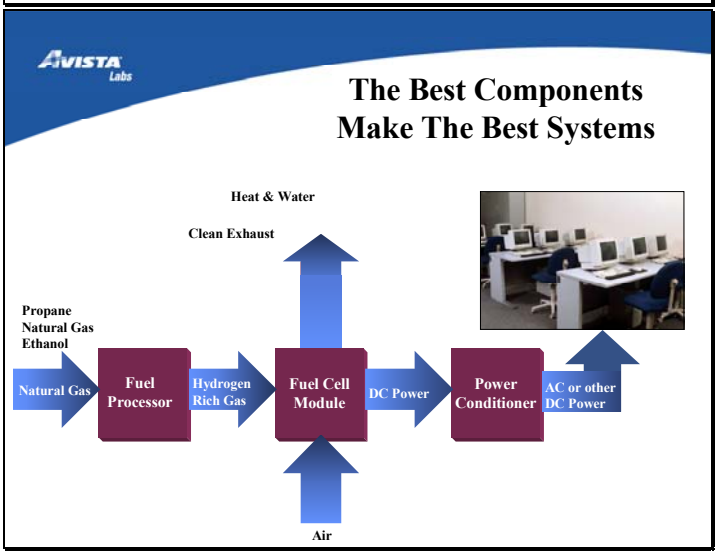
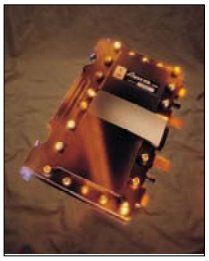


Slide 7

Simple, Hot-Swappable Cartridges

Slide 8

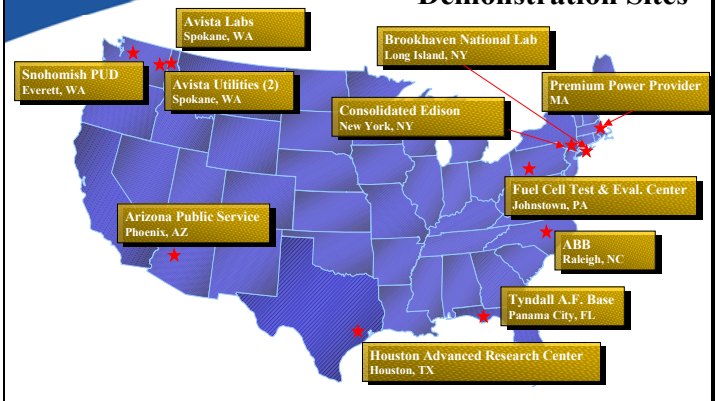
Our Cartridge



- Superior Reliability!!
- Patented modular architecture
  - Simple, Air Cooled Boxes
  - Hot-swappable cartridges
    - ✓ Failed membranes are bypassed
    - ✓ The Load is not interrupted
- Self-hydrating membrane
  - Less balance of plant is required
  - Performance is optimized at the cartridge level
- In the event of a membrane failure:
  - Immediate action is not required
  - A cartridge can be changed out in less than one minute

Slide 9

Demonstration Sites



Slide 10

AVISTA Labs

COMMERCIAL PRODUCTS

SR-72: 3kW FUEL CELL

SR-12: .5kW FUEL CELL

HYDROGEN SENSOR

Fuel Cells: A Status Report

Robert Rose
U.S. Fuel Cell Council
May 30, 2001

Executive Members

- 3M
- American Methanol Institute
- Avista Labs
- Ballard Generation Systems
- Chicago Transit Authority
- Conoco
- Conti Enterprises
- DaimlerChrysler
- Dana Commercial Credit
- Delphi Automotive Systems
- Donaldson Company
- DuPont Flouroproducts
- Energy Conversion Devices
- Energy Partners
- Engelhard Corporation
- Ford Motor Company
- Freudenberg-NOK
- FuelCell Energy
- GE Micro Generation
- Graftech
- H-Power
- Hydrogenics Corporation
- IMPCO Technologies
- International Fuel Cells

USFCC Mission

- Fosters commercialization of fuel cells in the United States.
- Open to anyone with a commercial interest in fuel cells in the U.S., including manufacturers, suppliers, and end users.

Executive Members cont.

- Johnson Matthey
- McDermott Technology
- Methanex Corporation
- Motorola Labs
- Nissan Technical Center
- Nuvera Fuel Cells
- Plug Power
- Poco Graphite
- Porvair Fuel Cells
- Proton Energy Systems
- QuestAir Technologies
- Renewable Fuels Association
- SGL Carbon Corp.
- Siemens Westinghouse
- Stuart Energy
- Sud-Chemie
- Syntroleum Corporation
- Texaco Energy Systems
- W.L. Gore
- World Fuel Cell Council
- ZeTek Power Corporation

Fuel Cell Family

PEM

Solid Oxide

Phosphoric Acid

Molten Carbonate

Other

Alkaline

Direct Methanol

Regenerative

Associate Members

- Abacus Controls
- Advanced Elastomer Systems
- Advanced Refractory Tech.
- Agile Systems
- Asbury Graphite Mills
- ATOFINA Chemicals
- California Air Resources Board
- Ceramic Fuel Cells
- CSA International
- Dais-Analytic Corporation
- Degussa Metals Catalysts
- Dow Corning
- Enable Fuel Cell Corp.
- Exergy Inc.
- Fuel Cell Technologies
- GAST Manufacturing
- Global Thermoelectric
- Heliocentris
- Houston Advanced Research Center
- Hydrogen Burner Technology
- IdaTech
- Independent Electrical Contractors
- National Fuel Cell Research Center
- NexTech Materials
- Reliant Energy
- SOCA
- South Coast Air Quality Management District
- Sure Power Corporation
- Thomas Industries
- US Army CERL
- Woodward Industrial Controls

Fuel cell product lifecycle

Source: Citibank

Fuel cells are in the early stages of a typical product life cycle.

Industry estimates fuel cell growth to market saturation over a 30-50 year cycle from product introduction.

The pace of change set by the technology industry indicates that this could occur sooner.

Recent Highlights

- 2003 commercialization for many?
- Purchase Orders
  - Bus "Orders" Near 100
  - H-Power, FC Energy, IFC
  - Small new "buy down" program
  - Honda buys Ballard engines
  - Ze-TeK reports strong stack orders, commits to 3 manufacturing plants
- Ballard/Coleman Target Late 2001

Recent Highlights

- Increases Announced in Manufacturing Capacity
- Major Suppliers Preparing for Commercialization (e.g. DuPont, 3-M, Celanese)
- Substantial Hydrogen Activity

Recent Highlights

- Bush Administration Support
- Congressional Support
  - Purchase/Installation Tax Credits
- State Interest (NY, CA, MA, OH, etc.)
- Significant C&S Activity

Recent Highlights

- CA Fuel Cell Partnership Grows
- GM Endurance Testing
- Internationalization Continues
  - GM/Toyota, IFC-Hyundai
  - Nuvera
  - Many JV's, Marketing Arrangements
  - New Demonstrations in France, Scandinavia, Japan, Germany, Latin America

Fuel Cell Investment

- Government R&D Funding (Per Year)
  -  $200M+
  -  $41M
  -  $80M
  -  $30M
- Significant Private Investment (Over $2B)

Markets and Applications

Stationary / Distributed Power	Backup Power Remote Power Premium Power Residential / Commercial Power
Transportation: Heavy / Light Duty Vehicles	Buses / Trucks Locomotives / Ships Passenger Vehicles
Portable / Battery Replacement	Consumer Electronics: Note / Subnotebooks, Cellular Phones, Camcorders, etc. Small Motors: Boating, Lawn Mower, Tools, etc.

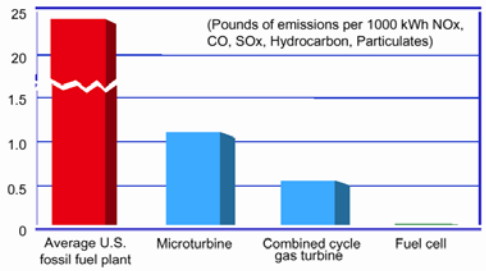
Fuel

Fuel Cell Market Drivers

- Reliable, Efficient, Clean Energy
- Move to Distributed Generation
- E-Commerce Economy
- High-Value Energy

Fuel Cell Summit 2001
Adelphi, MD
14

FUEL CELL EMISSIONS

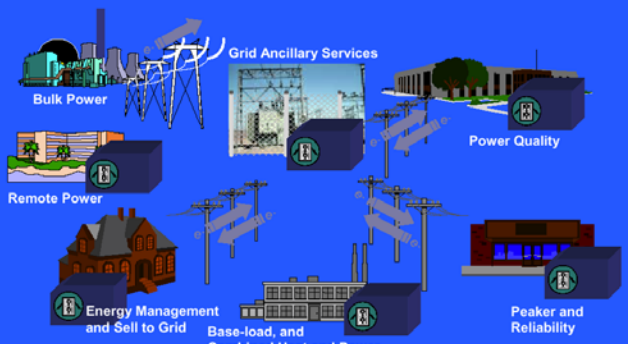


Fuel Cell Summit 2001
Adelphi, MD
15

High Efficiency

- Energy Efficiencies of 40-50% or Greater
- - Energy Security
- - Energy Savings
- - Greenhouse Gas Emission Reductions

Move to Distributed Generation



Source: NREL

High-Value Energy

- Poor Power Quality Costs U.S. Economy $150 Million to $450 Million Each Year
- Computer Servers Operate Reliably 99.999% of the Time
- Electric Utility Grid is 99.9% Reliable

High-Value Energy

- "The most expensive kilowatt is the one that is not available."

E-Commerce Economy

- Fuel Cells are Reliable to Six "Nines" or 99.9999% of the Time
- 1,000,000,000 watts of standby power generation sold every year.
- Fuel Cells are not subject to distribution pole failures.

Transportation Fuel Cell Applications

Automotive Fuel Cells

DCX Investing $940M in fuel cell development by 2004.

"Fuel cells will finally end the 100-year reign of the internal combustion engine."

Ford Chairman William Ford Jr.

HONDA "Fuel cell vehicles will probably overtake gasoline-powered cars in the next 20-30 years"

Honda R&D Director Takeo Fukui

Recent Developments

- GM/Toyota Join California F.C. Partnership
- Bus "Orders" Approach 100
- Roll-Outs of Test Vehicles Continue
- Bush DOE Supports Federal R&D Program
- SAE Activity Accelerates

Vehicle Demonstrations

- California Fuel Cell Partnership
  - Over 70 cars and buses by 2003.
- Clean Urban Transport for Europe (CUTE)
  - 30 buses in 8 countries by 2003.
- Fuel Cell 'Joint Project' (Japan)
  - Field testing several vehicles.
- World Bank / GEF Project
  - 30 buses in Brazil, Egypt, India, China & Mexico.

Fuel Cell Vehicles


Ford Focus


Volkswagen HyMotion


Honda FCX-V3


DCX Necar 5


GM HydroGen I


Mazda FC-EV

25

Fuel Cell SUVs


Nissan Xterra


Toyota FCHV-3


Jeep Commander II


Hyundai Santa Fe

Adelphi, MD 26

Fuel Cell Buses


MAN


DCX


Neoplan


Ballard

Auxiliary Power Units

IFC 5 kW APU

BMW 7-Series

Specialty Vehicles

Fuel Cell Mining Locomotive

Issues

- Fuel Choice
- Cost
- Heat rejection
- Performance issues
  - Startup Time
  - Range

Stationary Power Applications

Recent Developments

- Residential units are in the field
- Strong interest (demand?)
- Market is desperate for fuel cell attributes
  - High-tech growth needs high quality/high reliability power
- California story is increasing interest

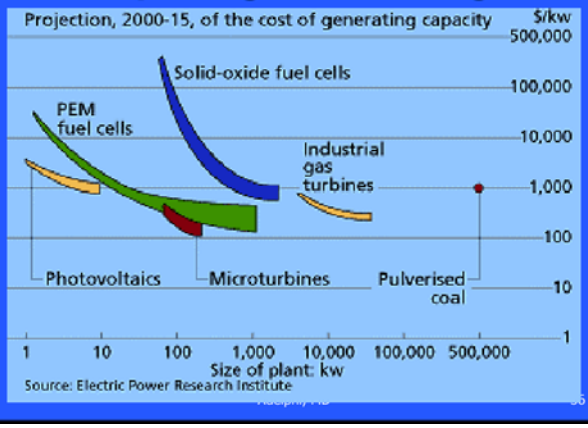
Current Fuel Cell Applications

- Remote Power
- Specialty Power
- Reliability Power
- Cogeneration
- Landfill / Waste Treatment Gas
- Portable Unit

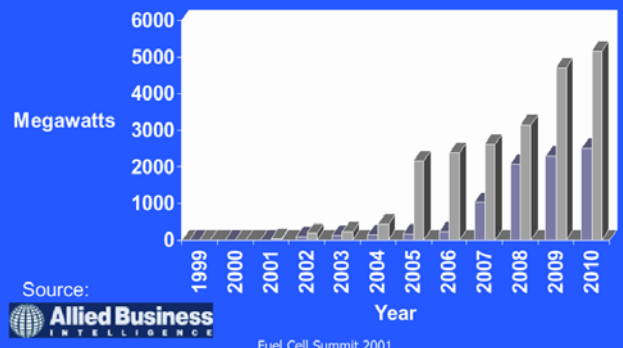
Commercial Fuel Cells

- The cost for commercial fuel cell systems is between $3,000 and $4,500 per kilowatt.
- Costs are expected to come down to $800 - $1,200 per kilowatt.
- For some customers, like the Omaha Bank, they are more concerned with reliability than per kilowatt costs.

Competing Technologies



Stationary Fuel Cell Penetration



Source: Allied Business Intelligence

Fuel Cell Summit 2001
Adelphi, MD
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FuelCell Energy Products

- High efficiency fuel cell power plants for stationary power generation in 300 kW, 1.5 MW and 3 MW

Premium Markets

4 Times Square, New York

US Post Office, Anchorage

Adelphi, MD
39

Premium Markets

Central Park Police Station, New York

1st National Bank, Omaha

Issues

- Cost
- Availability
- Competition

Residential Power Applications

Residential Fuel Cells

- Residential units with capacities of 3 kW to 10 kW are now being demonstrated.
- These units will be fueled by natural gas, propane or methanol.
- The fuel cell power unit can be used for primary and/or backup power.

Nuvera Test Platforms

1 kW Hydrogen	1 kW Propane
A simple demonstrator for super premium applications	Test bed for industrial vehicles and premium power

5 kW NG/Propane
Evaluation test bed for residential & premium applications

H-Power -- ECO

- H Power has received an $81 million contract with Energy Co-Opportunity, a consortium of rural electric cooperatives
- Marketing fuel cells exclusively through 300 cooperatives.
- ECO buying 12,300 of H Power's 10-kilowatt fuel cells for $10,000 each.
- Installation to start in the second half of this year.

Residential Systems

IdaTech

IFC

Plug Power

Avista Labs

Portable Power Applications

Recent Developments

- Ballard/Coleman may launch 1kw generator
- USFCC examining DOT fuel regulations
- Direct Methanol looking for niche
- DoD/DARPA wants miniaturized diesel reformer

Portable Power

49

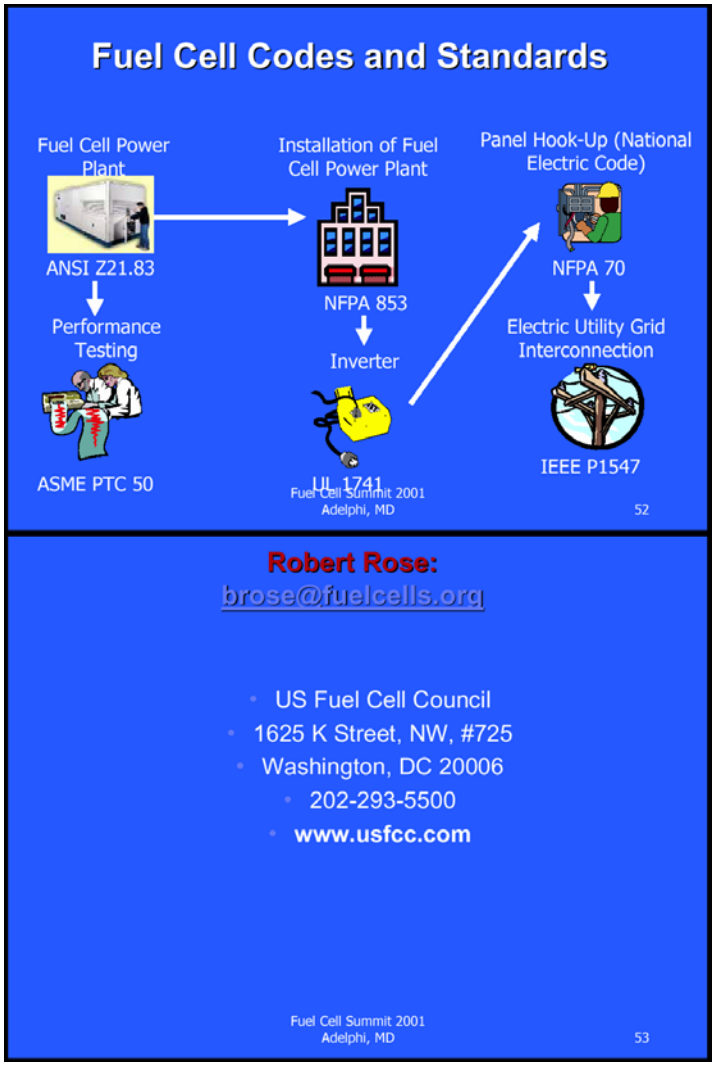
Portable Power

Honda

Ball Aerospace

Federal Funding Highlights FY 2001

Defense/Natl. Security	35.1
Hydrogen Program	30
Underground Mine vehicle	2
Transportation FCs	41.5
Stationary FCs	52.7
Fuel Cells in buildings	5.5
Transportation	11


Fuel Cell Codes and Standards
Fuel Cell Power Plant
ANSI Z21.83
Performance Testing
ASME PTC 50
Installation of Fuel Cell Power Plant
NFPA 853
Inverter
UL 1741
Panel Hook-Up (National Electric Code)
NFPA 70
Electric Utility Grid Interconnection
IEEE P1547
Fuel Cell Summit 2001
Adelphi, MD
52
Robert Rose:
brose@fuelcells.org
US Fuel Cell Council
1625 K Street, NW, #725
Washington, DC 20006
202-293-5500
www.usfcc.com
Fuel Cell Summit 2001
Adelphi, MD
53

Slide 1

Codes, Standards and Regulations - An Update

US DOE Fuel Cells Summit V

May 30, 2001

David R. Conover, CEO

National Evaluation Service, Inc.

Slide 2

Goal

A better understanding of current codes and standards initiatives that affect all fuel cell technologies, a focal point for discussion on those activities and identification of future needs in this area to facilitate fuel cell acceptance

Slide 3

Objectives

- Review the status of U.S. and international initiatives to develop new and maintain existing codes and standards
- Enhance the information presented through audience participation
- Identify holes that my need to be filled and how to fill them

Slide 4

Why Pay Attention to Codes and Standards?

Codes and Standards can support fuel cells

- reduce expenditure of manpower
- save time and money
- enhance technology marketing and deployment
- facilitate a manufacturing and servicing infrastructure
- realize multi-lateral approvals and international trade
- secure technology benefits
- protect the market from unsafe products
- allow for simpler testing and certification of products

Slide 5

The Ideal Situation

Uniformity in the acceptance and application of fuel cell design, installation, operation, and use including a supportive service infrastructure

Slide 6

Technology Differences Different Codes and Standards

- Stationary fuel cell power plants
  - The fuel cell equipment
  - Integration and interaction with the built environment
- Portable fuel cells
  - The fuel cell appliance
  - Acceptance for use in the built environment
- Vehicular applications
  - The fuel cell and on-board fuel source
  - Refueling, parking, servicing, etc. infrastructure

Slide 7

Specific Activities

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Terminology/definitions	IEC TC 105 WG 1 USFCC	IEC TC 105 WG 1 USFCC	IEC TC 105 WG 1 USFCC SAE Information report J 2574 (Draft), Fuel Cell Vehicle Terminology (to be mainlined directly to ISO TC 22/SC 21, IEC TC 69, JEVA and JAMA)
Fuel Cell safety	ANSI Z21.83 CSA U.S. Requirements No. 1.01, Residential Fuel Cell Power Generators IEC TC 105 WG 3 (liaison with IEC TC 31 on electrical apparatus for explosive atmospheres)	CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft) IEC TC 105 future WG UL (considering development of a standard)	IEC TC 105 future WG 6 (liaison with ISO TC 22 SC 21 on electric road vehicles and IEC TC 29 on electric vehicles) SAE J2578 (to be mainlined directly to ISO TC 22/SC 21, IEC TC 69, JEVA and JAMA)

Slide 8

Specific Activities

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Fuel cell module	IEC TC WG 2 CSA CAS No. 33	IEC TC 105 WG 2 CSA CAS No. 33	IEC TC 105 WG 2 SAE Fuel Cell Standards Committee (dialogue started to determine the direction it will pursue in this area related to I/E performance requirements by suppliers to the OEMs)
Fuel cell performance	ASME PTC 50 ANSI Z21.83 IEC TC 105 WG 4	ASME PTC 50 CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft)	ASME PTC 50 SAE Fuel Cell Standards Committee (3 work items to be draft documents by the end of summer, 2001)

Slide 9

Specific Activities

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Installation of a stationary fuel cell power plant	NFPA 853 Model Building Codes NES Fuel Cell Protocol IEC TC 105 WG 5		
Use of a stationary or portable fuel cell in, on or adjacent to buildings	NFPA 853 Model Building Codes	Model Building Codes	
Electrical components associated with the fuel cell	UL Standards are referenced in ANSI Z21.83 NFPA 70 NESC	NFPA 70	SAE

Slide 10

Specific Activities

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Inverters, controllers, and controllers	UL 1741	UL 1741	UL 1741
Interconnection of the fuel cell with the grid	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC
Parking, servicing, locating a non-stationary fuel cell in, on or adjacent buildings		Model Building Codes NFPA Standards	Model Building Codes NFPA Standards ICC Ad Hoc Committee for Hydrogen Gas

Slide 11

Specific Activities

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Hydrogen processing, storage and delivery		Model Building Codes NFPA Standards ISO TC 197	Model Building Codes NFPA Standards ISO 197
Service station hydrogen delivery components		ISO TC 197 NFPA Standards	ISO TC 197 SAE Fuel Cell Standards Committee Interface Working Group workshops bringing together vehicle manufacturers and connector suppliers addressing both hardware type and communication protocols. Draft document in process.
Hazardous fluids in fuel cell vehicles			SAE J2579

Slide 12

Status

ANSI American National Standards Institute

ANSI Z 21.83-1998 "Fuel Cell Power Plants"

Packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural or LP gas and having a maximum output voltage of 600 VAC and power output of 1,000 kW operating at no less than –20F (-29C)

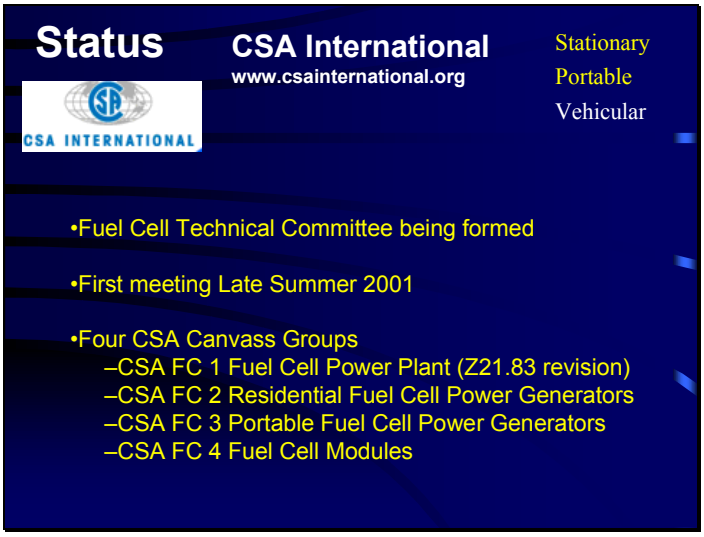
Stationary
Portable
Vehicular

- CSA Fuel Cell Working Group (WG) preparing revisions
- Working Group meetings 3/14-15 and 5/24
- Seventeen (17) Task Group assignments under the WG

- Future maintenance under CSA Canvass Group and Technical Committee on Fuel Cells (FCTC)
- Meeting of FCTC late Summer 2001
- Resultant standard to be CSA FC 1 and replace ANSI Z21.83

CSA INTERNATIONAL

Slide 13



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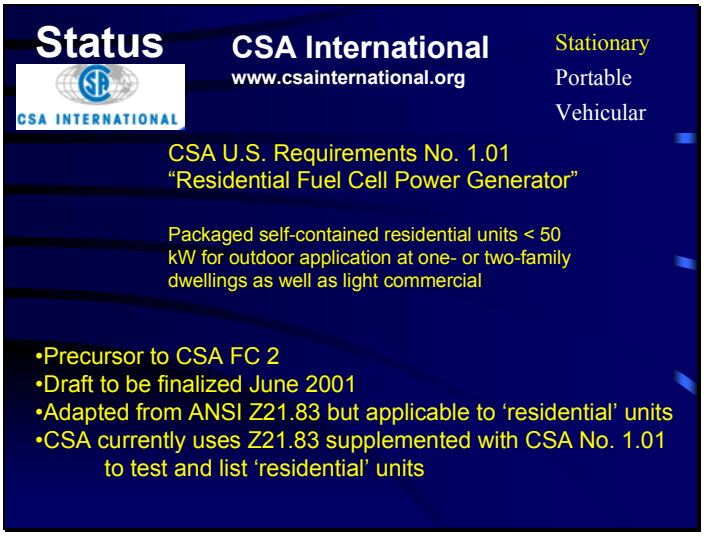

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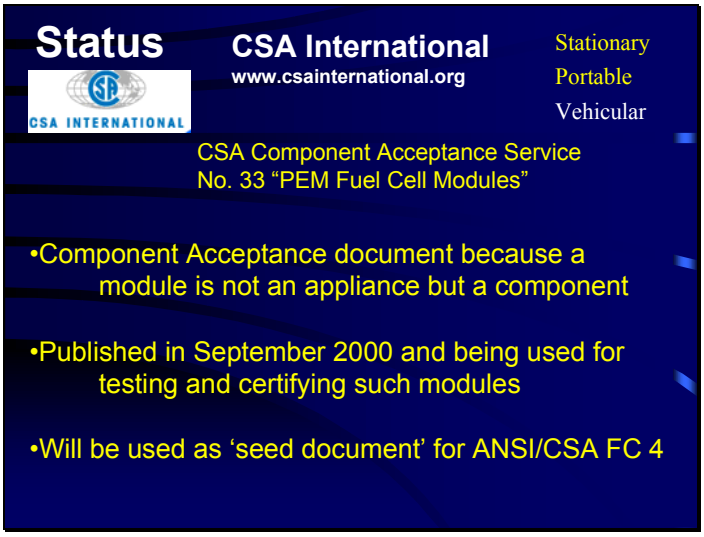

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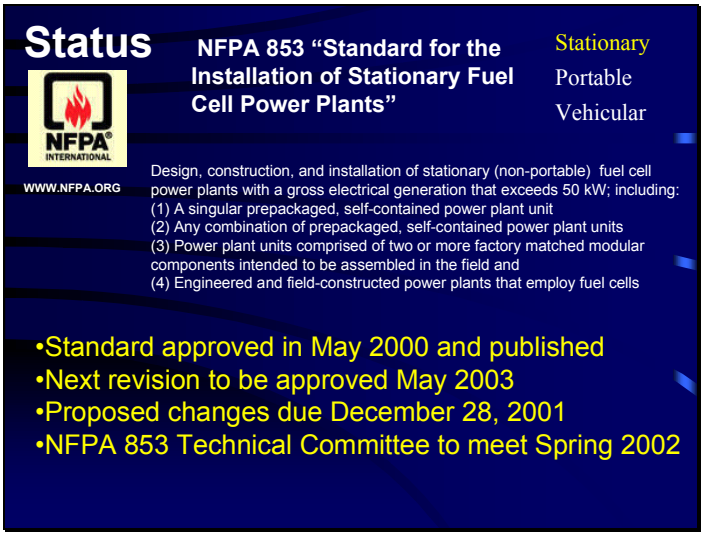

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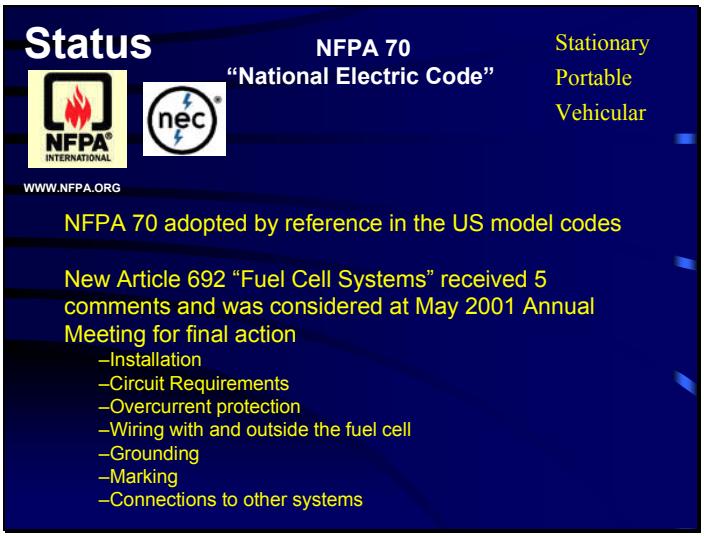

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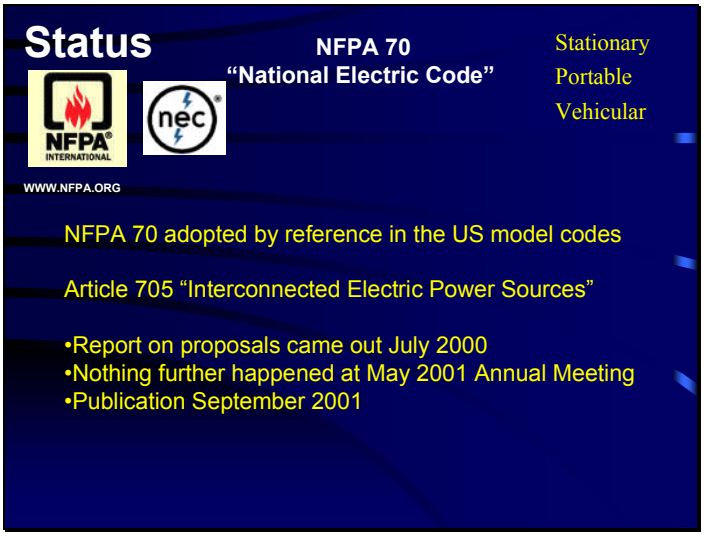

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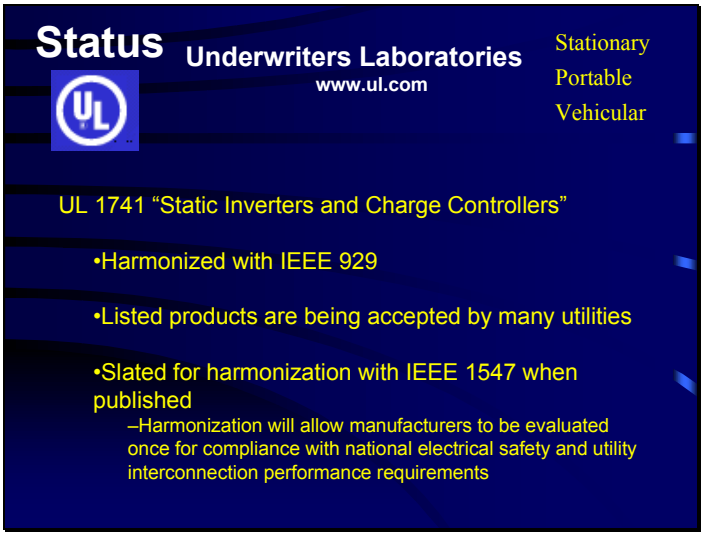

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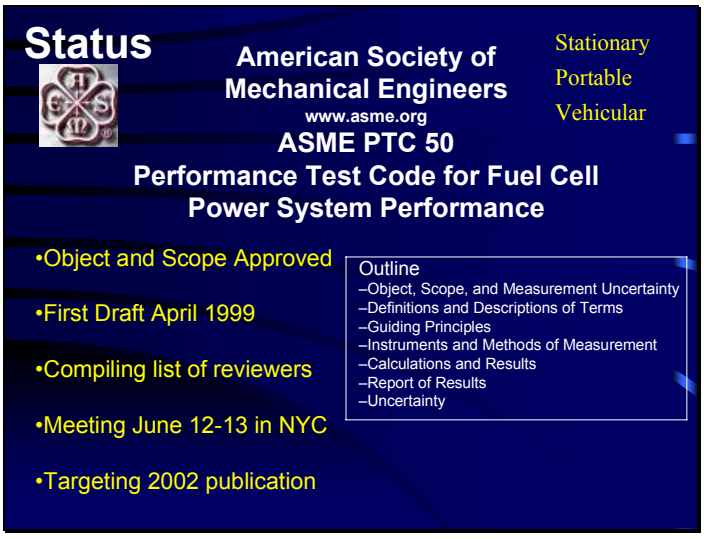


Slide 22

Status

International Code Council
www.intlcode.org

Stationary
Portable
Vehicular

2000 *International Mechanical Code*

"924.1 General. Stationary fuel cell power plants having a power output not exceeding 1,000 kW, shall be tested in accordance with ANSI Z21.83 and shall be installed in accordance with the manufacturer's installation instructions."

- Similar language approved in 2000 to the International Fuel Gas Code and proposed in 2001 to the International Residential Code
- Proposed changes to the IMC, IFGC and IRC to add definitions of stationary and portable fuel cell power plants approved March 2001 and will receive final action Fall 2001

Slide 23

Status

National Evaluation Service
www.nateval.org

Stationary
Portable
Vehicular

Evaluation Protocol for Stationary Fuel Cell Power Plants

- Undertaken on behalf of U.S. DOE (PNNL)
- Input from FC developers, manufacturers, research & testing labs, engineers, regulators, utilities, etc.
- Basis for evaluation and assessment of stationary FC PP's intended for building applications
- Advises manufacturers of testing/documentation needed for building regulatory acceptance
- Voluntary and advisory
- Published May 2001

Slide 24

Status

IEEE
www.ieee.org

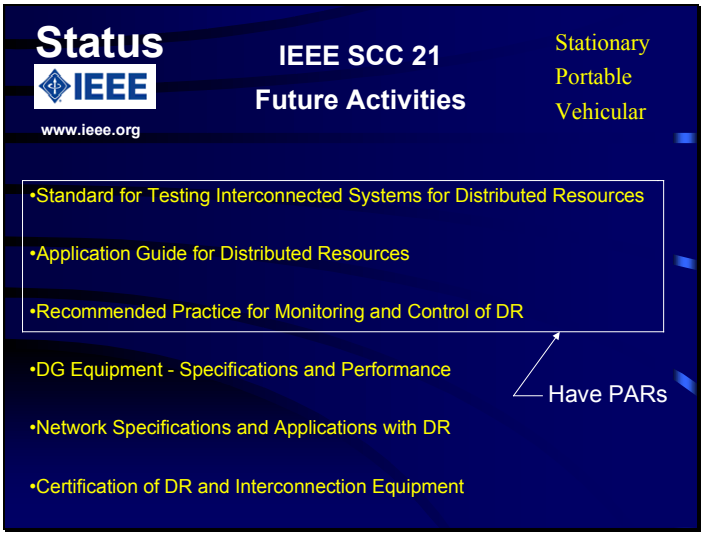
Stationary
Portable
Vehicular

P1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

To provide a uniform standard for interconnection of distributed resources with electric power systems, and requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection

- Being developed by IEEE Standards Coordinating Committee (SCC) 21
- Draft 7 balloted 3/28/01 and did not receive required 75% affirmative vote
- April 18-20 meeting addressed resolution of negative ballots
- Working group to meet June 5-8 to reword Draft 7 to address negatives
- Re-draft scheduled for circulation Summer 2001
- Standard slated for completion in 2001

Slide 25



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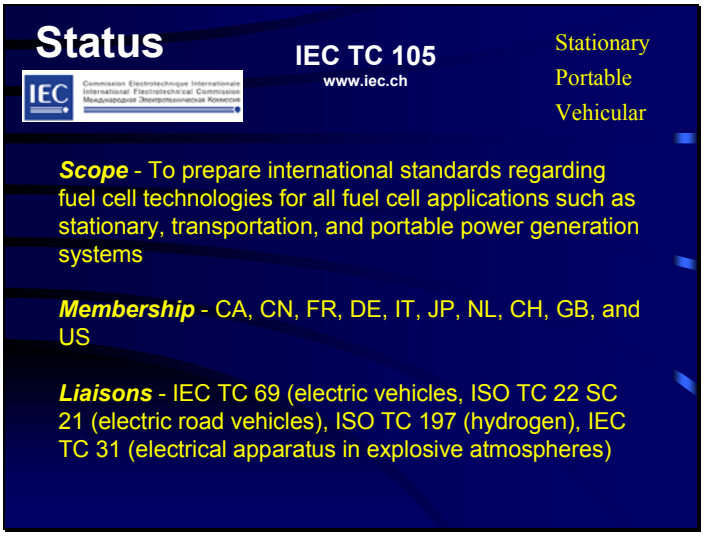

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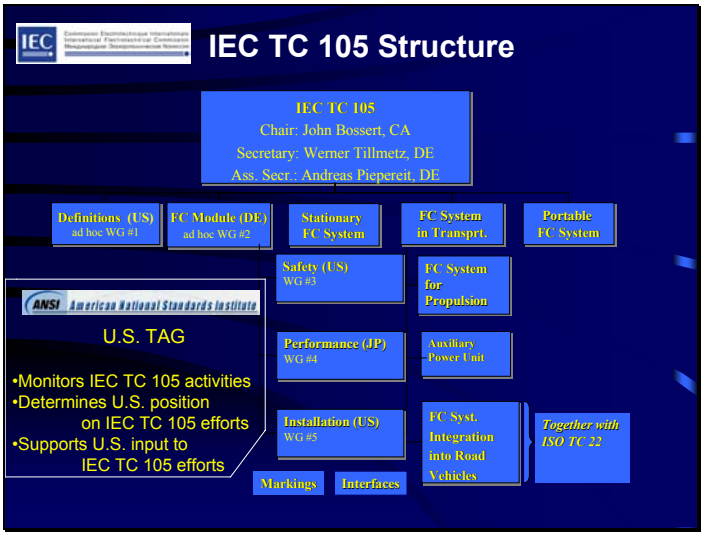

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Status

IEC TC 105
www.iec.ch

Stationary
Portable
Vehicular

- First meeting February 2000
- Second meeting scheduled September 6-7, 2001
- U.S. Technical Advisory Group, first meeting March 13, 2001
- Working Groups
  - –1 Definitions - work started using US and JP documents
  - –2 Fuel Cell Module - outline available, next meeting 9/4-5/01
  - –3 Safety for stationary fuel cell systems - using Z21.83 as a basis with next meeting 7/19-20/01
  - –4 Performance - using JP standard as basis
  - –5 Installation of stationary systems - using NFPA 853 as a basis
  - –6 Systems for propulsion - TBD

Slide 29

Status

Society of Automotive Engineers
www.sae.org

Fuel Cell Standards Committee

Stationary
Portable
Vehicular

To establish standards and test procedures for fuel cell powered vehicles covering safety, performance, reliability, and recyclability of fuel cell systems in vehicles with emphasis on efficiency and environmental impact. Also to establish test procedures for uniformity in test results and define interface requirements of the systems to the vehicle.

Slide 30

Status

Society of Automotive Engineers
www.sae.org

Fuel Cell Standards Committee

Stationary
Portable
Vehicular

Working Groups

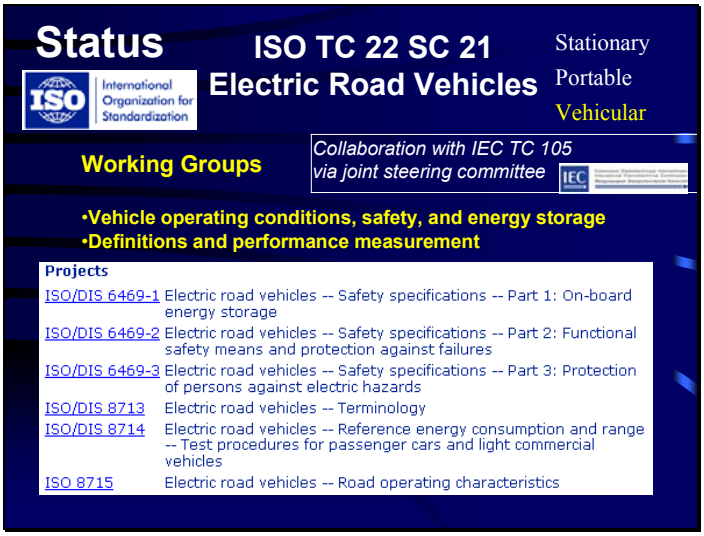
Safety - J2578 on general safety and J2579 on hazardous fluid systems under development

Terminology - J2574 jointly with JAMA and JEVA (ballot process to begin in June 2001)

Performance - drafts under development on fuel cell systems, fuel processor subsystems, and fuel cell stack systems

Slide 31

Slide 32



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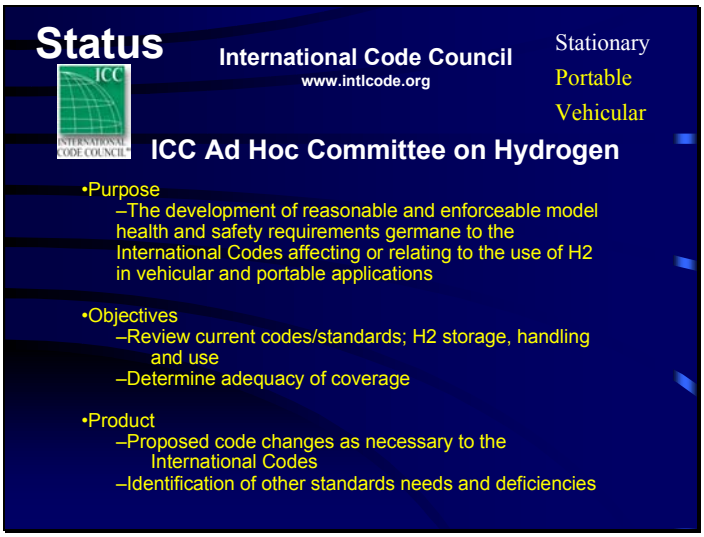

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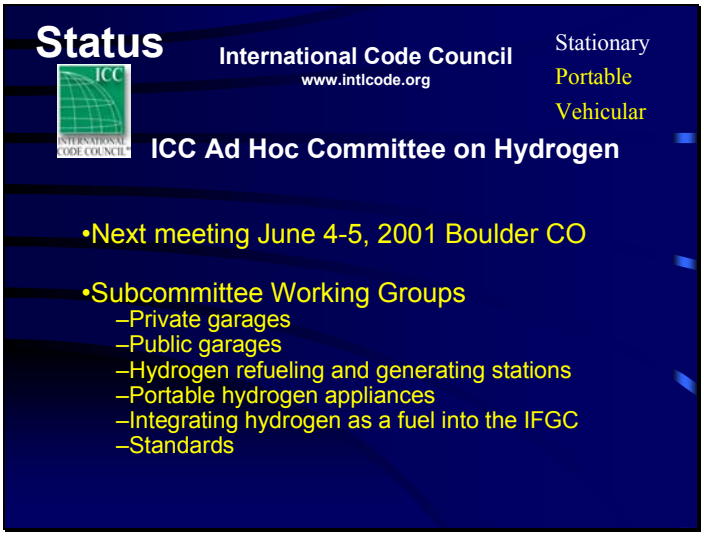

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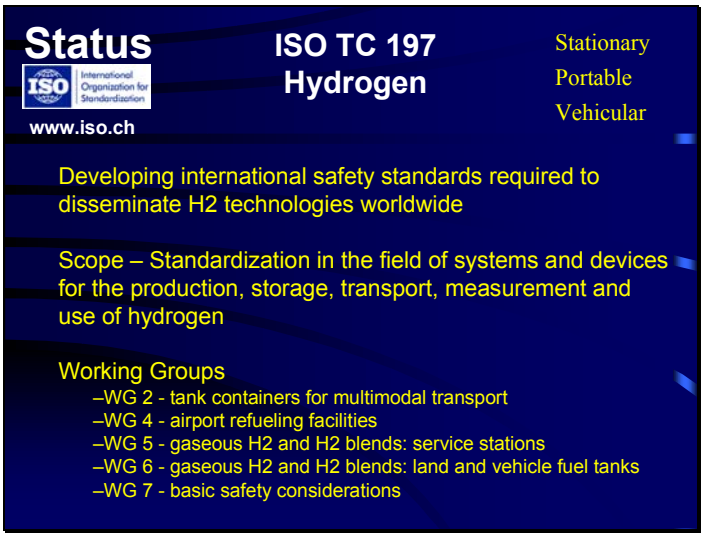
Slide 36



Slide 37

Status

ISO TC 197 Hydrogen

Stationary
Portable
Vehicular

www.iso.ch

Technical programme TC 197 print-friendly

TC 197 Hydrogen technologies

Subcommittees

Projects

ISO/DIS 13985-1	Liquid hydrogen -- Land vehicle fuel tanks -- Part 1: Design, fabrication, inspection and testing
ISO/DIS 13985-2	Liquid hydrogen -- Land vehicle fuel tanks -- Part 2: Installation and maintenance
ISO/WD TR 15594	Airport hydrogen fuelling facility
ISO/WD 15866	Gaseous hydrogen blends and hydrogen fuel -- Service stations
ISO/CD 15869	Gaseous hydrogen and hydrogen blends -- Land vehicule fuel tanks
ISO/WD 15916	Basic considerations for the safety of hydrogen systems
ISO/WD 17268	Gaseous hydrogen -- Land vehicle filling connectors

Slide 38

Status

ISO TC 197 Hydrogen

Stationary
Portable
Vehicular

www.iso.ch

- Agreement of cooperation signed with ISO TC 22
- Participating in working groups of IEC TC 105
- 10th Plenary meeting to be held October 2001

–WI 15916 on basic safety - final editorial changes approved for circulation to P members until May 20, 2001
–WI 15869 on land and vehicle fuel tanks to be circulated as a draft standard for 5 months in the next month or so
–WI 17268 on land vehicle filling connectors is under development in the working group
–WI 15686 on fuel service stations is under development in the working group

Slide 39

Status

EIHP

European Integrated Hydrogen Project

www.eihp.org

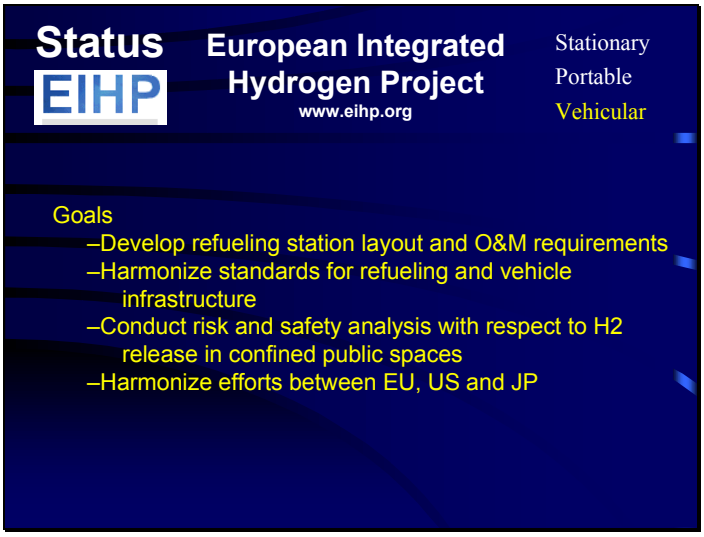
Stationary
Portable
Vehicular

Established in 1998 to address differences in national requirements throughout Europe that will affect the use of hydrogen

Objectives

–Create database of existing regulations and codes of practice
–Contact other authorities outside Europe
–Identify weak spots in current technology
–Define areas needing regulation
–Create a basis for ECE regulation for hydrogen vehicles

Slide 40



Slide 41

Slide 1

Assessment of Code Officials' Needs to Accelerate Permitting Process for Fuel Cell Installations

Timothy Hillman
Pacific Northwest National Laboratory

Slide 2

Introduction

- Background of Tri-Cities
- Assessment design
- Study findings
- How to proceed

Slide 3

Slide 4

Demographics

The Tri-Cities, WA

- Kennewick – 50,390
- Richland – 36,860
- Pasco – 26,090

Total Population of Tri-Cities Area ~150,000

Slide 5

Code Official Structure

- 5 Jurisdictions
  - 3 cities, 2 counties (Benton & Franklin)
- Code Officials
  - Building Officials (Building, Mechanical, Plumbing)
  - Fire Marshals
  - Electrical Inspectors (Dept. Labor & Industries)

Slide 6

Study Structure

- Questionnaire
  - Background info on Washington State codes & code officials
  - Access their current knowledge of fuel cells
- Group Interview
  - Identify major issues relating to a fuel cell installation
  - What would aid the plan review process
  - Determine most effective training tools

Slide 7

Study Findings

- Current knowledge of fuel cells = Very little to none!
- Many issues were identified; three of most concern were:
  - Fuel supply and storage systems
  - Utility interconnect
  - Fire fighter intervention

Slide 8

Fuel Supply and Storage

- What type of fuel is used
  - Storing liquid hydrogen was NOT a greater concern than other fuels
- Automatic shut-off valves
- Clearances around storage tank
- Appropriate signage

Slide 9

Utility Interconnect

- Local utilities may have different requirements
- "Islanding"

Slide 10

Fire Fighter Intervention

Major concern:
Entering a building being powered by a fuel cell.

- Appropriate signs/labels warning fire fighters
  - Location of emergency shut-off valves
  - Type of fuel used
  - Of fuel cell location

Slide 11

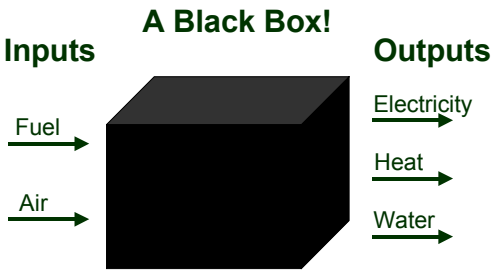
Aiding the Plan Review Process

- Manufacturer installation requirements
  - Is there a licensed installer besides manufacturer?
- A complete wiring schematic
- All necessary clearances

* Potentially over design to reconcile inconsistencies between different jurisdictional requirements.

Slide 12

Code Officials' View of a Fuel Cell



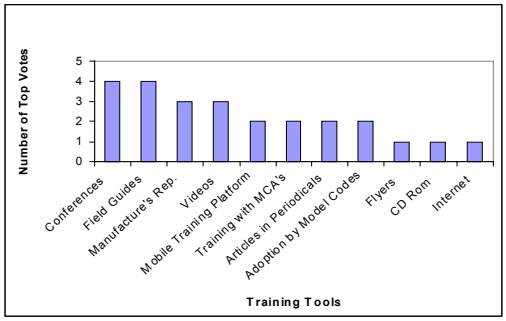
Slide 13

Training Tools

- Conferences
- Field Guides
- Manufacture's Rep.
- Videos
- Mobile Training Platform
- Training with MCA's
- Articles in Periodicals
- Adoption by Model Codes
- Flyers
- CD Rom
- Internet

Slide 14

Training Tools



Slide 15

Next Steps

An education program for code officials should consider:

- What information you want them to receive?
- What is the most effective way to get that information to them?

Slide 16

Training Tools

Things to consider while developing training tools:

- Who is our audience?
- What is their level of background?

Slide 17

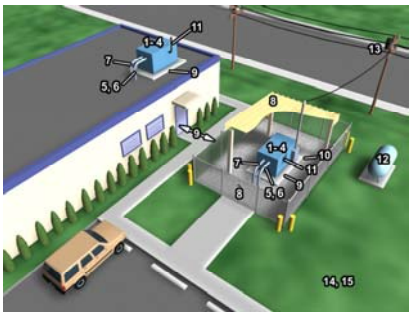
Training Tools

What might a tool incorporate?

- Brief description of the technology
- Listing of all relevant codes
- Common installation requirements

Slide 18

Installation Requirements



Slide 19

Summary

- Very little to NO previous knowledge of fuel cells
- Three major concerns
  - Fuel supply and storage systems
  - Utility interconnect
  - Fire fighter intervention

Slide 20

Summary

- Aids for plan review process
  - Manufacturer installation requirements
  - Consider over design to meet different jurisdictional requirements
- Training Tools
  - Speaking at conferences
    - Field guides
    - Videos
    - Manufacturer's representatives

Slide 21

Summary

Code officials see a black box!

Concerns:

- Inputs
- Outputs
- Connections

Slide 1

Office of Power Technologies

FUEL CELLS SUMMIT V

Distributed Generation in the Office of Power Technologies

William Parks
Associate Deputy Assistant Secretary
Office of Power Technologies

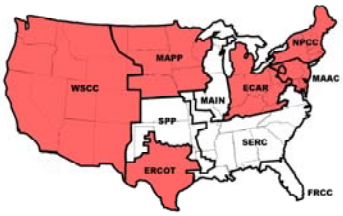
May 30, 2001
Adelphi, Maryland

Slide 2

Electric Power Constraints

"If the energy infrastructure of this country is inadequate or in some way excessively costly, it will undermine economic growth, and is therefore a major issue that must be addressed." *Alan Greenspan, January 26, 2001*

2009 Projections



Areas with Capacity Margins < 10 percent

ECAR- East Central Area Reliability Coordination Agreement
ERCOT- Electric Reliability Council of Texas
FRCC- Florida Reliability Coordinating Council
MAAC- Mid-Atlantic Area Council
MAIN- Mid-America Interconnected Network
MAPP- Mid-Continent Area Power Pool
NPCC- Northeast Power Coordinating Council
SERC- Southeastern Electric Reliability Council
SPP- Southwest Power Pool
WSCC- Western Systems Coordinating Council

Source: North American Electricity Reliability Council, 2000

Slide 3

Office of Power Technologies

Renewable Energy

- Biopower
- Solar Technologies
- Wind
- Geothermal
- Hydrogen
- Hydropower

Distributed Energy Resources

- Natural Gas Turbines, Fuel Cells & Engines
- Interconnection Standards
- Thermally Activated Technologies
- Natural Gas-Renewable Hybrids

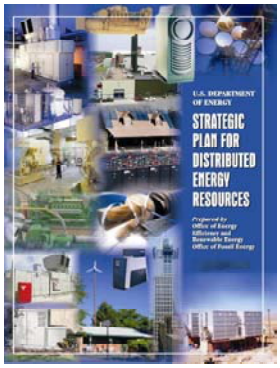
Reliability/ Power Quality

- Power Delivery
- Superconductivity
- Transmission Reliability
- Energy Storage
- Smart Controls

Slide 4

DER Strategic Plan

- **Vision 2020:** *The U.S. will have the cleanest and most efficient and reliable energy system in the world by maximizing the use of affordable DER.*
- **Goal 2012:** *DER will achieve 20%+ of new capacity additions.*



Slide 5

Federal Role

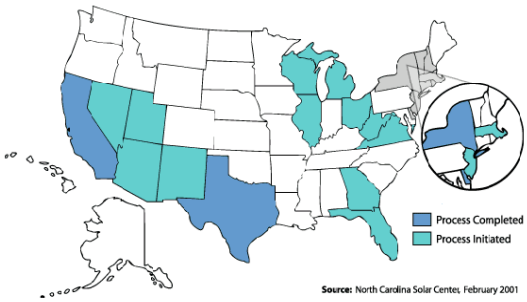
Federal government role in the development and deployment of distributed energy resources is twofold:

- Continue to support RD&D to raise efficiency and performance, and lower cost and emissions of advanced distributed energy technologies; and
- Address technical, regulatory, and institutional barriers and enable distributed energy resources to compete on an equal and consistent basis for supplying energy and ancillary services in competitive electricity and natural gas markets.

Slide 6

State Patchwork of Regulation

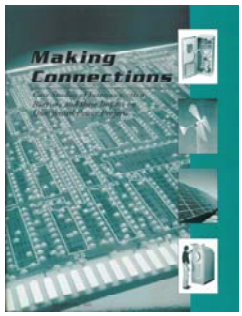
Status of State Distributed Resource Regulatory Activity



Slide 7

Activities Addressing Utility Interconnection

- "Making Connections" Report
  - 10 pt action plan for removing barriers to interconnection
- IEEE Process
- Solicitation awards focused on interconnection issues, 8-10 awards to be negotiated
- Workshops
  - RAP
  - NCSL
  - RTO/ISO



Slide 8

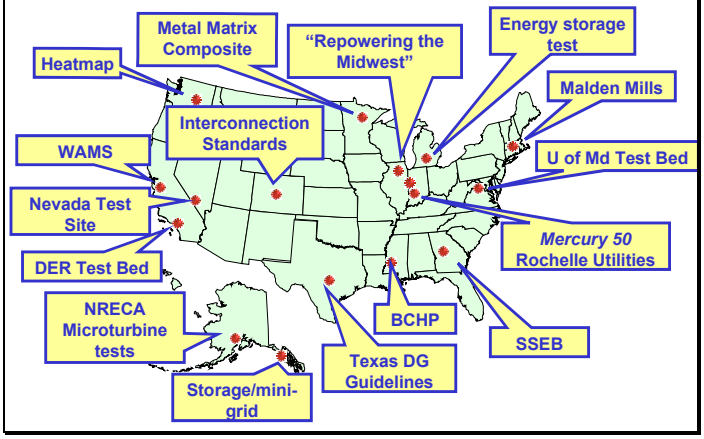
OPT Initiatives

OPT Initiatives Include:

- CHP Challenge
- Building Codes and Standards
- Environmental Siting and Permitting

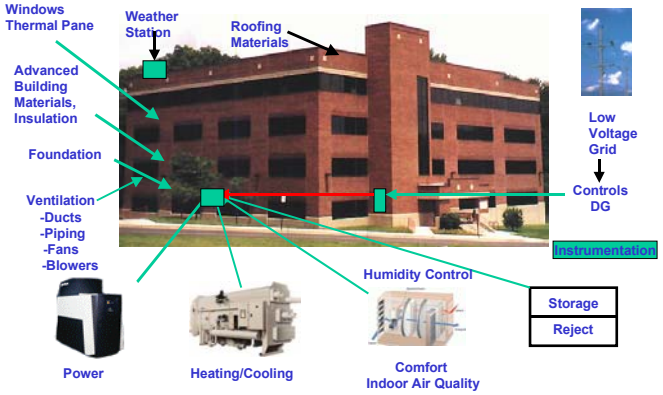
Slide 9

Activities



Slide 10

BCHP Installation at the University of Maryland



Slide 11

OPT Initiatives

OPT Initiatives Include:

- CHP Challenge
- Building Codes and Standards
- Environmental Siting and Permitting

Slide 12

Information Clearinghouse & Networking

Websites:

- www.eren.doe.gov/power
- www.eren.doe.gov/der
- www.eren.doe.gov/distributedpower

3.B. National Evaluation Service Memo: Status of Codes and Standards and Identification of Additional Needs to Support their Enhancement, Further Development, Deployment, and Use

National Evaluation Service, Inc.

5203 Leesburg Pike, Suite 600 Falls Church, Virginia 22041-3401
Phone: 703-931-2187 Fax: 703-931-6506
www.nateval.org

May 25, 2001

To: US DOE Fuel Cell Summit V Attendees
Parties Interested in Fuel Cells

From: David Conover

Subject: Status of Codes and Standards and Identification of Additional Needs to Support their Enhancement, Further Development, Deployment, and Use

I have been asked to assist DOE by preparing this summary document on the status of codes and standards and making a presentation on the subject at Fuel Cell Summit V. In addition I have been asked to identify needs to support deployment of current codes and standards documents and development of future codes and standards to support this technology. I had prepared and released communications on March 16th and May 1st, 2001 that were intended to secure input on the status of codes and standards activities as well as activities needed in the future to facilitate fuel cell technology deployment and implementation. I received comments on and input to the status of codes and standards and have prepared the information below. As the nature of these activities is dynamic and it is likely some relevant information was not identified or provided, it is expected that this document will be further enhanced as a result of discussions at Summit V.

Codes and Standards Activities Relevant to Fuel Cells

Table 1 below identifies specific documents and organizational efforts that provide standards and code criteria applicable to fuel cells. Note that Table 3 provides additional detail for a number of the specific items mentioned in Table 1. For the purposes of Table 1, a stationary fuel cell is considered to be a unitary or field assembled fuel cell power plant that is non-portable. A portable fuel cell is considered anything non-stationary but not used in a vehicle or for propulsion. A vehicular fuel cell is one that is used on board a vehicle. The ICC Ad Hoc Hydrogen Committee on Hydrogen submitted the definitions below to the International Codes of the International Code Council (ICC). The ICC Code Development Committees recommended these definitions for approval in March 2001. Final action will take place on them this fall.

PORTABLE FUEL CELL APPLIANCE. A fuel cell generator of electricity, which is not fixed in place. A portable fuel cell appliance utilizes a cord and plug connection to a grid-isolated load and has an integral fuel supply.

STATIONARY FUEL CELL POWER PLANT. A self-contained package or factory-matched packages which constitute an automatically-operated assembly of integrated systems for generating useful electrical energy and recoverable thermal energy that is permanently connected and fixed in place.

At the present time Table 1 does not include fuel cells that might be used in small portable applications such as for battery packs and cell phones. An attempt was made to determine if the table should also include such smaller applications for fuel cells. No input was received on that issue and the table does not specifically address such fuel cell applications, although they could be included within the category of portable fuel cells. The need for standards for such much smaller portable fuel cell devices continues to be an open issue that needs further discussion.

The purpose of this table is to identify codes and standards activities in the United States and at the international level (e.g. ISO and IEC). The darkened boxes indicate where there would be no logical entry possible.

Table 1

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Terminology/definitions	IEC TC 105 WG 1 USFCC	IEC TC 105 WG 1 USFCC	IEC TC 105 WG 1 USFCC SAE Information report J 2574 (Draft), Fuel Cell Vehicle Terminology (to be mainlined directly to ISO TC 22/SC 21, IEC TC 69, JEVA and JAMA)
Fuel Cell safety	ANSI Z21.83 CSA U.S. Requirements No. 1.01, Residential Fuel Cell Power Generators IEC TC 105 WG 3 (liaison with IEC TC 31 on electrical apparatus for explosive atmospheres)	CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft) IEC TC 105 future WG UL (considering development of a standard)	IEC TC 105 future WG 6 (liaison with ISO TC 22 SC 21 on electric road vehicles and IEC TC 29 on electric vehicles) SAE J2578 (to be mainlined directly to ISO TC 22/SC 21, IEC TC 69, JEVA and JAMA)
Fuel cell module	IEC TC WG 2 CSA CAS No. 33	IEC TC 105 WG 2 CSA CAS No. 33	IEC TC 105 WG 2 SAE Fuel Cell Standards Committee (dialogue started to determine the direction it will pursue in this area related to I/E performance requirements by suppliers to the OEMs)
Fuel cell performance	ASME PTC 50 ANSI Z21.83 IEC TC 105 WG 4	ASME PTC 50 CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft)	ASME PTC 50 SAE Fuel Cell Standards Committee (3 work items to be draft documents by the end of summer, 2001)

SUBJECT AREA	STATIONARY	PORTABLE	VEHICULAR
Installation of a stationary fuel cell power plant	NFPA 853 Model Building Codes NES Fuel Cell Protocol IEC TC 105 WG 5		
Use of a stationary or portable fuel cell in, on or adjacent to buildings	NFPA 853 Model Building Codes	Model Building Codes	
Electrical components associated with the fuel cell	UL Standards are referenced in ANSI Z21.83 NFPA 70 NESC	NFPA 70	SAE
Inverters, controllers, and controllers	UL 1741	UL 1741	UL 1741
Interconnection of the fuel cell with the grid	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC	IEEE 1547 UL1741 (to be harmonized with IEEE 1547 when it is finished) NESC
Parking, servicing, locating a non-stationary fuel cell in, on or adjacent buildings		Model Building Codes NFPA Standards	Model Building Codes NFPA Standards ICC Ad Hoc Committee for Hydrogen Gas
Hydrogen processing, storage and delivery		Model Building Codes NFPA Standards ISO TC 197	Model Building Codes NFPA Standards ISO 197
Service station hydrogen delivery components		ISO TC 197 NFPA Standards	ISO TC 197 SAE Fuel Cell Standards Committee Interface Working Group workshops bringing together vehicle manufacturers and connector suppliers addressing both hardware type and communication protocols. Draft document in process.
Hazardous fluids in fuel cell vehicles			SAE J2579

Future Needs

Some of the codes or standards in Table 1 may need revision and enhancement. In addition, there may be other standards and codes needed in the future to facilitate uniformity, communication, safety, etc. associated with fuel cells and the wide range of potential applications for the technology. Table 2 is intended to provide a framework for thought about what might be needed to support development of future codes and standards (both new and revisions to existing ones) as well as deployment and use of fuel cell technology. In addition a row has been included at the end of the table to allow for identification of codes and standards development and deployment initiatives that may be needed in the future.

Table 2

	STATIONARY	PORTABLE	VEHICULAR
Research	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ Safety related to hydrogen production ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ Safety related to hydrogen production ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them
Testing	▪ Hydrogen piping and use in buildings ▪ Basis for acceptance as an emergency power source ▪ Standardization of data	▪ Fail safe controls ▪ Standardization of data ▪ Dealing with hydrogen leakage, especially with indoor applications	▪ Ventilation needs for all parking garages ▪ How combustible liquids and flammable gases can co-exist in the same interior spaces or be stored on the same site ▪ Standardization of data
Documentation	▪ Protocol for verifying compliance with building codes	▪ Basis for acceptance as an appliance in buildings ▪ How much hydrogen can be stored where and in what for sale (work on the transport of the fuel supply for portable applications). The portable WG of the USFCC has commissioned a report from Rocky Mountain Environmental Strategies Inc. on this topic	▪ Basis for the acceptability of fuel cell vehicle storage, fueling, and use within the current building infrastructure
Education/Outreach (see information below on activities undertaken by the Hydrogen community)	▪ Presentations and videos for code officials on the technology and how to inspect and approve installations ▪ Commentary on fuel cells to support existing educational efforts for code officials ▪ Operational guidelines for building operators and consumers	▪ Operational guidelines for consumers	▪ Operational guidelines for consumers and distributors ▪ How to address hydrogen safety ▪ Servicing and maintenance protocols are being explored by SAE in cooperation with the Service Technicians Society (STS)

	STATIONARY	PORTABLE	VEHICULAR
Service/Field Support	▪ Availability of one trained technician to do all related design, permitting, installation and commissioning functions in lieu of a number of different experts on individual steps in the process	▪	▪
Future codes and standards	▪ Secure adoption by reference of NFPA 853 in the model building codes ▪ Develop standards for verifying or testing as-installed performance, which may be required for interconnection to the utility. The requirements for verifying as-installed performance can vary depending on the capacity of the unit, interconnection voltage, line PQ etc. Having some sort of as-installed test standard that recognizes these needs could avoid unnecessary testing or simplify testing of as-installed equipment ▪ Need for scope revision of NFPA 853 to cover equipment < 50 kW.	▪ This product will be asked to perform under a variety of environmental conditions and applications since conditions can vary significantly depending on the application. Standardized testing will be needed so the performance for a given range of conditions (e.g. temperature, humidity, etc.) can be stated or the recommended operating range of conditions can be identified and verified. ▪ CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft)	▪ SAE has started a dialogue with the Performance Review Institute (PRI) for potential mobile unit certification

- Almost 5000 copies of the H2 Safety video (Hydrogen – The Matter of Safety) along with a companion booklet have been distributed to building code and fire safety officials throughout the U.S., Canada and even in Europe.
- Russ Hewett of NREL has prepared a draft of a simplified H2 Source Book aimed directly at building code and fire safety officials. Currently the draft is being reviewed by six focus groups (BOCA, ICBO, SBCCI, UL, Fairfax, Virginia Building Code Enforcement Office, and Marietta, Georgia Fire Department.
- Mike Swain has performed comparative tests on gasoline and H2 automobiles simulating an accidental fire. The tests have been captured on a dramatic video. Additional tests may be performed. Once all testing is completed a comprehensive safety video, demonstrating that H2 is not more dangerous than gasoline, will be produced.
- Additional fire testing of residential garages is tentatively planned for July 2001. It will involve almost a full-scale garage, with a full tank of H2 in an automobile. Test protocols are currently being refined. Once the work is complete, it will provide guidance for the ICC H2 AHC and may be incorporated in future educational materials for the code community.
- Mike Swain is making a presentation on his work at the NFPA conference in mid-May.
- The existence and availability of the H2 Source Book is a source of educational information on H2.
- A seminar and hands on demonstration is being planned for the joint BOCA/ICBO conference in Cincinnati. This is the first of what will be a series of seminars for code officials. Once there is a significant H2 content in the codes, it is anticipated that these seminars will offer continuing education credits.
- A new interactive CD Rom was intended primarily to be part of the science curriculum for high school and/or middle school students and is being considered for dissemination to the code community.

Summary Information on Codes and Standards

A summary on the status and/or contents of the codes and standards identified in Table 1 above is presented in Table 3.

Table 3

TITLE AND CONTACT	STATUS	DESCRIPTION
ANSI Z 21.83-1998 *Fuel Cell Power Plants* Steven E. Kazubski Project Manager, Standards CSA International 8501 E. Pleasant Valley Rd. Cleveland, OH 44131-5575 216-524-4990 x 8303 steve.kazubski@csa-international.org www.csa-international.org	The CSA Fuel Cell Working Group continues to prepare proposed revisions to the Standard on *Fuel Cell Power Plants, ANSI Z21.83*, in preparation of the standard being maintained by a new CSA Canvass Group and Technical Committee on Fuel Cells. At their last March 14-15, 2001 meeting, the working group formed seventeen Task Group assignments for the drafting of additional proposed coverage to various sections of *ANSI Z21.83*. As part of this process the standard is being revised to cover all types of fuel cells (as it was originally written with only two types in mind). The working group's goal is to finish their task assignments and reach consensus before August by holding a series of teleconference meetings. In parallel to the activities of the working group, preparations for the formation of CSA Fuel Cell Canvass Groups and a parent CSA Fuel Cell Technical Committee are being made. The first meeting of the new CSA Fuel Cell Technical Committee will be in late August or early September. An Initiation of Canvasses posting was published in the April 6, 2001 edition of the *ANSI Standards Action* newsletter. Four CSA Canvass Groups are being formed for the following CSA fuel cell standards projects, of which all are intended to become ANSI standards when completed: ▪ CSA FC 1, Fuel Cell Power Plants (revise and re-designation of ANSI Z21.83-1998) ▪ CSA FC 2, Residential	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural or LP gas and having a maximum output voltage of 600 VAC and power output of 1,000 kW operating at no less than –20F (-29C). Criteria are provided for both construction and performance of applicable fuel cells. For construction the following are addressed: • Materials • General construction and assembly • Enclosures and associated construction • Heaters and vessels • Piping systems • Drain, venting, and ventilation exhaust systems • Automatic ignition systems and gas-air control • Flame safeguards • Fuel gas controls and equipment • Air/fluid handling and moving equipment • Electrical equipment and wiring • Protection of service personnel • Safety circuit analysis • Instructions and marking For performance issues such as ultimate strength, allowable leakage, protection, emissions, burner operation, automatic ignition, exhaust gas and surface and component temperatures, electrical tests, rain and wind, and adhesion/legibility of markings are addressed.

TITLE AND CONTACT	STATUS	DESCRIPTION
ANSI Z 21.83-1998 *Fuel Cell Power Plants (con't)*	Fuel Cell Power Generators (new standard) ▪ CSA FC 3, Portable Fuel Cell Power Generators (new standard) ▪ CSA FC 4, Fuel Cell Modules (new standard)	
CSA CAS No.33 *(CSA Component Acceptance Service No. 33 for PEM Fuel Cell Modules)* Todd Strothers CSA International Manager, Charlotte Office 5970 Fairview Road #416 Charlotte, NC 28210 (704) 552-5125 todd.strothers@csa-international.org www.csa-international.org	This is a 'Component Acceptance' document and not a 'Requirements' document, as a fuel cell module is not an appliance but only a component Published in September-2000, this document is currently being used by the U.S. and Canadian CSA Certification and Testing Departments for evaluating Fuel Cell Modules. This document will be used as a seed document for the creation of a U.S and Canadian national standard for *Fuel Cell Modules, ANSI/CSA FC 4*.	This document contains requirements for providing CSA International component acceptance service for Proton Exchange Membrane (PEM) fuel cell stacks (modules) using hydrogen as the fuel supply. The end product in which the fuel cell stack will be incorporated must be evaluated to additional requirements. Contents: Definitions - Cell reversal - Fuel cell - Fuel cell stack - Maximum operating pressure - Allowable working pressure Monitoring Systems - Temperature monitoring - Voltage monitoring - Gas leakage rate Verifications and tests - Specification verification - Gas leakage rate - Ultimate strength - Pressure withstanding test of cooling system - Abnormal test - Dielectric strength - Vibration Marking
CSA U.S. Requirements No. 1.01, Residential Fuel Cell Power Generators Todd Strothers CSA International Manager, Charlotte Office 5970 Fairview Road #416 Charlotte, NC 28210 (704) 552-5125 todd.strothers@csa-international.org www.csa-international.org	This document is currently in draft form and is expected to be finalized in June 2001. This supplemental guide to ANSI Z21.83-1998 mirrors many of the proposed coverage that the CSA Fuel Cell Working Group has been developing for updating the Z21.83 standard as such coverage pertains to residential fuel cell power generators. As it will take more than a year for the next version of ANSI Z21.83 to be approved, in the interim CSA International is issuing this supplemental standard to better provide coverage for residential fuel cells.	CSA U.S. Requirements No. 1.01 supplements the provisions contained in ANSI Z21.83-1998. This standard applies to packaged, self-contained residential fuel cell power generators for outdoor installation. The standard defines a residential fuel cell power generator as a unit serving a single family or two family dwelling not exceeding 50kW in total AC power output. Light commercial installations such as professional offices, shops, etc. which can be adequately powered by units not exceeding 50kW are also to be considered residential applications. Provisions are listed for a user's information manual and appliance markings. When certifying a residential fuel cell power generator design, CSA will use ANSI Z21.83-1998 and the CSA U.S. Requirements

TITLE AND CONTACT	STATUS	DESCRIPTION
CSA U.S. Requirements No. 1.01, Residential Fuel Cell Power Generators (con't)	As ANSI Z21.83 has yet to be fully approved in Canada, this CSA Requirements document is being developed only for the U.S. at this time.	No. 1.01 as a supplemental standard. Once ANSI Z21.83-1998 is updated with specific provisions for residential fuel cells or CSA FC 2 is developed and approved as an ANSI standard, CSA U.S. Requirements No. 1.01 will be withdrawn.
CSA Requirements No. 3.01, Portable Fuel Cell Appliances Todd Strothers CSA International Manager, Charlotte Office 5970 Fairview Road #416 Charlotte, NC 28210 (704) 552-5125 todd.strothers@csa-international.org www.csa-international.org	CSA International is currently creating the first draft of this document. A draft version of CSA Requirements No. 3.01 will be available for full industry review and comment by July 2001. When completed, this document will be used as a seed document for the creation of a U.S and Canadian national standard for *Portable Fuel Cell Power Generators, ANSI/CSA FC 3*.	It is the intent that this joint U.S. and Canadian standard will cover portable fuel cell power generators that incorporate various fuel cell technologies.
NFPA 853, Standard for the Installation of Stationary Fuel Cell Power Plants Mr. Richard P. Bielen, PE NFPA International 1 Batterymarch Park Quincy, MA 02669 617-770-3000 rbielen@nfpa.org www.nfpa.org Mr. Donald Drewry (Chair of Task Group on Fuel Cells) Hartford Steam Boiler don_drewry@hsb.com	NFPA 853 was developed over a 3-year period and was completed in May 2000. The standard is now available from the NFPA. The next revision of the standard will be completed by May 2003. The committee will be accepting public proposals until December 28, 2001 and will meet in the spring of 2002 to consider any proposals that were submitted.	The scope of the standard is the design, construction, and installation of stationary (non-portable) fuel cell power plants with a gross electrical generation that exceeds 50 kW; including (1) A singular prepackaged, self-contained power plant unit (2) Any combination of prepackaged, self-contained power plant units (3) Power plant units comprised of two or more factory matched modular components intended to be assembled in the field and (4) Engineered and field-constructed power plants that employ Fuel cells. Chapter 2 provides a description of various configurations of fuel cells, to which various criteria are applied. These configurations include pre-packaged self-contained, pre-engineered, and engineered and field constructed fuel cell power plants. Chapter 3 provides criteria related to the siting of fuel cells in all locations as well as specific indoor, outdoor, and rooftop installations and interconnections with other building systems. Chapter 4 covers fuel supplies including natural gas, LPG, biogas, fuel oil, and hydrogen. Chapter 5 addresses ventilation and exhaust of the installation. Chapter 6 covers fire protection. Chapter 7 lists other referenced publications. These include other NFPA standards, ANSI Z21.83, and certain ASME pressure and

TITLE AND CONTACT	STATUS	DESCRIPTION
NFPA 853, Standard for the Installation of Stationary Fuel Cell Power Plants (con't)		process piping standards.
NFPA 70 *National Electric Code* National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269-9101 Jean O'Conner Phone: 617-984-7421 Fax: 617-984-7070 joconner@nfpa.org www.nfpa.org	A proposal to add a new Article 692 to the NEC dealing with fuel cells has been submitted to NFPA for consideration in the NEC and approved in principal. At a December 2000 meeting the Article was titled Fuel Cell Systems. Public comment was solicited on the proposal and 5 comments were received. It was to be considered for final action in May 2001 by the NFPA. NEC / NFPA 70 Article 705 update. The revision is in a holding pattern. The report on proposals came out in July 2000. Public comment extends until October. At the Annual Meeting in May 2001nothing further happened regarding fuel cells on the floor of the Technical Session on the adoption of the NEC. Therefore, it will remain as it read in the draft. Publication is likely in September of 2001.	The NEC provides criteria that would apply to certain electrical installations related to fuel cell power plants. At the present time it does not contain any fuel cell-specific criteria. The draft Article 692 covering self-contained fuel cells addresses the following: • Installation requirements • Circuit requirements • Overcurrent protection • Wiring requirements associated with and outside the fuel cell • Grounding • Marking • Connections to other systems Fuel cells with outputs over 600 volts ac are required to meet Article 490 of the NEC.
UL 1741 , Standard for Inverters Converters and Controllers for use in Independent Power Systems Tim Zgonena (UL) 847-272-8800 x 43051 timothy.p.zgonena@us.ul.com	UL 1741 has been harmonized with IEEE 929. Utility Interactive products listed to the published UL 1741 are being accepted by many utilities across the nation for utility grid interconnection. UL 1741 is slated for harmonization with IEEE P1547, Distributed Resources Interconnected with Electric Power Systems, once IEEE 1547 is published. This harmonization should occur in the Fall of 2001 and will allow manufacturers to have their products evaluated once, to comply with the necessary national electrical safety and utility interconnection performance requirements.	
ASME PTC 50 *Performance Test Code for Fuel Cell Power System Performance*	The Object and Scope have been completed and approved by ASME. A first draft was completed in April 1999. Work continues with a targeted	*An outline of the standard is as follows:* 1. Object, Scope, and Measurement Uncertainty 2. Definitions and Descriptions of Terms

TITLE AND CONTACT	STATUS	DESCRIPTION
ASME PTC 50 Performance Test Code for Fuel Cell Power System Performance (con't) Jack Karian ASME staff 212-705-8552 karianj@asme.org Tony Leo FuelCell Energy Inc. 3 Great Pasture Road Danbury, CT 06813-6135 Work Phone: 203-825-6068 Fax: 203-825-6135 E-mail: tleo@fce.com	date of 2002 for completion and publication. PTC 50 is currently compiling a list of potential reviewers for a draft of the standard. A meeting of PTC 50 is scheduled for June 12th and 13th in New York City.	3. Guiding Principles 4. Instruments and Methods of Measurement 5. Calculations and Results 6. Report of Results 7. Uncertainty PTC 50 covers PA, PEM, MC and SO fuel cells for all applications. Test procedures, methods, and definitions are provided to address the performance characterization of fuel cell power systems (overall) with respect to inputs and outputs at steady state conditions.
2000 International Mechanical, Fuel Gas, and Residential Code International Code Council 5203 Leesburg Pike Suite 708 Falls Church, VA 22041 703-931-4533 www.intlcode.org	The 2000 International Mechanical Code (IMC) has been published and provides criteria for the installation and use of mechanical equipment and appliances. Revisions to the 2000 International Fuel Gas Code (IFGC) were made in 2000 to include similar language to that in the IMC. The ICC AHC (see below) submitted proposals (M1-01, FG4-01, and RM9-01) in 2001 that define the terms STATIONARY FUEL CELL POWER PLANT and PORTABLE FUEL CELL APPLIANCE in the International Codes, while adding coverage for stationary fuel cell power plants in the International Residential Code by way of reference to ANSI Z21.83-1989. Those changes were recommended for approval in March 2001 hearings. Final disposition of the changes will be addressed in the Fall of 2001at hearings held in conjunction with the BOCA/ICBO and SBCCI annual business meetings.	Section 924 of the IMC covers stationary fuel cell power plants as follows: "924.1 General. Stationary fuel cell power plants having a power output not exceeding 1,000 kW, shall be tested in accordance with ANSI Z21.83 and shall be installed in accordance with the manufacturer's installation instructions." Fuel cell power plant installations greater than 1,000 kW output would have to be approved under a section of the IMC on alternative methods and materials wherein the technology proponent would have to provide test data, calculations, and other documentation showing that what they proposed was "equivalent in performance from a safety and health standpoint" to other technologies specifically provided for in the code.
Evaluation Protocol for Stationary Fuel Cell Power Plants	The NES developed the evaluation protocol with the assistance of an expert panel comprised of individuals familiar with fuel cell	The Protocol is for use by the National Evaluation Service to facilitate the process of evaluating stationary fuel cell power plant technology for compliance with the above codes. The protocol sets forth general criteria

TITLE AND CONTACT	STATUS	DESCRIPTION
Evaluation Protocol for Stationary Fuel Cell Power Plants (con't) *National Evaluation Service* *5203 Leesburg Pike, Suite 600* *Falls Church, VA 22041* *David Conover* *703-931-2187* *dconover@nateval.org* *www.nateval.org* *Darren Meyers* *708-799-2300 x 307* *dmeyers@bocai.org*	technology and health and life-safety issues. The protocol was published in May 2001 and is available for use by fuel cell proponents who want to determine what information and documentation they may need to verify their compliance with the U.S. model codes. If they desire an evaluation report from NES supporting their claim of compliance, NES staff will also use the protocol as a guide in performing the evaluation and issuing an NES evaluation report.	for testing and evaluation of the covered technology and its installation and integration with the built environment. Manufacturers and users of the technology can use it as a roadmap to testing, calculations, documentation and other supporting information necessary for obtaining approval for a particular installation under the codes above. An outline of the protocol is as follows: • Scope • Intent • Reference Standards ▪ Product Evaluation Criteria ▪ In-situ evaluation criteria • Definitions • Evidence required • General • Conditions of Use
IEEE Standards Coordinating Committee (SCC) 21 IEEE Standards Department 445 Hoes Lane, P.O. Box 1331 *Piscataway, NJ 08855-1331, USA* Richard DeBlasio (Chair SCC 21) National Renewable Energy Lab 303-384-6452 deblasid@tcplink.nrel.gov T. Basso (Secretary of P1547 Working Group) National Renewable Energy Laboratory – MS1614 1617 Cole Blvd Golden, CO, 80401-3393 303-384-6765 thomas_basso@nrel.gov P1547 website and archives http://grouper.ieee.org/groups/scc21/1547 http://grouper.ieee.org/groups/scc21/1547/archives/	The IEEE SCC has a number of different projects underway and is responsible for standards associated with fuel cells, photovoltaics, dispersed generation and energy storage *SCC 21 reports directly to IEEE Standards Board.* The *P1547 Draft Standard for Interconnecting Distributed Resources With Electric Power Systems* is a very active and fuel cell-relevant activity. Draft 7 of that standard was balloted, ending 3/28/01 and did not receive the 75% affirmative vote required by IEEE. The April 18th through 20th meeting of P1547 addressed ballot resolution and was attended by 88 individuals. A working group will meet June 5th through 8th to re-word draft 7 to address negative comments. The resultant re-draft is scheduled for re-circulation this summer. The P1547 working group has met about every 2 months for 2-1/2 years and will meet during the summer in Golden CO. The standard is slated for completion in 2001. Six prospective new IEEE distributed resources activities were identified and discussed for consideration by the	Chapter 1 of the standard provides an introduction including scope and purpose. The standard establishes criteria and requirements for interconnection of distributed resources with electric power systems. The purpose of P1547 is to provide a uniform standard for interconnection of distributed resources with electric power systems, and requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection. The criteria and requirements in P1547 are applicable to all distributed resource (DR) technologies and to the primary and secondary voltages of the electric power distribution systems. Installation of DRs on radial primary and secondary distribution systems are the main emphasis, although primary and secondary network distribution systems are considered. The requirements of P1547 are to be met at the point of common coupling, although the location of the protective devices may not necessarily be at that point. Chapter 2 lists references required to be used in conjunction with P1547 to meet the standard. Chapter 3 provides definitions and terminology pertinent to P1547 that is not already included in the IEEE Standard 100 Dictionary. Chapter 4 covers technical requirements and specifications associated with items such as voltage regulation, power quality, and abnormal operation. Chapter 5 provides test specifications and requirements, including interconnection tests, production tests, interconnection installation evaluation, commissioning tests, and periodic tests.

TITLE AND CONTACT	STATUS	DESCRIPTION
IEEE Standards Coordinating Committee (SCC) 21 (con't)	SCC21/P1547 members at their January and April 2001 meetings. Some of those activities include aspects directly pertinent to all dispersed generation including fuel cells. Project Authorization Requests (PARs) were established for: ▪ Standard for Testing Interconnected Systems for Distributed Resources ▪ Application Guide for Distributed Resources ▪ Recommended Practice for Monitoring and Control of Distributed Resources Future discussion will cover possible PARs for: ▪ DG and equipment – specifications and performance ▪ Network specifications and applications with DG ▪ Certification of DR and interconnection equipment	There also are informative annexes on testing, and a bibliography.
IEC TC 105 on Fuel Cells John Bossert, Canada (Chair) Werner Tillmetz, Germany (Secretary) Andreas Piepereit, Germany (Asst. Secretary) Kelvin Hecht (US Technical Advisory Group [TAG] Technical Advisor) International Fuel Cells 127 Craigemore Circle Avon, CT 06001 860-673-9181 kelvinhecht@home.com David Conover (US TAG Deputy Technical Advisor) NES, Inc. 5203 Leesburg Pike Suite 600 Falls Church, VA 22041 703-931-2187 dconover@nateval.org	IEC TC 105 has a scope to prepare international standards regarding fuel cell technologies for all fuel cell applications such as stationary, transportation and portable applications. Membership is from CA, CN, FR, DE, IT, JP, NL, CH, GB, and the US. Liaisons have been established with IEC TC 69 (electric vehicles), ISO TC 22 SC 21 (electric road vehicles), ISO TC 197 (Hydrogen technologies) and IES TC 31 (electrical apparatus in explosive atmospheres). SAE and IEC TC 105 have agreed to support each other's activities. IEC TC 105 had their first meeting February 23 and 24, 2000 will meet again September 6th and 7th in London. Some working groups of IEC TC 105 have had meetings during the past year. The US TAG had their first meeting on March 13, 2001. IEC TC 105 will meet in London on September 6 and 7, 2001. WG 2 will meet in advance of that meeting on the	The IEC TC 105 membership have developed the following program of work that is being conducted by various ad hoc working groups (WG) who are lead by specific country convenors. WG 1 – Definitions (US) with a draft being based on US FCC and Japanese definition documents WG 2 – Fuel Cell Module (DE), for stationary, portable and vehicular applications, with an outline available and meetings held to draft a standard WG 3 – Safety for stationary fuel cell systems (US) with an outline available that is based on the criteria contained in ANSI Z21.83, ISO, IEC and EN standards WG 4 – Performance of stationary fuel cell systems (JP) with a working draft of a standard available based on a Japanese Standards Association technical report on test methods for performance of phosphoric acid fuel cell power plants WG 5 – Installation of stationary fuel cell systems (US) with a work proposal to be developed and use of NFPA 853 as a starting point under development. A first WG5 meeting could occur by the end of 2001. WG 6 – Fuel cell systems for propulsion (DE) TC 105 has also identified work needing to be done on the following items but have yet

TITLE AND CONTACT	STATUS	DESCRIPTION
IEC TC 105 on Fuel Cells (con't) CSA America, Inc. U.S. TAG Administrator Steve Kazubski (Secretary) 8501 E. Pleasant Valley Rd. Cleveland, OH 44131-5575 216-524-4990 x 8303 steve.kazubski@csa-international.org	4th and 5th of September. WG 3 will meet on July 19th and 20th in Boston. IEC and ISO have also been working to address coordination of efforts between IEC TC 105 and ISO/TC 197 (hydrogen) and a coordination meeting was requested. The ISO has also encouraged ISO/TC 197 to participate in IEC TC 105 working group meetings.	to form working groups to address them. • Fuel cell system integration into road vehicles (with ISO TC 22) • Auxiliary power units for fuel cell systems in transportation • Portable fuel cell systems
Society of Automotive Engineers (SAE) SAE International 400 Commonwealth Drive Warrendale, PA 15096 Tony Androsky 724-772-8557 androsky@sae.org Jane Hock 724-772-8557 jhock@sae.org	The Society of Automotive Engineers has established a very broad base Fuel Cell Standards Committee that addresses the needs of the producer, user, consumer, and regulator in regards to fuel cells for transportation applications. The SAE Technical Standards Board is currently addressing passenger vehicle applications. Because of the broad application potential of fuel cell technology work is being identified by the Aerospace Council, ConAg Council, Truck & Bus Council, ITS Division, Manufacturing Division, and the Fuels & Lubricants Division. In addition the Service Technicians Society (STS) is identifying servicing and maintenance need sand the Performance Review Institute (PRI) is exploring certification requirements.	The SAE Fuel Cell Standards Committee has established the following living scope of work and mission statement: "To establish standards and test procedures for fuel cell powered vehicles. The standards will cover the safety, performance, reliability, and recyclability of fuel cell systems in vehicles with emphasis on efficiency and environmental impact. The standards will also establish test procedures for uniformity in test results for the vehicles/systems/components performance, and define interface requirements of the systems to the vehicles." The Committee has establish the following Working Groups as covered below: ▪ Safety ▪ Terminology ▪ Performance ▪ Recyclability ▪ Interface ▪ Emissions & Fuel Economy ▪ Reliability
SAE Fuel Cell Standards Committee Safety Working Group Jane Hock 724-772-8557 jhock@sae.org	Draft document in work.	J2578 Recommended Practices for General Fuel Cell Vehicle Safety J2579 Recommended Practice for Hazardous Fluid Systems in Fuel Cell Vehicles
SAE Fuel Cell Standards Committee *Terminology Working Group* Jane Hock 724-772-8557 jhock@sae.org	Ballot process will begin in June 2001.	J2574 Fuel Cell Electric Vehicle Terminology (Developed jointly with JEVA, JAMA)
SAE Fuel Cell Standards Committee *Performance Working Group*	Draft documents in development.	Documents cover: Fuel Cell System Performance Testing

TITLE AND CONTACT	STATUS	DESCRIPTION
SAE Fuel Cell Standards Committee *Performance Working Group (con't)* Jane Hock 724-772-8557 jhock@sae.org		Fuel Processor Subsystem Performance Testing Fuel Cell Stack Subsystem Performance Testing
SAE Fuel Cell Standards Committee *Recyclability Working Group* Jane Hock 724-772-8557 jhock@sae.org	Draft document in development.	J2594 Fuel Cell Recyclability Guidelines
SAE Fuel Cell Standards Committee *Interface, Working Group* Jane Hock 724-772-8557 jhock@sae.org	Second design request letter being sent out in May 2001. Draft Document in work. Next workshop in planning process.	Several workshops have been conducted bringing together OEMs, plumbing and connector manufacturers, along with communications (RF, IR, and Default) protocol experts. These are focused on ensuring globally harmonized standards for compatible refueling activities.
SAE Fuel Cell Standards Committee *Emissions & Fuel Economy Working Group* Jane Hock 724-772-8557 jhock@sae.org	Ballot process to begin in September 2001.	J2572 Recommended Practice for Measuring the Exhaust Emissions, Energy Consumption and Range of Fuel Cell Powered Electric Vehicles Using Compressed Gaseous Hydrogen
ISO/TC 22/SC 21 on electric road vehicles (ERVs) Klaus Orchowski [Klaus.Orchowski@t-online.de] ISO XXXXX Fuel cell powered road vehicles-Safety specifications-Part 1...4 under development by ISO/TC 22/SC 21WG 1 (convenor Klaus Orchowski, klaus.orchowski@t-online.de)	Within ISO this subcommittee is responsible for all electrically propelled road vehicles on standards related to the vehicle as a whole. For components, off-board and specific aspects other ISO and non-ISO standardization committees have or share the responsibility with ISO/TC22/SC21. An agreement of cooperation designating working mode 4	ISO/TC22/SC21 has two working groups. WG 1 addresses vehicle operating conditions, safety and energy storage installation. WG 2 addresses definitions and performance measurement. WG 1 has developed a three-part ISO/DIS 6469-1 ERV safety specification covering onboard energy storage, functional safety means and protection against failures, and protection of persons against electric hazards. WG2 has developed three standards: ▪ ISO/DIS 8713 ERV Terminology ▪ ISO/DIS 8714 ERV Test procedure for energy consumption and range for

TITLE AND CONTACT	STATUS	DESCRIPTION
ISO/TC 22/SC 21 on electric road vehicles (ERVs) (con't)	working mode 4 (collaboration) has been signed with IEC TC 105 to facilitate integration of fuel cells into road vehicles. ISO will take the lead in standardization associated with integrating the fuel cell into the vehicle and IEC will take the lead in standardization associated with fuel cells for propulsion (IEC TC 105 WG 6). A joint steering committee will coordinate activities and resolve issues. Early stage of development	passenger cars and light commercial vehicles ▪ ISO/DIS 8715 ERV road operating characteristics This standard will prescribe the necessary minimum of fundamental safety requirements specific to fuel cell powered road vehicles. The various parts deal with hazards related to hydrogen, higher voltage levels, vehicle operational modes specific to fuel cells as part of the propulsion system.
ICC Ad Hoc Committee (AHC) for Hydrogen Gas Darren Meyers, Secretariat BOCA International 4051 East Flossmoor Road Country Club Hills, IL 60478 708-799-2300 x 307 dmeyers@bocai.org	The AHC (balanced membership of hydrogen users, producers, manufacturers and regulator interests) is undertaking a review of current codes and standards applicable to the vehicular and portable hydrogen infrastructure in buildings. They are focused on the acceptance and safe deployment of portable and vehicular hydrogen-based technologies in the built environment. Six (6) subcommittee working groups have been established and are working closely with the AHC during the draft development stages of proposed changes to the ICC International Codes: WG1 Private Garages WG2 Public Garages WG3 Hydrogen Refueling and Generating Stations WG4 Portable Hydrogen Appliances WG5 Integrating hydrogen as a fuel into IFGC WG6 Standards The next meeting of the AHC is at NREL in Boulder CO on June 4th and 5th, 2001.	Preliminary conclusions regarding hydrogen fire impingement tests and hydrogen gas dispersion characteristics as they pertain to home-based refueling of hydrogen vehicles were presented at the AHC meeting in Portland OR in March 2001. An effort to promote a joint U.S. Canadian, harmonized standard for portable fuel cell power plants was also discussed at that meeting. Dr. Mike Swain, University of Miami, is conducting a variety of tests to establish ventilation and fire protection needs and design parameters for residential garages and presented the results of his research at the March meeting. The AHC remains focused on current and anticipated topics involving the acceptance and safe deployment of portable and vehicular hydrogen-based *technologies in the built environment.* *The AHC has also developed definitions for portable and stationary fuel cell power plants to help differentiate between a consumer product that may be addressed by building codes differently than a more stationary piece of equipment.*

TITLE AND CONTACT	STATUS	DESCRIPTION
National Hydrogen Association 1800 M Street NW, Suite 300 Washington, DC 20036-5802 Karen Miller, Vice President phone: (202) 223-5547 fax: (202) 223-5537 email: kmiller@ttcorp.com www.HydrogenUS.com	NHA's technical goal is to create draft standards for hydrogen systems and components using the expertise of the NHA membership. NHA will identify areas where codes and standards for the safe use of hydrogen energy systems are needed and coordinate their being addressed. Only when hydrogen safety issues are not being properly addressed would the NHA would want to initiate new standard. NHA has seven (7) working groups, in various stages of activity. WG1: Connectors WG2: a.Containers; b. Hydrides WG3: Refueling Stations WG4: Safe use of electrolyzers in customer sites, including homes. WG5: Self-service refueling (liquid and gaseous hydrogen). WG6: Coordination with the SAE on hydrogen safety with respect to the on board hydrogen systems. WG7: Maritime applications of hydrogen (identify unique applications).	*A draft standard has been developed by WG1 for gaseous hydrogen connectors. It was accepted by ISO/TC-197 and is undergoing international development.* *Related to WG2, the initial NHA draft standard for tanks included only materials used in CNG that were compatible with hydrogen. The international standard does not exclude composites and other materials, as long as they meet a stated performance standard. The NHA encourages members to join the ISO/TC-197 WG 5 and continue to advance the item internationally.* *Under WG 3 the NHA developed a draft standard on hydrogen refueling stations for ISO TC 197. The work item was accepted, but it has not advanced due to lack of US support for convening this working group.* The scope of WG 4 is to develop a standard for installation, safety and use of electrolyzer hydrogen generators in end use applications, including the residential commercial and industrial sectors. Activities will include identifying appropriate group participants in addition to NHA members, assessing the existing relevant codes; establishing parameters and developing a technical envelope for the WG. A code/building and zoning review will also be important to this WG. Finally, the NHA would like to develop a draft standard based on an appropriate template document and scope. WG5 will specify design criteria for safe self-service refueling with Liquid and Gaseous hydrogen. This will include consideration for vehicle grounding, venting of fuel lines and elimination of possible ignition sources. This activity is in conjunction with the SAE Interface and safety working groups. The Scope of WG6 is to verify the performance of on board hydrogen systems. The hydrogen system includes storage, generation, distribution, power source, and controls. The NHA is actively working with SAE Fuel Cell Standards Forum C&S safety task force. The SAE has the lead on this issue. The Scope of WG 7 is to identify maritime unique applications of hydrogen. This was done in cooperation with the Maritime Hydrogen Technology Development Group as well as other interested standards bodies. The MHTDG has published a report on the subject.

TITLE AND CONTACT	STATUS	DESCRIPTION
ISO TC 197 on Hydrogen Tappan Bose (Chair ISO/TC 197) Sylvie Gingras (Secretary, ISO/TC 197) 418-982-2238 The NHA above acts as the U.S. Technical Advisory Group Administrator on ISO TC 197	WI 15916 Basic Considerations for the Safety of Hydrogen Systems: final editorial changes were approved for circulation to P members of TC 197until May 20th. Three work items are being advanced by ISO TC 197 that are based on NHA work items. ▪ WI 15869 Gaseous Hydrogen and Hydrogen Blends-Land Vehicle Fuel Tanks: To be circulated as a Draft International Standard for a five-month voting period in the next month or two. ▪ WI 17286 Gaseous Hydrogen-Land Vehicle Filling Connectors: This work item is being advanced, addressing design issues of potential cross-connection. It is still in the working group. ▪ WI 15866 Gaseous Hydrogen Blends and hydrogen Fuel-Service Stations: This item is still at the working group level. Issues regarding the baseline document and convenor availability are being worked. The 10th plenary meeting of ISO/TC 197 will be held on Paris in October 2001. An agreement of cooperation has been signed with IEC TC 22. As noted above under IEC TC 105, the ISO has suggested ISO TC 197 participate in working group activities of IEC TC 105. IEC TC 105 has responsibility for fuel cells and ISO/TC 197 has responsibility for hydrogen infrastructure issues. ISO/TC 197 members receive standards drafts from IEC TC 105 and review and comment on them. Final drafts are considered approved by ISO/TC 197 if 2/3 of their voting members are in favor of the standard.	The ISO TC 197 structure includes five working groups. ▪ WG 2 on tank containers for multimodal transportation of liquid hydrogen ▪ WG 4 on airport hydrogen fuelling facilities ▪ WG 5 on gaseous hydrogen and blends and hydrogen fuels – service stations ▪ WG 6 gaseous hydrogen and hydrogen blends – land vehicle fuel tanks ▪ WG 7 basic considerations for the safety of hydrogen systems

TITLE AND CONTACT	STATUS	DESCRIPTION
European Integrated Hydrogen Project project coordinator Reiner Wurster (wurster@lbst.de) vehicle registration related matters Dieter Stoll (dieter.stoll@bmw.de). http://www.eihp.org/.	In total 47 EC directives are applicable for vehicles. The directives for emissions, fuel consumption and engine power cannot be fulfilled by hydrogen vehicles because of the absence of a standardised reference fuel or the absence of a procedure for testing the engine power. Requirements regarding the safety of the hydrogen on board storage system however are missing. Therefore each country is applying their national requirements regarding the safety of the hydrogen onboard storage system. These national requirements are differing significantly.	The European Integrated Hydrogen Project was established in 1998 and co-sponsored by the former GD XII Science, Research and Development under Contract N° JOE3-CT97-0088. *The objectives of the project are:* *- To create a Pan European database of existing regulations and codes of practice* *- To contact other pertinent authorities outside Europe* *- To identify weak spots in today's technology* *- To define the areas requiring regulation* *- To create a basis for an ECE regulation for hydrogen vehicles*

Summary: (EIHP Project Summary Phase II, start in 2001)

Draft regulations for the approval of hydrogen fuelled road vehicles have been developed during the last two years and are presently in the submission process to the relevant European regulatory bodies. These draft regulations shall be developed to such a level that they can be harmonised on a global level, initially between the EU and North America. By applying these draft regulations to the design and approval of fuel cell vehicles with direct onboard hydrogen storage they will be validated by taking into account not only hydrogen related vehicle components and systems but also safety requirements, refuelling procedures and periodic inspections.

For the relevant hydrogen refuelling infrastructure components and systems, for which existing standards, codes of practice and regulations are only partly identified, the applicable national standards and regulations will be identified and necessary requirements for new draft standards and possibly draft regulations for approval will be developed. These activities among others will also comprise refuelling procedures, safety aspects, periodic inspections and the layout of refuelling stations. The interface between the refuelling station and the vehicle (receptacle and nozzle) will be an important issue. The eligibility for EU-wide harmonisation will be checked. It will also be investigated to what extent certain elements of the refuelling systems are suitable for harmonisation on a global regulatory scale, e.g. components.

Comparative risk and safety analyses with respect to the release of hydrogen in confined and semi-confined environments, such as tunnels, garages, refuelling stations, and inner city streets will be undertaken. These shall provide data in sufficient depth in order to enable the partnership to define the required inputs for hydrogen-related standards and regulations.

EIHP 2 - Partners

L-B-Systemtechnik GmbH, Ottobrunn, Germany
Adam Opel AG, Ruesselsheim, Germany
Air Liquide S.A., Sassenage, France
Air Products, Walton-on-Thames, United Kingdom
Bayerische Motoren Werke AG, Munich, Germany
BP Amoco, Sunbbury-on-Thames, United Kingdom
Commissariat a l'Energie Atomique, Bruyeres le Chatel, France

DaimlerChrysler AG, Stuttgart, Germany
National Centre for Scientific Research Demokritos, Aghia Parakevi-Attikis, Greece
Det Norske Veritas, Department for Strategic Research, Hoevik, Norway
EC-Joint Research Centre, Ispra, Italy
Ford Werke-Aktiengesellschaft, Koeln, Germany
Forschungszentrum Karlsruhe GmbH, Karlsruhe, Germany
Hydrogen Systems N.V., Turnhout, Belgium
Instituto Nacional de Técnica Aerospacial, INTA, Madrid, Spain
Messer Griesheim GmbH, Krefeld, Germany
Norsk Hydro SA, Oslo, Norway
Shell Research Ltd., Chester, United Kingdom
AB Volvo Technological Development, Göteborg, Sweden
Raufoss ASA, Raufoss, Norway

Results:

- *Development of a worldwide harmonised regulation for hydrogen fuelled road vehicles.*
- *Development of procedures for periodic vehicle inspections (roadworthiness).*
- *As far as possible development of a worldwide standard or regulation and of periodic inspection procedures for the relevant refuelling infrastructure, subsystems or components.*

These draft regulations and standards will enable vehicle and infrastructure industry to save enormous resources in bringing hydrogen fuelled fuel cell vehicles onto the road. Many countries will for the first time have the legal basis to approve the operation of hydrogen fuelled vehicles on public roads and refilling at public refuelling stations. In addition, the access of European vehicle and infrastructure component manufacturers to the EU market as well as the North American market will be facilitated in the medium and long term.

3.C. Table of Needs Articulated on First Day

TOPIC	STATIONARY	PORTABLE	VEHICULAR
Research/Testing/ Documentation	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them ▪ Hydrogen piping and use in buildings ▪ Basis for acceptance as an emergency power source ▪ Standardization of data ▪ Protocol for verifying compliance with building codes ▪ *Consider matched sets of components to simplify approval* ▪ *Use testing agencies for pre-assessments on products to prevent problems* ▪ *Need standard acceptance tests for installations* ▪ *What is the impact of the fuel cell on the residential construction process? Specialty contractors?* ▪ *Testing labs can do site evaluations to help authorities having jurisdiction* ▪ *Manufacturers need to closely track feedback from the field* ▪ *During product development cycle the prototype may not be listable since the product is in flux – need opportunities to install prototypes without being listed* ▪ *Most code officials more concerned with fuel rather than fuel cell system* ▪ *NAHB RC working on PATH initiative and is looking at code issues relative to fuel cells*	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ Safety related to hydrogen production ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them ▪ Fail safe controls ▪ Standardization of data ▪ Dealing with hydrogen leakage, especially with indoor applications ▪ Basis for acceptance as an appliance in buildings ▪ How much hydrogen can be stored where and in what for sale (work on the transport of the fuel supply for portable applications). The portable WG of the USFCC has commissioned a report from Rocky Mountain Environmental Strategies Inc. on this topic	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular ▪ Safety related to hydrogen production ▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them ▪ Ventilation needs for all parking garages ▪ How combustible liquids and flammable gases can co-exist in the same interior spaces or be stored on the same site ▪ Standardization of data ▪ Basis for the acceptability of fuel cell vehicle storage, fueling, and use within the current building infrastructure ▪ *Need to address reforming on board or off site and issues associated with each*

TOPIC	STATIONARY	PORTABLE	VEHICULAR
	(collaboration with DOE efforts) ▪ *Consider using the spirit and intent provisions of codes to get permits (performance equivalency)* ▪ *What about CE marking – may not be consistent response across various bodies in the CE* ▪ *Reduce time between when fuel cell manufacturer decides what they want to build to the inclusion of criteria in the codes (code officials, utilities and test labs felt that there are no obstacles for stationary fuel cells* ▪ *Manufacturers see no obstacles other than time)* ▪ *What is the cycle time to be listed under Z21.83? One to six months unless components are not listed to standards in Z21.83*		

TOPIC	STATIONARY	PORTABLE	VEHICULAR
Education/Outreach and Service/Field Support	▪ Presentations and videos for code officials on the technology and how to inspect and approve installations ▪ Commentary on fuel cells to support existing educational efforts for code officials ▪ Operational guidelines for building operators and consumers ▪ Availability of one trained technician to do all related design, permitting, installation and commissioning functions in lieu of a number of different experts on individual steps in the process ▪ *Need to address long term maintenance and the impact on continued code compliance* ▪ *Interchangeability with respect to future maintenance (inter-manufacturer parts, intra-manufacturer parts, and similar part in new technology) – may need to certify components and systems* ▪ *Design, installation and commissioning* ▪ *Get copies of Z21.83 soon in product development* ▪ *By code terminology fuel cells are appliances and location on property, site plans, certification, listings, supporting statements and documents need to be provided to the code official* ▪ *Need to deal with 2 bodies at the state level; code officials and utility commissions* ▪ *Need implementation of the code, not just the*	▪ Operational guidelines for consumers ▪ *Interchangeability with respect to future maintenance (inter-manufacturer parts, intra-manufacturer parts, and similar part in new technology) – may need to certify components and systems* ▪ *Fire codes are the most important codes for portable fuel cells*	▪ Operational guidelines for consumers and distributors ▪ How to address hydrogen safety ▪ Servicing and maintenance protocols are being explored by SAE in cooperation with the Service Technicians Society (STS) ▪ *Need to integrate fuel cell technology into airline support applications* ▪ *Need to compete against gearhead mentality regarding IC engine competition* ▪ *Need energy efficiency message to drive application of fuel cells* ▪ *EMTs need help dealing with increased issues associated with use of fuel cells and related fuels* ▪ *Service technicians need to be educated, in place and certified* ▪ *Aircraft in process inspectors need to be trained in fuel cell technology* ▪ *What do commercial insurance carriers need?*

TOPIC	STATIONARY	PORTABLE	VEHICULAR
	code ▪ *Need to be aware of zoning and environmental requirements* ▪ *Be careful how we represent the fuel cell (new technology versus on site technology)* ▪ *Protect the one opportunity with residential construction to get it right* ▪ *Monitor standards making process relative to fuel cells and make sure you are represented* ▪ *Code writers need to know what to write code for and manufacturers need to know what codes to develop products for* ▪ *Fire marshals are the key officials right now* ▪ *Disparity between rural and urban code official* ▪ *Would builders and homeowners be willing to accept a fuel cell as a black box as the code officials do?* ▪ *Use community opinion to overcome some of the barriers to acceptance* ▪ *What about the qualification of the installers? Who is doing something about this? Can this issue be brought into codes?* ▪ *Manufacturers fearful that codes will drive the product development (some manufacturers using international standards)* ▪ *Safety is the most important issue for code officials to address* ▪ *The winner in residential construction will be the manufacturer who figures out how to make the use of fuel cells in buildings transparent*		

TOPIC	STATIONARY	PORTABLE	VEHICULAR
Future codes and standards	▪ Secure adoption by reference of NFPA 853 in the model building codes ▪ Develop standards for verifying or testing as-installed performance, which may be required for interconnection to the utility. The requirements for verifying as-installed performance can vary depending on the capacity of the unit, interconnection voltage, line PQ etc. Having some sort of as-installed test standard that recognizes these needs could avoid unnecessary testing or simplify testing of as-installed equipment ▪ Need for scope revision of NFPA 853 to cover equipment < 50 Kw. ▪ *Issue of separation of reformer and fuel cell (2 or 3 black boxes versus 1 big black box* ▪ *May need separate reformer standard* ▪ *Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility-need to review use group issues* ▪ *Need hydrogen generation standard-CSA needs to complete work started* ▪ *May change zoning if serving multifamily building and fuel cell is used to generate income from sale of power* ▪ *Need to address natural hazard survivability both for automatic shutdown and lifeline support* ▪ *Need to work on different requirements for small and large units – yes CSA is doing this*	▪ This product will be asked to perform under a variety of environmental conditions and applications since conditions can vary significantly depending on the application. Standardized testing will be needed so the performance for a given range of conditions (e.g. temperature, humidity, etc.) can be stated or the recommended operating range of conditions can be identified and verified. ▪ CSA Requirements No. 3.01, Portable Fuel Cell Appliances (Draft) ▪ *Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility facility-need to review use group issue* ▪ *Who addresses fuel storage devices carried on aircraft – USFCC is working on this and need to change DOT regulations and IATA regulations* ▪ *CSA writing FC3 and should be ready this year* ▪ *Transportable fuel supplies* ▪ *Storage of fuel supply at the destination* ▪ *ICC has defined portable fuel cells and exempted them from permitting(Gray area is where portable connected to hard piping at residence)* ▪ *Household use may trigger monitoring from consumer Product Safety Commission* ▪ *Codes for portable fuel cells should impose similar requirements to portable gas generators*	▪ SAE has started a dialogue with the Performance Review Institute (PRI) for potential mobile unit certification ▪ *Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility facility-need to review use group issues* ▪ *SAE has relationship with transit standards consortium for standards for bus applications* ▪ *Federal transit authority – bus standards on safety, but also performance* ▪ *Refueling stations may be a big issue (OEMS considering getting involved in distribution of fuel)* ▪ *SAE is doing a lot in codes and standards* ▪ *Need hydrogen infrastructure* ▪ *Need to address parking garages?* ▪ *What about tunnels? (DOT and NITSA need to address this)* ▪ *Will state vehicle inspectors need to inspect fuel cell related components?* ▪ *What about passive ventilation of enclosed spaces for hydrogen safety?*

TOPIC	STATIONARY	PORTABLE	VEHICULAR
	▪ *Fuel cell may have residual combustible gases on shutdown* ▪ *Treatment of breach of separators and air bleeds – NFPA 853 covers this* ▪ *What about catalytic technologies when Z 21.83 refers to open flames* ▪ *What about reverse power controls backfeeding the grid?* ▪ *Need to address deodorized gas* ▪ *Criteria for fabrication of sulphur traps* ▪ *Get NFPA 853 adopted into the model codes* ▪ *Keep standards and codes moving and out of draft stages* ▪ *Look at issues like use of equipment for standby use versus non-emergency use and fuel storage* ▪ *Design systems so that standard connections can be made to minimize installation problems* ▪ *European CE markings define safety requirements but don't limit designs – this makes it tough to know what need to be done or what directive apply (performance versus prescriptive)* ▪ *Do we need a standard for annual ratings of fuel cells for consumer labeling (consider ASHRAE standard for seasonal ratings)* ▪ *What about combination fuel cells and microturbines? (UL 2200 is used to test microturbines)*	▪ *Indoor use issues may be important*	

3.D. Summit Agenda

Agenda for Fuel Cells Summit V
May 30-31, 2001
University of Maryland Inn and Conference Center

Summit Objective: To confirm existing actions in support of fuel cell acceptance, identify remaining needs, and develop a coordinated plan of action to address those needs.

Day One - Wednesday May 30

8:00 am Registration and Continental Breakfast

8:30 am Welcome and Introduction
- Ronald Fiskum, Office of Power Technologies, US Department of Energy
- Mike Davis, Avista Corporation
- Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

9:00 am Status Report on the Fuel Cell Industry
- Robert Rose, US Fuel Cells Council

A broad update on the status of commercialization efforts in the fuel cell industry for all key markets, including portable, stationary and vehicular applications

9:45 am Status Report on Institutional Issues and Responses to Them
- Dave Conover, National Evaluation Service, Inc.

Presentation on the status of codes and standards related activities at the national and international levels with respect to stationary, vehicular, and portable fuel cells and presentation of a framework for identifying remaining needs related to a joint and cooperative codes and standards agenda to facilitate fuel cell technology acceptance.

10:30 am Break

10:45 am Presentation of Real World Experiences with Code Officials and Fuel Cell Installations
- Timothy Hillman, Pacific Northwest National Laboratory

Results of a Needs Assessment investigated by pursuing a hypothetical fuel cell installation in the Tri-Cities, Washington.

11:30 am Sit Down Lunch with Speaker
- Robert K. Dixon, Deputy Assistant Secretary, Office of Power Technologies, US Department of Energy

1:00 pm Group Discussion
- Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

Identification/clarification of the needs suggested thus far and a basic prioritization in terms of their relative importance.

2:00 pm Expert Panel Discussion

Panel Commitments to Date

- Guy Tomberlin, County of Fairfax
- Harry Jones, Underwriters Laboratories
- Alan Mace, Idatech
- Tony Androsky, Society of Automotive Engineers
- Chris Fennell, National Association of Home Builders Research Center
- Tim Bernadowski, Dominion Virginia Power

Barriers related to the needs identified, focusing on the subcomponent activities of codes/standards, research/testing/documentation and education/outreach.

3:00 pm Break

3:15 pm Continue Expert Panel Discussion(s)

4:00 pm Group Discussion

- Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

Re-visit the needs based on the panel discussions and re-confirm their characterizations and relative priorities.

4:45 pm Wrap-up and Overview of Day Two Agenda

5:00 pm Adjourn

5:30 pm Barbecue and Tour of the Cooling, Heating and Power for Buildings Test Site on the University of Maryland Campus.

Shuttle service begins at 5:15 pm from the Inn and Conference Center.

Day Two - Thursday, May 31

7:30 am Continental Breakfast

8:30 am Brief Recap of Day One and Instructions for Breakout Sessions

- Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

Three breakout groups are anticipated, designed around the activity categories of Codes/Standards, Research/Testing/Documentation, and Education/Outreach.

9:00 am Breakout Sessions

Focusing on more concise definition of needs (if necessary) and brainstorming of who, what, when and how to address each, and best means of integrating these activities with all others being undertaken to facilitate fuel cell deployment and acceptance.

10:30 am Break

10:45 am Continue Breakout Sessions

12:00 pm Lunch

1:00 pm Presentation of Results from Breakout Sessions

Each group will designate a speaker to represent its discussion to the larger plenary session.

2:00 pm Group Discussion

- Ronald Jarnagin, Pacific Northwest National Laboratory, Facilitator

Identification of common threads among the presentations, suitable action items and roles of various individuals or organizations, with an emphasis on cooperative activities among interested parties. In addition, identify activities that would benefit from cooperation with other (i.e., non fuel cell) distributed generation technology interests.

3:15 pm Wrap-up

3:30 pm Adjourn

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3.F. Presentations and Notes from the Breakout Sessions

Residential Fuel Cells Breakout Session Flipcharts

Top Issues To Be Dealt With

- Standards for hydrogen piping
- Beta, gamma units or prototypes vs. code development (moving targets)
- Acceptance tests (hydrogen infrastructure)
- Installers – qualifications – code, certification, licensed. "One-stop installers."
- Standards, codes for fuel cells
- Education of consumers, codes officials, rural and urban building operators. Action items.
- Long-term (15-20 year) maintenance. ESCO could be a viable alternative. Incident handling?
- Certify components for field support
- Insurance/risk reduction
- Texas initiative
- Lessons from solar water heaters. Single incident. Qualifications. Manufacturer instructions
- Fire marshals [extension of building] – major issue
- NFPA 853 to address < 50 kW installation standard
- Hydrogen production and storage changing zoning
- Sensors, olfactory organ for deodorized gases.
- Sulfur traps
- Annual ratings for fuel cells (NIST, ASHRAE)

Other Items For Consideration

- Copper piping vs. stainless steel
- Listed for hydrogen? Materials – valves, piping.
- Action: ASTM to address B31.3
- Prototype units installed. Experimental units. Length of time/timeframe specified. Universities: self inspection. Broad application.
- Acceptance testing. Manufacturer installation instructions. IMC Section 924.

Installers

- OEMs – only ones allowed to certify installers.
- Licensing at national, state.
- Voluntary certification
- Stakeholders – OEMs, end-users, building people, contractors, banks, government.
- Government financed. Training/certification system.
- Certified or voluntary?

Education (Joe Galdo, Anne-Marie Borbely, DOE/PNNL)

- Code officials, users, installers
- Stakeholders (identify)
- Awareness – exists – architects/engineers/end-users
- Marketing – cultivating customers
- "Turbotax" for Distributed Generation technologies

Long-Term Maintenance

- Definitions
- Hydrogen storage/production
- Insurance
- Texas initiative
- Sulfur traps
- Disposal
- 20 year maintenance
- Banks/insurance companies
- Resale of units

Discretionary (I.E., Less Critical) Items

- CE marking – self certification – not acceptable to code officials. Model bodies will accept 3rd party, non-biased entity with quality problems. (next three items included)
- Long-term maintenance, not code issue. When house is sold? Insurance? Lender? Lack of contractors? ESCO – one approach (PGE, Edison). Any incident?
- Fuel cells are appliances – codes and for educational purposes.
- Grid – I/C – utility. Transfer switch – backup generator. Identify stationary vs. portable. 1547 standard, standardize requirements and utility acceptance – Texas initiative.
- Adopt current codes – noted.
- Contact local AHJ on zoning/environmental requirements – early in the process. Size will impact – kW, volume, height
- Fuel cell education – downplay technical and emphasize value. Compare existing technology – furnace.
- Increase participation of end-users, consumer, A&Es, contractors on
    - Model code building
    - Standards – building.

  In ANSI, established process of participation.
- Code writers and manufacturers need to talk to each other
- Rural and urban codes implementation different, including fuel cells – 40,000 jurisdictions

- Hydrogen generator (reformer) standard in draft is available from CSA (Todd Strothers)
- ANSI standard addresses natural hazards impact on R-fuel cell. Z21.83 also addresses residual gases on shutdown.
- 1547 addresses reverse back feed
- Sulfur traps – manufacturers need to address
- Cincinnati, OH, September 16-20, 2001 model building codes, second half of code changes
- Emergency generator – not for fuel cell
- Component compatibility – gas codes address these

Other Observations

- Matched sets may not be an issue – more relevant to commercial size
- Indoor or outdoor units? – Z21.83 addresses outdoors, especially SOFC
- Emergency generators NFPA 110 – may include fuel cells, may exclude hospitals (NFPA 111?)
- ASME PTC 50 (performance test standard) – standardization of data report (performance, measurement)
- NES Protocol – to verify compliance with building codes
- ICBO – similar evaluation service (under development) (IMC 2000)
- IEEE 1547 (electrical) addresses installation commission
- Normal installations do not need testing lab unless installed outside requirements/instructions
- Use installation acceptance at other jurisdictions as a possible route
- Manufacturers should have customer feedback – duly noted
- Fuel, rather than fuel cell, is major concern
- HUD initiative to include energy-efficiency – including renewables, fuel cells, in new residential development (also DOE: Rebuild America). Specific segments address codes
    - PATH – Test technologies, performance
    - NAHBRC.org/PATH
    - Pathnet.org (includes fuel cells)
- Model building codes recognize spirit and intent – demonstrate equivalency in performance (particularly prototypes)

Vehicular Fuel Cells Breakout Session Notes

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
Research/Testing/ Documentation	▪ Basis for designation of a fuel cell as stationary, portable, or vehicular		X	X	IEC TC-105 Working Group #1 should handle this. Dave Conover will ocmmunicate with Kelvin Hecht and Steve Kazubski of the US TAG to ensure these three terms are addressed: Stationary Fuel Cell Portable Fuel Cell Vehicular / Mobile Fuel Cell	Dave Conover, Deputy Director of the US TAG for IEC TC-105. To be accomplished ASAP.
	▪ Safety related to hydrogen production	X			SAE has a Fuel Cell Standards Working Group on Safety, covering all aspects of vehicular safety for fuel cell vehicles, led by Glenn Scheffler.	
					On-Board Reformer design criteria is addressed by SSAE J2579 under the SAE Working Group. Jane Hock will convey this concern to the SAE Fuel Cell Standards Working Group at the next meeting on June 12.	SAE, Jane Hock
					Vehicle crash response is covered by SAE J2578 under the SAE Safety Working Group. Jane Hock will follow up.	SAE, Jane Hock
					List out safety issues associated with each scenario and I.D. who is is working on each one of them. SAE has developed a list of safety issues, available on their web site. NHA and ISO TC-197 are also working on these issues. SAE has liaison	Dave Howell

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
					agreements with NHA and ISO Tc-197. ICC is also working on some of these issues. Dave Howell will work with PNGV to explore the task to compile a list of all these safety scenarios and keep it up to date.	
	▪ I.D. of necessary safety concerns for each type of fuel cell and how to address them			X	This list will be explored by Dave Howell of PNGV	Dave Howell
	▪ Ventilation needs for all parking garages		X		Being researched by ICC for Fuel Cell Safety Standards Work by Dr. Swain in Florida. Additional work on garages and tunnels may be necessary. DOT and NHTSA may need to be involved. Jane Hock will convey this concern to the SAE Fuel Cell Standards Working Group at the next SAE meeting on June 12, 2001.	ICC, Guy Tomberlein
	▪ How combustible liquids and flammable gases can co-exist in the same interior spaces or be stored on the same site		X		Same as above	ICC, Guy Tomberlein
	▪ Standardization of data		X		The following proposed SAE standards address these issues: Fuel Cell System Performance Testing Fuel Processor Subsystem System Performance Testing Fuel Cell Stack Subsystem Performance	SAE, Jane Hock ASME, Bob Wichert

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
					Testing ASME PTC-50 also addresses fuel cell system efficiency performance. Jane Hock will bring this to the attention of SAE. Bob Wichert will bring this to the attention of ASME.	
	▪ Basis for the acceptability of fuel cell vehicle storage, fueling, and use within the current building infrastructure		X		ICC ad hoc hydrogen working group is addressing this issue.	ICC ad hoc hydrpgen working group.
	▪ *Need to address reforming on board or off site and issues associated with each*		X		See hydrogen production above	

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
Education/Outreach and Service/Field Support	▪ Operational guidelines for consumers and distributors			X	Education/Training	SAE/Industry/OEM/Component Manufacturers
	▪ How to address hydrogen safety	X			Covered previously	
	▪ Servicing and maintenance protocols are being explored by SAE in cooperation with the Service Technicians Society (STS)	X			Covered by SAE	Covered by SAE
	▪ *Need to integrate fuel cell technology into airline support applications*	X			Covered by SAE.	SAE, Jane Hock
	▪ *Need to integrate fuel cell technology into portable power applications.*	X			Fuel Cell Manufacturers should work with various temporary power markets.	Manufacturers
	▪ *Need to identify regulatory barriers to fuel cell utilization.*	X			Fuel Cell Manufacturers should work on this issue.	Manufacturers
	▪ *Need to compete against gearhead mentality regarding IC engine competition*			X	Fuel Cell Manufacturers should educate appropriate audiences.	Manufacturers
	▪ *Need energy efficiency message to drive application of fuel cells*	X			Develop education package.	DOE, Fuel Cell Manufacturers, NGOs, Associations, EPA
	▪ *EMTs need help dealing with increased issues associated with use of fuel cells and related fuels*				Covered by SAE action item above.	SAE

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
	▪ *Service technicians need to be educated, in place and certified*				Add qualified service technicians to operational guidelines above.	Manufacturers, SAE, Jane Hock
	▪ *Aircraft in process inspectors need to be trained in fuel cell technology*				Same as above.	Manufacturers, SAE
	▪ *Auto Inspectors / mobile platform inspectors*				Same as above.	Manufacturers, SAE
	▪ *What do commercial insurance carriers need?*				Being accomplished by SAE in cooperation with insurance liability industry.	SAE Working Group, Jane Hock

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
Future codes and standards	▪ SAE has started a dialogue with the Performance Review Institute (PRI) for potential mobile unit certification				No action required	
	▪ *Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility facility-need to review use group issues*				ICC is studying this issue ASAP.	ICC ad hoc hydrogen working group.
	▪ *SAE has relationship with transit standards consortium for standards for bus applications*				Continue relationship.	SAE, Transit Standards Forum
	▪ *Federal transit authority – bus standards on safety, but also performance*				Continue this work.	FTA
	▪ *Refueling stations may be a big issue (OEMS considering getting involved in distribution of fuel)*				Inform ICC of the possibility of dealerships becoming fueling stations for hydrogen or otherwise.	ICC, Guy Tomberlein
	▪ *SAE is doing a lot in codes and standards*				Continue this effort	SAE
	▪ *Need hydrogen infrastructure*				This is a market issue. DOE OPT (Carol Hammel) is assessing what needs to be done and developing a plan for what the infrastructure should be.	DOE (Carol Hammel), manufacturers, etc.

TOPIC	VEHICULAR	PRIORITY H	PRIORITY M	PRIORITY L	ACTION	RESPONSIBLE PARTY
	▪ *Need to address parking garages?*				See ICC item above.	
	▪ *What about tunnels? (DOT and NITSA need to address this)*				See ICC item above.	
	▪ *Will state vehicle inspectors need to inspect fuel cell related components?*				See educational item above.	
	▪ *What about passive ventilation of enclosed spaces for hydrogen safety?*				See ICC item above.	
	• *NFPA Building Codes*				Review NFPA Building, Mechanical, Electrical, Plumbing, and other new NFPA building codes to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.	Manufacturers
	• *National Building Code of Canada, Administered by the National Research Council of Canada*				Review National Building Code of Canada to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.	Manufacturers
	• *Utility Company or Federal refueling stations may not be required to follow building codes.*				Utility companies and Federal facilities will have to review their requirements	Utility companies and Federal facilities.

Vehicular Fuel Cells Breakout Session Presentation

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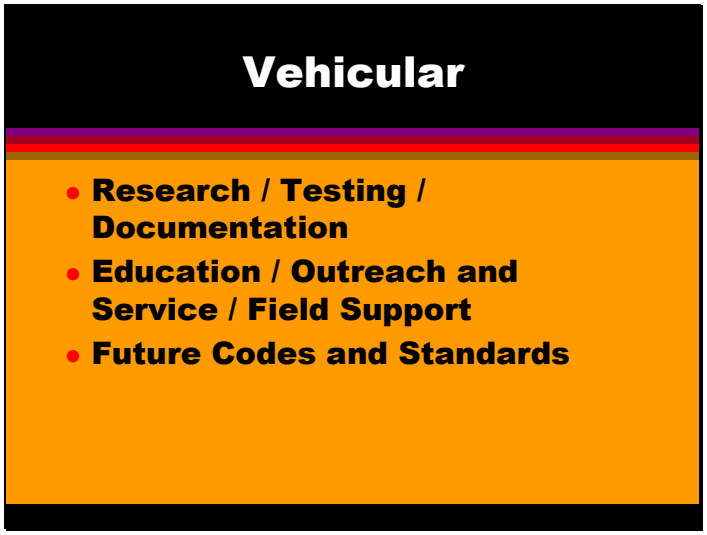

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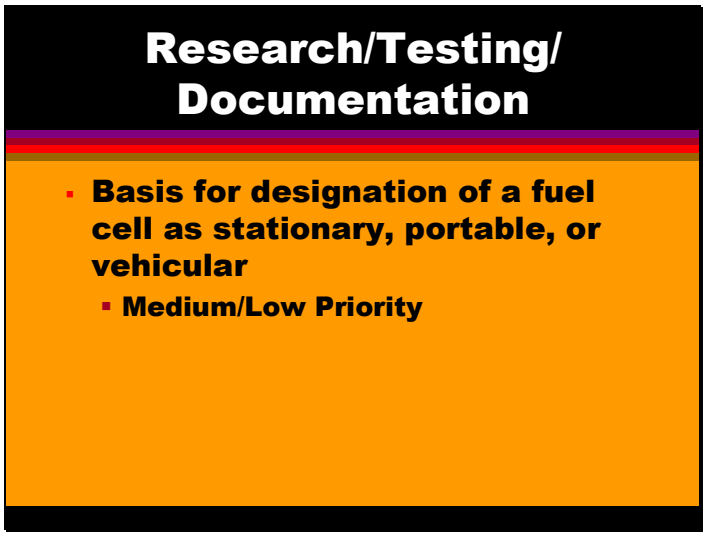

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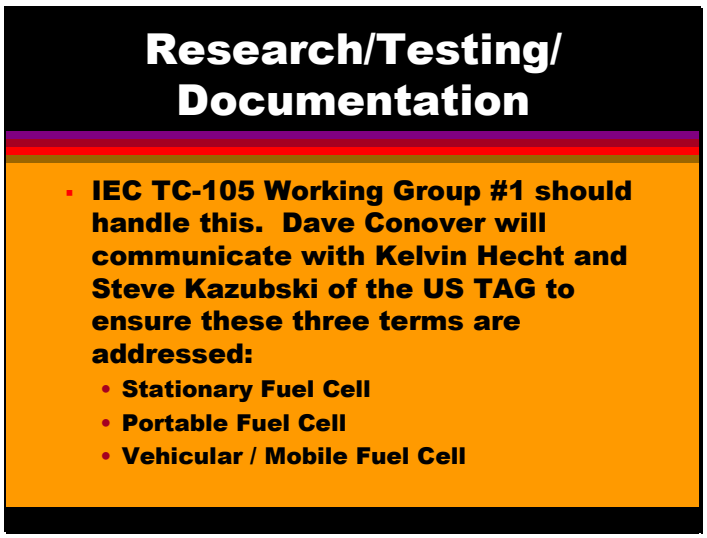

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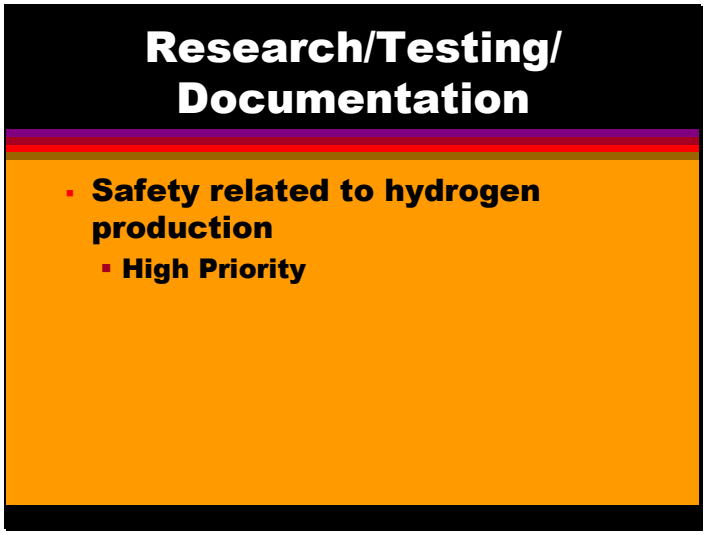

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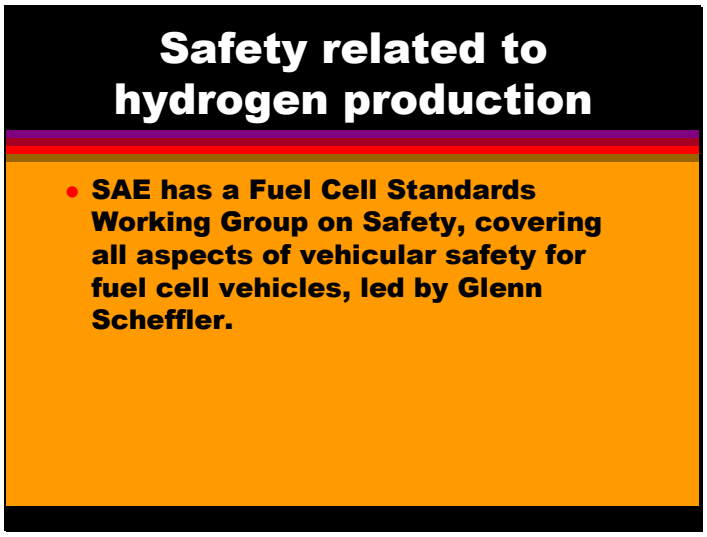

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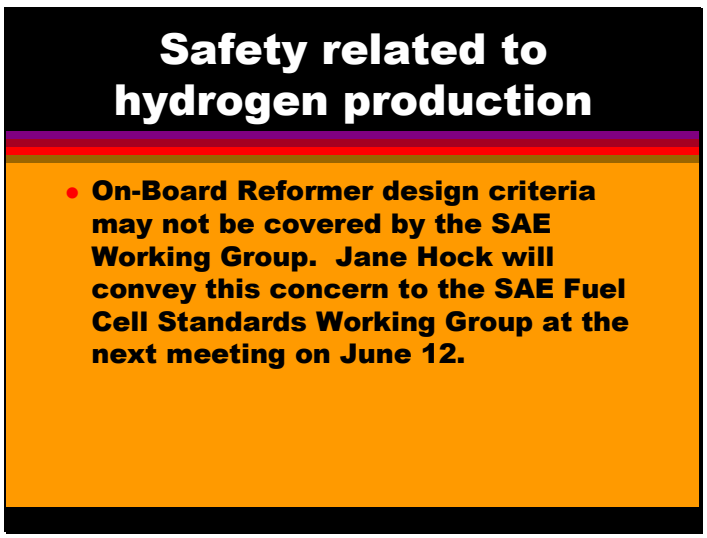

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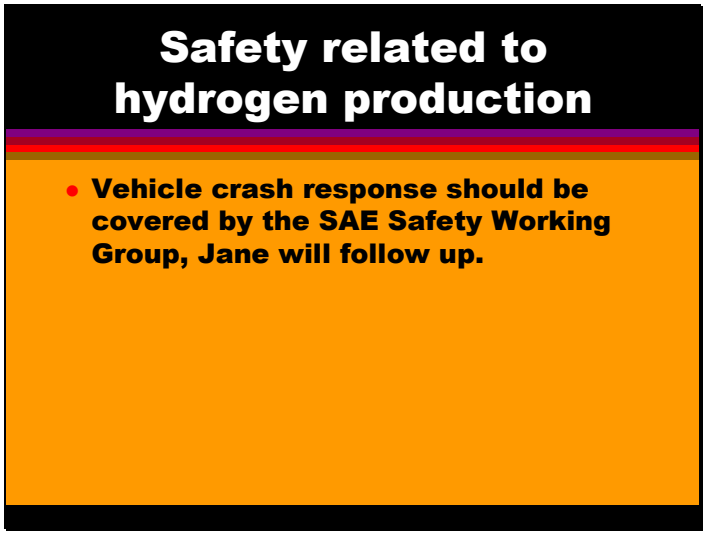

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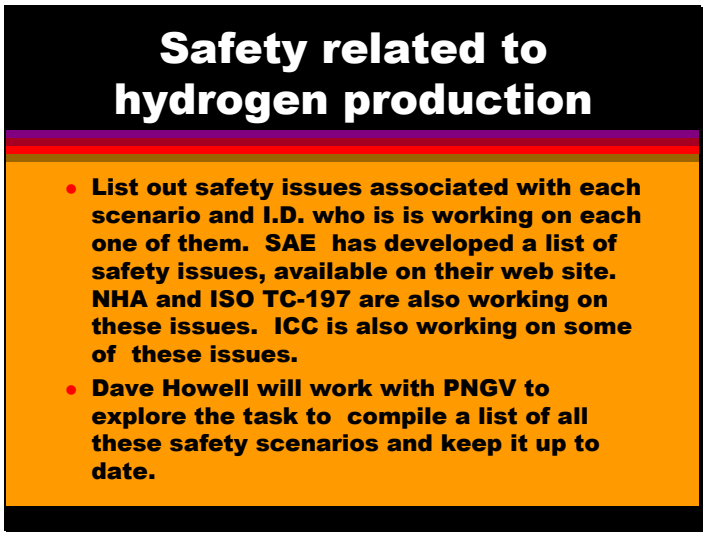

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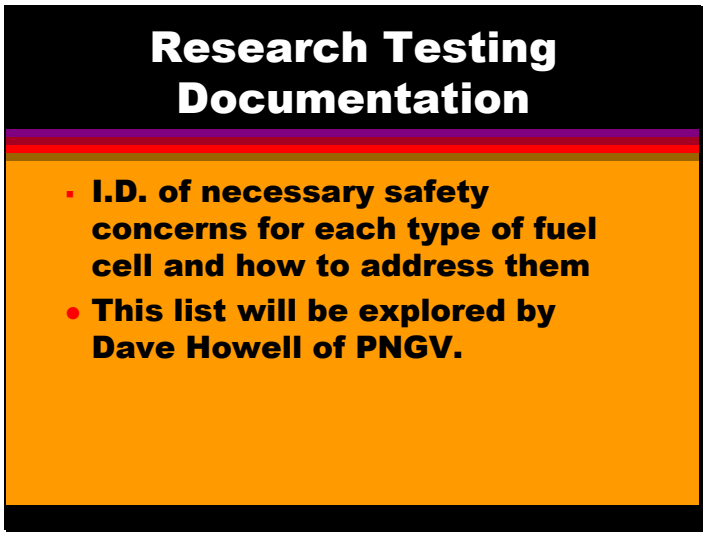

Slide 10

Research Testing Documentation

- **Ventilation needs for all parking garages.**
  - **Being researched by ICC for Fuel Cell Safety Standards Work by Dr. Swain in Florida. Additional work on garages and tunnels may be necessary. DOT and NHTSA may need to be involved.**

Slide 11

Research Testing Documentation

- **How combustible liquids and flammable gases can co-exist in the same interior spaces or be stored on the same site.**
  - **Same as above.**

Slide 12

Research Testing Documentation

- **Standardization of data**
- **The following proposed SAE standards address these issues:**
  - **Fuel Cell System Performance Testing Fuel Processor Subsystem System Performance Testing**
  - **Fuel Cell Stack Subsystem Performance Testing**

Slide 13

Research Testing Documentation

- **Standardization of data**
  - **ASME PTC-50 also addresses fuel cell system efficiency performance.**

Slide 14

Research Testing Documentation

- **Standardization of data**
  - **Jane Hock will bring this to the attention of SAE.**
  - **Bob Wichert will bring this to the attention of ASME.**

Slide 15

Research Testing Documentation

- **Basis for the acceptability of fuel cell vehicle storage, fueling, and use within the current building infrastructure.**
  - **ICC ad hoc hydrogen working group is addressing this issue.**

Slide 16

Research Testing Documentation

- ***Need to address reforming on board or off site and issues associated with each***
  - **Same as hydrogen production, above.**

Slide 17

Education/Outreach and Service/Field Support

- **Operational guidelines for consumers and distributors**
  - **Education & Training by OEMs, Component Manufacturers, SAE.**
- **How to address hydrogen safety**
  - **Covered above**

Slide 18

Education/Outreach and Service/Field Support

- **Servicing and maintenance protocols are being explored by SAE in cooperation with the Service Technicians Society (STS)**
  - **Covered by SAE, Jane Hock**

Slide 19

Education/Outreach and Service/Field Support

- ***Need to integrate fuel cell technology into airline support applications***
  - **Covered by SAE, Jane Hock**

Slide 20

Education/Outreach and Service/Field Support

- ***Need to integrate fuel cell technology into portable power applications.***
  - **Fuel Cell Manufacturers should work with various temporary power markets.**

Slide 21

Education/Outreach and Service/Field Support

- ***Need to identify regulatory barriers to fuel cell utilization.***
  - **Fuel Cell Manufacturers should work on this issue.**
- ***Need to compete against gearhead mentality regarding IC engine competition***
  - **Fuel Cell Manufacturers should educate appropriate audiences.**

Slide 22

Education/Outreach and Service/Field Support

- ***EMTs need help dealing with increased issues associated with use of fuel cells and related fuels.***
  - **Covered by SAE action item above.**

Slide 23

Education/Outreach and Service/Field Support

- ***Service technicians need to be educated, in place and certified***
  - **Add to operational guidelines above.**
  - **Manufacturers, SAE, Jane Hock**

Slide 24

Education/Outreach and Service/Field Support

- ***Aircraft in process inspectors need to be trained in fuel cell technology***
  - **Same as above**
- ***Auto Inspectors / mobile platform inspectors***
  - **Same as above**

Slide 25

Education/Outreach and Service/Field Support

- ***What do commercial insurance carriers need?***
  - **Being accomplished by SAE in cooperation with insurance liability industry -- Jane Hock.**

Slide 26

Education/Outreach and Service/Field Support

- ***Need energy efficiency message to drive application of fuel cells***
  - **DOE, Fuel Cell Manufacturers, NGOs, Associations, EPA to develop educational package**

Slide 27

Future codes and standards

- **SAE has started a dialogue with the Performance Review Institute (PRI) for potential mobile unit certification**

Slide 28

Future codes and standards

- ***Producing and storage of hydrogen on site may change the building categorization to a hazardous production facility facility-need to review use group issues***
  - **ICC is studying this issue ASAP.**

Slide 29

Future codes and standards

- ***Refueling stations may be a big issue (OEMS considering getting involved in distribution of fuel)***
  - **Inform ICC of the possibility of dealerships becoming fueling stations for hydrogen or otherwise.**
  - **Guy Tomberlein**

Slide 30

Future codes and standards

- ***SAE is doing a lot in codes and standards***

Slide 31

Future codes and standards

- ***SAE has relationship with transit standards consortium for standards for bus applications***
- ***Federal transit authority – bus standards on safety, but also performance***

Slide 32

Future codes and standards

- ***SAE is doing a lot in codes and standards***
- ***Need hydrogen infrastructure***
  - **This is a market issue. DOE OPT (Carol Hammel) is assessing what needs to be done and developing a plan for what the infrastructure should be.**

Slide 33

Future codes and standards

- ***Need to address parking garages?***
  - ***See ICC above***
- ***What about tunnels? (DOT and NITSA need to address this)***
  - ***See ICC item above***

Slide 34

Future codes and standards

- ***Will state vehicle inspectors need to inspect fuel cell related components?***
  - ***See educational item above***
- ***What about passive ventilation of enclosed spaces for hydrogen safety?***
  - **See ICC item above**

Slide 35

Future codes and standards

- ***NFPA Building Codes***
  - **Manufacturers to Review NFPA Building, Mechanical, Electrical, Plumbing, and other new NFPA building codes to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.**

Slide 36

Future codes and standards

- ***National Building Code of Canada, Administered by the National Research Council of Canada***
  - ***Manufacturers to* Review National Building Code of Canada to ensure proper coverage of fuel cells, consistent with work done for ICC Building Codes.**

Slide 37

Future codes and standards

- ***Utility Company or Federal refueling stations may not be required to follow building codes.***
  - **Utility companies and Federal facilities will have to review their requirements**

Portable Fuel Cells Breakout Session Notes

Portable Fuel Cell Appliances (Definition)

1. A fuel cell generator of electricity, which is not fixed in place. A portable fuel cell appliance utilizes a cord and plug connection to a grid-isolated load and has an integral fuel supply.

- definition needed for battery substitutes.(remove cord and plug connection) May not be the case in scenarios.
- Micro fuel cells
- Fire Codes – Stockpiling fuel
- Quick disconnect to fuel tank ? OK but not to utility fuel line
- Action: expand definition scope to include non-cord connected products i.e laptop, flashlight (HJ, JG to address with the ICC Ad Hoc Hydrogen Comm. in Golden, CO 06/04-5)
- 18.1 Occupancy (Code)
- 18.2 Container (Standard)
- (Beth to verify)
- Add "non-reversible" to definition ?

2. Indoor use (Confined Spaces)
- -work is being done by CSA 3.01 to address oxygen depletion, hydrogen emissions
- limit power output/fuel supply of FC to intrinsic levels
- toxicity
- other indoor emissions issues i.e. MEOH, Propane etc…) Impact
- Confined Space (Boat, house, RV's, aircraft) what std. Will Apply (ask T.Strothers)
- Fuel storage technology (NaBH4, NH3…)
- H2 Gaseous fuel Detection – Will H2 be odorized ? detection.
- Actions: ID CSA limits (T.Strothers), FC Council determine issues other than home/garage, commercial bldgs (FC Council Portable Group) Requires research
- Make sure product stds insure full range of confined space issues including O2 depletion, H2 emissions, multiple appliance use.

3. Education/Consumer Awareness
- Literature, product search
- USFCC Working Group (Web Site)
- Educating Manufacturers
- Educating Regulators
- Educating Consumers
- Actions: Status report at FC 6

4. Interchangability fo Components
- Disposal/Recycling (Options and opportunities)
- MF lifetime ownership

- Product life cycle
- Study hazards
- Certification of replacement components (Stack?)
- Actions: Expand the scope of the CSA to include other FC technologies

5. Testing Protocols (Standards for operating range – performance
- Actions: Verify whether ASME PTC 50 covers portable (ask D.Conover/B.Wichert)
- Do we need performance standards ? (Ask the USFCC WG for portable)

6. Transport of fuel supply
- DOT
- Fuel type
- Actions: Update from portable WG for FC Summit 6 (RMES report)

7. Marking and labelling (misuse of appliance) – beyond standard (CSA) requirements. Product liability. Misuse of appliance.
- Actions: Review and participate in the development of CSA 3.01. Encourage CSA to action and identify gaps. Review CSA standard at FC Summit 6

8. Reversible FC appliances

Stationary/Commercial Fuel Cells Breakout Session Presentation

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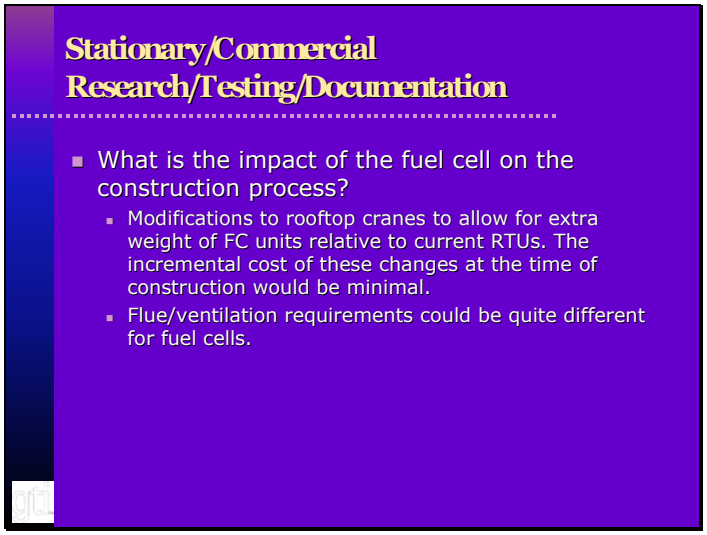

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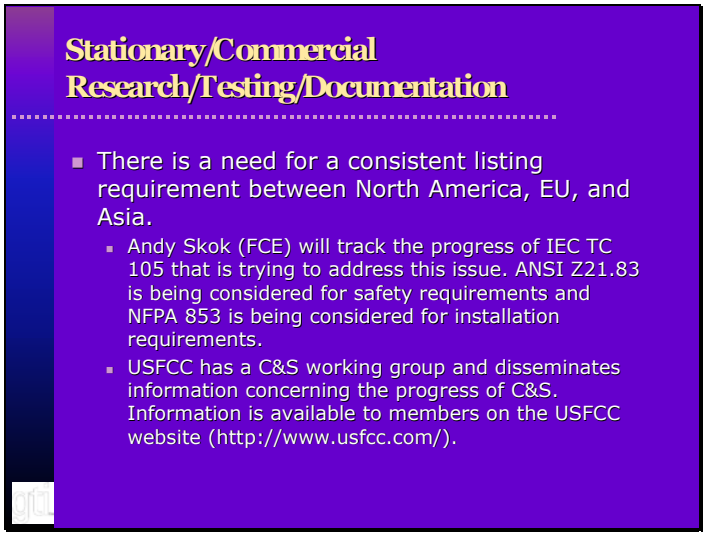

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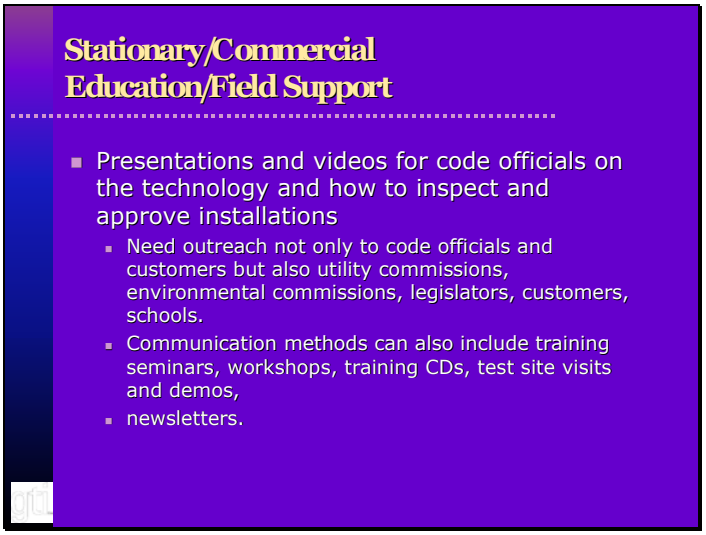

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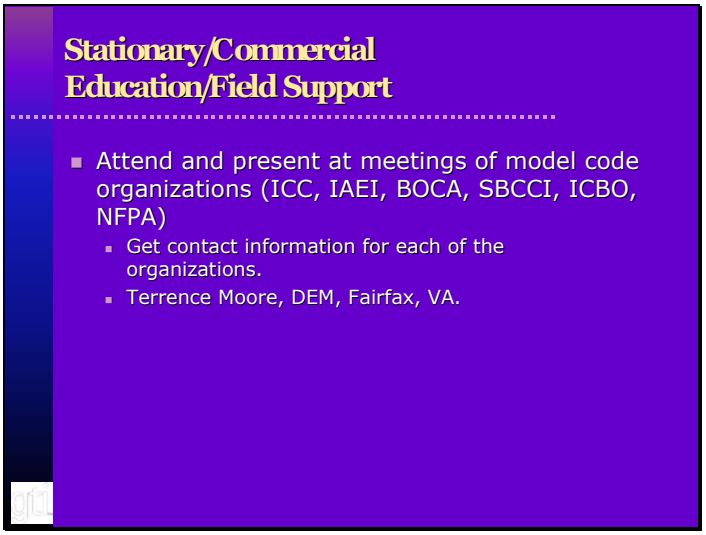

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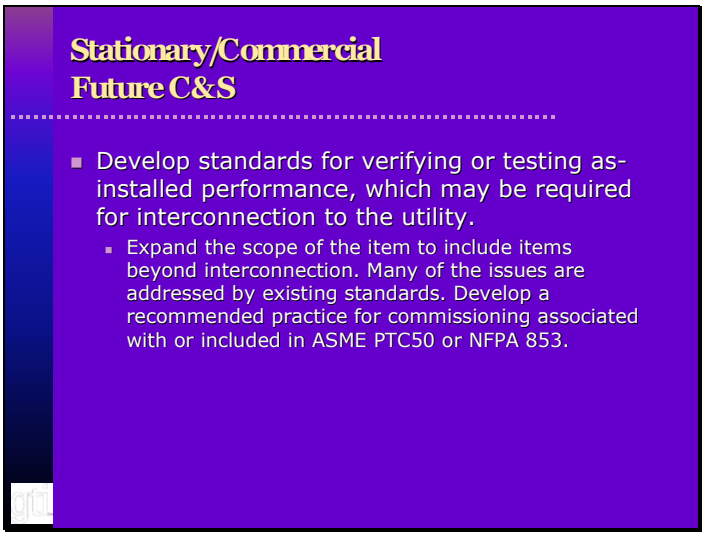

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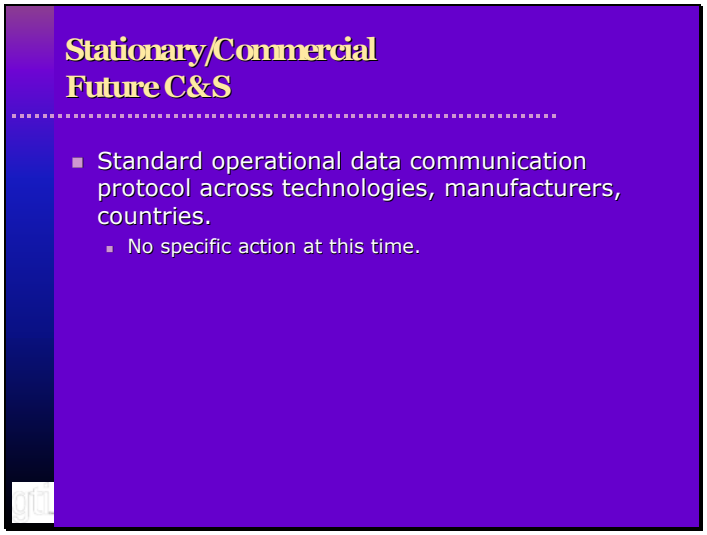

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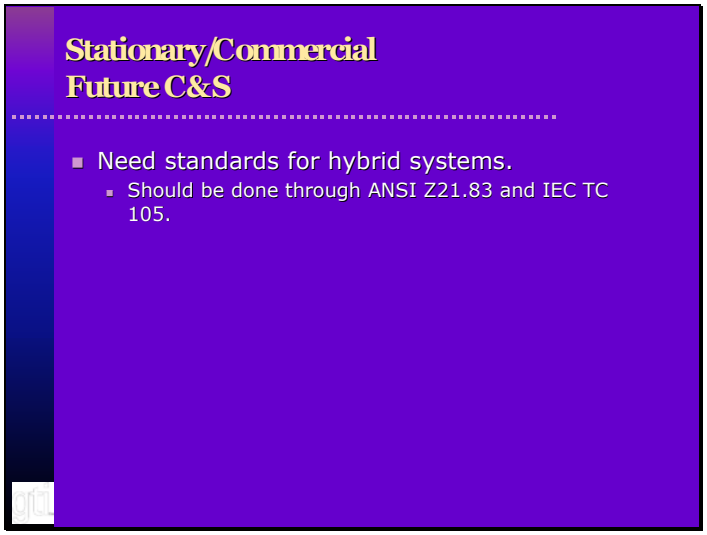

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