U.S. National Work Group (USNWG) Meeting
for the
Development of Commercial Hydrogen Measurement Standards

April 28-30, 2009
California Fuel Cell Partnership (CaFCP)
3300 Industrial Blvd.
West Sacramento, CA 95691

Call In Number: 1-916-371-2124
Participant Code: N/A
Host Code: N/A

CONTACTS:
NIST Weights and Measures Division – (301) 975-4004
Lisa Warfield (NIST) – (301) 975-3308
Juana Williams (NIST) – (301) 975-3989
Linda Carrizosa (CaFCP) – (916) 371- 2870

AGENDAS

The meetings of the USNWG Subcommittees are sponsored by the U.S. Department of Energy and U.S. Department of Commerce's National Institute of Standards and Technology.

Purpose: The U.S. National Work Group (USNWG) Subcommittees are meeting to continue their work to promote the establishment of a comprehensive set of (1) design, accuracy, installation, use, and method of sale requirements, (2) test procedures, and (3) quality standards for equipment used in hydrogen measurements for vehicle and other refueling applications.

ATTACHMENTS:

Appendix A Summary of the February 2009 USNWG Meeting
Appendix B Examination Procedure Outline 29 (Draft Dec 2008)
Appendix C Pros and Cons of the Performance Test Methods
Appendix D Powertech Coriolis Meter Test Data
Appendix E Draft 4.0 of NIST Handbook 44 Gas Measuring Devices Code
Appendix F Comparison of MMQ Requirements in Draft H2 Code and OIML R 139
Appendix G Wholesale Delivery Gaps
Appendix H Draft 2.3 of NIST Handbook 130 Uniform Laws and Regulations, Engine Fuel Quality

AGENDA – DAY 1

DEVICE STANDARDS SUBCOMMITTEE (DSS) MEETING

Tuesday, April 28, 2009, 8:30 a.m. – 5:00 p.m. (PDT)
California Fuel Cell Partnership
West Sacramento, CA
Chair – Kristin Macey (CDFA DMS)
Technical Advisor – Juana Williams (NIST WMD)

8:30 - 8:40 **(1) Welcome and Introductions**

The DSS participants will be welcomed in-person and on audio conference, the meeting is called to order, and its purpose reviewed. The collaborative work by the meeting's sponsors will be recognized. Participants will be briefed on the facilities available at the California Fuel Cell Partnership, the schedule of events, meeting procedures, and materials. Participants will be invited to provide their name, affiliation, and state their specific area of interest in the work to develop hydrogen measurement standards.

8:40 - 9:00 **(2) Administrative Business**

The DSS will discuss and decide on procedures for managing and documenting its technical work. The following items will be addressed:

(a) Approve the Summary of the February 2009 USNWG Meeting (See Appendix A).

9:00 - 10:00 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement**

The issues in paragraphs (a) and (b) below regarding the draft hydrogen gas measuring devices code requirements and corresponding test procedures were identified and discussed to some degree by the USNWG. During the February 2009 teleconference, the USNWG agreed to decide on a tentative action plan for any outstanding issues either before or during the course of this week's meeting. An action plan is recommended to ensure that there are no gaps in the final code that might delay its acceptance in the weights and measures standards development process in fall 2009.

Several items were identified as requiring additional discussion and possible resolution by the DSS. These items are listed in a table, along with where they occur in the April agenda and some strategies for managing each issue.

Wrap Up Strategies for the Hydrogen Codes					
Rank by Priority (1 Low* – 8 High)	**Issue**	**April 2009 Agenda Item**	**Form a Special Task Force [Yes (Y)/No(N)]**	**Schedule a Tele/Web Conference [How Many]**	**Comments**
	Minimum Measured Quantity	**(3)(b)(i)**			
	Wholesale Applications	**(3)(b)(ii)**			
	Carry Over Codes	**(3)(b)(iii)**			
	SAE Fill Protocol Guidelines	**(3)(a)(i)**			
	Test Data and Procedures	**(3)(a) and (3) (a)(ii)**			
	Key Players	**(3)(b)(v)**			
	Stationary vs. Mobile	**(3)(b)(iv)**			
	Other (Please List)				
	Tolerances				
* This issue is neither complex nor controversial and requires minimal work to resolve. The work is near completion and could be conducted without					

expending significant resources using options such as email.

(a) Test Procedures

Test procedures for field officials and type evaluation criteria are based on the requirements in NIST Handbook 44 code sections. On multiple occasions the DSS has requested input from the weights and measures and hydrogen communities on test procedures and equipment. During the December 2008 meeting Diane Lee provided the DSS with a draft outline of an examination procedure for field officials (See Appendix B). This will be an opportunity for updates and/or planning for future work on these test procedures.

(i) SAE Test Tank/Standard and Protocol

The DSS agreed to consider an SAE guidelines for a single test unit for use to verify a device's compliance with SAE standards and legal metrology requirements. The USNWG may wish to discuss the SAE guidelines for tank sizes, which are designed to prevent over heating and pressurization of the tank. The USNWG should discuss the suitability of these recommendations for use in weights and measures test that simulate real world deliveries to hydrogen vehicles and other refueling applications.

(ii) Test Data

Based on the allowable errors and uncertainties for a test standard (see NIST Handbook 44 Appendix A Fundamental Considerations 3.2. Tolerances for Standards (page A-2)). The USNWG is in the early stages of establishing guidelines for test methods so that each test method does not contribute significant error to the test results and the dispenser test results do not exceed the tolerances in NIST Handbook 44. Given this fact, can we proceed with minimal test data and require that dispensers meet the 1.5% Acceptance and 2.0% Maintenance Tolerances? These tolerances are consistent with those specified for similar applications in the Mass Flow Meters Code and corresponding international requirements.

During the December 2008 meeting Diane Lee provided the DSS with a preliminary analysis (See Appendix C) of the uncertainties for test methods. This will be an opportunity for updates on the analysis.

In response to the DSS's request for data the results of tests by Powertech were made available by Micro Motion (See Appendix D). This will be an opportunity for the DSS to fully discuss the test data in its possession since March 2009.

The data provides the results of coriolis mass flow meter tests performed by Powertech. The performance data represents fast fill testing of two separate meters used to deliver gaseous hydrogen. The data demonstrates the performance of meter A with an average error of

– 4.06% and meter B with an average error of – 0.99%, where meter B was within the proposed tolerances specified in the draft code. The gravimetric test method was used to gather the results. The DSS may also wish to explore other opportunities for obtaining test data.

(b) Draft Code

The DSS will have the opportunity to discuss Draft Version 4.0 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code (See Appendix E). This latest version of the draft code is the result of work by the DSS at its February 2009 meeting.

The DSS is reminded that it identified fall 2009 as the target date for submitting a final draft of the device and fuel quality code for national adoption. This means that the work needs to escalate to have the code ready by mid August 2009 so that it can be distributed to all four fall 2009 meetings of the regional weights and measures association and technical sector for measuring devices which are the start of the weights and measures standards development process for 2010.

(i) Minimum Measured Quantity (MMQ)

Has the DSS fully developed requirements that define how to derive the MMQ so that the MMQ value does not conflict with other requirements in the Hydrogen Gas Measuring Devices Code and the Mass Flow Meters Code? Is there a need to further clarify the relationship of MMQ, if one exists, to other measurements, tolerances, and parameters of the system.

The DSS may wish to compare references to MMQ in corresponding OIML R 139 (See Appendix F) as it discusses the readiness of these requirement in the draft code.

(ii) Wholesale Applications

Does the USNWG need to develop requirements to address wholesale applications where a delivery is not made to the end user? Is there a need to ensure that existing requirements intended to apply to both retail and wholesale applications are not so prescriptive that most wholesale applications would have difficulty complying.

The DSS may wish to review specific paragraphs (See Appendix G) identified in the draft code by Bob Boyd (Linde NA, Inc.) to determine if these sections adequately address commercial wholesale applications.

(iii) Application of Corresponding CNG Code to Hydrogen Devices
Like other organizations the USNWG borrowed from existing codes for similar applications rather than reinvent a new code for hydrogen. The DSS may wish to consider paragraphs carried over from the Mass Flow Meters Code which were in need of updating for compressed natural gas applications (e.g., test procedures where condensation affects the test result) so that they are also suitable for hydrogen refueling applications?

(iv) Stationary versus Mobile Applications
Are there sufficient provisions in the draft code so that it is clear as to how it applies to stationary, mobile, and vehicle-mounted applications?

(v) Stakeholder Input
Do we have sufficient input from all stakeholders affected by weights and measures requirements for hydrogen refueling systems? For example have all OEM weighed in on whether or not there are significant differences in the design of hydrogen dispensers that might create concerns for officials attempting to access marking information located behind a cabinet door. The DSS may wish to identify sectors that may be impacted by the hydrogen codes, who have yet to comment on the requirements prior to their being adopted and recognized nationally.

(c) Opportunity for Reports on Related Activities
The DSS is working to harmonize where possible with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The DSS will receive updates on related work by organizations such as ASTM, CaFCP, NHA, OIML, SAE and others as their work continues to progress.

(i) Update on Work at CDFA DMS

(ii) Update on Work at Other Agencies/Organizations

10:00 - 10:15 **Break**

10:15 - 12:15 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

12:15 - 1:30 **Lunch (On your own)**

1:30 - 2:45 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

2:45 - 3:00 **Break**

3:00 - 5:00 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

Meeting adjourns and reconvenes on April 29, 2009 at 8:30 a.m. (PDT)

AGENDA – DAY 2

DEVICE STANDARDS SUBCOMMITTEE (DSS) MEETING

Wednesday, April 29, 2009, 8:30 a.m. – 5:00 p.m. (PDT)
Chair – Kristin Macey (CDFA DMS)
Technical Advisor – Juana Williams (NIST WMD)

8:30 - 10:30 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

10:30 - 10:45 **Break**

10:45 - 12:15 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

12:15 - 1:30 **Lunch (On your own)**

1:30 - 2:45 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Continued)**

2:45 - 3:00 **Break**

3:00 - 4:00 **(3) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement (Wrap Up)**

4:00 - 4:30 **(4) Next Steps/Tasks**
The DSS will discuss ideas for how the work should progress to develop hydrogen measurement standards and test procedures. Several projects were identified in Agenda Item (3). The DSS might consider prioritizing and selecting target dates for each issue.

4:30 - 5:00 **(5) Next Meeting**
At the conclusion of the April 28-29 meeting the DSS will have a better understanding of the work ahead to develop hydrogen

measurement standards and test procedures. Some tasks may be completed by conference calls and email, while others may require an in-person meeting of the DSS. The dates of August 18-19, 2009 have been identified for the next DSS meeting. It is anticipated that there may be a need to dedicate an entire meeting to one specific device related project that is identified by the USNWG. Future meeting locations will be based on logistics and technical tasks that the USNWG must accomplish. The USNWG will make every effort to post meeting information and to avoid scheduling conflicts with upcoming events and meetings in the weights and measures and hydrogen communities.

5:00 **DSS Meeting Adjourns**

AGENDA – DAY 3

FUEL SPECIFICATIONS SUBCOMMITTEE (FSS) MEETING

Thursday, April 30, 2009, 8:30 a.m. – 12 noon (PDT)
California Fuel Cell Partnership
West Sacramento, CA
Chair – Robert Boyd (Linde North America, Inc.)
Technical Advisor – Lisa Warfield (NIST WMD)

8:30 - 8:40 **(1) Welcome and Introductions**

The FSS participants will be welcomed in-person and on audio conference, the meeting is called to order, and its purpose reviewed. The collaborative work by the meeting's sponsors will be recognized. Participants will be briefed on the facilities available at California Fuel Cell Partnership, the schedule of events, meeting procedures, and materials. Participants will be invited to provide their name, affiliation, and state their specific area of interest in the work to develop hydrogen measurement standards.

8:40 - 9:00 **(2) Administrative Business**

The FSS will discuss and decide on procedures for managing and documenting its technical work. The following items will be addressed:

(a) Approve the Summary of the February 2009 USNWG Meeting (See Appendix A).

9:00 - 9:45 **(3) Method of Sale for Hydrogen Dispensing Applications**

The FSS will discuss the latest developments in the method of sale requirements based on Draft Version 2.3 (see Appendix H) of the Uniform Laws and Regulations.

(a) Opportunity for Reports on Related Activities
The FSS is working to harmonize where possible with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The FSS will receive updates on related work by organizations such as ASTM, CaFCP, NHA, OIML, SAE and others as their work continues to progress.

(i) Update on Work at CDFA DMS

(ii) Update on Work at Other Agencies/Organizations

9:45 - 10:00 **Break**

10:00 - 10:30 (**4) Engine Fuel Quality**

(a) Opportunity for Reports on Related Activities
The FSS is working to harmonize where possible with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The FSS will receive updates on related activities by other agencies/organizations.

10:30 - 10:45 **(5) Laboratory Manual**

(a) Opportunity for Reports on Related Activities
The FSS is working to harmonize where possible with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The FSS will receive updates on related activities by other agencies/organizations.

(b) Laboratory Practices and Procedures
The FSS will discuss ongoing work to ensure fuel quality laboratories perform measurements that are traceable to recognized national standards. The FSS will work to promote the establishment of documented laboratory practices and procedures that encompass:

(i) Test Methods and Reproducibility Limits

(ii) Equipment (minimum and recommended) Source and Cost

(iii) Documentation (e.g., Standard Operating Procedures)

(iv) Handling and Storage of Hydrogen Fuel

(v) References and Good Laboratory Practices

(vi) Minimum Training Standards for Laboratory Personnel

(vii) Facilities

(viii) Safety

10:45 - 11:00 **(6) Field Sampling Procedures**

(a) Opportunity for Reports on Related Activities
The FSS is working to harmonize where possible with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The FSS will receive updates on related activities by other agencies/organizations.

(b) Procedures/Guidelines
The FSS may wish to consider work to establish field sampling procedures to provide uniform inspection, sampling, and enforcement procedures to promote the protection of consumers (vehicles) and businesses from economic loss resulting from substandard product and to encourage safe practices by officials conducting inspections. It is recommended that these procedures/guidelines address:

(i) Equipment/Source/Cost

(ii) Good Sampling Practice

(iii) Handling, storage, and transportation

(iv) Minimum Training Standards for Field Officials

11:00 - 11:30 **(7) Next Steps/Tasks**
The FSS may wish to consider how future work should progress to reach the appropriate hydrogen fuel quality standards. Project work and target dates will also be identified.

11:30 - 12 noon **(8) Next Meeting**
At the conclusion of the April 30th meeting the FSS will have a better understanding of the work ahead to develop hydrogen measurement standards and test procedures. Some tasks may be completed by conference calls and email, while others may require an in-person meeting of the FSS. August 18-20, 2009 has been identified as the date for the next USNWG meetings. It is anticipated that there may be a need to dedicate an entire meeting to one specific device related

project that is identified by the USNWG. Future meeting locations will be based on logistics and technical tasks that the USNWG must accomplish. The USNWG will make every effort to post meeting information and to avoid scheduling conflicts with upcoming events and meetings in the weights and measures and hydrogen communities.

12 noon **FSS Meeting Adjourns**