Fuel Cell Power
Office of Power Technologies
DOE

FUELCELL SUMMIT

Volume 1, Issue 1 SPRING 2000

A quarterly newsletter published by the U.S. Department of Energy for the U.S. fuel cell industry to foster development and adoption of codes and standards that put new technologies to work

Moving from Standards to Codes and Enforcement

It's true; good things come to those who wait. . . as long as you work like crazy while you're waiting. The codes you must comply with today were begun years ago by manufacturers, professional societies, trade associations, government agencies, and advocates working together to develop a set of consensus standards. The codes influence the design, manufacture, marketing, and installation of fuel cells. They can bring uniform products to a large market as opposed to divergent products to fragmented markets. They raise consumer confidence and acceptance of new technology and increase the rate of adoption. They break down barriers to trade and open the doors to a worldwide market. If the current codes don't meet your present and long-term needs, it's time to go to work.

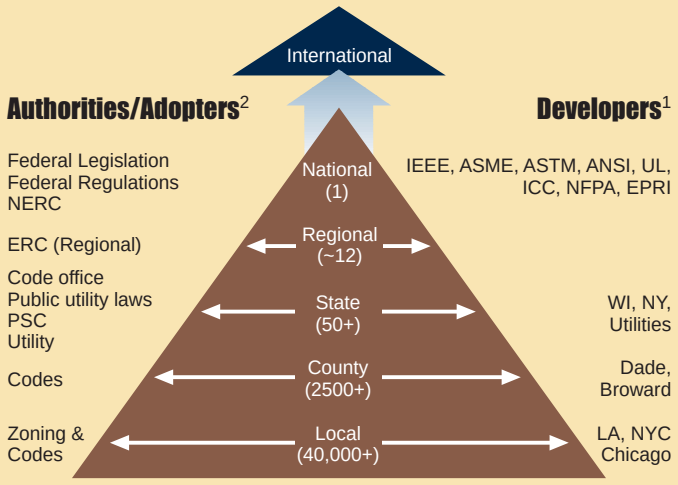
Moving from a consensus on standards to codes that are in force and enforced can be time-consuming. It's a long pipeline with very few shortcuts. The consensus process driving voluntary codes and standards is, by necessity, methodical (read: slow) and always lags technology. If your technology or application is leading-edge, it may not be addressed specifically in existing codes and may require your seeking approval under the "alternate methods and materials" provision. If the work of others has not and is not now preparing code compliance paths for your technology, perhaps you should become involved. If you'd rather have your competitors write the rules you must play by, rest assured, they will.

Somewhere soon, maybe today, a standing committee or standards group will meet to agree on standards to be put forth to code development organizations for incorporation into their model codes. The process can begin to address a common need but is most often initiated to remedy differences. Individuals with diverse expertise meet as peers to determine recommended practices for designing equipment to facilitate uniform methods of installation, agree on performance testing procedures, and provide guidance on other issues related to the technology.

Organizations such as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronic Engineers (IEEE), the International Electrotechnical Commission (IEC), Underwriters Laboratory (UL), and others develop standards that impact the fuel cell industry. These standards are often a part of or are included by reference in the national consensus model codes developed by Building Officials and Code Administrators International, Inc. (BOCA); International Conference of Building Officials (ICBO); Southern Building Code Congress International, Inc. (SBCCI); and the International Code Council (ICC). The code change cycles for these organizations vary widely and can easily run three years or longer. Add to that the non-concurrent changes and the codes become even more difficult to understand.

Once the changes are accomplished and printed copies of the code are available, then the process of educating the design professionals and code official on the new requirements begins. Training and professional development is available from each model code organization and other professional and trade associations. Workloads and budget constraints severely limit the amount of time jurisdictions can allot for training their code enforcement officials, which can hinder application approval. Jurisdictions may adopt the model codes or simply use them as starting points for developing their own. The code being enforced in any particular jurisdiction may not be a verbatim restatement of the national model and may have to be addressed on a case-by-case basis.

Make participation in the code development process a part of your overall business strategy and avoid unwelcome surprises.



[1] There are numerous developers of standards, model codes, guidelines, etc.; each address a number of issues affecting distributed power development, adoption, and implementation.

[2] A number of authorities/adopters of the documents are developed. Development of criteria at the highest (national/international) level possible facilitates uniformity, and those in authority at all levels are more likely to focus their resources on adoption and implementation.

Summary of Selected Codes and Standards for Distributed Power Technologies

Evaluation Report to Bridge the Gap Between New Technologies and Building Codes

"My product is so new the codes and standards don't provide sufficient guidance for the code official to approve the application." "How can I convince the official my application of this technology meets the regulations? What documents do I need to provide?" "Building codes will accommodate new technologies but they are not developed at the same pace, and I need approval for installations now." Hang on, the bridge between new technologies and building codes is under construction.

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To facilitate acceptance by regulatory officials, the U.S. Department of Energy, through its Pacific Northwest National Laboratory, has the National Evaluation Service working with fuel cell developers and manufacturers to develop a protocol by which stationary fuel cell power plants for buildings can be evaluated. With the protocol as a basis, a National Evaluation Report can be issued on the subject technology. The report will detail the conditions under which a particular fuel cell satisfies the requirements of model codes and will help regulators assess the proposed installations. The report will serve as a single codes and standards compliance document for jurisdictions nationally and offer uniformity to the documentation needed to support the request for permit. The protocol will also apprise fuel cell power plant manufacturers, distributors, and installers of the testing and documentation needed by the regulatory community to accept the technology and approve installations in a timely manner.

An advisory committee is currently working with the National Evaluation Service in developing the protocol. With a first draft prepared in April, a completed document is expected in August 2000. Additional information is available on the National Evaluation Service web site at www.nateval.org.

Clean Energy Partnership Delivers New Fuel Cell Power Technology to Long Island

Secretary of Energy Bill Richardson joined state and local officials at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory in March to dedicate an advanced fuel cell power system that will be tested there. The installation of three state-of-the-art 7-kW cells is the first of several installations planned across Long Island by the Long Island Power Authority and Plug Power to test the performance and measure the potential for power generation from fuel cells.

Installed in homes and businesses, the cutting-edge fuel cell technology converts natural gas into usable electricity without combustion through an electrochemical reaction. The fuel cell also produces heat, which can be used to provide hot water or meet other heating needs with greater energy efficiency and significantly fewer emissions than other power systems. "Just one of these fuel cells would be able to meet the electricity and hot water needs of the average home on Long Island," said Secretary Richardson.

"We believe that fuel cells will become an integral part of the new economy for the energy industry and will help fulfill our mission of providing a complete range of power solutions— from wellhead to consumer," said Robert L. Nardelli, president and CEO of GE Power Systems. "Field testing at sites like Brookhaven is an important step in Plug Power and GE Power System's efforts to refine fuel cell technology and develop competitive product offerings for residential and small commercial applications."

The research that brought the fuel cell system to Brookhaven is the result of a partnership forged between DOE, the Long Island Power Authority, Plug Power, and the New York State Energy Research and Development Agency.

The Case for a CHP Performance Standard

The U.S. Department of Energy (DOE) has set a goal of doubling the number of installed combined heat and power (CHP) systems in the United States by 2010. To help meet this goal, a system performance standard needs to be developed so newer designs of competing technologies can be compared to a baseline performance of CHP systems. A system performance standard that measures heat recovery efficiency, fuel conversion efficiency, and carbon management would move fuel cell systems to the top of the list of desirable technologies for industrial and commercial energy customers.

A system performance standard could be applied to a CHP system during a "system commissioning" process as is commonly done with other energy systems. System commissioning is a quality assurance process for achieving, verifying, and documenting the performance of a system to meet its operational need within the capabilities of the documented design and specified equipment capacities. System commissioning should result in a fully functional system that can be operated properly and maintained throughout its useful life. So in addition to listing the procedures, methods, and documentation requirements during the commissioning process, the performance standard could also contain a section on the formal training program to be used by operation and maintenance personnel.

A system performance standard could fall within the purview of a standards-development organization such as the American Society of Heating, Air-Conditioning and Refrigerating Engineers (ASHRAE) or the American Society of Mechanical Engineers (ASME). Industry, government, and end-users working together could develop a formal standard or a guideline to be used in evaluating the performance of competing systems among the various distributed generation technologies.

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2000 Calendar of Events

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	May 10-11	U.S. DOE Fuel Cell Summit IV
	May 16-18	Cogeneration and Distributed Generation - Brazil Exhibition and Seminar in Campinas, SP, Brazil
	May 17	World Fire Safety Congress and Exposition - Denver, CO. NFPA membership vote on NFPA 853 document
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2001	May 2001	NFPA 70 - Article 691 Proposal considered for final action by NFPA

Genesis of the International Codes

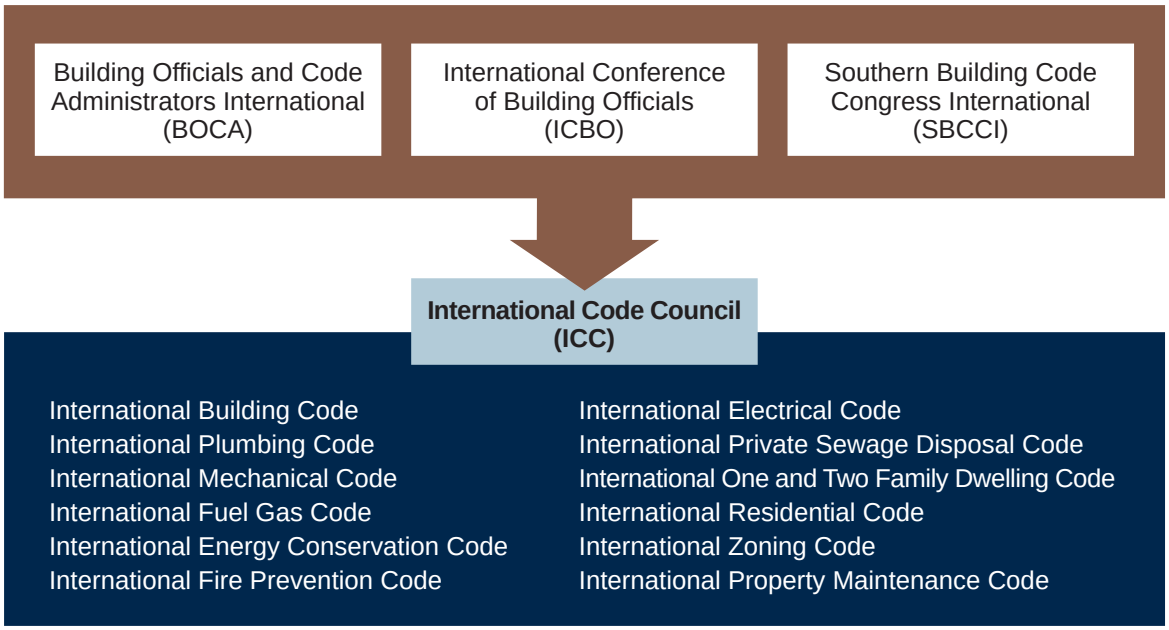
A single family of model codes is now available—internationally. In the United States, model building codes have been promulgated by three national organizations, Building Officials and Code Administrators International, Inc. (BOCA); International Conference of Building Officials (ICBO); and Southern Building Code Congress International, Inc. (SBCCI). These three model code organizations, following their own pilot of the harmonized Model Energy Code (MEC), unified their building code efforts in creating the International Code Council (ICC). In 1994, recognizing a global market for economic and efficient code development, the ICC began developing a complete family of comprehensive and coordinated model construction codes to serve both nationally and internationally as models for adoption.

A single family of model codes allows jurisdictions to adopt technically uniform codes that meet their needs without the heavy burden of development costs. This allows a jurisdiction to direct more of its limited resources to implementation and enforcement. Uniformity also fosters a mutual understanding of code requirements and consistency in interpretation and enforcement. Manufacturers, suppliers, and design professionals are less likely to encounter regional code differences, interpretation variances, and enforcement deviations, and are more likely to develop a universal comprehension of the regulations.

Starting with the mechanical codes of BOCA, ICBO, and SBCCI, a development committee drafted the technical content for the 1996 International Mechanical Code (IMC). The code change cycles first produced the 1998 and now the 2000 IMC, which is available from various sources. This code addresses the design and installation of mechanical systems through requirements emphasizing performance that safeguard public health and safety. Section 924 of the 2000 IMC requires that stationary fuel cell power plants not exceeding 1,000kW be tested in accordance with ANSI Z21.83 and be installed according to manufacturer's installation instructions.

Developed similarly, the International Fuel Gas Code addresses the design and installation of fuel gas systems and gas-fired appliances through requirements emphasizing performance that safeguard public health and safety.

Infrastructure of International Codes



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New Article Proposed for NFPA 70

A proposal to add a new article to the National Electrical Code (NEC) dealing with fuel cells has been submitted to the National Fire Protection Association (NFPA) and approved in principle. The NEC provides electrical requirements that would apply to certain installations of fuel cell power plants and could be in place as early as next year.

Since 1911, the NFPA has acted as the sponsor of the NEC, also known as NFPA 70. The purpose of the code is the practical safeguarding of persons and property from hazards arising from the use of electricity. It covers the installation of electric conductors and equipment in buildings and other applications. This code also covers installations of fuel cell power plants within or on public and private buildings or other structures including mobile homes, recreational vehicles, and floating buildings and other premises such as yards, carnivals, parking and other lots, and industrial substations.

Through a consensus standards development process approved by the American National Standards Institute (ANSI), volunteers representing varied viewpoints and interests achieve consensus of fire and other safety issues. The NFPA administers the process but does not warrant or enforce the document produced. The document is copyrighted, made available for adoption by reference or transcription by public authorities and others, and enforced by the adopting organization.

The proposed Article 691 has been accepted in principle by NFPA with significant revision by Code Making Panel 3. In June, the document will be published in the Report On Proposals and the period for public comment will begin. The period for public comment will close on October 27, and comments will be reviewed in Phoenix in December. The Report On Comments will be published in April 2001, with the final vote by NFPA membership scheduled for May 2001.

The fuel cell industry can participate in developing the electrical requirements for installing their products or abide by the efforts of others.

"The document will be formed through this process" says Jean O'Connor at NFPA, "and, if approved in May 2001, will become part of the code." The fuel cell industry can participate in developing the electrical requirements for installing their products or abide by the efforts of others. As with this proposed new article, the NFPA process for changing the NEC takes three years.

NFPA 853: Installing Fuel Cells

By the summer of 2000, installation requirements for fuel cells over 50kW output will be standardized under NFPA 853, Standard for the Installation of Stationary Fuel Cell Power Plants.

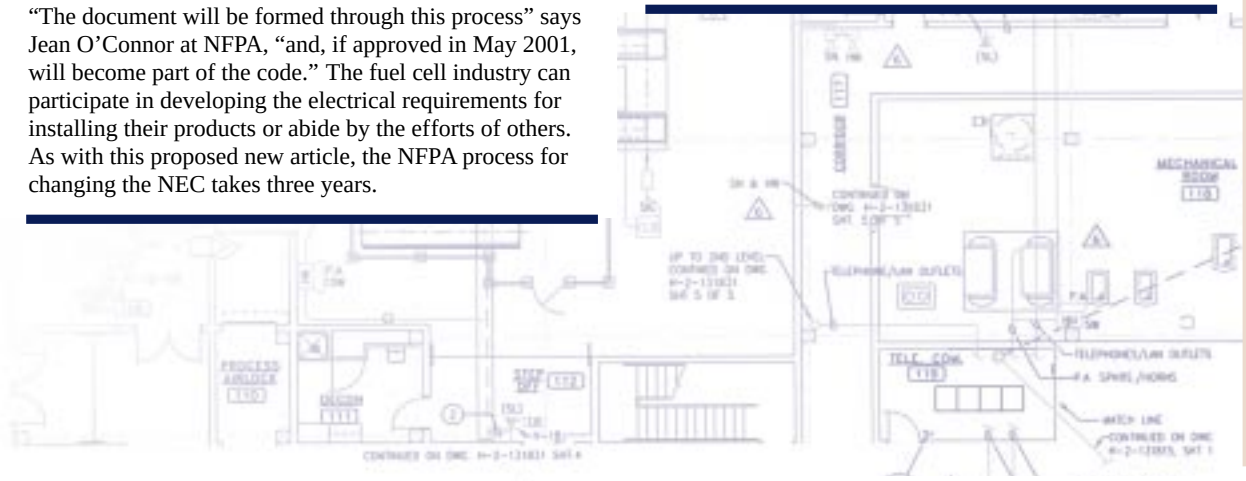
Beginning in 1996 with a request for the development of a standard on fuel cell power plants, the National Fire Protection Association (NFPA) formed a task group to produce a draft of the standard. The draft was available for public proposals and comments in late 1998, and the technical committee addressed them over the next year. In May 2000, the NFPA membership will vote on the document. It is anticipated that the membership will vote favorably, and the Standards Council will issue the standard in July. The new standard will be published in August and can be incorporated by reference in building codes by jurisdictions.

The scope of the standard is the design, construction, and installation of stationary fuel cell power plants exceeding 50kW, including:

1. ***A singular package, self-contained power plant***
2. ***Any combination of pre-packaged, self-contained power plants***
3. ***Power plants comprising two or more factory matched modular components intended to be assembled in the field***
4. ***Engineered or field-constructed power plants that employ fuel cells.***

NFPA Standard 853 references ANSI Z21.83, American National Standard for Fuel Cell Power Plants, for pre-packaged, self-contained, and pre-engineered fuel cell power plants. Engineered and field-constructed units require a fire-risk evaluation. Additional requirements pertain to siting and interconnection, fuel supplies and storage arrangements, ventilation and exhaust, fire protection, and other referenced publications.

The NFPA has responded to the original request and produced the standard in a timely manner. Meanwhile, interest in addressing residential fuel cells has increased. The NFPA can revise the scope of NFPA 853 to address residential fuel cells or it can develop a separate standard to address this topic. The time required to make changes to this standard or to develop a new standard is three years. The NFPA has stated a willingness to address other needs, if requested to do so.



Codes and Standards Developments Impact Distributed Generation

Now that several large companies have joined in the development of distributed generation (DG) products, it appears a market is ready to take off in this area. Moving from research-based prototype installations to mainstream commercial, residential, and industrial markets is a large step. As industry takes this step, many codes and standards-related issues will surface.

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The two entities that must be addressed when moving to a real-world DG market are the utility company and the local authority having jurisdiction. Both will want some oversight of each installation, and each entity has very different concerns about the DG system.

Utility Concerns

Utility companies have extensive experience connecting large generators to their systems but little understanding of small DG systems. Often DG developers face high costs, similar to those for large generators, to connect much smaller systems. These unnecessary costs often eliminate any profitability of the original project. This is a significant dilemma for DG developers and the impetus behind developing interconnection standards for DG systems.

In January, a standard was approved entitled, IEEE 929-2000, Recommended Practice for Utility Interface of Photovoltaic (PV) Systems. This is a significant step forward for PV systems and has led to the broader IEEE P1547 effort, Standard for Interconnecting Distributed Resources with Electrical Power Systems. In developing IEEE 929-2000, the test standard from Underwriters Laboratories (UL), UL 1741, Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems, was updated to match the utility requirements in IEEE 929. The outcome is that a listed inverter tested to UL 1741 meets all the equipment requirements set forth in IEEE 929, and the utility's concerns are addressed by the certification. Underwriters Laboratories is currently changing UL 1741 to include the test procedures for all DG interconnection equipment.

Utility grid connections could be the same for all DG technologies.

Local Authority Concerns

The local authority having jurisdiction is primarily concerned that the installation is safe and complies with applicable codes and standards. On the electrical side, that means complying with the National Electrical Code (NEC) most recently published in 1999. The 2002 NEC is likely to include Article 691, Fuel Cell Systems, which is based on the 1984 Article 690, Solar Photovoltaic Systems, and will help inspectors review installations from a more knowledgeable basis. Other requirements may apply to various DG products based on their fuel source and the potential hazards involved with their operation. The National Fire Protection Association, which publishes the NEC, also publishes a series of bulletins specific to various applications including fuel cells. These bulletins include important safety information used by inspectors and fire marshalls.

Photovoltaic systems have led the way for many new distributed energy resources, and DG systems can benefit from the development work for PV systems. Better codes and standards will make DG installations safe, inexpensive, and straightforward.

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Calendar of Events by Organization

American National Standards Organization

ANSI Z21.83-1998/CSA 12.10

American Society of Mechanical Engineers

ASME PTC 50

Institute of Electrical and Electronics Engineers (IEEE)

Standards Coordinating Committee (SCC) 21 - P1547

Distributed Resources and Electric Power Systems Interconnection Working Group (WG)

June 7-8, 2000	IEEE SCC21 - P1547 Working Group meeting in Universal City, CA, hosted by Capstone Turbine Corporation

International Code Council

April 9-20	ICC Code Development Hearings in Birmingham, AL
May 26	Publication of results of ICC Public Hearing
June 26	Deadline for receipt of public comments on ICC code change proposals
August 4	Publication of public comments on ICC code change proposals
September 4-9	BOCA and ICBO Annual Meeting in San Francisco, CA
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International Electrotechnical Commission (IEC)

Technical Committee on Fuel Cells (TC 105)

National Evaluation Service

May	First draft of National Evaluation Protocol by National Evaluation Service
August	National Evaluation Protocol published by National Evaluation Service

National Fire Prevention Association

NFPA 70 - 691

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NFPA 853

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National Hydrogen Association

National Rural Electric Cooperative Association

U.S. Combined Heat and Power Association

International Colloquium and Exhibit on Environmentally Preferred Advanced Energy Generation (ICEPAG) April 3-6, 2000 in Newport Beach, CA; second annual; hosted by: US DOE; California Energy Commission; the World Bank; and the Pacific Rim Consortium