Efforts to Promote Widespread Use of Stationary Fuel Cells

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1. Introduction

The widespread use of fuel cell cogeneration systems is eagerly anticipated, since they will be a powerful tool in promoting energy conservation and reducing CO_2 emissions. Stationary polymer electrolyte fuel cell (PEFC) systems are already at the market introduction stage, as indicated by the start of a government-backed large-scale trial project in 2005. The development of solid oxide fuel cell (SOFC) systems has also progressed rapidly in recent years. A government-backed trial and research project in actual homes is scheduled to begin this fiscal year, and there are high expectations of expanded use in the future.

Together with the Japan Gas Appliances Inspection Association (JIA) and the Japan Electrical Manufacturers' Association (JEMA), the Japan Gas Association (JGA) was commissioned by the New Energy and Industrial Technology Development Organization to undertake a project entitled "Establishment of Codes & Standards for Hydrogen Economy Society", which includes re-examining regulatory measures necessary to promote the widespread use of stationary fuel cells and taking initiatives aimed at standardization of testing methods, etc. This paper outlines JGA efforts as part of the above project, progress with deregulation, and future plans.

2. The Need for Deregulation

Development of next-generation SOFC systems is progressing rapidly. However, since they are currently subject to the same technical standards as large power stations, operators are obliged take steps such as submitting notifications under safety regulations and appointing an electric chief engineer, even for small residential-use systems. Although PEFC systems are at the market introduction stage, there is no provision in fire regulations for pure-hydrogen-fueled systems without reformers. Thus there is an urgent need to re-examine regulatory provisions for both SOFC and PEFC systems, especially for stationary fuel cells with electricity output of less than 10 kW.

3. "Establishment of Codes & Standards for Hydrogen Economy Society" Project

3.1 Project Outline

This project establishes testing and evaluation methods relating to the safety and reliability of small stationary fuel cell systems and gathers safety data that contribute to the government's examination of regulatory measures. It also strives to have these matters reflected in domestic and international standards, i.e., JIS and IEC.

Figure1. Test units

3.2 SOFC Systems

Various tests were conducted (see Figure 1) on small stationary SOFC systems with fuel/reform system maximum allowable working pressure of less than 0.1MPa and power output of less than 10 kW, to determine whether safety can be assured if inert gas purges are not carried out and if the systems are treated as general electric facilities.

Figures 2 and 3 are examples of the results, showing safety data relating to the omission of inert gas

purges. This test compared the internal status of shut-down SOFC systems when inert gas purges were carried out in accordance with existing regulations and when this step was omitted. In addition to the results shown in figures 2 and 3, this test also analyzed data on factors such as cell stack voltage and exhaust gas composition, and confirmed that there was no difference in safety between the two cases.

While in operation the systems were also subjected to artificially induced abnormalities such as loss of control functions and leaks of reformed gas. The real-time data collected confirmed that SOFC systems can be safely operated and shut down even when abnormalities occur. Since SOFC systems have no carbon monoxide (CO) removal equipment in their reformers, priority was placed on confirming whether or not CO is emitted. The results obtained were used as safety verification data and submitted to official committees examining regulatory measures.

3.3 Pure-Hydrogen PEFC Systems

Various safety evaluation tests were conducted with the aim of contributing to easing fire regulations pertaining to pure-hydrogen PEFC systems. As an example of actual test results,

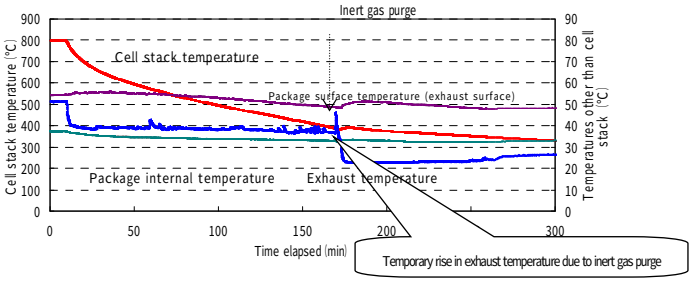

Figure2. Internal Status of Equipment when Insert Gas Purge Was Conducted

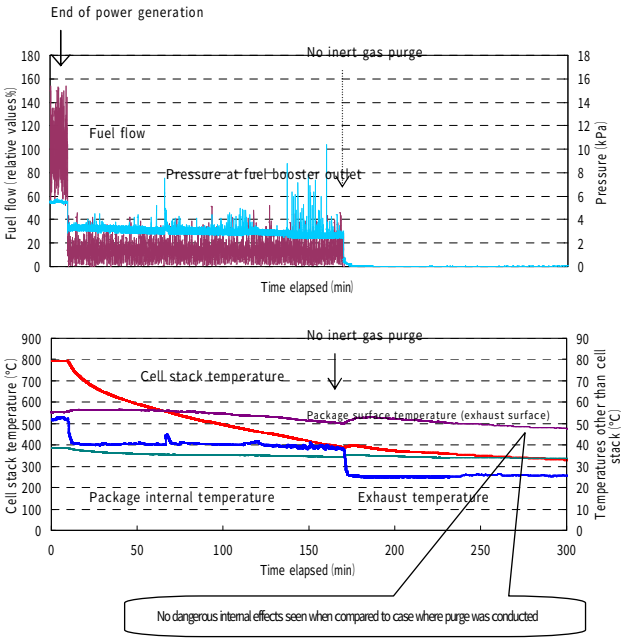

Figure3: Internal Status of Equipment when Insert Gas Purge Was Omitted

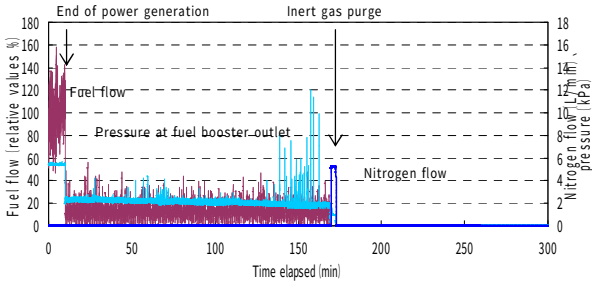

Figure 4 shows data obtained with a view to reducing the minimum distance from surrounding wooden walls at which PEFC units can be installed. This test measured to what extent radiant heat from pure-hydrogen PEFC systems in operation raised the temperature of surrounding wooden walls. In the example shown in Figure 4 the maximum temperature was confirmed to be around 49°C, well within the safety standard (100° or less).

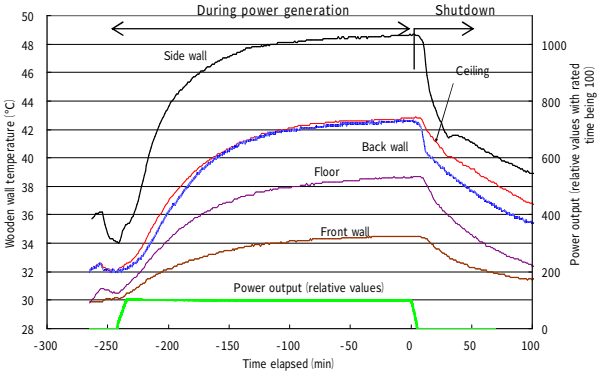

Figure4:Example of Test Data on Offset Distance from Walls（Pure Hydrogen Units）

〔Surrounding wooden walls on each side were set 10mm from the fuel cell〕

Tests were also conducted to check safeguard functions when abnormalities occur, and these confirmed that safety of pure-hydrogen fueled systems is equal to that of reformed gas systems.

4. Results

Chart 1 summarizes the status of deregulation efforts. Following deliberation by an official committee, in fiscal 2006 small SOFC systems (output of less than 10 kW) intended for residential installation were deemed not to require constant monitoring (Chart 1, Item [1]). Based on data obtained during the ”Establishment of Codes & Standards for Hydrogen Economy Society” project and safety calculations, in fiscal 2006 an official committee eased regulations relating to small SOFC systems meeting certain requirements, including determining that inert gas purges could be omitted and that such systems could be treated as general electric facilities (Chart 1, Items [2] to [6]).

Examination of three items relating to fire regulations for pure-hydrogen-fueled systems are progressing (Chart 1, Items [4] to [6]), with safety evaluation of the systems’ internal workings having been completed based on the results of real-system tests and safety verifications conducted from various perspectives. In fiscal 2006 omission of excess pressure prevention devices on PEFC systems was permitted (Chart 1, Item [8]) as part of a safety standard review leading to cost reductions.

Chart1: Status of Deregulation Efforts

Deregulation item	SOFC	Pure-hydrogen PEFC	PEFC
[1] No necessity for constant monitoring	◎(Dec. 2006)	○	○
[2] Omission of inert gas purge	★	○	○
[3] Treatment as general electric facilities • Abolition of requirement to appoint electric chief engineer • Abolition of requirement to submit notifications under safety regulations	★	○	○
[4] Abolition of requirement to notify installation	★	■	○
[5] Reduction of offset distances	★	■	○
[6] Omission of flame arrester	★	■	○
[7] Omission of combustible gas detector	-	■	■
[8] Omission of excess pressure prevention device	-	◎(Oct. 2006)	◎(Oct. 2006)

◎ Deregulated in fiscal 2006 ○ Deregulated in or before fiscal 2004

★ Scheduled for deregulation in fiscal 2007 ■ Working towards deregulation

5. Conclusion

Small stationary fuel cell systems for residential use have finally just reached the market introduction stage. With a focus on deregulation and other aspects of building usage platforms, JGA is promoting activities aimed at future widespread use of these energy-saving and environmentally friendly systems.