Available online at www.sciencedirect.com
ScienceDirect
Renewable Energy 32 (2007) 382–406
RENEWABLE ENERGY
www.elsevier.com/locate/renene

Equipment arrangement planning of a fuel cell energy network optimized for cost minimization

Shin'ya Obara*

Tomakomai National College of Technology, 443 Nishikioka, Tomakomai, Hokkaido 059-1275, Japan

Received 1 December 2005; accepted 16 February 2006
Available online 17 April 2006

Abstract

The systems configuration and operation plan of a fuel cell energy network using the micro-grid of the power using a solid polymer membrane-type fuel cell and the hot-water piping network to which exhaust heat is conveyed are considered. In this study, a computer program that optimizes the equipment arrangement of each building linked to a fuel cell network and the path of the hot-water piping network for supplying the exhaust heat of fuel cells and reformers to each house under the cost minimization objective was developed. As a result of analyzing the fuel cell network constructed in four to nine houses using the energy demand pattern of the average house of Sapporo, which is a cold, snow-covered city, compared with the system that is not optimized, it clearly showed lower equipment and installation costs. As a result of using and analyzing the energy demand pattern of the house in Sapporo, and outside temperature data in February, there will be 18%–25% cost reduction by optimization. Having optimized and planned the path of hot-water piping and arrangement of equipment so that the heat release of a hot-water piping network decreases is a reason for the cost reduction result. Furthermore, by this study, the capacity of a heat storage tank, and the arrangement planning of boilers and each capacity, and the quantity of flow of the hot-water circulating pump were investigated, and the operation plan of each piece of equipment was considered.
© 2006 Elsevier Ltd. All rights reserved.

Keywords: Fuel cell; Energy network; Micro-grid; Energy planning

*Tel.: +81 144 67 8010; fax: +81 144 67 8010.
E-mail address: shinya@me.tomakomai-ct.ac.jp.

0960-1481/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.renene.2006.02.012

Nomenclature

D_c	outside diameter of the heat insulating material, m
D_i	inside diameter of the hot-water piping, m
D_o	outside diameter of the hot-water piping, m
E	electricity, W
F	objective function
g	acceleration of gravity, m/s^2
g_c	weight of facility cost
g_d	weight of operation cost
g_y	weight of facility installation cost
H	heat, W
H_w	heat release of hot-water piping, W
h_w	heat transfer coefficient inside hot-water piping, $W/m^2\,K$
h_∞	heat transfer coefficient between heat insulation material and the open air, $W/m^2\,K$
J_c	unit cost of equipment capacity, US dollars/W
J_{cl}	unit cost of hot-water piping, US dollars/m
J_f	installation unit cost of equipment, US dollars/set
J_s	unit cost of fuel, US dollars/J
K	coefficient of overall heat transmission, $W/m^2\,K$
k_p	heat conductivity of piping material, W/m K
k_c	heat conductivity of heat insulation material, W/m K
l_{xy}	length of hot-water piping between, S_x and S_y, m
N	number of set
N_{bd}	number of buildings linked to a network
P	power, W
Q	quantity of heat, W
q_w	volume flow rate, m^3/s
S_x	number of buildings ($x = 1, 2, \ldots, bd$)
T	temperature
t	sampling time
Δt	sampling interval, s
U	capacity of facility
W_p	water head of hot-water circulation pump, m
Y_c	equipment cost, US dollars
Y_d	operation cost, US dollars
Y_f	equipment installation cost, $

Greek letter

ρ	density of water, kg/m^3

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات