


کد سند: RO-S-F-28-02	معاونت پژوهشی	
تاریخ صدور: ۱۳۹۹/۴/۲۲		
تاریخ ویرایش: ۱۳۹۹/۵/۱۵	فرم خلاصه انگلیسی طرح / پروژه	

Project Title: Design, Simulation and Implementation of Energy Management System for Commercial Refrigerators

Department:	The Center of Cooling Load Management	Employer:	Niroo Research Institute & Electrosteel Company
Project/Program Manager:	Omid Shahhoseini	Executor:	Amir Farhang Sotoudeh
Project Financial Code:	815800	Project Quality Code:	JENES01
Type of Project/Program:	Collaborative	Assistant:	Technology

Project Staff: Shabnam Mansouri, Mohsen Jafari

Project Necessity:

Existing evaluations indicate that despite the constant presence of commercial refrigerators and freezers in the consumption network, so far less measures have been taken to improve the energy efficiency of this equipment and consumption management measures in the commercial sector have been more limited to lighting. On the other hand, the refrigerators and freezers used in this sector are mostly produced in-house and traditionally assembled, and unlike the imported refrigerators and freezers used in the home sector, they have used less of the latest technologies in the world. Also, in comparison, the refrigeration capacity of commercial refrigerators and freezers is much higher than home refrigerators and freezers (between 1 to 5 kW), and therefore the management of consumption of this equipment in the commercial sector is of paramount importance. The high price of electricity tariffs for commercial subscribers in the country (2000 Rials per kilowatt hour on average) and the expansion of the replacement of digital meters instead of single-tariff meters also increases the motivation to manage the consumption of this equipment from the consumer perspective.

Paying attention to parameters such as variable load in the refrigerator and thus adjusting the required cooling accordingly, ambient temperature variable, variable reference temperature inside the refrigerator, cold storage, etc. can be the basis of energy management strategies in commercial refrigerators and freezers. The operational results of using different solutions in different climatic conditions and in different parts of the world (research of the Italian company CAREL) show that the use of energy management system for commercial refrigerators can reduce the consumption of this equipment by at least 20%, which is significant.

Project Goals:

- 1- Acquiring technical knowledge of using variable speed compressors in refrigerators and freezers
- 2- Design, construction and application of energy consumption management system for commercial refrigerators
- 3- Reducing the electricity consumption of commercial refrigerators (at least 10%)

Abstract:

In this project, in the first step, the literature on the subject and the review of commercial refrigerators were reviewed. The second step was devoted to extracting the dynamic and static equations governing the performance of commercial refrigerators. In the third step, the control method was selected and the structure of the required controllers for commercial refrigerators was extracted. In the fourth step, the operation of commercial refrigerators and their components (without energy management system) was simulated in MATLAB software. In the fifth step, simulation of energy consumption management system for commercial refrigerators in MATLAB software including variable speed compressor technologies, electronic expansion valve, variable speed fan for condenser and evaporator and intelligent thermostat is performed and after technical-economic studies and meeting with stakeholders The project, the variable speed compressor and its drive system as the technology to be implemented selected on the 2-meter open refrigerator (as a sample commercial refrigerator). In the sixth stage, the purchase, installation, commissioning and performance testing of the pilot of the energy consumption management system were performed and in the seventh stage, the pilot executive plans of the energy management system were prepared. Despite numerous follow-ups, Electrosteel Company (Industrial Partner) refused to fulfill its obligations in this project, and as a result, the 2-meter open refrigerator equipped with a variable speed compressor was never put into production, and the project was completed with 81.5% progress.

Steps and Methodologies:

- 1- Reviewing the literature on the subject and reviewing commercial refrigerators and freezers
- 2- Extraction of dynamic and static equations governing the performance of commercial refrigerators
- 3- Simulating how commercial refrigerators work and selecting the required controllers
- 4- Simulation of energy consumption management system for commercial refrigerators in MATLAB software
- 5- Implementing the energy consumption management system in the 2-meter open refrigerator

Main Results (technical outputs, patents, papers, books, reports, etc.):

- 1- Technical report on the use of variable speed compressors in commercial refrigerators
- 2- Simulator of refrigeration systems (refrigerators and freezers) in MATLAB environment with the ability to use different technologies
- 3- Technical knowledge of using variable speed compressors in refrigerators and freezers
- 4- Power consumption management system of 2-meter open refrigerator with the ability to reduce the amount of electricity consumption by 16.5% compared to the basic state