Comparative Analysis of a Competitive Technology for a Major Electrical Power System

Young-Duk Koo, Eun-Sun Kim and **Young-Seo Park**, *Member, KIMICS*

Abstract—Currently, advanced countries invest lots of efforts to develop improvement of electric power production and supply, confronting environmental problems and new energy development. They set up long term plan focusing on electric power transmission infrastructure construction technology, establishment of the customer care service network using electric technologies, improvement of economic productivity by innovative electric technology, prevention of global warming gas and clean and efficient energy use etc. Comparing to those countries, the level of technologies that we have are in behind and moreover, technological resources are limited.

Therefore, Korea is required to reconsider efficient distribution of R&D investment by concentrating on limited R&D resources to important technologies which could be stepping stone to gain competitive advantage. It can be done through comparative analysis of electric technologies among advanced countries and analysis of electric technology development policy.

Keywords—Electric power system, High efficiency generator, Electric motor, Electric power equipments, video surveillance

I. INTRODUCTION

Differential supply technology by electric power quality, electric quality improvement technology, Electric power equipment video surveillance and control technology, high-temperature superconductor wire development technology, High efficiency generator and electric motor development are categorized by important technologies in electric system.

Therefore, this study tries to compare and analyze electric technological level by countries such as US, Japan, Europe and Korea and semi-delphi method has been chosen as main methodology.

Moreover, this study aims to provide the basic data that research organizations in Korea have to study in the future through investigation and research of the major research organizations and technologies that they focus on.

II. TECHNOLOGY LEVEL ANALYSIS OF MAJOR ELECTRIC POWER SYSTEM

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A. Differential Supply Technology by Electric Quality

Differential electric supply technology is corresponded to consumer needs by diversifying choices of the electric power quality services through cooperation with electric power system, dispersed storage, small scale IPP to solve electric power quality problems which occurs both sides of demand and supply due to the restructuring of electric power industry.

EPRI in the United States, Hokkaido University, Tohoku electric Power in Japan, related organizations in Sweden, Great Britain, France and Germany in Europe are developing electric technologies.

In Korea, electric research organizations and Kyung Sang University have been carrying out study about electric supply reliability evaluation for distribution power system considering consumer power failure expense under competitive environment.

In terms of element technologies of the differential supply technology, consumer power failure expense evaluation technology, electric transmission system supply reliability evaluation technology, electric power quality charge menu design technology and new electric supply system construction technology for different electric quality supply are raised as major evaluation items. Among those technologies, electric transmission system supply reliability evaluation technology and new electric supply system construction technology for different quality supply are assessed as important items.

Differential supply technology by electric power quality in the US has highly ranked, however technology gap of each country is not so big when setting up technology level of the US as 100 and Japan as 98, Europe as 83 and Korea as 70.

Table 1 Evaluation of Technology Level : Differential supply technology by electric power quality

Country	Technology Level
United States	100
Japan	98
Europe	83
Korea	70

When it comes to detailed technology fields the United States, Japan and Europe have equal technology level for the consumer power failure expense but the United States is preceding the electric power supply system supply reliability evaluation technology, electric power quality different charge menu design technology and new electric distribution power system for different quality supply.

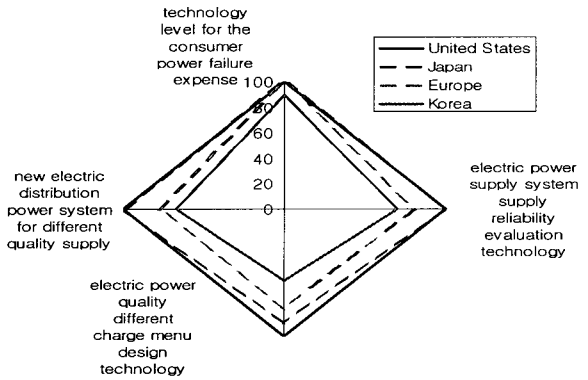

Fig. 1 Comparison of Technology Level: Differential supply technology by electric power quality

B. Electric Quality Improvement Technology

EPRI, BMA and Dranets in the US, CREEPR, electric power companies and universities in Japan and IEC and IEEE in Europe are under way of technology development.

In Korea, KERI has been studying and developing related technologies such as web-based supervision system and system construction technology, measurement and analysis for electric quality check for transmission and supply system, electric quality improvement equipment development, high reliability and quality supply system construction, high frequency evaluation index calculation and forecasting calculation program.

In terms of element technologies, program development and system construction technologies are raised as major evaluation items and system construction technology is assessed as high ranking technology.

Table 2 Electric Quality Improvement Technology Valuation

Country	Technology Level
United States	100
Japan	96
Europe	93
Korea	63

The US has scored 100 on the highest level of electric quality improvement technology whereas Japan 96 and Europe 93. Even technological gap among those countries is not so big, the technology level of Korea is only 63. Japan is going ahead of component technology whereas the US is ahead of web technology, program development and system establishment technologies.

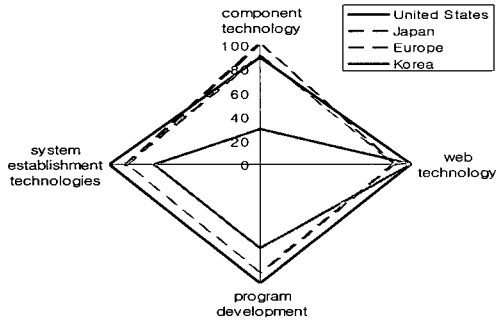

Fig. 2 Element Technology Level Comparison of Electric Quality Improvement Technology

C. Electric power equipment video surveillance and control technology

Electric power equipment video surveillance and control technology supervises status of electric power equipments using infrared ray camera which can detect heat. Further the technology controls electric power supply quantity using measured condition data.

The electric power company(OPPD) in the United States has already developed the control technology for electricity transmission analyzing heat emission of transmission line and sagging phenomenon caused by flow of electricity increase using security camera established in the power transmission tower.

Japan has developed supervision system for transmission line using infrared ray security camera of which technology is in the initial stage in Europe and Korea.

In terms of electric power equipment image supervision and control technology, processing speed(frame/sec), accuracy(%) and the resolution(pixel size) are raised as major comparison specifications and processing speed is analyzed as the most important part. In the element technology aspect, H/W design technology, diagnosis and control technology, remote data transmission technology are raised as major evaluation items and H/W design technology shows high level of importance among them.

When technology level of electric equipment video surveillance and control technology in the US set for 100, Japan also has relatively good score 85 and Korea 65.

Small technology gap is shown. H/W design technology, diagnosis and control technologies shows equal level between the United States and Japan but the United States is going ahead of the remote data transmission technology.

Table 3 Technology Level Evaluation: Electric Equipment video surveillance and Control

Country	Technology Level
United States	100
Japan	85
Europe	-
Korea	65

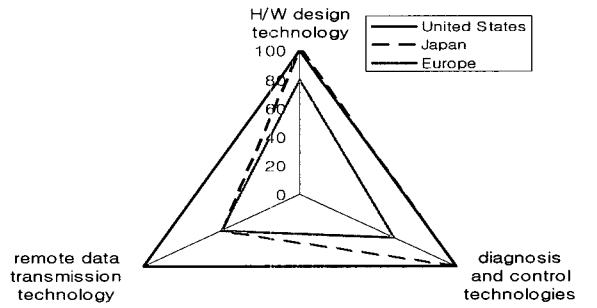

Fig. 3 Technology Level Comparison: Electric Equipment video surveillance and Control

D. High efficiency generator and electric motor development

Electric motors and generators are the machine that changes electric energy to machine energy or machine energy to electric energy. High efficiency electric generators

and motors reduce energy loss and increase energy efficiency compared with normal electric generators and motors. It reduces mechanical friction loss, like resistance loss by coil, iron loss by iron core.

According to recent technology trend, various type of high efficient motor has been developing such as reluctance electric motor, BLDC electric motor, transverse electric motor, Disk type electric motor as a result of the development of electric conversion technology, permanent magnetic material, design technology. Changes into those developed electric motors will bring about energy savings.

GE, MHI in Japan, Siemens, and Hyundai Heavy Industries Co., LTD., Doosan Heavy Industries & Construction are under way of development of related technologies. Capacity(KW), efficiency(%) and weight(KG) are raised as major comparison specifications on efficiency aspect of high efficient generators and electric motor manufacturing technologies. Capacity(KW) is analyzed as the most important item.

From the element technology point of view, high efficient iron core material technology, electric power conversion technology, insulated technology, design technology are raised as major evaluation items. High efficient iron core material technology is assessed as the most important item among them.

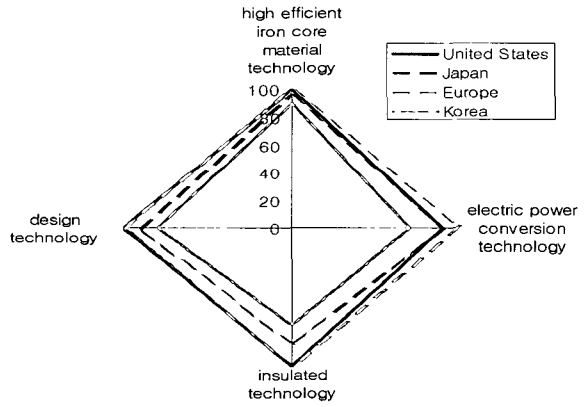

Fig. 4 Technology Level Analysis : High Efficient Generators and Electric motors

Europe is going ahead in terms of high efficient generator and electric motor technologies. When the technology level of Europe is scored as 100, the United States is 97, Japan is 91 and Korea 79. It seems that the technology gap is not big.

From the detailed technology point of view, high efficient iron core material technology, insulated technology and design technology parts shows equal technology level between Europe and the United states whereas Europe is running ahead of the electric power conversion technology.

Table 4 Technology Level Evaluation of High Efficient Generators and Electric motor

Country	Technology Level
United States	97
Japan	91
Europe	100
Korea	79

III. CONCLUSION

The technology level of the electric power system fields in Korea reaches 60-80% compared to advanced countries. While the US is generally ahead in electric power system fields, Europe is going in advance of high efficient generator technology and high-temperature superconductor wire development technology.

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