Evaluation of IRAN Dispatching Status for Next 10 Years with Neural Network

Seyed Siavash Karimi Madahi
Dept. of Elec. Eng.
University of Tafresh
Tafresh, Iran
sija.karimi@taut.ac.ir

Saeid Amir Araghi
Dept. of Elec. Eng.
Islamic Azad Uni. of Tehran, South branch
Tehran, Iran
saeed.amiraraghi1987@gmail.com

Farzad Razavi
Dept. of Elec. Eng.
University of Tafresh
Tafresh, Iran
razavi.farzad@taut.ac.ir

Ali Asghar Ghadimi
Dept. of Elec. Eng.
Faculty of Eng., Arak University, Arak, Iran
a-ghadimi@araku.ac.ir

Abstract

Dispatching centers play an important role in safe and stable operation and also have a great importance observing economical usages. Basically stepwise dispatching system is corresponding to electrical network structures and the ministry of power management methods, and also has to be more flexible with future operation methods and able to coordinate with future structure of country power network. In this paper, important hints and tips to improve dispatching situation, is presented besides clarifying the status of Iran power network with the current structure of AOC's in next 10 years. Since the demand of each AOC is a nonlinear and multivariable function, Artificial Neural Network (ANN) is used for load consumption estimation. Finally total generation need in each AOC for satisfying one of the major indexes, generation and consumption balance, will present.

1. Introduction

The basic and natural structure of integrated power electric network is such that the power generation sources and load centers are normally kilometers apart from each other, and the power system has expanded in a big and vast geographical area, which could be a country or sometimes many adjacent countries. Economical and stable operation of this vast network requires gathering and processing data in a control center and making appropriate commands to the system equipments. This kind of control center is called dispatching center. Since dispatching centers should control a network with hierarchical structure, so it must be compatible with the network [1].

In the Iran power network and the search dispatching center from other countries around the world.

There are five levels in power system dispatching which are explaining follow [2-3]:

- First Level: Central Dispatching (National Dispatching)

In all countries there is a main dispatching center called as "national dispatching" or System Control Center (SCC).

- Second Level: Area Operation Centers (AOC)
- Third Level: Regional Dispatching Center (RDC)
- Fourth Level: Distribution Dispatching Center (DDC)
- Fifth Level: Low Voltage Distribution Dispatching

Recent shapes and structures of electrical network in Iran, is followed as [4-7]:

- Generation network (vapor, water, gas power plant and combine cycle)
- Transmission network (400,230kV)
- Super distribution network (63, some 132kV)
- Distribution network (33, 20, 11kV)
- Low voltage distribution network (400,230V)

Due to different voltage level, each mentioned network is controlled and performance by different managed centers, although two or more of these centers might be observed by a unit company [8].

One of the main problems in dispatching filed is finding the best place of dispatching centers in order to make the whole power system of a country stable and secure. Main indexes for specifying the number and location of AOC as follow:

- Generation and Consumption Balance
- Possession or Heritage
- The Least Transferring Connection (Minimum Connection)

978-0-7695-4073-3/10 $26.00 © 2010 IEEE
DOI 10.1109/ICFPEE.2010.19

- Major Power Plant
- Sensitive Points for Extra Controlling
- Number of Available Regional Electric Company (REC) in Country
- "n-1" Contingency
- Islanding Operation
- Communication Capacity Limitation
- Information Processing Speed
- The Specified Budget
- Vulnerability of War Issues

Due to lack of information in this field, this paper is based on the earlier experiences in Iran and reviewing the main relevant references. The aim in this paper is to examine the balance between generation and consumption in Iran current power network structure and suggesting a new efficient structure.

2. Existent Status of IRAN Area Dispatching Centers

For illustrating the way for considering the defined index, in this section the index of generation and consumption balance is examined in Iran network as a case study.

The first step in order to evaluate this index is to obtain load equations, load demand as a function of time (the relevant year), of each AOC. Therefore, maximum load consumption over five sequent years in each 16 Regional Electric Companies (see table I) is used to define the load equations.

Table I
Maximum Load in Each REC over the Years (MW)

REC \ year	2005	2006	2007	2008	2009
Tehran	5733	6442	6572	6686	6722
Semnan	321	320	340	363	398
Zanjan	818	919	988	1018	1030
Gilan	764	885	890	980	932
Mazandaran	1376	1820	1947	2084	2053
Khuzestan	4119	5140	5130	5768	5458
Esfahan	2874	3160	3472	3724	3722
Azarbaijan	1823	2155	2069	2218	2164
Sistan &Baluchestan	568	661	715	802	843
Yazd	519	613	644	739	712
Kerman	1183	1390	1398	1547	1330
Hormozgan	1327	1495	1451	1695	1763
Khorasan	2074	2595	2745	2648	2596
Bakhtar	1985	2265	2185	2533	2520
Gharb	1100	1141	1177	1310	1043
Fars	2313	2899	2866	3025	3391

In current structure, Iran's electricity network is composed of 9 AOC and each of them is made of one or more REC-Regional Electric Company as figure 1 shows.

Figure 1. Present AOC in Iran

So by adding the maximum load consumption of REC forming the AOC with considering diversity factor for AOC regions including more than one area, considering the current structure of Iran's electricity network diversity factor is considered as 95% [7]. So load equations of each AOC can be obtained.

In the second step production of power plants in AOCs is gathered. Considering that the aim of this section, review index of balance generation and consumption in 2009, the amount of MW production and the largest power plant unit of each AOC has been show in table II. For satisfying "n-1" contingency it should existed the reserve equal to largest power plant unit in each AOC. In this way by taking out a power plant unit out of the network no impairment influence the network. So the production should be equation as in (1):

$$P=G-S \qquad (1)$$

where S consider as Spare and equal of production the largest power plant in that area.

It explained that the values in this table are the lowest production values of power plants in 2009 (to obtain optimum conditions for manufacturing plant design the lowest values of production is considered).

Table II
The Amount MW Produced Separately by Power Plant of Each AOC in 2009

AOC \ year	production 2009	name of major unit power plant	production of major unit
TAOC	8107	Rajaei(steam)	250
NAOC	4138.5	Salimi(steam)	420
SWAOC	9057.5	Ramin(steam)	305
CAOC	3931	Esfahan(steam)	320
NWAOC	2560	Tabriz2(steam)	350
SEAOC	4857	Bandar Abbas(steam)	320
NEAOC	3369.5	Toos(steam)	150
WAOC	3499.5	Shazand(steam)	325
SAOC	2664.5	Kazerun(combine cycle)	120

3. ANN Based Demand Estimation

Generation and consumption balance is one of the most important indexes in order to determine the optimum number and site of AOCs. So it is necessary to estimate rate of consumption's growth in the next years in each AOC. An Artificial Neural Network MLP - Multi Layer Perceptron with back-propagation (BP) method can be used for reaching this aim.

3.1. ANN Structure

A neural network is determined by its architecture, training method and exciting function. Architecture, determines the pattern of connections among neurons. Network training changes the values of weights and biases (network parameters) in each step in order to minimize the mean square of output error. Feed-forward neural networks, Multi-Layer Perceptron (MLP) ANNs are using for engineering applications such as load forecasting, nonlinear control, system identification and pattern recognition [9]. Thus in this article multi-layer perceptron network (with two inputs, one output and hidden layer) with Back-Propagation (BP) training algorithm have been used. Since in this method which is based on error gradient method, function differential is used, thus differentiable functions like Sigmoid, hyperbolic tangent must be used that in this case nonlinear sigmoid transformation function is used. Figure 2 shows the MLP network that is used in this study.

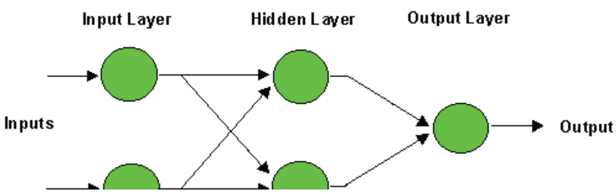

Figure 2. Artificial Neural Network

3.2. Inputs and Output of ANN

Also, required data and information which have been gathered since five years ago is obtained from Iran power network (table I) that are used for estimating the load consumption. In this structure have two inputs (code of AOC and year) and one output is load consumption in that AOC in this year.

3.3. Training of ANN

To determine weights and biases of neural network, number of data's is needed to learn network. Regarding this fact data's of table I is used. Training curve is shown in figure 3. In this figure mean squared error decreasing by increasing the number of repeats is illustrated.

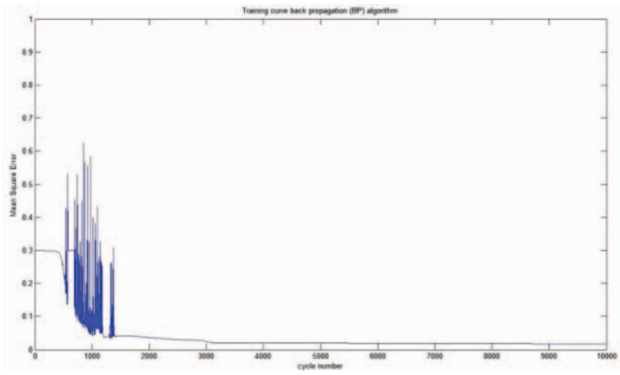

Figure 3. Mean Square of Output Error Curve in Training of ANN

3.4. Determining Demand for Next 10 Years

After training network and converging of weights and biases rate of load consumption in the next years can be reached. Results for next 10 years, maximum load consumption of each AOC are shown in table III.

Table III

Maximum Load in Each AOC Region with Load Simultaneity Coefficient over the Future Years, per MW

AOC \ year	REC under cover	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TAOC	Tehran,Zanjan,Semnan	8180	8539	8970	9379	9852	10337	10823	11340	12009	12672
NAOC	Gilan,Mazandaran	3031	3264	3492	3721	3981	4271	4529	4779	5135	5538
SWAOC	Khuzestan	5901	6228	6542	6845	7268	7764	8124	8630	9140	9688
CAOC	Esfahan	3801	3850	3968	4058	4186	4285	4394	4512	4665	4875
NWAOC	Azarbaijan	2245	2348	2485	2613	2733	2897	3089	3254	3405	3588
SEAOC	Yazd,Kerman,Hormozgan, Sistan&Baluchestan	4935	5273	5673	6091	6533	7019	7493	8069	8705	9332

NEAOC	Khorasan	2788	2895	3055	3275	3459	3622	3845	4188	4459	4752
WAOC	Bakhtar,Gharb	3804	4003	4356	4706	5038	5405	5845	6222	6667	7131
SAOC	Fars	3625	3830	4088	4361	4631	4859	5201	5695	6069	6511

According to results of ANN and yearly increasing of load consumption it is necessary to establish new power plants in each AOC to observe production and consumption balance in the next 10 years. Table IV represent amount of generation needed in order of priority on the basis of year and location of AOC.

Table IV
The Amount MW Produced Separately by Power Plant of Each AOC in Next 10 Years

year / AOC	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TAOC	323	359	431	409	473	485	486	517	669	663
NAOC	0	0	0	0	262.5	290	258	250	356	403
SWAOC	0	0	0	0	0	0	0	0	387.5	548
CAOC	190	49	118	90	128	99	109	118	153	210
NWAOC	35	103	137	128	120	164	192	165	151	183
SEAOC	398	338	400	418	442	486	474	576	636	627
NEAOC	0	0	0	55.5	184	163	223	343	271	293
WAOC	629.5	199	353	350	332	367	440	377	445	464
SAOC	1080.5	205	258	273	270	228	342	494	374	442

4. Conclusion

In this paper the index of number and site determination of Area Operation Centers (AOC) in power network dispatching was introduced. This index can be used to evaluate the AOCs in any country. One of the major index, generation and consumption balance was examined in Iran network with 9 AOC for next 10 years. Firstly using an ANN the demand of each AOC was determined and according to this demand the needed generation in each AOC in next 10 years was concluded.

5. References

[1] Maziar Jamshidi, Reza Fatehi, Mohamad Ameli "Exploitation structure and Iran's power network control, future outlook and problems" 23th international power system conference (PSC) 2008, (Persian Conference).

[2] Iran Electricity organization, technical document of national dispatching.

[3] NIROO research center, investigation of building dispatching center possibility in Iran.

[4] Firuzeh Rameshkhah, Mehrdad Abedi, H. Hoseinian, "New approaches to the systems control and dispatching of power network with modern communication and overall control facilities (WACS)" 23th international power system conference (PSC) 2008, (Persian Conference) .

[5] Khalil Ghalambar, Naser Ghandehari, "Low voltage dispatching as the last link of dispatching centers chain" 8th conference of power electric distribution network (PDC) 2003, (Persian Conference).

[6] Mahmood Aghaie,"The ways to form dispatching centers in Iran" Research and scholarly journal of electricity, number 19, November 1996.

[7] "Fixed guide direction of exploitation" Iran Grid Management Company (IGMC).

[8] Yiyo Kuo a, Taho Yang b, Chiwoon Choc, Yao-Ching Tseng, "Using simulation and multi-criteria methods to provide robust solutions to dispatching problems in a flow shop with multiple processors", Mathematics and Computers in Simulation 78 (2008) 40–56.

[9] S. Panta, S. Premrudeepreechacharn, S. Nuchprayoon, C. Dechthummarong, S. Janjornmanit and S. Yachiangkam, "Optimal Economic Dispatch for Power Generation Using Artificial Neural Network", the 8th International Power Engineering Conference (IPEC 2007), IEEE Conference, 2007, pp. 1343-1348.

2010 International Conference on Future Power and Energy Engineering （ICFPEE 2010）

June 26-27, 2010, Shenzhen, China

http://www.icsa-association.org/icfpee/

Shenzhen University

Conference Program Guide

Co-Sponsors

Intelligent Information Technology Application Research Association, Hong Kong
International Communication Sciences Association (ICSA)
IEEE
The Power & Energy Chapter of IEEE Calcutta Section
Conference Publishing Service
Shenzhen University, China
Optical Valley Software Park

Part III Oral Session

Session 1: 11:00-12:00
Meeting Room
Research on Wavelet Image Threshold De-noising Chenggang Zhen,Yingmei Su 5 Plan for the Wind Power Device to Make the Best of Earth Wind Energy Bingwen ZHANG, Yingjin ZHANG 6 A New Type Heat Exchanger for Coal Burning Boilers Bingwen ZHANG, Yingjin ZHANG 7 Speeding up the Development of China's Small Hydropower Resources by International Cooperation Li Ming 9 Application of WinCC Software to Building Automation System Zhao Xiu-fen,Wang Hong-yu 28 A Service-Oriented Modeling of Production Forecasting Jinfa Shi,Hejun Jiao 36 Universal Design Research Based on "Make the Best Use of Things" in an Aging Society Yongxiang Liu,Feng Wen 38 Indoor Analogue Tests for High Temperature Heat Pump and Its Industrial Application Yongchen Song, Wenzhe Yang, Zhiguo Wang, Xinyao Xiang 40 Modelling and Application of Secondary Circuit Signals for Power grid Intelligent Alarm Kang Taifeng,Wu Wenchuan,Sun Hongbin,Zhang Boming,Li Jingxiong 43 A hybrid fault event detection algorithm using fault recorder data Kang Taifeng,Wu Wenchuan,Sun Hongbin,Zhang Boming,Qian Xiao 53 A Variable N Synchronous Sampling Method for Grid Aperiodic Harmonic Detection and Analysis Hui Zheng, Zhao Chen, Dongkai Peng,Tianhao Tang 44 Developing an integrated simulation model to design a 100% renewable building energy system Yangang Xing 45 Evaluation of IRAN Dispatching Status for Next 10 Years with Neural Network Seyed Siavash Karimi Madahi, Saeid Amir Araghi, Farzad Razavi, Ali Asghar Ghadimi 46