## 산업용 수용가의 정전비용 조사 및 분석

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### Investigation and Analysis of Interruption Costs for Industrial Customer

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Abstract - As the power industry moves towards open competition, there has been a call for methodology to evaluate power system reliability by using customer interruption costs. This paper presents an evaluation of interruption costs by industrial customer type in Korea using customer survey methodology. When various research results are examined, the customer damage survey methodology becomes much more generalized. Especially, in the case of industrial customers, it is known that the evaluation by customer damage survey is more useful. Accordingly, this paper selected the customer damage survey method to evaluate interruption costs by industrial customer type in Korea considering interruption and customer characteristics.

#### 1. Introduction

When competition is introduced to the power industry, power companies have to consider the market value of their power service, while customers have to consider supply reliability and its cost for the power they purchase since the maintenance of supply reliability costs both the power companies and customers.

In the competitive power market, calculation of interruption cost is very significant as interruption, i.e. supply reliability will be an important factor for decision making for both the supplier and the user. Accordingly, development of a model to assess interruption cost for customers is economical and important as it is one of basic data to ensure fair power transactions in the future.[1]-[3]

Several studies on the interruption cost from power companies perspective have been carried out in Korea but almost no study has been done on the economic cost of power interruption to customers. In recent years, momentary power outages tend to cause more damages to industrial customers than the ones lasting more than 5 minutes, the statistical standard for interruption.

Therefore, it is necessary to develop an interruption cost mod el by industrial customer type according to power quality includi ng momentary outage to improve power supply environment, whi ch will ultimately improve the international competitiveness of Ko rean enterprises.

This paper presents an examination of the direct and short/long term interruption costs borne by industrial customer type through a customer damage survey. The questionnaire included interruption characteristics, such as interruption duration, day, time, and month of interruption, whether an advance warning was given or not, as well as customer characteristics, such as business size and type.

# 2. Evaluation and analysis of the Interruption Costs by Industrial Customer Type

For the assessment and analysis of outage costs for industrial customers, the industrial customers were classified into 11 catego ries based on the examination of outage costs for industrial custo mers included in this year's technology development plan as follo ws; manufacture of food and beverages, manufacture of textiles a nd apparel, manufacture of pulp and paper products, manufacture of chemicals and chemical products, manufacture of basic/fabricat ed metal products, manufacture of other machinery and equipment, manufacture of electric machinery, manufacture of audio and visual equipment, manufacture of motor vehicles, and manufacture of other transport equipment.

#### 2.1 Analysis of the survey respondents by industry type

Table 1 shows the customer types for the survey of interrupt ion costs for industrial customers.

(Table 1) Analysis of the respondents by industrial customer type

No	Customer type	Dotails
1	Food and beverages	Manufacture of food and beverages, processing of meet, fruit, vegetables and greins, manufacture of tobacco products, manufacture of starch and feed products, and processing of fet and oil
2	Textile and apparel	Manufacture of fabric and textile products, sewn atticles and apparel leather goods, yarns, and luggage and footwear, and dyeing
Э	Pulp and paper products	Manufacture of pulp and paper products, corrugated cardboard, paper containers, and cardboar
4	Chemical and chemical products	Manufacture of coke and related products, rubber and plastic, compounds and chemical products, and medical product
5	Basic/fabricated metal	Manufacture of basic metal products, basic steel products, basic non-metallic mineral products, fabricated metal products, metal products for structural purposes, and other fabricated metal products, due-casting, and metal processing.
6	Other machinery and equipment	Manufacture of other machinery and equipment, weaponry, shells and bullets, home machinery, and machine tools for processing
7	Electric and electronic equipment	Manufacture of semi conductors, electric and electronic related components, home appliances, insulations and cables, storage batteries, and bulbs and lighting device
8	Electric machinery	Manufacture of motors, generators, storage batteries, power supply devices, and other electric machinery
9	Audio visual equipment	Manufacture of audio, visual, and communication equipment, and broadcasting equipment
10	Motor vehicles	Manufacture of automobiles and trailers and engine, body, and automobile part
11	Other transport equipment	Manufacture of freight transportation and other transportation equipment

#### 2.2 Analysis of the worst period for interruption

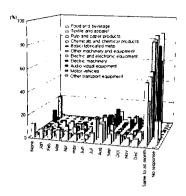
Analysis of the worst period for interruption(by month)

Survey subjects were asked about the worst month for interr uption. Most of the respondents (80%), except those in textiles a nd apparel category and pulp and paper products category, answe red that there was no worst period for interruption. The highest percentage, 67.7% answered that all the months were the same a nd 9.2% and 8.2% answered the worst months were summer months, July and August, respectively. By industry type, August was considered the worst month for interruption by the respondents in food and beverage, textiles and apparel, and pulp and paper products categories more often than those in other categories. Fig.1 below shows the worst month for interruption by industrial custo mer type.

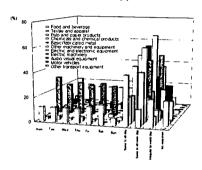
■ Analysis of the worst period for interruption(by day of the week)

Survey subjects were asked about the worst day of the week for interruption. The highest percentage, 8.6% answered Monda y was the worst. Except for Monday and Sunday, the remaining 5 days elicited almost the same percentage of response of 5%, which means there is not much difference between days of the week. Especially, differences between days of the week were smaller for food and beverages, basic/fabricated metal, and other transport equipment categories than other categories. In addition, the highest percentage, 35.8% answered that when an interruption occurred, the loss was about the same for all days of the week. Of the weekdays, Monday was most frequently mentioned as the wor

st day specifically. Fig. 2 below shows the worst day of the wee k for interruption by industrial customer type.

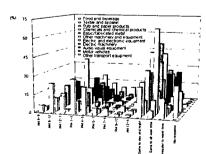


<Fig 1> Worst month for interruption by industrial customer type



<Fig 2> Worst day of the week for interruption by industrial customer type

■ Analysis of the worst period for interruption(by time of day) Survey respondents were asked about the worst time for inte rruption. The highest percentage, 30.6% answered that the loss w as the same for night and day. 26.7% answered that all working hours were the same. 13.8% answered that 9-12 AM was the wo rst. 12.6% answered that 1-4PM was the worst. When the data was analyzed by industry type, respondents in the other machine ry and motor vehicle categories were more likely to answer that there was no difference between night and day than others. And the respondents in the pulp and paper products category were m ore likely to answer that there was no difference during the wor king hours than others. And 33.9% of the respondents in the oth er transport equipment category answered that 9-12AM was the worst. The interruptions occurred in the morning hours caused m ore damages to other transport equipment category than other ca tegories. Fig. 3 below shows the worst time for interruption by i ndustrial customer type.



<Fig 3> Worst time for interruption by industrial customer type

# 2.3 Estimation of interruption cost for average power comsumption

As explained above, the interruption cost by interruption durat ion was estimated by assessing the direct costs such as the loss of production and sales and the cost of overtime working, etc. T he interruption cost for average power consumption according to the interruption duration has been calculated by industrial type is shown Table 2.

<Table 2> Interruption cost for average power consumption according to the interruption duration by industrial customer type

	Monthly average power use(kWh)	Interruption cost per average kW (unit : \$/kW)			
Туре		3sec below	1min below	5min below	30min below
Textile and apparel	1,233,844	8.421	8.724	9.500	13.935
Pulp and paper products	3,093,209	1.650	1.678	1.781	2.100
Chemicals and chemical products	5,046,603	39.806	50.294	52.042	61.505
Electric and electronic equipment	1,087,592	80.335	120.718	174,493	230.076
Food and beverage	43,927	22.783	44.747	78.020	128.504
Basic/fabricated metal	69,283	12.886	19.706	33.359	63.288
Other machinery and equipment	107,437	11.594	15.950	26.605	59.443
Electric machinery	158,957	7.700	13.634	21.470	45.794
Audio visual equipment	94,041	9.647	12.709	23.045	53.517
Matar vehicles	184,107	23.699	36.683	49.706	83.612
Other transport equipment	103,562	9.316	12.862	15.782	39.420

	Monthly	Interruption cost per average kW (unit : \$/kW)				
Туре	nse(kMJ) sverage	lhour below	4hour below	8hour below	8hour above	
Textile and apparel	1,233,844	16.952	22.881	34.398	39.768	
Pulp and paper products	3,093,209	2.619	9.017	15.381	22.055	
Chemicals and chemical products	5,046,603	70.181	84.372	98.950	115.854	
Electric and electronic equipment	1,097,592	229.500	299.389	405.556	430.514	
Food and beverage	43,927	182.430	410.426	896.906	1,103.595	
Basic/fabricated metal	69,283	111.716	210.649	420.882	554.733	
Other machinery and equipment	107,437	106.757	229.865	399.013	619.161	
Electric machinery	159,957	86.796	226.114	388.452	604.103	
Audio visual equipment	94,041	92.411	215.753	337.946	448.962	
Motor vehicles	184,107	120.061	206.528	351.617	560.296	
Other transport equipment	103,562	66.047	142.871	253.682	298.673	

#### 3. 결 론

This paper evaluates the interruption costs by industrial customer type in Korea. While assessing customer interruption costs, the importance of the electric facility, characteristics of emergency power supply use and interruption cost changes by period were analyzed statistically.

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