
[Summary]

Approximately at 22:40 on December 10, 2019, a fatal safety accident occurred at the Taean Thermal Power Plant of Korean Western Power Co., Ltd. as a young worker named Kim Yong-gyun, affiliated under Korea Engineering & Power Service Co. Ltd. (KEPS), was killed after being trapped between a belt and roller while inspecting conveyers from the access shaft to the closed cavity of conveyer belt for coal transportation.

What was the reason for the late Mr. Kim to do his job by putting his upper body into the access shaft to the closed cavity of conveyer belt in operation? Was it because he was overly enthusiastic? Or, was there any structural reason that he just had to engage in such behavior?

According to the statistics from the Ministry of Employment and Labor, the yearly number of workers suffering fatality from occupational accidents in Korea was 2,040 workers in 2016, 2,209 in 2017 and 2,142 in 2018, which shows no sign of decrease in numbers. While most of us are completely unaware of, 6 workers are losing their lives due to occupational accidents every day.

What is the reason for Korea to be unable to escape from the stigma of being the No.1 nation in the workplace fatality rate, despite being a country with over \$30,000 of national income per capita? Why do Korean workers have to continue carrying on the disgraceful title of the “World’s No.1 in death rate” at their workplaces?

We can find a clue from these fatal accidents suffered by the late Kim Yong-gyun and another Mr. Kim at the Guui Station. A high-ranked official from the safety quality division of Korean Western Power Co., Ltd. commented concerning the fatal accident of the late Kim by saying, “Belts do

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not need to be inspected by way of putting the worker's head into the machinery. There is no such instruction in the manual." And they even criticized the late Kim for committing unacceptable behavior right after the accident. The head of safety management at the Seoul Metro also said right after the fatal accident of another Mr. Kim at the Guui Station, "When a worker engages in his/her duties at the platform while trains are in operation, the worker has to report his/her works to the station office, but Kim failed to complete the report at the station office." This comment drew heavy criticism as viewed as an attempt to place the blame on Mr. Kim for individual negligence.

The common denominator that we can find from these two accidents was an attempt to find the cause of occupational accidents from individual violation of safety regulation or negligence. Based on such diagnosis, Korean workers commit mistakes 20 times more than British workers and 5 times more than workers of European Union, which can be translated that workers' mistakes are causes frequent fatal accidents. There is no question such diagnosis makes no sense whatsoever.

Every time a major occupational accident occurred at workplace and becomes a major social issue, the Ministry of Employment and Labor (MOEL) probed tens of or thousands of violations for the cause of occupational accident through special labor supervision and then presented various technical responsive measures for each field, including facility improvement. But one of the key characteristics in Korea occupational accident is that identical type of occupational fatalities repeatedly happens from identical business, and such repeating accidents happen to be simple traditional type of accidents. Will announcement of a list of violations and proclamation of technical responsive measures be a true solution for safety issues at workplaces?

The board firmly believes that the task bestowed upon this special investigation board by the death of the late Kim Yong-gyun is to identify structural elements obstructing the safety of power plants and present

fundamental corrective measures which would make the workplace safer rather than proposing technical responsive measures accordingly after discovering violations of safety-related laws and risk factors.

To accomplish the given task, reviews need to be made in a reverse order, starting from the worksite where the late Kim suffered the accident to working conditions exposed to danger, separation and outsourcing of operation of fuel environment facility which jeopardized safety under the premise of cost reduction, compulsory public disclosure of alignment maintenance, introduction of competitive systems between power companies and division of power companies based on the above, governmental assessment on business performance, governmental policies on power industry and policies on reorganization of power industry structure. Reviews also need to be made upon significance of procurement of workers' right for the sake of safety by verifying the absence of workers' rights. In addition, lenient legal systems regarding safety issues and the lack of business enterprises' awareness of their social responsibilities also need to be examined.

We should never again commit the same horrible mistakes of placing blames on victims for safety accidents. If someone commits an unsafe act, there have to be conditions and causes for them to commit such acts. We need to look carefully into working conditions at the worksite where safety accident occurs and structural and in-depth causes which shaped such working conditions. Multi-dimensional investigation and analysis has to be made throughout changes in organizational structures, employments, labor civil rights, safety and health, facility technology, safety and health management system, workers' right to participate and policies and legal systems.

For the purpose of investigating the fatal accident of the late Kim Yong-gyun and structural causes for major occupational accidents at coal-fired thermal power plants, the Special Labor Safety Investigation Board of Coal-fired Thermal Power Plant for Fact Finding and Prevention of

Reoccurrence for Fatal Accident of the Late Kim Yong-gyun (the “SLSIB” hereafter) was launched with 16 board members. For the duration of 4 months, the SLSIB conducted fact-finding investigation using various means, including field survey, questionnaire survey, data examination, literature analysis and interviews, and now comes to a point of summarizing the findings from such investigation and making public announcement of them to the bereaved family and general public.

I . Fields of Structure, Employment and Civil Rights

1. Field _ Competitions among Public Power Companies, Concerns for Outsourcing and Improvement Measure for Structure of Power Industry

Stemming from factitious privatization and outsourcing efforts made in the field of power generation maintenance and operation of fuel/environment facility, business from the private sector entering into the market of power generation facility maintenance and operation have been generating substantial profits by lowering labor costs through massive hiring of unskilled young workers. At the same time, by means of short-term subcontract agreements for 3 years at most, those businesses pushed these workers into unstable employment situations. Moreover, through operational practices ignoring safety concerns, they also exposed these workers to risks.

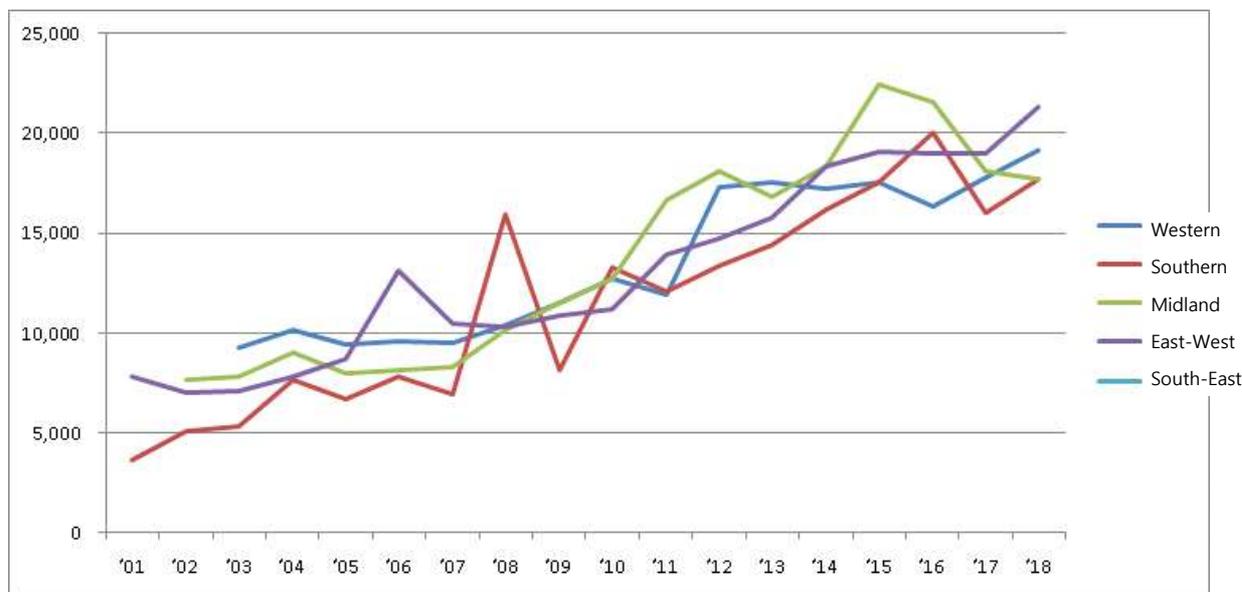
As evidenced above, the cause of expanding privatization and outsourcing of power generation maintenance and operation of fuel/environment facility can be found from the division of power generation fields of Korean power industry (5 power companies + Korea Hydro & Nuclear Power Co., Ltd.) because of the policy on reorganization of power industry structure.

The competitive systems amongst 5 public power companies, ignited from the reorganization of power industry structure in 2001, ① caused high

fluctuation of wholesale price in the power market to subsequently result in fluctuation and instability of operating profit to sales ratio of public power companies, and ② deteriorated the effects of competition from vertical division and power generation division after competitive purchasing of fuel led to elevated purchase costs for fuel compared to global standards. On the contrary, new negative impacts were created from the competition amongst 5 public power companies, including ③ reduction of direct manpower for power generation with increasing indirect manpower for management fields and ④ weakening of scale economies due to collapse of cooperative relationships between public power companies stemming from governmental management assessment focusing on business feasibility and competitions.

On the other hand, power companies have been claiming that they procured measures to “introduce optimal competitions capable of improving efficiency and stability of the market” based on the principle of competition and such directions after deciding on the adoption of competition within power generation maintenance industry in 2013. However, ① despite the importance of workers’ skillfulness for the sake of stable operation of facility, their competitive measures forced workers into prolonged unstable employment situations, which completely contradicted stable operation of facilities. ② To secure technical workers for stable operation of facility, power companies allocated a certain level of direct labor costs; however, private companies embezzled substantial amount of money from the direct labor costs under the subcontract agreements after executing those agreements. ③ Furthermore, because power companies failed to guarantee proper number of personnel required for stable operation of facilities, workers were forced to work alone or for an extended period of time.

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[Subcontract Amounts Compared to Power Generation Capacity]

* Source: Data submitted by power companies (unit: KRW/kW), Data unavailable from the Korea South-East Power Co. Ltd.

<Profits & financial conditions of maintenance companies in 2018 (unit: %)*>

Subject	KEPCO KPS	Geumhwa	KOPIA	Susan	ILJIN	One Plant	KEPS	Optimal
Operating earnings rate	15.4	19.5	9.5	17.3	16.6	17.3	9.1	12.6
Tangible asset** value ratio ¹⁾	25.6	7.2	1.4	7.9	11.5	8.0	1.4	15.6
Debt ratio	20.7	14.6	3.6	18.4	31.9	17.1	18.1	13.3

* Source: DART of Financial Supervisory Service

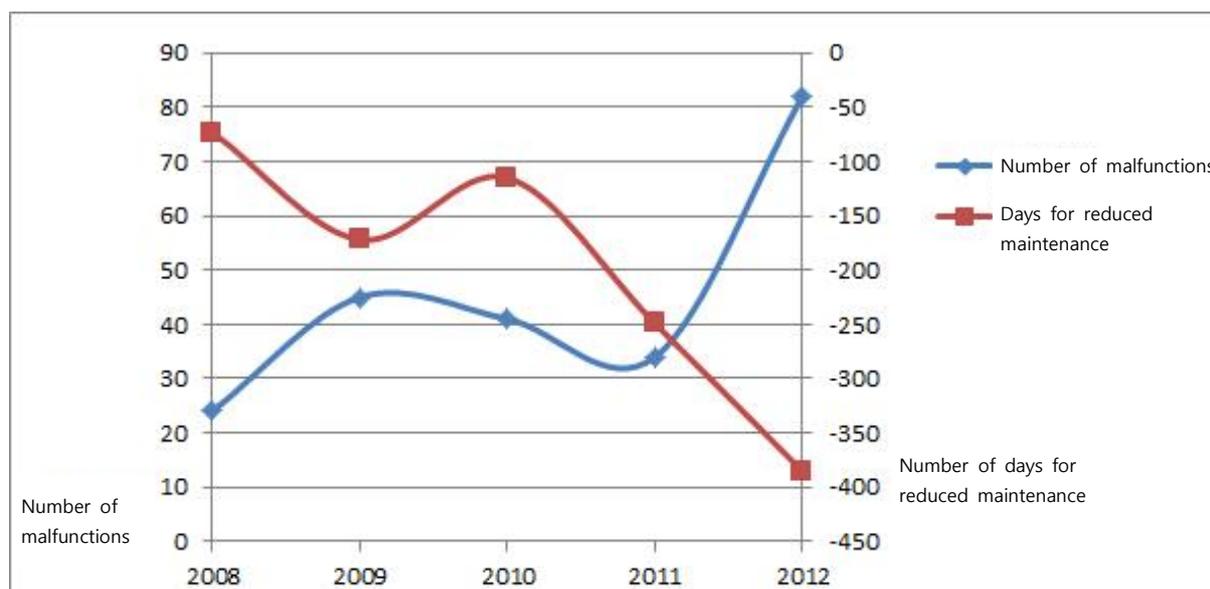
** Tangible asset: It represents tangible assets (including land, building, structure, machinery, vehicle, asset under construction and supplies) expected of future economic benefits for being used during business activities of business enterprises for a long period of time from non-current assets.

<Extended working hours of one month (March, 2017) during planned preventive maintenance by private maintenance company>

1) Ratio of tangible ratio compared to assets (current assets + non-current assets)

No.	Extended working hours	No.	Extended working hours	No.	Extended working hours
1	58.50	11	84.00	21	212.00
2	50.25	12	69.75	22	189.00
3	66.75	13	213.50	23	163.50
4	156.25	14	71.50	24	158.25
5	162.25	15	99.75	25	176.25
6	145.50	16	198.25	26	184.75
7	156.25	17	172.50	27	199.00
8	147	18	106.50	28	83.25
9	122.25	19	178.25	29	87.75
10	171.00	20	181.00	30	73.50

* Source: Sourcebook on introduction of competition in power generation maintenance and evaluation conference for conversion to regular employment in the field of maintenance (Nov. 26, 2018). Extended working hours represent the value of actual extended working hours multiplied by 1.5 in order to pay overtime allowances.



[Number of stoppage from malfunction at 5 public power companies & number of days for reduced planned maintenance]

* Source: Press release from the office of Hyeon-mi Kim, National Assembly Member (Oct. 15, 2013) – ‘Constant suspension of power plant, caused by failure of planned maintenance. What is the cause for abnormal operation of power plants?’

Therefore, in order to address structural causes incurring outsourcing of risks in the field of power generation, the board hereby recommends protecting

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public interest and stability by ① contemplating measures for vertical and developmental integration of power industry capable of responding to future energy conversion and ② putting an end to privatization and outsourcing through withdrawal of factitious opening to private sectors with regard to maintenance and operation workload to bring them over to public companies.

2. Employment _ Current Practice of Outsourcing and Improvement Measure for Hiring Structure

There are diverse factors threatening labor safety at thermal power plants. It is necessary to identify what are the elements arising out of hiring structure from various risk factors for workers and to specify what mechanism from such elements threatens labor safety. Though the hiring structure is not a direct cause inducing risks, the hiring structure should be carefully examined more than anything else in order to procure labor safety when assuming that risks are originated from the issues of working conditions, communications and management system. Hence, examination needs to be made upon how so-called 'outsourcing of risks' or 'risks arising from outsourcing' persist at power plants.

○ Current practice of outsourcing & issues with subcontracting structure

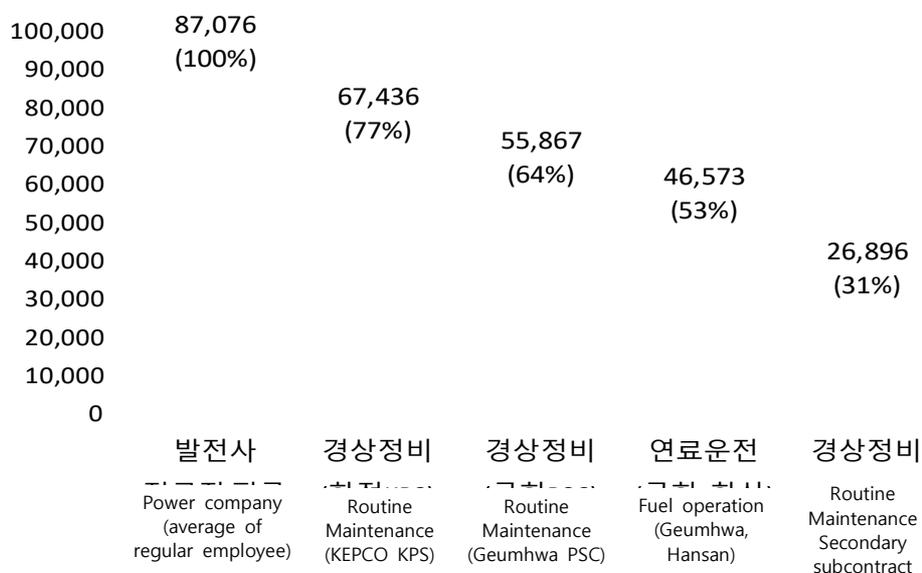
Focusing only on operation and routine maintenance of fuel/environment facility, the total number of workers affiliated to subcontractors working at 5 power plants is 6,220 as of June 1, 2019. Counting the wage for regular workers at power companies as 100%, the wage for routine maintenance workers at KEPCO KPS is 77%, routine maintenance workers at Geumhwa PSC are at 64%, and fuel operation workers at Geumhwa PSC and Hansan are at 53%. For workers under subcontractors, the wage is at mere 31%.

<Subcontracted manpower at 5 power companies>

(Unit: number of people, as of June 1, 2019)

Subject	Fuel/environment operation		Routine maintenance		Total
	Primary subcontractor	Secondary subcontractor	Primary subcontractor	Secondary subcontractor	
Western	379	19	707	49	1,154
Southern	327	0	266	4	597
Midland	516	33	686	134	1,369
East-west	573	61	736	124	1,494
Southeast	597	48	824	137	1,606
Total	2,392	161	3,219	448	6,220

* KEPCO KPS is included in subcontractors.



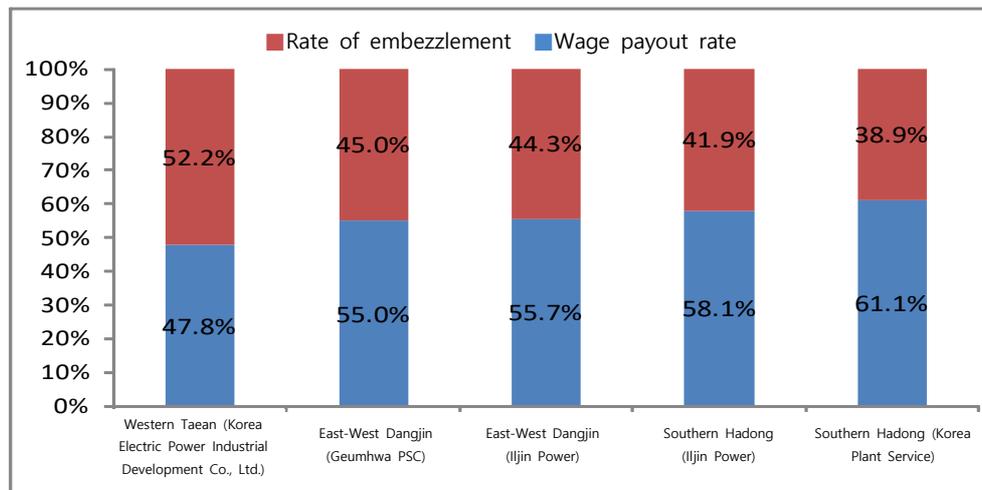
[Comparison of Wage between Power Company & Subcontractor (Unit: 1,000KRW)]

According to the comparison between the amount reversely calculated from the labor wage paid and the settled amounts (labor costs paid for actual subcontract amount) from contracted amount of labor costs based on the payments of health insurance premium paid, the actual amounts paid to workers from the labor costs received by subcontractors are at about 47 to 61% of the amount received. It means that 39~53% of the amount received by subcontractors as labor costs were embezzled and disappeared before reaching workers.

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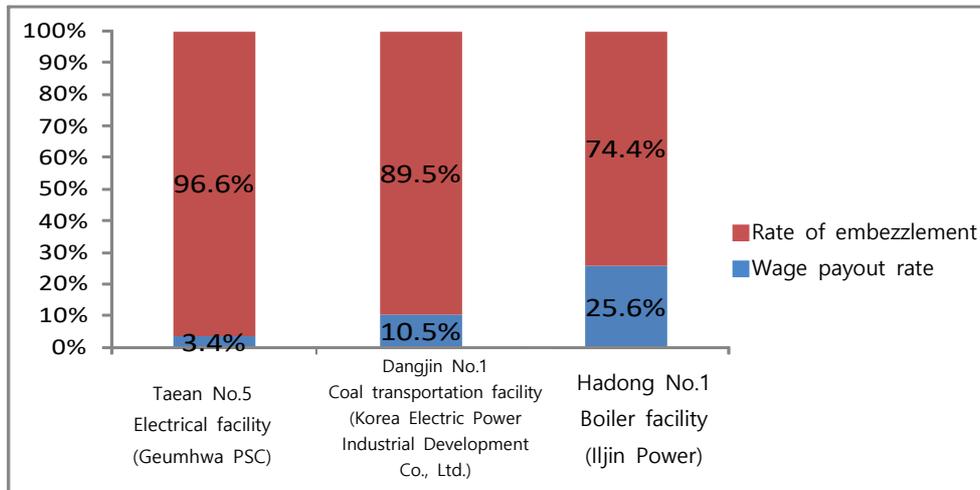
<Estimated comparison between settled amounts of labor costs and actual labor costs (Unit: KRW)>

Power Plant	Name of Works	Labor costs (contracted amount)	Settled amount of labor costs	Completion rate	Health insurance/national pension (payment records)	Estimated actual labor costs (inverse calculation from insurance premium)	Payment ratio of labor costs compared to settled amount (rate of embezzlement)
East-west Dangjin (Iljin Power)	Routine maintenance of boiler facility in 2018	2,322,512,892 (Direct labor costs)	2,322,512,892	100.0%	40,353,682 (Employer's contribution to health insurance premium: 3.12%)	1,293,387,244	55.7% (44.3%)
East-west Dangjin (Geumhwa PSC)	Routine maintenance of boiler No.1 & turbine in 2018	2,628,167,500 (Direct labor costs)	2,514,280,242	95.7%	43,174,523 (Employer's contribution to health insurance premium: 3.12%)	1,383,798,814	55.0% (45%)
Southern Hadong (Iljin Power)	Routine maintenance of boiler facility between Nov. 2017 and Oct. 2018	11,707,863,971 (Direct labor costs)	11,707,863,971	100.0%	212,196,780 (Employer's contribution to health insurance premium: 3.12%)	6,801,178,846	58.1% (41.9%)
Southern Hadong (Korea Plant Service)	Routine maintenance of boiler & turbine in 2018	7,112,566,888 (Direct labor costs)	7,034,987,413	98.9%	134,142,790 (Employer's contribution to health insurance premium: 3.12%)	4,299,448,397	61.1% (38.9%)
Western Taean (Hansan)	Routine maintenance of coal processing facility No.1~8 in 2018	6,391,346,272 (Direct + indirect labor costs)	6,250,204,045	97.8%	134,390,010 (Employer's contribution to national pension: 4.5%)	2,986,444,667	47.8% (52.2%)



[Estimated payment rate and embezzlement ratio from direct labor costs for routine maintenance]

Planned maintenance works are generally performed by routine maintenance workers. But subcontract agreements are being executed separately. With planned maintenance works, the payment ratio of labor costs were 3 to 25% when compared to the settled amount of direct labor costs received directly by subcontractors after actual labor costs were inversely calculated based on the payment records of health insurance premiums. The reason why the payment ratio of labor costs for planned maintenance works is significantly low is because labor costs for a single worker are separately calculated for planned preventive maintenance under private contracts in addition to routine maintenance. While the number of worker actually performing his/her duties is only one, labor costs are appropriated twice: one for routine maintenance and another for planned preventive maintenance. Thus, it is suspected that subcontractors are embezzling the labor costs from both routine maintenance and planned preventive maintenance.



[Estimated payment rate and embezzlement ratio from labor costs for planned maintenance works]

Consequently, it strongly suggests that the current structure of subcontract payments appeared to bring low wage to subcontracted workers but deliver excessive profits to subcontractors. Such structural low wages leave workers no other choice but to continue performing their duties despite apparent risks rather than caring about their own safety even if they are exposed to risks. Fundamental improvement measures need to be implemented against outsourcing structures where no management, supervision or sanction is imposed upon intermediary exploitations.

○ Problems with outsourcing of fuel/environment facility operation

Operation of coal-fired thermal power plants represents consecutive processes consisting of unloading of fuel (unloading from vessel at harbor to coal yard, followed by storage) → coal yard → coal loading and coal selection process → transportation through conveyer belt → pulverizer → boiler → turbine (power generation) → environmental treatment (desulfurization, ash disposal, etc.). In terms of industrial engineering, conveyer belt is a transportation means between processes, and it is also a part of line-flow operations characterizing consecutive flows. During continuous processing, if one segment of the process is halted, it would directly affect and cease other processes or certain measures have to be taken. Subcontracted workers are required to respond to the above through collaboration with fuel facility

division, power generation division, environment facility division and boiler division under the supervision of the power generation division under the power operation department of the power company.

With the continuous processing system, the business owner of principal contractor overseeing the entire process is to give work orders when necessary (especially in the event where certain issues arise) while directing and supervising the processes for which subcontractors are responsible for. And since the system is interlocked with the determination of time to begin and finish daily business, determination of extended and night shifts, operation of shift system and work speed, the principal contractor, i.e. the power company, just has to make such decisions and determinations. Therefore, it is highly possible that subcontracting a part of continuous processing would fall under illegal placement of temporary workers.

Because operation of fuel/environment facility takes care of a part of continuous processing, the operation is conducted under the overall supervision of power generation division under the power operation department. From the case of petition for decision on required maintenance works at power companies, each principal contractor, i.e. power companies and users, has made such claims, and the labor commission and courts have concurred with those claims. In the case of petition for decision on required maintenance works, the labor board determines the maintenance rate to be at 100% with regard to operation works at control rooms (identical with the works of control staff the control rooms for coal transportation, desulfurization and ash disposal), operation works at on-site facility (identical with the works of on-site operators for coal processing facility) and operation works of environmental chemical facility (identical with the works of on-site operator for desulfurization and ash disposal). In order to prevent occupational safety accidents and problems at power plants from occurring, it is definitely and unavoidably necessary to secure appropriate involvement of each relevant department, required supervision and work orders. Changes in directive protocol under the consideration of risks from illegal temporary work placement and passive directives are consequently required for operations of power plants, which makes directives necessary to prevent labor safety

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accidents unclear or passive to elevate risks of accidents. While such tendency is bound to escalate, can we really let it happen? If not, it is only justifiable when each power company directly executes fuel environment operations.

○ Problems with Privatization of Routine Maintenance

Because the field of power generation maintenance essentially depends on the assignment of manpower to perform repair-oriented maintenance, the core element of power generation maintenance can be represented by its manpower as the technical skills of the maintenance manpower for power generation stands for the maintenance capability of the power-generation maintenance companies. In order to improve the competitiveness of private maintenance company, increasing number of professional personnel is required; however, the supply source of such manpower is limited because such personnel is only available from retired employees of KEPCO KPS or experienced workers from plant and construction industries. Within the dual/partial competitive structure between KEPCO KPS and private maintenance companies, such workforce is not easily allowed to move around, and the transfer of technology is also conspicuously limited.

Privatization of maintenance field in Korean power-generation industry has been driven by outside industrial factors under the situation where questions toward industrial necessity have not been resolved. The process of introducing competition, which has been implemented while clear grounds and causes were still absent, was fully initiated since 2013 following a series of suspensions; however, it is still believed that formation of proper competitive system focusing on transfer of technology has yet to be fulfilled as of today. On the contrary, power companies, i.e. principal contractors, are still fully responsible for designing key details of routine maintenance and issuing work orders whereas private maintenance companies have been merely providing simple labors. The distribution of experienced manpower, a practically lone indicator for technical accumulation, still heavily relies on KEPCO KPS, while technical transfer through relocation of manpower remains limited. To develop and execute maintenance plans through discussion with principal contractors of power companies, problems are still evident arising from technologies and competitiveness of private maintenance companies and their status as a contractual counterpart. Under such current situations, the policies to install competition in the field of power-generation maintenance have no

other choice but to remain questionable from both aspects of justification and practical benefits. Instead, it now needs to reorganize the whole structure in a completely different manner unlike in the past in order to procure integrated technology and efficiency in the field of maintenance.

Current practices where over 10 subcontractors are involved for each power company need to be avoided. Considering the unique nature of power generation industry, which requires organic processes, the maintenance field can secure safer and more efficient working conditions when integrated professionalism is improved rather than the works being divided. Upon such occasions, a contractual counterparty will be required to possess a certain level where it carries professional technical capability and is able to reflect its own insights from the development phase of maintenance plans. Hence, since KEPCO KPS is not only a company in possession of independent technology but also a subsidiary of KEPCO equivalent to 5 power companies, the company can be an option that can be aggressively considered. At least, the enhancement of public interest can go hand-in-hand with efficiency in the power-generation industry.

○ Criteria to Secure Appropriate Manpower

Key issues to be considered regarding the size of manpower are as follows. First, it is whether the current scale of manpower is appropriate to perform the workload given. Excessive workload usually leads to enhanced labor strength and outbreak of risks. Second, it is whether complying with statutory standards, such as restricted working hours and guarantee of right to use paid leaves. A total to 52 working hours per week, including extended working hours, must be abided by, and the size of manpower should be procured enough to warrant the right to use annual paid leave. Ultimately, 40 working hours a week should be realized by going beyond compliance of 52 working hours per week, the upper limit of working hours. Third, it is to examine whether a single group of 2 people can be accomplished to engage in hazardous works. The principle of a group with 2 people should not be a mere provision within a regulation; instead, proper number of manpower must be secured in order to implement such principle in reality.

There had been a principle of a working group with a pair of workers even before the accident of the late Kim Yong-gyun occurred. The operational

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guideline (2016) of the KEPS prescribes that workers are required to work in a pair when accessing the area of noise and dusts. Looking at the manpower placement sheet within the same operational guideline, however, a single person is assigned at each section of coal transportation facilities. There are no specific guidelines concerning the operation of a working group in a pair. Conveyor belts should be used during the process of coal transportation, removal of fallen coal, ash disposal and desulfurization, or the minimum safety personnel must be procured at the sections with revolving shells. In cases of operators and their assistants for conveyors at coal transportation process, persons handling fallen coals, persons handling fallen gypsum/limestone, operators of common utility and wastewater treatment and operators of conveyors for ash disposal process, the manpower must be distributed to ensure all works to be done by at least a group of 2 workers.

<Manpower required for a group of 2 workers to work on hazardous processes and operations>

Process	Hazardous facility	Duties	Manpower currently dispatched (estimated)	Required manpower		Emergency deployment (estimated)	Additionally required manpower	Remark
				In detail	Total			
Coal	Conveyor belt	Conveyor operator	230	230	470	170	300	At least 30% required for fallen coal
		Assistant for conveyor operator	180	180				
		Worker handling fallen coal	200	60				
Desulfurization	Conveyor belt	Worker handling fallen gypsum/limestone	-	38	146	-	146	Newly established
	Bowl mill/dehydration	Operator of common utility	52	52				
	Wastewater treatment	Operator of wastewater treatment	56	56				
Ash disposal	Conveyor belt	Conveyor operator	-	44	44	-	44	Newly established
Total			718	660	660	170	490	

○ Collective labor-management relationship to secure safety

When safety and health regulations are specifically and practically prescribed by the collective bargaining agreement (collective bargaining), core element of labor-management relationship, or operation regulation of occupational safety and health commission (OSHC), safety can be further secured. To secure such functions, efforts made by labor unions to enforce such regulations are truly critical. Procurement of safety and health regulations by means of collective bargaining is quite important; however, principal contractors have the authority over facility management and operation of the worksites where workers of subcontractors are actually working. The collective bargaining agreement of subcontractors contains provisions where subcontractors shall not dismiss or give disadvantageous treatments to workers who reasonably suspend operations and evacuate when safety accidents occur. But workers of subcontractors cannot be certain if such provisions would be actually enforced when suspension of operation actually happens. It is because suspension of operation not only incurs losses to a principal contractor but also bring significant impacts on the interests between the principal contractor and subcontractor.

When operations of subcontractor's workers are performed within the facility of power companies, just as in power plants, both principal contractor and subcontractor cannot resolve safety issues within workplaces through labor-management relationships of their own. The collective bargaining issues of fatigue or extended working hours regarding subcontractor's workers can be taken care of by the subcontractor; however, safety issues at operational facilities operated and managed by the principal contractor within power plants need to be taken care of by the power company or through mutual agreement between principal contractor and subcontractor.

○ Improvement measure for hiring structure in order to overcome outsourcing of risks

In conclusion, fuel operation needs to be integrated and operated through direct hiring by power companies, and routine maintenance has to be

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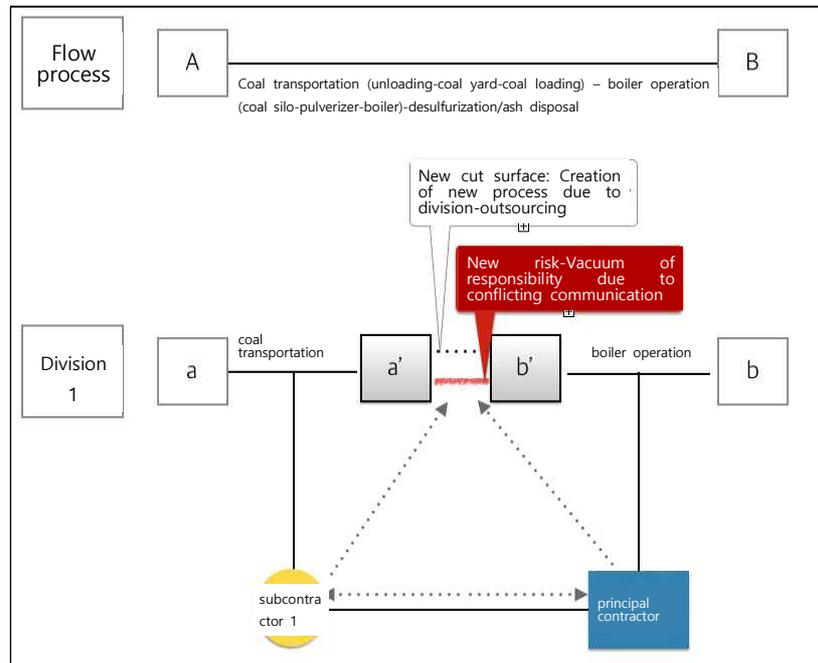
re-collectivized through KEPCO KPS. Considering that coal-fired thermal power plants are operated by a series of production methods of coal unloading-boiler-turbine-ash disposal- desulfurization, flawless communication between pre-process and post process and integration of management is much more desirable for safety of workers and efficient operations. It is necessary for power companies to engage in integrated operation especially when considering the facts where power companies used to do just the above in the past, power companies are currently required to comprehensively command and give orders as well as exchange information and safety of workers cannot be guaranteed without organic communication between departments and between workers. Unstable employment practices can be rectified through operations by a single organization, and safe working environment can be established as unnecessary hierarchy at workplaces is eliminated. And routine maintenance is better to be integrated and operated through unification of managements, the same as operating works, as a regular supporting department of power generation system; hence, integrated operation needs to be pursued in the long run. But when recalling the past experiences where KEPCO KPS used to oversee maintenance works all by itself, a direction to strengthen maintenance expertise can be a step-by-step alternative measure unlike the field of operation. However, with current competitive system with private companies, it is difficult to fully take advantage of the strength that KEPCO KPS has. Thus, through re-collectivization of KEPCO KPS, power companies and KEPCO KPS need to be able to cooperate with each other at the equal capacity.

3. Civil Rights _ For the Sake of Fair Accident Investigation and Practical Guarantee of Rights to Labor Safety

Looking into the <Report on Investigation of Major Accidents> prepared by the power-generation headquarters, 'workers' negligence' is being pointed out as the overwhelming cause of accidents. However, it was clearly evident from the investigation that subcontracted workers were the ones who want the worksite to be safe more than anyone else. It is because workers' right to

labor safety was a matter of life and death. Despite the above, workers were never really given a right to remove and take care of risks under the structure of principal contractor and subcontractor. Requests for facility improvement were just one of their duties or works as a means to fulfill given assignments every quarter. Although risk factors were removed from the worksites, the process where such removal was applied to safety systems to modify the safety system that leads to the feedbacks with principal agents at the worksites was nowhere to be found. Instead of such flow of safety, pressure of responsibility and restriction was imposed from the top to downward. And it consequently leads to repeated accidents caused by 'structured risks' rather than starting with 'structured safety.'

The structure of principal contractor and subcontractor forced the flow process of power plants to be divided and outsourced. And it also changed the communication process into a vertical and top-down structure. Structural conditions where horizontal exchanges are improbable ended up severing communications through multi-layered divisions, and proliferation of processes and procedures on the other hand proves improbability of communication under the structure of principal contractor and subcontractor. Now at power plants, communications are not being conducted through words but executed by a medium of manuals on operational procedures. As communications become more difficult as more efforts are made to fill the void of communication, communications ended up being further ossified.



For instance, following the occurrence of major accidents, such as the one at Dangjin in 2016, processes and procedures were expanded based on the communications between principal contractors and subcontractors. 4-step process was expanded to 26 steps for the purpose of risk assessment, and the number of processes where accidents occurred was increased from 20 to 26. Since increased procedures replace horizontal communication, verification forms in a matter formality were also increased in order to clarify appropriation of responsibilities. Subsequently, risks arising from stiffened communication are bound to increase, and accidents occur under such risks. And increased procedures from the above serve as the ground to pass on responsibility from the top to downward, which is the pathway where the ‘negligence for fatal accident’ becomes the cause; and at the same time, it serves as mechanism where vacuum of responsibility is created.

Under such vertical and hierarchical structure, workers’ rights to safety are replaced with obligations. Underlying cause for safety measures to not properly function is because safety measures function as tools to restrict field workers. Such restrictions merely work as pressure exercised top-down, which only shuts down the flow of bottom-up communication and improvements. In addition, when an accident occurs, field workers cannot be a main principal to investigate and resolve the accident mainly because they become a major

culprit of accident under the vertical and top-down structure. They only carry a responsibility to endure risks without having any rights to address risks. This is the fundamental nature of risks under the structure of principal contractor and subcontractor.

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Therefore, for the sake of safety, rights of field workers to address risks need to be strengthened rather than controlling the risks. To accomplish this mission, it has to start with direct hiring of field workers. Rights can be assured from equal status. Exercise of rights at the equal stance depends on competence, but for the issue of rights under unequal relationships, structural and systematic measures have to be implemented in advance. Direct hiring is the starting point to minimize such unequal relationships.

Through such processes, exploration should be made to develop measures to realize the rights to investigate accidents, rights to address issues for investigation of accidents, rights to act to respond to accidents and rights to know about risks.

II. Field of Safety Technology

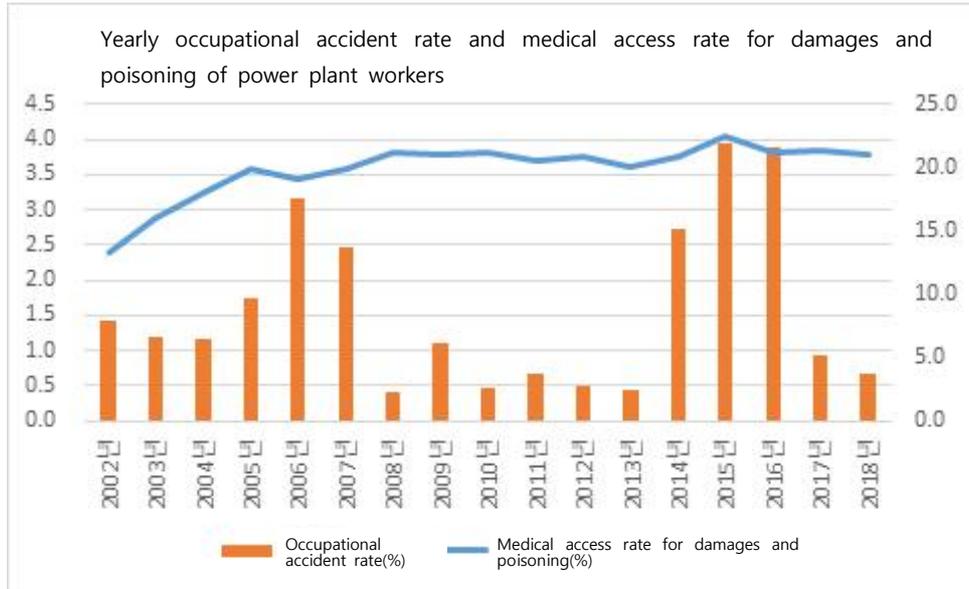
1. Occupational Accidents, Problems in the Field of Health and Alternative Measures

In order to understand occupational accidents and health conditions at coal-fired thermal power plants, analysis was conducted upon national statistics data, including findings from survey on 10,031 workers, statistics on approval of occupational accidents, data on treatments from health insurance corporation and results of special health examination.

- Occupational accident rate was rapidly increased during the time of organizational restructuring, and the rates of medical treatments for damages and poisoning have been continuously increased for 16 years.

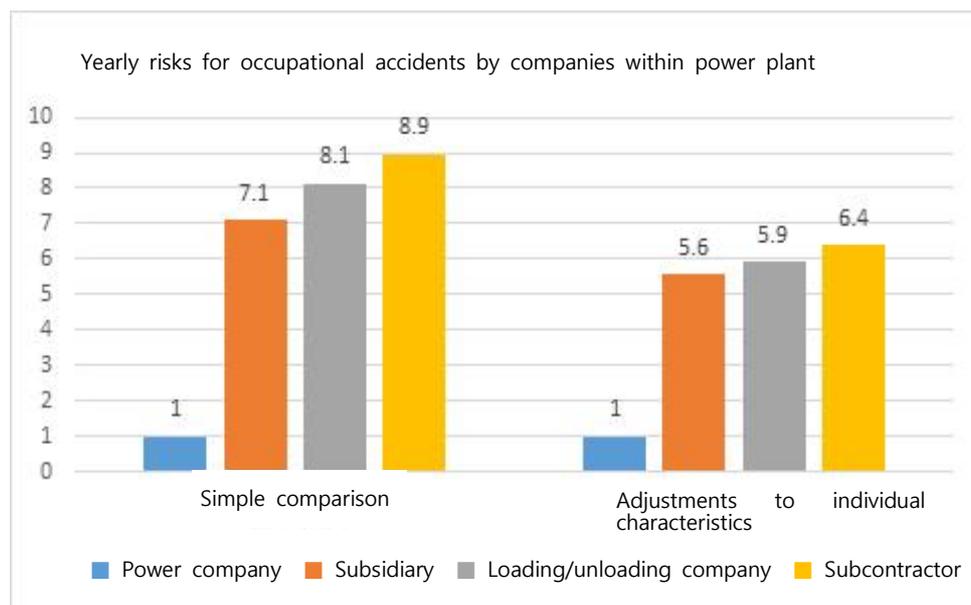
The rate of occupational accidents suffered by power plant workers learned from the statistics on approval of occupational accidents between 2002 and 2018 showed increasing trends from 2002 until 2006 following the division of companies, decreased between 2007 and 2014, increased after 2013 when competitive bidding open to private sector began, and reached the highest in 2015 but showed not much changes afterward. During this period, the medical access rate for damages and poisonings verified through data from the National Health Insurance Corporation continued increasing, and access rate for damages and poisonings during the period when the occupational accident rate was high was also increasing. It shows that it is quite possible to be affected by structural causes which may incur long-term changes to the safety of power plant workers.

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○ Risks of work-related accidents and poisoning for subcontractors are 5.6 to 6.4 times of those of power companies

Based on surveys of workers, work-related damages and poisoning experiences treated through visits to hospitals for the past one year were identified, and risk ratio of experience with treatments of damages and poisoning was obtained through comparison by each type of companies within power plants. Upon simple comparisons by types of companies, the risks for damages and poisoning of subsidiaries were 7.1 times higher than those of power companies, loading/unloading companies were 8.1 times higher, and subcontractors were 8.9 times higher; and when adjustments were made to individual characteristics, such as gender, age and educational backgrounds, and simple impacts by types of companies were examined, they were 5.6 times, 5.9 times and 6.4 times higher respectively.



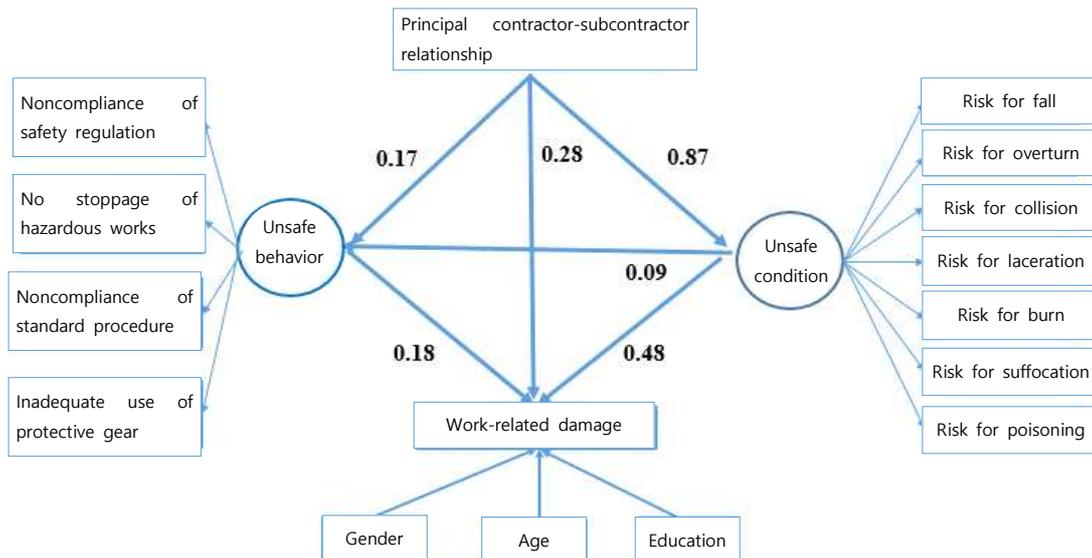
○ Key reason for work-related accidents and damages lies in the relationship between principal contractor and subcontractor.

In order to identify how such differences between types of companies occurred, analysis using a structural equation model was conducted upon

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workers of power companies and maintenance companies of which workplaces are similar. Unsafe conditions and unsafe behaviors of workers are increased depending on whether those workers belong to a principal contractor or subcontractor, and such factors were found to elevate work-related damages. Moreover, it was confirmed that whether they were affiliated with a principal contractor or subcontractor increased work-related damages. Non-standardized coefficient accumulating direct/indirect effects from the relationship between the matter of a principal contractor or subcontractor and the number of work-related damages and poisoning was 0.75.

It means that when the number of subcontracted workers is increased by one at a coal-fired thermal power plant, annual work-related damages are increased by 0.75 times. Meanwhile, the scale of effects on work-related damages by each factor is compared through standardized coefficients. The factor with the biggest impact on work-related damages was the unsafe condition (0.278), followed by the matter of a principal contractor or subcontractor (0.208) and unsafe behavior (0.036).

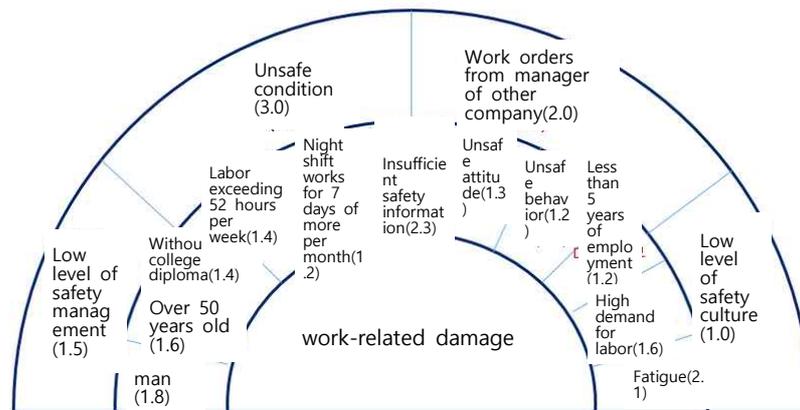


[Mechanism affecting work-related damages depending on whether a principal contractor or subcontractor]

The matter of a principal contractor or subcontractor directly affects work-related damages maybe because various risk factors for occupational accidents are affected by the relation between principal contractors and subcontractors. In order to identify factors at individual level and organizational level associated with work-related damages and poisoning experiences, multi-level analysis was performed.

The factors significantly increasing risks for work-related damages and poisoning at individual levels are insufficient provision of safety information (2.3 times), fatigue (2.1 times) and high demand for workload (1.6 times) to name a few. Those factors at organizational levels are workplaces with more unsafe conditions (3.0 times), workplace with more work orders from managers of other companies²⁾ (2.0 times) and workplace with lower level of safety and health management (1.5 times), which carry higher risks for work-related damages and poisoning experiences than workplaces with less of the above. That is, in order to reduce risks for occupational accidents at power plants, constant efforts need to be made to reduce such risk factors at individual and organizational levels. Especially, the fact that risks for work-related damages and poisoning are higher at workplace with more work orders from managers of other companies suggests that problems of in-house subcontracts, of which nature is similar to temporary dispatched workers, need to be resolved in practical terms.

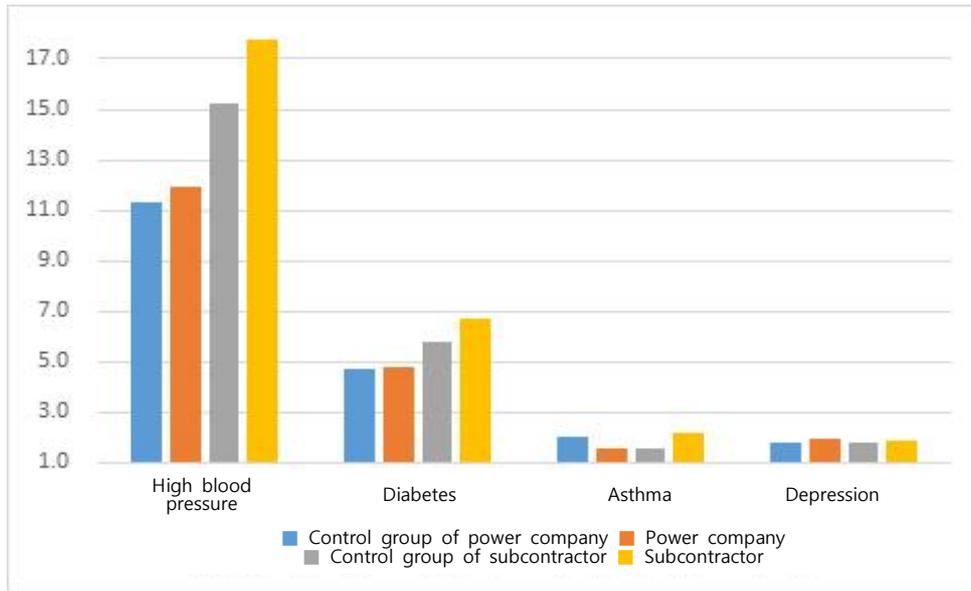
2) A case of work orders from a manager of other company: While a subcontracted worker insisted to obtain a permit first before performing drainage works at manhole under the situation required to engage in manhole works at a confined space without a work permit, a manager from a power company directed the worker concerned to proceed with the duty via Kakao Talk.



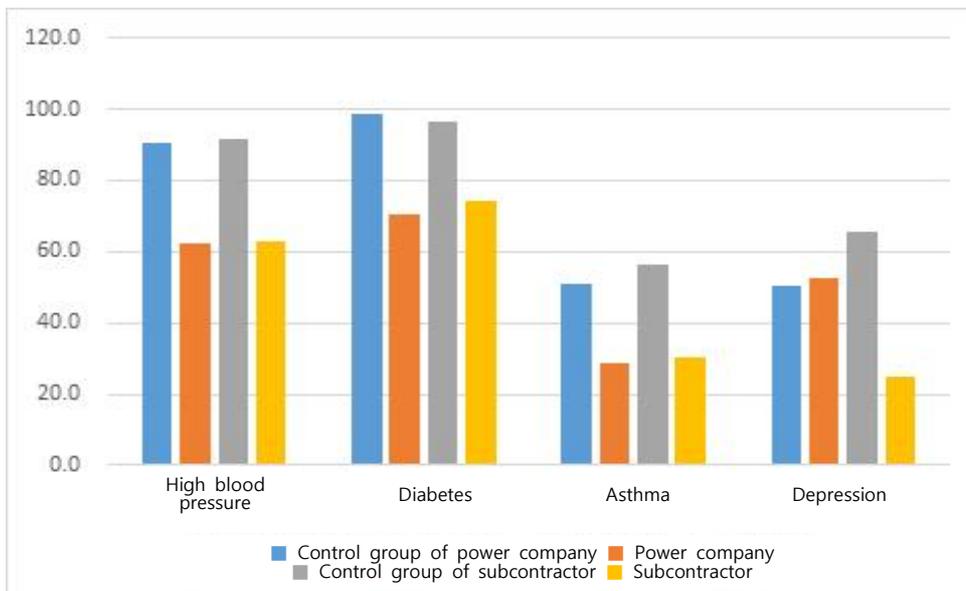
[Relevant factors for work-related damages at individual and organizational levels]
 (Figures in parentheses represent cross ratio indicating risks for occurrence)

○ Subcontracted workers at power plants with higher prevalence rate but with lower treatment rate

Comparing the survey on workers to the national statistical data, the workers at power plants showed higher prevalence rates and lower treatment rates for high blood pressure, diabetes, depression and asthma than general wage workers. Such tendency was more evident from subcontracted workers than workers of power companies. Because such prevalence rates of chronic diseases tend to increase as working hours increase, it showed that those diseases can occur in relation to given duties. Complications from such disease are critical, but it is important to note the fact that those disease can be prevented.

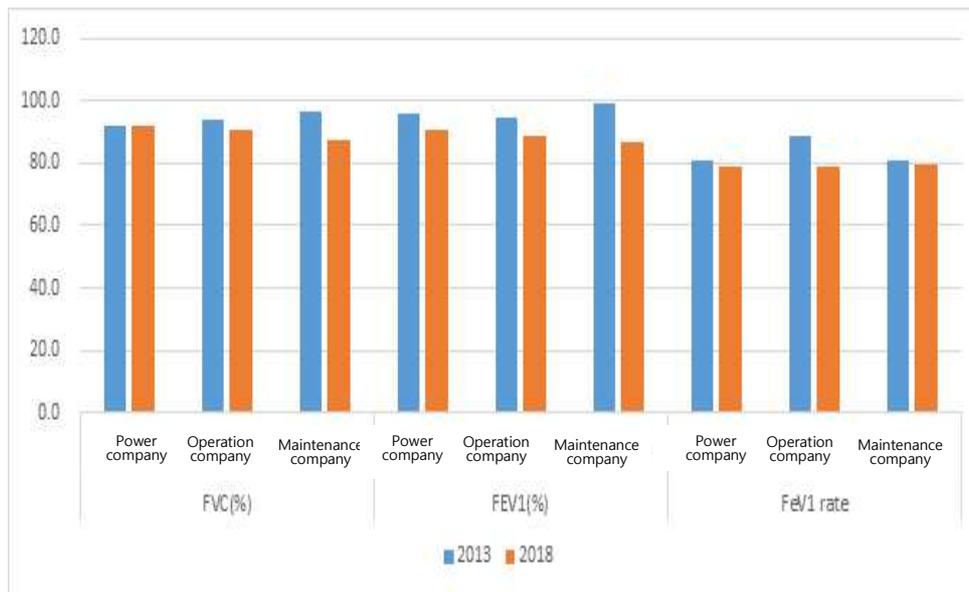


[Prevalence rate of chronic disease from power plant workers (%)]



[Treatment rate of chronic disease from power plant workers (%)]

Based on comparison of lung function in 2013 and 2018 by FEV1/FVC using special health examination data of power companies, operation companies and maintenance companies in order to identify health impacts of dusts, the rate showed dramatic drop, approximately 10% in average, from the operation companies. Aggressive responsive measures for health management of power plant workers are definitely necessary.



[Changes in lung function of power plant workers (2013–2018)]

Looking into these findings, contracted workers at power plants experience significantly more health problems and occupational accidents than workers of power companies, and one of the key reasons for such problems is coming from the relationship between a principal contractor and subcontractor. That is, the most effective responsive measures to prevent occupational accidents and resolve discrepancy in health management for power plant workers have to be making corrections to the hiring practices.

2. Problems and Alternative Measures in the Field of Facility Technology

Since competitive system was introduced to the field of power supply following the structural reorganization of power industry in 2001, fuel purchase and effective facility management emerged as the key element to enhance competitiveness of companies. Under such competitive systems, power companies have mixed and used bituminous coal and subbituminous coal in order to cut down the expenses to purchase fuels. But according to the 'Report on Major Projects and Management Practices of Public Companies' published by the Board of Audit and Inspection in 2013, the report pointed out

that it rather hinders safety of power generation facilities and leads to increasing operating costs and deterioration of power supply. It means that the use of low calorific coal led to increase of facility accidents, which negative affected the safety of workers. Hence, in conjunction with the accident at coal handling facility of Taean Thermal Power Plant, we are here to propose preventive measures for reoccurrences.

Examining on-site surveys of coal-fired thermal power plants similar to the thermal power generator No.9 and No.10 (1,050MW) at Taean, ABC (air borne conveyor) facility was introduced at each section under the consideration of safety and environment unlike the 1990s. While the tail-side pulley of conveyor belt at the Taean Thermal Power Plant, the key issue of the accident concerned, was supposed to be covered with a steel enclosure during its design; however, it was believed that the load on the facility and fallen coals were increased because of the operation with some access shafts at the return-side enclosure remaining open, the fact that the accident occurred in December (frozen coal & wet coal) and increasing fired coal due to the design with low calorific value. Moreover, since risks for safety accident were always present during operation because the conveyor belts transporting coals was constructed with various revolving shells, observations were made, including failure to install wire nets at inspection pathways, measuring instrument capable of verifying the connection of devices, sprinkler facility handling fallen coals if any, vacuum facility removing dusts and the fact that lighting may be dimmed by dusts during operation of facility; at the same time, some parts of the manual were found to be corrected and supplemented, which led us to present improvement measures for the above.

First, regarding facilities, it is ① to improve existing coal transportation facility to a closed-type (ABC), ② to improve the Car at Triffer Room to a Scraper Type, ③ to regulate to use suction wheels upon fallen coals or install sprinkler facility capable of spraying high-pressure water, and ④ to install fences near pulley and belt.

Second, regarding operational aspects, it is ① to strongly recommend aggressive use of design coal. Third, from the perspective of management, it is ① to implement regular test inspection tables on pull cord of conveyor belt,

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② to install safety bar alerting warning sound for approaches, ③ to attach a sign indicating location and how to operate an emergency control and safety device, ④ to operate differentiated lightings by classifying dust conditions for each section, and ⑤ to correct and supplement the manuals of coal handling facility and guideline of fallen coal treatment.

3. Problems and Alternative Measures in the Field of Safety Management

A. Safety Management System

No one would raise objections against procurement of safety at worksites regardless of types of industries, classes or social statuses. To secure safety, a number of safety-related statutes and autonomous safety management systems designed to procure safety and improve health for workers are being implemented at power plants, and the power companies are established as a large-scale organization carrying a variety of objectives, including stable power generation, safe and healthy working environment and power generation through disasters and fire.

For the purpose of stable and economic electric power generation, various operation subcontractors and maintenance subcontractors are dividing and fulfilling their duties with power companies leading the way. And all of power companies and regular subcontractors are also working hard to improve corporate images by adopting autonomous safety and health management system.

But it is nearly impossible for on-site workers to fully understand countless legal requirements and autonomous safety standards to secure safety, and it would rather push on-site workers farther away from the safety as a result. To address such problems, the most important task is to build a safety management organization in which workers can voluntarily participate rather than being controlled by outside agencies.

Unless responsibilities for top managements concerning safety are not clearly prescribed in a large organization, the responsibility for safety management

becomes more unclear the higher the job title becomes while such responsibilities are widely dispersed. To address the above, major responsibilities to secure safe operation at worksites need to be assumed by a line organization, and a director should be appointed from the board of directors to assume overall responsibilities regarding the issue of safety and health within the company.

At the same time, diversified division of duties for economic electric power generation may greatly endanger the risk management system if power generation system is being operated mainly focusing on power generation rather than safety in addition to dispersion of responsibilities for safety among top managements, and the autonomous safety management system, if wrongly operated, can also bring the result of ignoring legal requirements or company regulations.

Especially, under the safety/health system between a principal contractor and subcontractor, numerous guidelines, such as safety and health manuals and company regulations on safety provided by the principal contractor, are prepared and secured by subcontractors; however, those guidelines are hardly being used at worksites, and many expressed their views that those guidelines are not much helpful in reality.

These situations where manuals and guidelines are available yet not being used prove that communications between top managements and on-site workers are not fully functional, which can be also viewed as a problem caused by dualization of organizational structure under the relationship between a principal contractor and subcontractor. It means that it should be an administrative waste caused by a practice where the principal contractor, that is not familiar with operation and maintenance works at the worksites, prepares and provides various guidelines.

The most sensitive issue that can arise out of communication between a principal contractor and subcontractor is the issue of the right to suspend operation under the hazardous situation which may occur at worksites. Except urgent situations, only a principal contractor has and exercises the authority to suspend operation of facilities. But when looking into the entire processes concerning works under urgent and unforeseeable situations, field workers are

required to first report to the situation room of the subcontractor even if suddenly facing hazardous situation, and the situation room subsequently reports to the principal contractor, which quite often ends up delaying proper responsive measures to be taken.

A method where a subcontracted worker under the situation responding to risks is required to contact the principal contractor through a field agent of the subcontractor may seem like a operation protocol at production sites designed to evade disputes of illegal dispatch of temporary workers which may arise from direct communication with subcontracted workers; however, it reveals the limitations of the right to suspend operation under urgent situations.

This investigation proposes the following basic matters as solutions for the problems stated above:

- ① Safety at industrial sites begins from autonomous participate by workers, and the government and business owners need to support systems, budgets and manpower to assist the above.
- ② Because safety procurement by power companies begins from the responsibility for safety management by top managements, company regulations need to be established to support the above.
- ③ Since risk management system of power plants is safer when it's simpler, power companies need to make efforts to jointly unify risk management systems together with subcontractors.
- ④ As self-regulatory safety management system is primarily based on legal requirements and active participation by workers, strong leadership by managements is required to support the above.

B. Risk Factors & Risk Assessment

Various risks are ever present at power plants. Considering that the plants are complex and gigantic in size, diverse types of accidents are prone to occur during regular operation works or routine maintenance works to repair facilities and during construction works to additionally install separate plants or remove aged facilities.

Based on analysis on risk assessments conducted by power plants and records of

accidents for the past 10 years, types of frequent accidents were mostly old-fashioned accidents, such as fall, collision, fall-down (overturn) and trapping as evidenced from the accident of the late Kim Yong-gyun. Unfortunately, however, it was confirmed that the worker group mostly exposed to such risk factors and vulnerable to occupational accidents was the workers from subcontractors, and such risk factors are yet to be corrected and still cause disasters.

The Occupational Safety and Health Act stipulates to independently identify and improve risk factors; however, though power plants have in the past performed risk assessments required by laws and continued making improvements, occupational accidents to subcontractors have not decreased unfortunately. Examining the independent analysis by power plants upon causes of fatal accidents and disasters occurred at power plants, the analysis suggests that causes of accidents were mainly originated from unsafe behaviors, workers' negligence in other words. And since subsequent responsive measures focus on warnings and training for workers, it is believed that there has been a lack of efforts to improve unsafe situations and address fundamental causes.

Risk assessments need to start from identifying what type of risk factors are present; however, the most realistic basic data to understand risk factors needs to begin from analysis of accident history at power plants. Despite the above, unfortunately, it is believed that continuous risk factors have not been improved because causes for accident history have been summed up as workers' negligence.

Hence, when a power company conducts risk assessment, it should assure performing accident investigation with interested parties (including subcontracted workers) participating during investigation of accidents in order to identify risk factors with involved workers participating, and the scope of accident investigation needs to be expanded by including accidents with major disaster in addition to fatal accidents. At the same time, by including consigned operation of subcontractors and routine maintenance works performed by subcontractors in the subjects to risk assessments, it is to ensure not omitting work processes related to operation of facilities within power plants, and interested parties (including workers involved in given works) also need to be included during risk assessments. Taking one step further, we hereby recommend constructing and operating a system capable of comprehensively sharing the details of accident investigation and risk assessments under the consideration of unique nature of

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power plants operating similar facilities.

It is believed that the reason why risk factors have yet to be identified or improved and accidents continue occurring at power plants is because it is troublesome for the government to have managing the system by separating occupational accidents of the relationship between a principal contractor and subcontractor. That is, though occupational accidents may have been caused by the unsafe conditions provided by a principal contractor, the principal contractor manages those accidents as separate accidents of subcontractors when managing business sites; thus, the principal contractor can become free from accidents once it transfers risks over to subcontractors. Considering the above, we recommend the government to build a system capable of fully identifying occupational accidents of the relationship between principal contractor and subcontractor.

4. Problems and Alternative Measures in the Field of Health Management

Coal-fired thermal power plants can be exposed to various harmful substances contained in coals during the entire processes, including unloading of fuel (coal), transportation, storage, pulverization, combustion and ash disposal. What is more serious is that content of inorganic matters, such as various carcinogenic agents like mineral dust, will be even higher when coal is concentrated into coal ash after going through combustion process. Hence, workers at coal-fired thermal power plants can be exposed to various carcinogenic agents, including crystal quartz, benzene and arsenics, such problems can become ever severer during certain processes, such as maintenance works and ash disposal works. That is why workers at power plants have been known to face high prevalence rate for pulmonary emphysema, bronchitis, pneumoconiosis, asthma, lung cancer and leukemia.

Looking into the details of management thus far, however, despite the presence of various first-degree carcinogenic agents, proper management has yet to be implemented, which led to serious problems with workers' health management, as it was confirmed. ① Measurement of working environment regarding high toxic substances (crystal quartz, benzene, etc.) critically harmful to human bodies has not be properly performed, and ② risks for maintenance workers and workers at indoor coal

yard, whose risks for exposure are the highest, have been underestimated. ③ Most of all, temporary re-subcontracted workers deployed to maintenance works are not managed at all as if they are nonexistent.

A number of problems were also found from the health management system managing those workers. ① Since health managers are part-time employees, they are not only understaffed but also experience disadvantages in welfare, wage and authorities. ② Health management between a power plant and subcontractor is being operated separately independent, closed and inefficient without any communication system. ③ Job regulation for health managers focuses on health management, and a separate expert (industrial hygienist) for on-site management is not available, which poses systematic limitations where on-site management to prevent occupational diseases cannot be done. ④ Moreover, professional manpower and facilities are not sufficiently made available to manage occupational diseases although prevalence rate of power plant workers for high blood pressure, diabetes, depression, asthma and chronic lung diseases is soaring. Considering such problems, the following improvement measures are hereby recommended as means for prevention since workers at coal-fired thermal power plants are highly likely to face serious health issues:

- ① Intensive management measures for high toxic substances (carcinogenic agents, reproductive toxicants, mutagenic substances, etc.) must be developed. Measurement of working conditions and subjects to management need to be expanded by including crystal quartz, benzene, arsenics, asbestos and mercury, which most of all should focus on maintenance works and operational managements at indoor coal yards. And management measures for work history of temporary subcontracted workers at maintenance works, who are treated as if nonexistent, have to be separately established.
- ② Efficient health management system should be secured. Health managers shall not suffer any disadvantages for their job status, their organization needs to be independent, and they should be granted with appropriate authorities. Health management systems between power plants and subcontractors must be integrated, professional manpower (industrial physicians) and facility (affiliated clinics) for the above need to be procured, and the works of health managers have to focus on the management of on-site workers.

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5. Problems and Alternative Measures in the Field of Workers' Right to Participate

After an occupational fatal accident occurred at the Taean Thermal Power Plant on November 15, 2017, the plant posted a huge sign at the accident site, stating 'Worker's failure to comply with safety regulation.' Even after the late Kim Yong-gyun was killed on December 11, 2018, media manipulation was attempted under the disguise of anonymity as if the accident was caused because the late Kim was at fault; however, workers at the site exposed the truth. Eventually, Korean Western Power Co., Ltd. acknowledged its responsibility for the fatal accident of the late Kim Yong-gyun. Changes in power companies' attitudes handling fatal accidents in 2017 and 2018 were possible because of participations made by workers and the roles of labor unions. Knowing the way that power plants had treated occupational fatal accidents, it is possible to assume that they must have handled other general accidents by way of making workers a scapegoat.

Through this investigation by the SLSIB, all those entities, such as the occupational safety and health commission (regulation on safety and health management), honorary occupational safety supervisor, right to suspend operation (safety call by power company) and safety and health training, do exist on paper, but there were signs that they did not really exist.

The guideline on safety management of public company established by the Ministry of Strategy and Finance following the accident of the late Kim Yong-gyun presented some of roles that business owners of public institutions are required to comply with, but there were still rooms to improve. The regulation still prescribes to place human error first when identifying causes of accidents. No workers are free from disciplinary actions and penalties. Performance-oriented practices under the premise of performance evaluation encourage hiding the accidents, blaming colleagues suffering from accident and forcing them to hide facts.

Safety and health managements separately operated by 5 power companies, over 100 subcontractors (including secondary subcontractors) and subsidiaries were merely regulations designed only to protect power companies without safety and health management regulations and their workers and guidelines and procedures that only increases after accidents happen in addition to being the operation of occupational

safety and health commission as a matter of formality, failure to appoint to honorary occupational safety supervisor, and safety and health training that only exists on paper. Under the nominal safety and health management, workers are working as if running a treadmill while being hounded to work “faster and faster.”

Basic safety plans of 5 power companies prepared pursuant to the guideline on safety management of public institutions do not seem to guarantee the participation by workers or require expansions. But they only stressed safety culture demanded for workers, control subcontractors and were searching causes of accidents from workers.

Matters where the role of labor union was important were recorded based on the cases of the Seoul Metro engaging in removal of asbestos by implementing a system of environmental supervisor by going beyond legal regulations, Seoul University Hospital considering safety of both patients and families in addition to safety and health management regulation, Hyundai Heavy Industries specifying the right to suspend operation, which used to be a matter of formality under the request from ship owner, in the collective bargaining agreement, Railroad Corporation agreeing to have business owners to participate in the safety management committee and Seoul Metro excluding the number of occupational accidents from indicators of in-house business evaluation. The role of workers is important as an observer of risks and principal agent of safety. Especially under the situation with multiple labor unions and conditions of power company/subcontractor, collaborative works for workers' life are required.

We hereby recommend the followings to the government, power companies, subcontractors and labor unions in order to secure the right to participate in safety and health: ① Joint composition of safety and health operating system by 5 power companies (including subcontractors), ② vitalization and stabilization of operation of occupational safety and health commission (regulation on safety and health management), ③ conversion from allocation of responsibility for accidents to identification of causes, ④ guarantee of honorary occupational safety supervisor's activities, ⑤ specific measure to mobilize the Safety Call system, and ⑥ execution of joint safety and health training as well as reflection of manpower/budget, which will give voice to workers.

6. Problems and Alternative Measures in the Field of Safety Culture

With respect to the number of accident victims from 5 power companies for the past 5 years (2014~2018), the total number was 371 workers. Discrepancy amongst power companies was apparent with the least of 49 and the most of 139. Accident victims were 26 (7.0%) from principal contractors and 345 (93.0%) from subcontractors, but all fatal victims (21 workers) came from subcontractors.

The reason why such discrepancy was apparent despite the fact where similar technology, facility, workers and managers, budget, materials and operating system are being used must be because other contributing factors are in the works, and it can be tied to safety culture that is called 'the way we work.' Safety culture is a driving engine sustaining the health of safety regardless of any consideration of personal traits of managers or corporate profits, and it is a goal to make efforts on despite being difficult to accept in this real world.

Looking into the overall average from the safety culture assessment of power plants, the indicator on compliance of legal regulatory requirements was the highest with 3.07 points, and the indicator of conformity management was highly reviewed with 3.00 points. At the same time, the indicator of performance evaluation was the lowest with 2.68 points, and indicator on communication, employee participation and motivation was also low with 2.85 points.

Therefore, the level of safety culture at power companies was found caught between the calculative phase and preemptive phase, safety systems are being under construction, and related tools and training are deemed necessary. Also, organizations are currently focusing their efforts on resolving existing accident cases or specific risks presenting problems. Mutual trust within an organization serving as a foundation of powerful culture, sharing of value recognition for safety and health and belief in safety and health means are still insufficient in overall.

To elevate the level of safety culture, it is necessary to build and effectively promote lower culture as a foundation, and the lower culture includes culture of sharing information, culture of reporting, culture of flexibility, culture of fairness and culture of learning. Safety culture is more than a sum of pieces. An approach method to an organization of which members are satisfied needs to first have essential elements. Such elements can be developed. And using them leads to thoughts and belief.

Considering the current level of safety culture at coal-fired thermal power plants, the level of corporate soundness to prevent accident can be deemed low, and it would be a huge misjudgment if anyone believes they have trust on prevention only because accidents do not occur frequently. Just like elegance, safety culture is hard to attain by pursuing. Means is more important than ends just like in religions. Virtue and rewards depend on efforts rather than outcomes.

For the purpose of promoting safety culture, lower culture needs to be built as follows:

1. **Construction of information sharing culture:** In order to elevate the sense of guarding against risks while accidents rarely happen, it is important to collect and spread accurate information; hence, it is recommended to reevaluate information sharing system.
2. **Promotion of reporting culture:** For availability of safety information system, participation by workers in direct contact with risks is critical. And to achieve the above, reporting culture is required. Since it is necessary to foster safety working environment by reporting workers' errors, mistakes and hazardous works, effective measures to utilize the safety call system are required.
3. **Making culture of flexibility:** Organizational flexibility means that the organization possesses capability to effectively adjust to demands for changes. A trustworthy organization shows quite a different look during emergency from a superficial shape based on daily and bureaucratic standard operation procedures (SOP). Authorities are moved to functional technology basis, and mutually cooperative authority replaces bureaucratic matters. Official job title and stature disappears from works, and vertical hierarchy is replaced by technical expertise. Composition of organization and code of conduct for workers need to be reexamined in order for these types of flexibility to be applied to power generation industries.
4. **Promotion of culture of fairness:** In order to promote employees' true participation in safety and health, it needs to develop the process of determining responsibility for accident, disciplinary action system and disciplinary procedures, and it is to ensure safety and health to be properly understood through transparent operation of those processes.

5. **Promotion of learning culture:** Elements forming the culture of learning are observation (awareness, participation, interests and tracking), thoughts (analysis, interpretation and diagnosis), creation (imagination, design and plan) and action (execution, implementation and experiment). Reorganization is required for examination of risk factors, owning of accident reporting system, possession of punishment-type regulatory system, support for autonomy of frontline managers and development and implementation of improvement measures for safety and health.
6. **Operation of leadership promotion program:** It needs to operate leadership promotion programs for executives, managers, safety and health officers and executives of subcontractors.

III. Management Supervision of Government and Field of Laws/Systems

1. Enhanced Management and Supervision by Government

Because occupational safety and health overseeing life and health has notable characteristics where regulatory administration takes up a big part of it, the influence by the occupational safety and health administration is simply overwhelming for the advancement of occupational safety and health as well as prevention of disaster in the nation. And an occupational safety supervisor, who has absolute power with authority of the special judicial police to effectively perform occupational safety and health administrative works, has been deemed as an absolute being.

Despite the above, there have been plenty of concerns and complaints that occupational safety and health administration is not properly working at the worksite of coal-fired thermal power plants. It was because occupational safety and health administration has been staying at more of amateur-like level while it was supposed to preemptively and effectively respond to harmful risk factors which are advanced, specialized and complicated along with rapidly advancing today's industrial society. Peter Ferdinand Drucker, a world-renowned scholar, said that two conditions are required in order to strengthen an organization and expect good performance from the organization. One is 'high quality' of the people working for an organization, and the other is 'complete responsibility' imposed on those people. Unfortunately, however, none of those two elements can be found from our current occupational safety and health administration.

Fundamental cause for the above can be summarized in two issues based on this investigation into coal-fired thermal power plants.

First, it is the lack of professionalism of public officials in occupational safety and health administration.

Even through the occupational safety and health system is excellent, if its executive body is incapable of properly operating the system, occupational

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safety and health administration just cannot be successful. Unless the independence of occupational safety and health administration is guaranteed, professionalism of occupational safety and health cannot be improved, and it is also impossible to develop specialists through hiring, work performance evaluation, career management and educational training.

Second, it is incompleteness of occupational safety and health administrative organization.

Even if policies on occupational safety and health are reinforced, it is really difficult for the current occupational safety and health organization to fulfill its duties and responsibilities with the size of current organization which is run as a single department under the Ministry of Employment and Labor. In order to successfully implement high-powered policies and monumental occupational safety assignment, including reduction of occupational fatalities by half by 2022, safety enhancement measures for workplaces of public institutions and whole amendments to Occupational Safety and Health Act, the current organization of occupational accident prevention compensation policy division needs to be restructured.

As recommendations for improvements upon the above, in short terms, ① it is to enhance job competence by running systematic educational training programs for public officials in occupational safety and health administration, and ② it is to assure career management and incentives appropriate for the work of occupational safety and health from their employments and also to improve the issue of current job rotation system. In addition, ③ it is to expand and reorganize the current occupational accident prevention compensation policy division to a [department] level in order to preemptively perform the policies on occupational safety and health. In long terms, ④ mid-to-long term plans need to be established in order to guarantee the independence of occupational safety and health administrative organization.

2. Enhanced Statutory Responsibility for Business Enterprise

Sad reality repeats itself where countless workers are losing their lives because of outsourcing of risks under the pretext of cost savings. Business

enterprises cannot be expected to voluntarily take necessary measures to safeguard the safety at workplaces by investing substantial amount of money while current legal systems helping business enterprises escaping from legal responsibilities even if occupational accidents occur remain intact. The wholly amended Occupational Safety and Health Act for the first time in 28 years since the death of the late Kim Yong-gyun is called the 'Kim Yong-gyun Act' with public-wide hope for stopping workers from getting killed any longer; however, not much changes have been actually made to the structure where workers are forced to solely endure risks from outsourcing practices. Subordinate statutes announced for legislation also have not advanced far from the amended statutes.

Works subject to prohibition of outsourcing and approval did not include numerous works placed under harmful conditions due to the structure of a principal contractor and subcontractor in the past. During the course of fact-finding investigation, harmful substances contained in coal fuel, especially crystal quartz known to be key dust component and carcinogenic agent, were confirmed to become problematic during almost all processes at power plants, and there were cases where the measurement exceeded 7 times of acceptable level. If worker's health can be seriously endangered when exposed to harmful substances during operations at confined spaces within power plants, it seems necessary to include the 'works exposed to high-content crystal quartz at confined space' to the scope of works prohibited for subcontracting.

Meanwhile, workers' right to suspend operation was specified as a separate right, but it is difficult to assure effectiveness of exercising such right; hence, it is necessary to aggressively nurture environment where workers are able to exercise the right at worksites, and when intending to relieve the order of suspending operation initiated upon outbreak of major accidents, regulations on responsive measure required to be taken by business owners also need to be enhanced. While the works subject to suspension of operation were limited to 'identical works,' there is a concern for the possibility that the scope of suspension of operation may be interpreted in a reduced capacity. For improvement measures to be developed by business owners after occupational accident occurs, it is necessary to warrant the workers' right to know by

enforcing the obligation to submit those measures to the head of local employment and labor agency as well as to display the measures at worksites. When a worker is killed because of failure to fulfill obligations under the Occupational Safety and Health Act in the event of occupational accident, preventive effects through stern disciplinary actions can hardly be expected because the lowest punishment was not specified in the disciplinary regulation.

Because no legal means is available for business enterprise to assume legal liabilities aside from individual doers or persons in charge taking legal responsibilities when major accident occurs, it is difficult for business enterprise to feel compelled to spend money in order to prevent occupational accidents from occurring. The death of the late Kim Yong-gyun ignited the discussion on ‘Punishment act on corporate for major accident’ once again, and it is necessary to secure legal means that can affect actual operation and profits of business enterprises by imposing fines based on operating income of the enterprise, restricting permits and licenses and publicly announcing the facts of crime. Moreover, it is also necessary to prepare a punitive damage compensation system in order to stop businesses from seeking profits through violation of laws.

For administrative sanctions, the amended Occupational Safety and Health Act prescribes the penalty surcharges not to exceed 1 billion KRW, which makes difficult for this penalty surcharge provision to be effective, especially from big companies. Penalty surcharge needs to be imposed based on operating incomes of each company in question.

3. Enhanced Social Responsibility for Business Enterprise

Socially responsible management by corporate means a management practice where a business corporate engages in its business under the consideration of benefits for all interested parties both inside and outside the company, including workers, consumers, subcontractors and local communities, in addition to its shareholders under the premise that the company is one of social beings. Such benefits also include safety and health of workers at worksites.

Looking at global trends, business enterprises tend to understand their roles by further strengthening socially responsible management; however, such trends are not quite active in Korea.

For socially responsible management, it is essential for a business enterprise, the principal agent, to fully understand its importance and have a strong will to practice it. But it is not easy to make it happen overnight. That is why the government and civil society also need to fulfill their roles.

Many western countries have been treating socially responsible management by business enterprise as a major agenda in terms of government policies as well as laws and systems. Key implications that can be learned from cases of German, British, French and Danish governments are that ① the governments are leading the way with the issue of socially responsible management as a major national agenda, ② government policies are designed to encourage business enterprises to voluntarily participate in socially responsible management and government implements various political means to help businesses applying the model of socially responsible management, and ③ construction of social partnership and network is being pursued concurrently through participation by civil society.

Taking a closer look at these cases, government-led implementation of socially responsible management in Korea is still left far behind western countries, and we need to develop improvement measures for this as soon as possible and continuously exercise them.

For specific recommendation to accomplish the above, we hereby present recommendations where ① it is to establish the issue of socially responsible management, including occupational safety and health issue, as a core political agenda at the pan-government level and to build social network as well as execute activities of campaign/training/information provision to improve social awareness, ② it is to present proper guidelines or models of socially responsible management, including occupational safety and health issue, and to explore joint participation by business corporate/labor/civil society, ③ it is to effectively implement official certification/evaluation through independent certification/evaluation agencies, ④ it is to prepare laws/systems enforcing a certain range of businesses to assume obligations to prepare and publicly

announce a report on socially responsible management and to take social verification, and ⑤ it is to review various incentive policies, such as guaranteeing companies with outstanding socially responsible managements to benefit from preferential opportunity for public procurements, offering them benefits of tax exemptions or offering financial aids to small-and-medium-size enterprises.