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An Evaluation of EOCS Regarding Safety Management Effects on Buried Gas Pipelines and Convenience of the Excavators and the Operators of Gas Companies

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Abstract: We introduced the Excavation One Call System (EOCS) as a pilot system, in Seoul, Korea. The system utilizes the phone and internet to transfer information about digging underground and buried gas pipelines, although currently written forms are used in accordance with the City Gas Business Law. After one year, we evaluated the business model by surveying the excavators and the operators of the gas companies. This paper shows that the EOCS was more effective in preventing the buried gas pipelines from being damaged than the existing method that has to use due form. It also shows that the EOCS was more convenient and cost efficient than the present policies in place. We come to the conclusion that the EOCS should be extended nationwide and gradually include other subsurface facilities.

Key words: EOCS, excavation, digging, one call, subsurface facilities

1. Introduction

As the amount of subsurface installation (such as underground pipelines, conduit, duct, sewer lines, water supply lines, and electric power lines) is increasing, the frequency of conducting the excavation is also increasing. Owing to the rise in the number of excavations to install and repair the subsurface facilities, we have many possibilities for gas accidents. These include: gas leakage from buried gas pipelines, the damage to buried gas pipes and cracks in buried gas pipes. Actually gas accidents caused by excavations have been continually occurring over the last 5 years, as shown in Table 1. We can see the total number of the gas accidents from excavations is 33 (which occupied 34% out of all the number of city gas accidents) and is ranked at the top of all categories of city gas accidents.

In this paper, we introduced the Excavation One Call System (hereafter referred to as EOCS) to reduce the occurrence of a gas accidents caused by excavation. We then evaluated the safety management effects of EOCS.

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1.1 Present Safety Management System regarding Excavations

The following is the regulation of City Gas Business Law connected with excavation safety management. The purpose of this regulation is to protect the gas pipeline from damage. The regulation was legislated after the tragic gas accident on the Daegu Subway line construction site occurred in May 1995, killing 101 people and injuring 201.

According to the Article 30-3 in City Gas Business Law, anyone who intends to carry out any kind of exca-

Table 1. Classification of gas accidents by the cause
(The figures mean the number of gas accidents)

Cause	'01	'02	'03	'04	'05	Total (rate)	
Carelessness	2	5	5	4	4	20	20.6%
Excavation	6	12	4	6	5	33	34%
Imperfection facilities	5	6	4	5	6	26	26.8%
Defective product	3	3	2	3	1	12	12.4%
Etc	2	1	-	3	-	6	6.2%
Total	18	27	15	21	16	97	100

vation (such as boring, piling, digging and other disturbing the ground) on roads (according to the Road Law), lands controlled by the housing complexes, or the areas within 3 meters' distance from the roads in the city gas served area (here after referred to as ANISBP, the Areas in Need of Inspecting the State of Buried gas Pipelines) must ask gas companies if any buried gas pipeline exist under the ground prior to digging.[6,7,8] The city gas company then has to determine if a gas pipeline is located under the ground where the intended excavation is to take place.

According to the Article 30-5 in City Gas Business Law, when the city gas company confirms that a gas pipeline is buried under the ground where excavators are supposed to dig, the excavators have to discuss with the operators of the city gas company (here after referred to as "operators") how to protect the buried gas pipeline from any potential damage before doing any excavation.

According to the Article 58-2 in City Gas Business Law Regulation, the city gas company also dispatches operators who take full charge of safety for buried gas pipelines and has them control and manage the digging site. The operators have to teach the workers who drive any type of construction machine for digging, trenching, ditching, augering, scraping or drilling, not to use the mechanical equipment within one meter's distance from either side of the buried gas pipeline or the marked line.

1.2 Analysis of the Gas Accidents Caused By Excavations

Even though the regulation was amended to protect the buried gas pipeline from damage, 33 gas accidents by excavation occurred over the last 5 years. We can see from Table 2, fourteen of 33 accidents have broken out during excavations for building construction (building and removing houses, enlarging the building, etc).

Table 3 shows the classification of gas accidents according to the area in which they occurred. Twenty three accidents among the 33 recorded occurred in the ANISBP, where the excavators had to inform the city

Table 2. Classification of gas accidents by the type of excavation

(The figures mean the number of gas accidents)

Type of excavation	Building construction	Sewer lines	Water supply lines	Electric and telephone lines	etc	Total
2001	4	-	2	-	-	6
2002	5	1	1	1	4	12
2003	2	1	-	-	1	4
2004	2	2	1	-	1	6
2005	1	1	1	2	-	5
Total	14	5	5	3	6	33

Table 3. Classification of gas accidents according to the area where they occurred

Accidents caused by excavation	No. of accidents					Total (rate)
	'01	'02	'03	'04	'05	
□ Accidents occurred in the ANISBP	5	10	3	2	3	23
○ by avoiding buried gas pipe check	4	6	1	1	2	14 (43%)
- on the roads	1	-	1	-	2	4
- in other areas	-	-	-	-	-	-
· lands in housing complexes	2	4	-	1	-	7
· areas within 3 m from the road	1	2	-	-	-	3
○ by other causes	1	4	2	1	1	9 (27%)
- because of a gas company's error	-	1	-	-	-	1
- because of an excavator's error	1	3	2	1	1	8
□ Accidents occurred outside of the ANISBP	1	2	1	4	2	10 (30%)
□ Total	6	12	4	6	5	33

gas company about any scheduled digging and request information regarding the location of any buried gas pipelines prior to excavation, in accordance with city gas business law, mentioned above. Fourteen of 23 accidents occurred by excavators' avoiding the law, and 9 of them occurred (though the excavators complied the law), by carelessness of the excavators and inaccuracy (or mismatch) of the map where the buried gas pipelines are marked. Ten accidents even occurred outside of the ANISBP, where the excavators were not required to check the buried gas pipeline.

1.3 Problems Inherent in the Excavation management system

The excavators must inform the gas companies of their digging prior to excavation, and discuss the methods to utilize to prevent the buried gas pipeline from damage. However, there are some problems with enforcing the law so the possibility of gas accidents is still in existence.

First, some of the excavators are ignorant of the fact that there is a law in place requiring them to ask gas companies if any gas pipeline is located under the ground before they dig. Even if they know of the law's existence, it is not easy to ask the city gas company in accordance with the law. It is unclear to many excavators where the company is located or which company they should ask for. Actually, we have 33 city gas companies in Korea and there are more than 2 companies in the same county in some cases.

Second, the process of informing a gas company and checking on a pipeline's location when they plan on digging is so complicated that the excavators often avoid these crucial initial steps. Owing to this noncompliance on the part of excavators, fourteen out of 33 gas accidents occurred over the last 5 years. Figure 1 shows how complicated the process regarding these steps between the excavators and the gas companies really is.

The last problem is that the present safety management system concentrates more on bureaucratic compliance (e.g., paperwork), rather than on the practical side of locating pipelines and informing excavators where it's safe to dig.

2. EOCS' Development

If the process of excavators' requests becomes simpler and the excavation site is managed more thoroughly, the number of the accidents by excavation can be decreased; we can see it from the analysis of the gas accidents and the problems of excavation management system mentioned above. To make up for the weak points in the current underground gas pipeline checking system, we introduced the EOCS as a pilot system, in Seoul, Korea, in October 2005.

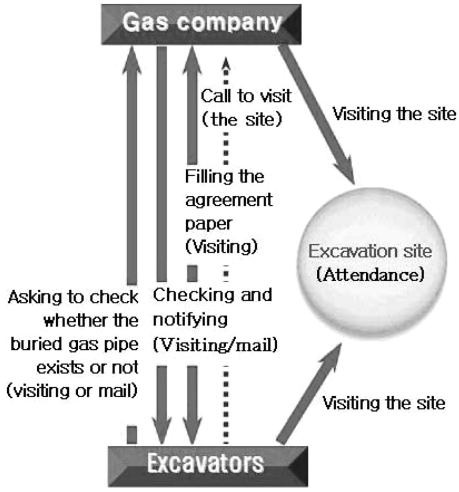

Fig. 1. Currently process to ask and notify the buried gas pipeline existence.

2.1 EOCS' components

The system utilizes the phone and internet to transfer information about digging underground and buried gas pipelines, although currently written forms are used in accordance with the City Gas Business Law.

We developed software for EOCS and installed the hardware, which are comprised of: a Web Server, a PBX (DB server), a CTI/PDS server, an IP IVR server, and a recording system at Excavation One Call Center (hereafter referred to as EOCC) in KGS (Korea Gas Safety Corporation). We launched these components last October. Customer service representatives, System operators, the leader of customer service representatives and the Manager of EOCC are the members of EOCC. Figure 2 shows that customer service representatives are working at EOCC in KGS.

Fig. 2. Customer service representatives at EOCC.

2.2 EOCS process

The EOCS is a much more simplified system because excavators are required simply to inform EOCC of any scheduled digging. The gas companies are required to check if a buried gas pipeline exists where the excavators ask to check; they then notify EOCC of the inspection result via internet, and after that, they set an appointment and discuss the protection method of the buried gas pipelines. We can see the simplified process from Figure 3.

2.2.1. The Process for Excavators

(1) Informing Excavation Plan to EOCC

Anyone who intends to excavate the ground in ANISBP has to inform EOCC about excavation prior to digging. The excavator can utilize the phone or the internet to inform EOCC of his plan. The required information includes: the name of the company placing the excavation order, the excavation company's name, the caller's name, the name of the person in charge of the excavation, the cellular phone number of the person in charge of the excavation, the location of the excavation, and the date when the work is scheduled to begin.

(2) Deciding How to Mark

Anyone who intends to excavate the ground in ANISBP has to talk with the city gas company about whether he will meet the operators to mark the intended excavation location and any buried gas pipeline's location. In this case, the excavator has to follow the decision of the gas company.

(3) Marking the Intended Excavation Area

If the excavators decide to meet with the gas company's employee to mark the location of the proposed excavation, they have to mark the location with white paint.

If they decide to mark the location of excavation without meeting the operators, the excavators have to mark their locations with white paint. They then must inform the EOCC of the deed of marking by placing a phone call or using the internet.

(4) Marking the Buried Gas Pipeline Location

If the excavators and the operators decide to mark the buried gas pipeline location together, the operators have to tell the excavators about the location of any buried gas pipeline which can be damaged from the proposed excavation, the excavators then have to mark the location right on the grounds of the buried gas pipeline with yellow paint.

(5) Starting the Excavation

The excavators should not start to excavate the ground before they have received permission from the EOCC to commence with excavation.

2.2.2 The Process for Gas Companies' Operators

(1) Checking the Buried Gas Pipeline's Existence

When the operators receive the information from the EOCC about the excavation plan, they have to check if a buried gas pipeline exists under the ground or the vicinity area where the excavators proposed to excavate; they then have to notify the EOCC of the inspection result via internet within 24 hours.

(2) Deciding How to Mark

When the city gas company found out that some bur-

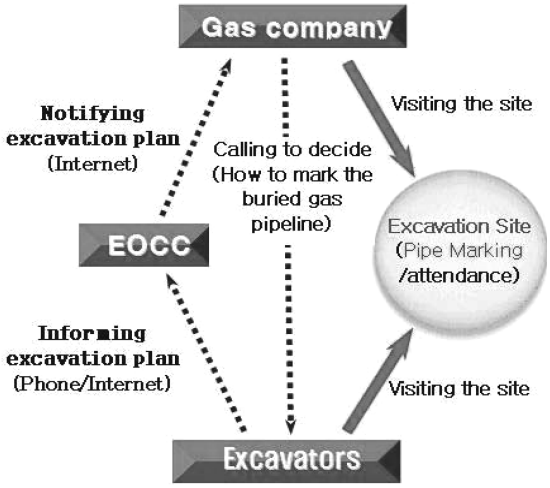

Fig. 3. The EOCS' simplified process.

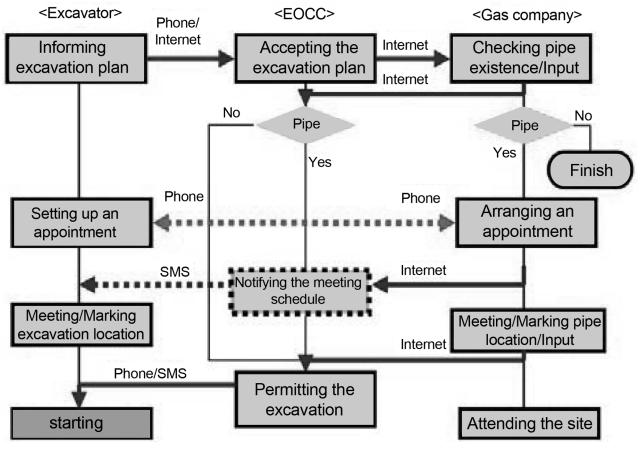

Fig. 4. A diagram of the EOCS process

ied gas pipeline exists under the ground or the vicinity area where the excavators were proposed to excavate and that the pipeline will be conflicted with the proposed disturbance of ground, the operators have to decide through talking with the excavators whether they will meet the excavators to mark the location of the buried gas pipeline or not.

(3) Notifying the Decision of Marking Method

The operators have to notify the EOCC of the decision of marking method (whether they will meet the excavators to mark the locations or not). In this case, the information has to include the name and the cellular phone number of the person in charge of the excavation, and the excavation's start date.

(4) Marking the Buried Gas Pipeline Location

If the operators and the excavators decide to mark the buried gas pipeline location together, the operators have to tell them about the location of the buried gas pipeline that has any possibilities of damage from the resulting excavation, to make the excavators mark the location.

If they decide not to meet each other, the operators have to mark the location of the buried gas pipeline, which can be damaged from the proposed excavation, just on the ground of the buried gas pipeline by themselves with yellow paint within a 48 hour period. They have to do this after they are notified by the EOCC of any notice that the excavators have marked the location of the proposed excavation.

(5) Notifying the Marking Result

The city gas companies have to notify the EOCC of the fact that they marked the location of the buried gas pipeline through either a phone call or the internet. We can see the EOCS process diagram from Figure 4.

3. Evaluation of EOCS

The EOCS, as a model case, has been working successfully for more than one year. After one year, we evaluated the business model by surveying the excavators and the operators. We asked them about the safety management effects on buried gas pipelines and the advantages of procedure and job load, compared to the current method using written form.

3.1 Increase in Instances of Informing Gas Companies Prior to Excavation

We asked 100 excavators and 100 gas company operators if the number of the inquiries (informing excavation plan) increased or not. The survey results show 89% of the excavators replied that the number of instances where the gas company was informed prior to excavation increased and 62% of the operators answered that the number of requests by excavators (via EOCC) increased.

Actually the number of inquiries and the number of the known excavation sites increased dramatically, as shown the Table 4.

3.2 Improvement in Safety Management

We asked the excavators and operators if the EOCS method of marking the excavation area and the buried gas pipeline's location was helpful, specifically regarding accuracy in confirmation of buried gas pipelines and safety management of the excavation.

Ninety four percent of the excavators answered that the EOCS was helpful as regards the accuracy in reporting the location of buried pipelines and 98% of the operators answered that EOCS was more helpful with respect to safety management of the excavation than present method.

3.3 Reduction of Job Load and Cost

We also asked excavators and operators if the EOCS made the load of their jobs in checking the buried gas pipeline increased and if the EOCS was helpful as

Table 4. A numerical statement for the number of inquiries and the number of excavation sites

Gas co.	No. of inquiries			No. of excavation sites		
	Before EOCS	After EOCS	Increase rate	Before EOCS	After ECOS	Increase rate
A gas co.	998	5,853	5.9	2,320	14,358	6.2
B gas co.	751	5,699	7.6	1,516	8,646	5.7
C gas co.	839	3,278	3.9	1,005	4,724	4.7
D gas co.	280	1,355	4.8	646	2,676	4.1
E gas co.	384	1,193	3.1	685	1,673	2.4
Total	3,252	17,378	5.3	6,172	32,077	5.2

regards cost reduction in checking the buried gas pipelines.

Eighty nine percent of the excavators answered that the load was not increased in comparison with the current method. Eighty four percent of the excavators answered that the EOCS method was helpful as regards cost reduction.

3.4 Good Efficiency and Convenience

Lastly, we asked the excavators and the operators if the EOCS process was convenient to inform and check, and if the process was efficient in comparison with the current method (using the document).

Eighty eight percent of the excavators found that the EOCS process was more convenient with respect to informing gas companies than the present method; 91% of excavators replied that the EOCS process was more efficient than the present policies in place.

4. Public Hearing

After the survey, we also held a public hearing on the extension of EOCS. Most of the panel agreed to extend the EOCS to the whole country and include other subsurface facilities gradually.

5. Conclusions

We found out that the EOCS model was more effective in communicating information about excavation to gas companies in an efficient and convenient manner and that the EOCS was more effective in preventing damage to buried gas pipelines than the existing method; we can see it from the survey and the public hearing mentioned above. We concluded that the ANISBP needed to be expanded to other areas, in addition to the roads, housing complex areas and the areas which are in the vicinity of the roads. We also reached the conclusion that the EOCS should be extended nationwide and gradually include other subsurface facilities.

References

[1] Korea Gas Safety Corporation, An Evaluation Report of EOCS model, Aug. 2006
[2] Government Code Section 4216-4216.9, The California One Call Law.
[3] Virginia Underground Utility Damage Prevention Act 56-265.14-56-265.32
[4] Korea Gas Safety Corporation, A Report for the gas safety management system of the advanced countries, Dec. 2005.
[5] The Damage Prevention Process In Alberta
[6] City Gas Business Law.
[7] City Gas Business Law Enforcement Ordinance.
[8] City Gas Business Law Enforcement Regulation.