

Securing the power infra and developing the hybrid system based on the diesel generator

Author: UnKi James Han, Korea Electrical Safety Corporation

Index

- 1** Introduction
- 2** Improvement business
for the diesel generator using as power resource
- 3** Hybrid system development
- 4** Domestic and international trend
and Economic analysis
- 5** Constructing social electric safety network

1. Introduction

Fédération Internationale pour la Sécurité des Usagers de l'Electricité
International Federation for the Safety of Electricity Users
Federación Internacional para la Seguridad de los Usuarios de la Electricidad

■ Next generation power resource based on Diesel generator

✓ Power supply status

- Though the increase of power supply ability, occurring the large-scale circulation power outage (2011.09.15.)
- Negative opinions about the unclear power and constructing transmission tower

➔ **Raising the necessity for safety at the emergency situation**

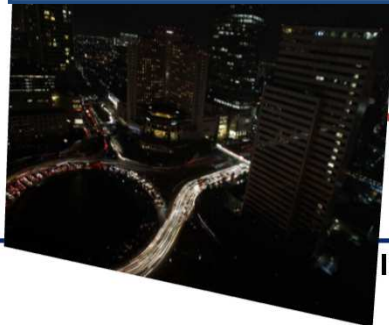
✓ Solution for the power supply limit

- Active coping for the power supply problem
- Immediate respond for the unexpected crisis

➔ **Using the diesel source located at the optimized position**

Constructing the next generation power system

Weak at the crisis



Using the optimized source



1. Introduction

Fédération Internationale pour la Sécurité des Usagers de l'Electricité
International Federation for the Safety of Electricity Users
Federación Internacional para la Seguridad de los Usuarios de la Electricidad

■ Next generation power resource based on Diesel generator

✓ Improving the usage of diesel generator

- For ensuring the safety
 - : Power outage, Peak-cut control
- Using as the power resource
 - : Using as the Demands respond resource

→ Conducting “Using the diesel generator as a power resource business” as the national pilot project

Using the diesel generator as a power resource business



Diesel generator



CTTS



For ensuring the safety

- Active coping for the unexpected power supply problem like power outage
- Contribute to the stabilization through the power supply peak control

Using as the power resource

- Improving the usage of diesel generator as power resource
- Available for using as the Demands Respond resource

1. Introduction

Fédération Internationale pour la Sécurité des Usagers de l'Electricité
International Federation for the Safety of Electricity Users
Federación Internacional para la Seguridad de los Usuarios de la Electricidad

■ Survey the distribution of diesel generator nationally

✓ Research for the usage of diesel generator

- Spreading all over the nation (about 23GW, same as 23 nuclear power plants)
- Low usage → Improving the usage and utilizing as the power resource for power supply

Potential resource status

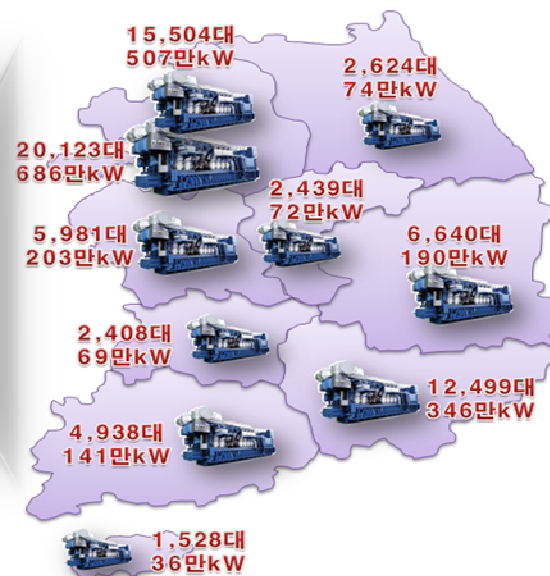
Installation :

74,684 generators

Total capacity : 23.24GW



23 nuclear power plants



<Status of diesel generator distributed nationally>

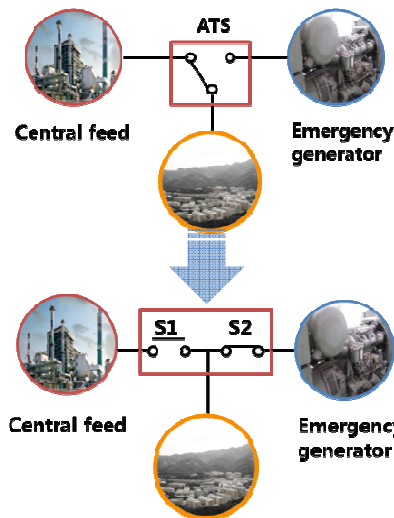
2. Improvement business for the Diesel generator using as power resource

▪ Business purpose

✓ Improving the usage of existing diesel generator

- Replacing the ATS to CTTS and Facility improvement
- Developing the qualification standard
- Improving the Diesel generator environment

✓ Replacing the ATS to CTTS for facility improvement



ATS (Automatic Transfer Switch)

- Power outage during transfer
- Shortening the lifespan of generator by the impulse current occurring at switching

CTTS (Closed Transition Transfer Switch)

- Uninterruptible power transfer
- Synchronizing the frequency, phase, voltage → instant parallel operation → uninterruptible transfer

2. Improvement business for the Diesel generator using as power resource

■ Business purpose

✓ Developing the qualification standard

- Improve the system stability and propose the CTTS certification standards for reliability
- Developing the evaluating method cited international standards (IEC standards)
- CTTS Certification standards presented in accordance with international standards such as UL 1008



<Performance test for the CTTS synchronizing>



<Official test for the CTTS>

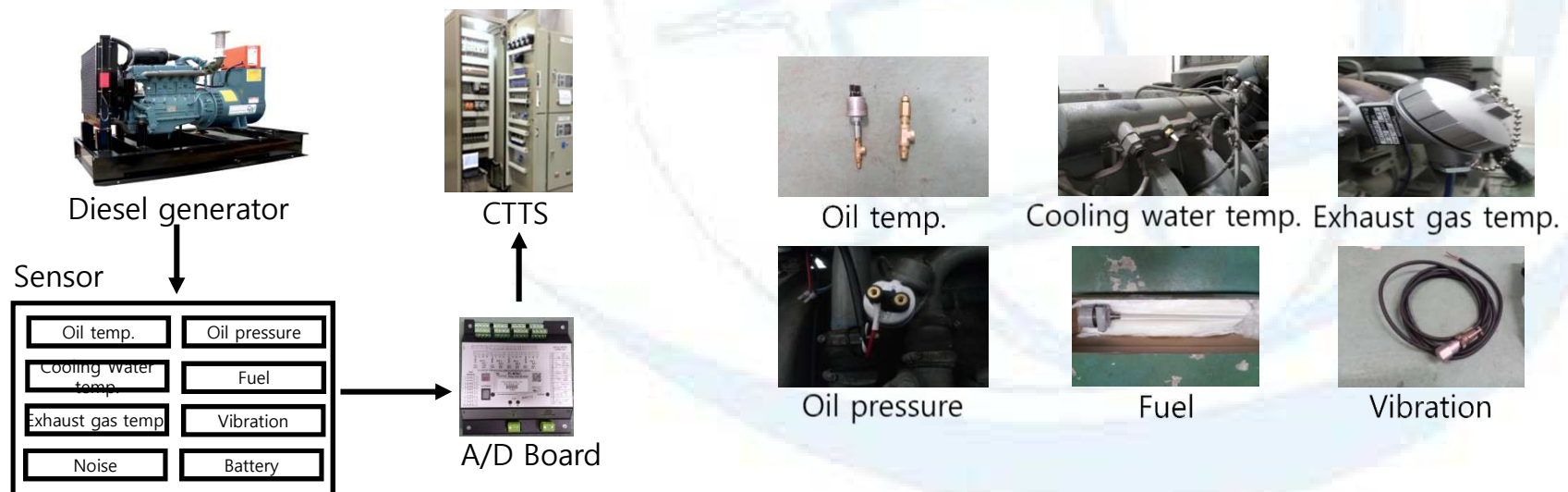
2. Improvement business for the Diesel generator using as power resource

■ Business purpose

✓ Improving the Diesel generator environment

- Analyzing the environmental influence by the diesel generator and researching the environmental-friendly system conducting
- Developing the diagnosis system for reducing the pollution and the improvement method

✓ Developing the diagnosis system for diesel generator



2. Improvement business for the Diesel generator using as power resource

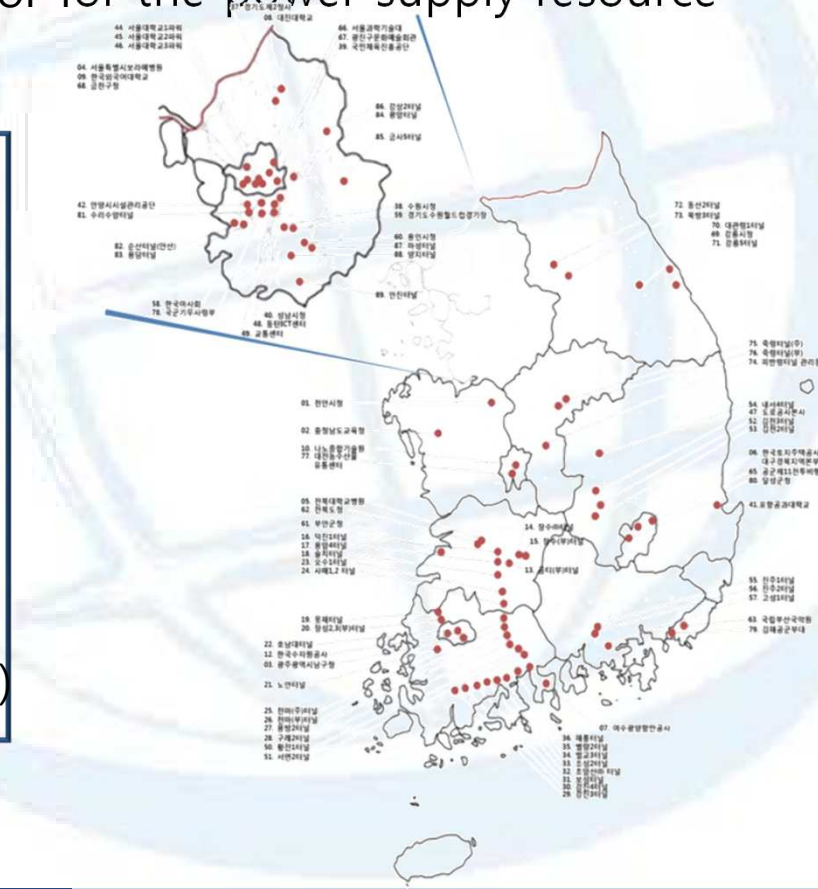
■ Conducting Pilot Business

✓ Project purpose

- Using the emergency diesel generator for the power supply resource

Outline

- Managing department : KESCO
- Budget : 12.5B won
- Period : 2014.01.01.~2015.06.30.
(18month)
- Secure the resource : 130,000 kW
- Constructing the cooperation :
34 public institutes (86 sites)



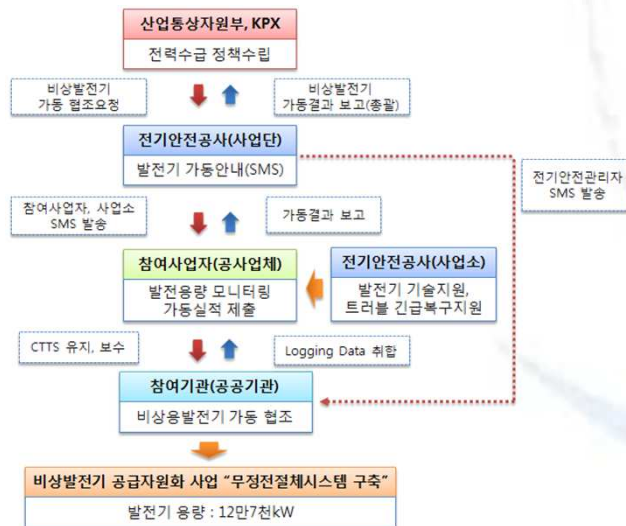
2. Improvement business for the Diesel generator using as power resource

■ Status of the Business

✓ Conducting the operating training

- Check the diesel generator condition and maintaining it as the resource
- Exercising the cooperation system preparing for the national disaster

✓ Training method and result



<training process>

Training result

- Complete constructing the off-line network cooperation system at each site
 - Field workers ↔ manufacture staff
 - ↔ KESCO specialized staff
- During the training period (4 days), 34 public institutes(86 sites) are 100% attended

2. Improvement business for the Diesel generator using as power resource

▪ Survey the usage of equipment

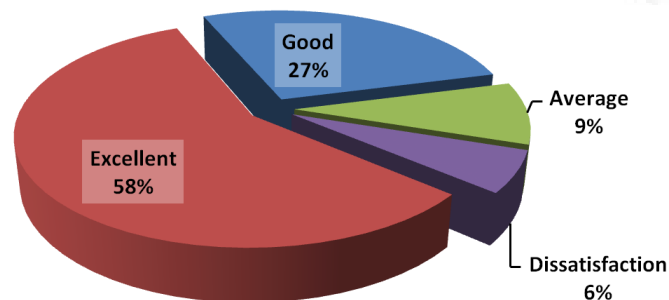
✓ Survey introduction

- Survey satisfaction with public institute who participated in the project
- 97% high response rates show high interest in project

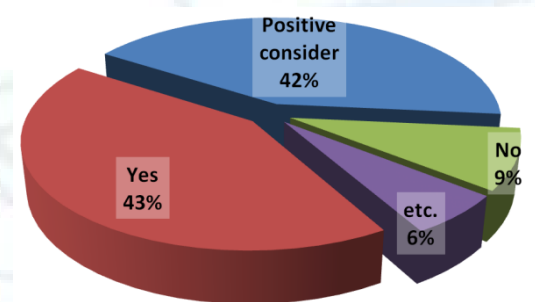
✓ Survey result analysis

- 85% answered that the public institutes are satisfied with the business
- 85% answered that they will participate the next ESS linked expanding project

➔ 'Actively used', 'useful' reaction shows



<project whether satisfied>



<Participate in the following projects>

2. Improvement business for the Diesel generator using as power resource

■ Assessment of business

- ✓ Government : High trust formed by business success, reference for the next business
- ✓ Congress : Check up the utilizing the existing resource better than unclear plant
- ✓ Press : Efficient for the power supply, evaluation for the export item
- ✓ Market : Market expand from the government market to private market
 - After the business, Korea Expressway corporation, K-water corporation, Korea airports corporation(Incheon, GimPo, GwangJu) adopting the system voluntarily



<Signed the R&D MOU
for expanding the business>



<Discussing for entering
the overseas market>

3. Hybrid system development

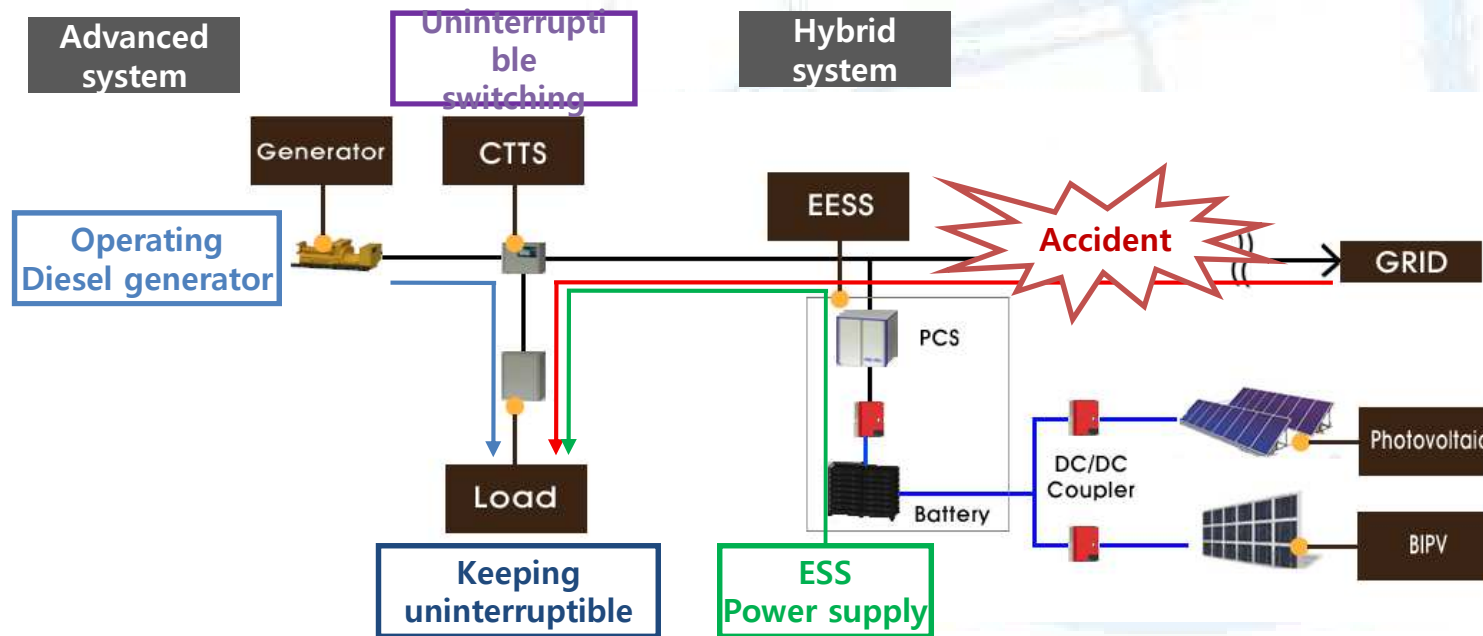
Fédération Internationale pour la Sécurité des Usagers de l'Electricité
International Federation of Electricity Users
Federación Internacional para la Seguridad de los Usuarios de la Electricidad

Hybrid system introduction

✓ Advantage of hybrid system

- Solving the power outage problem based on the diesel generator system at the unexpected situation
- Increasing the power supply efficiency by optimizing the distributed resource

✓ Comparing the existed system with the hybrid system

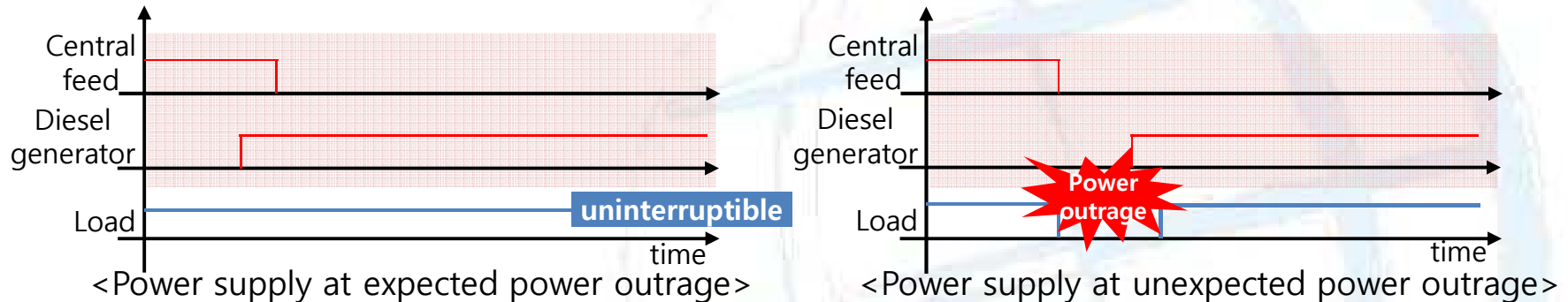


3. Hybrid system development

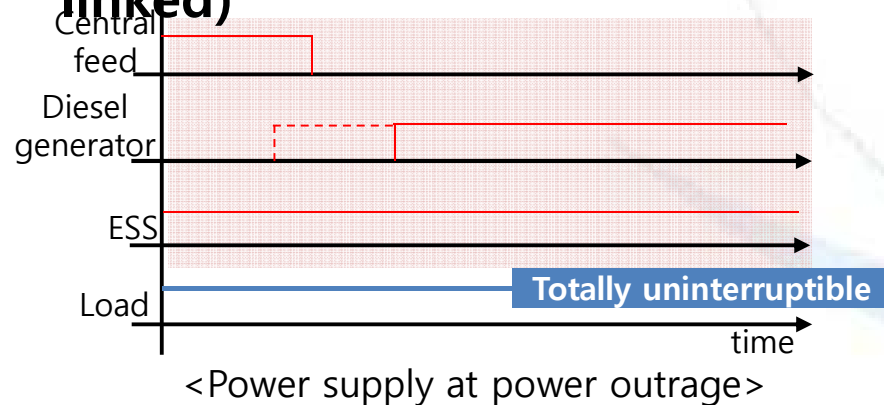
Fédération Internationale pour la Sécurité des Usagers de l'Electricité
Federation of Electricity Users
Federacion Internacional para la Seguridad de los Usuarios de la Electricidad

■ Equipment utilization

✓ Power outage situation by the advance diesel generator system



✓ Power outage situation by the hybrid system (Diesel generator-ESS linked)



Hybrid system

- Adding the ESS at the CTTs-Diesel generator linked system
- Charged ESS immediately respond for the power system even though the unexpected power outage

3. Hybrid system development

System demonstration

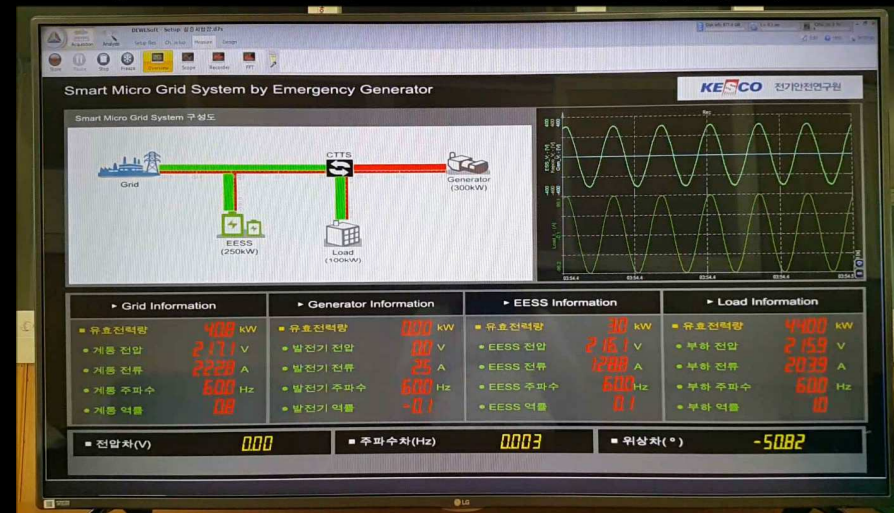
✓ Uninterruptible power supply systems simulation components

- Diesel generator, Energy Storage System(ESS), Close transition transfer switch (CTTS), Simulation RLC load

Emergency Diesel Generator



Fully uninterruptible power supply system



System

Simula

4. Domestic and international trend and economic analysis

■ Domestic



- Micro Grid village
 - Difficult power supply area such as island (GaPa Island, ShamMah island)
 - Consist of diesel generator, ESS and renewable energy

■ International



- Developing the suitable business model considering the regional characteristic
 - Southeast Asia (such as Vietnam) : for power breakdown
 - Africa (such as Uganda) : Energy

4. Domestic and international trend and economic analysis

■ Economic analysis

✓ Economic analysis method

- Comparing the new system construction costs with the loss due to power failure
- Calculate the investment repayment terms

Construction costs

- Except for existing installed diesel generator
- Additional installation such as CTTS and ESS costs are calculated
 - Calculated in accordance with the load capacity

Loss due to power failure

- analysis separated by industry
 - Heavy industry, light industry, service industry
- Costs are broken down for accurate analysis
 - labor cost, equipment depreciation, repair costs, etc

4. Domestic and international trend and economic analysis

▪ Economic analysis (southeast Asia, for example H company)

✓ Calculate the construction costs

| Construction costs (1MW standard) | |
|-----------------------------------|------------------------------|
| Diesel generator (installed) | 0 won |
| CTTS | 0.05B won |
| ESS (0.5M won/kWh) | 0.4B won |
| Total | 0.45B won 0.4M \$ |

| H company construction costs | |
|---|------------------------------------|
| Supply capacity | 3,600kW |
| Apply capacity (critical load : 40%) | 1,440kW |
| Uninterruptible power system Unit price | 0.6B won/1MW |
| H company construction costs | about 0.65B won 0.5M \$ |

4. Domestic and international trend and economic analysis

▪ Economic analysis (southeast Asia, for example H company)

✓ Loss due to power failure

| Loss due to power failure (1 year standard) | |
|--|--------------------------------|
| Labor cost | 8.5M won |
| Equipment depreciation | 14M won |
| Product reliability | 50M won |
| Total | 72.5M won 60,000 \$ |

✓ Investment repayment term

| Investment | Loss | Repayment term |
|----------------------|------------------------|----------------|
| 0.65B won 0.5M \$ | 72.5M won 60,000 \$ | 8 year |

✓ Economic analysis

- decreasing the construction costs
 - CTTS localization and ESS price decrease
- increasing the loss
 - losses increased by rising labor costs

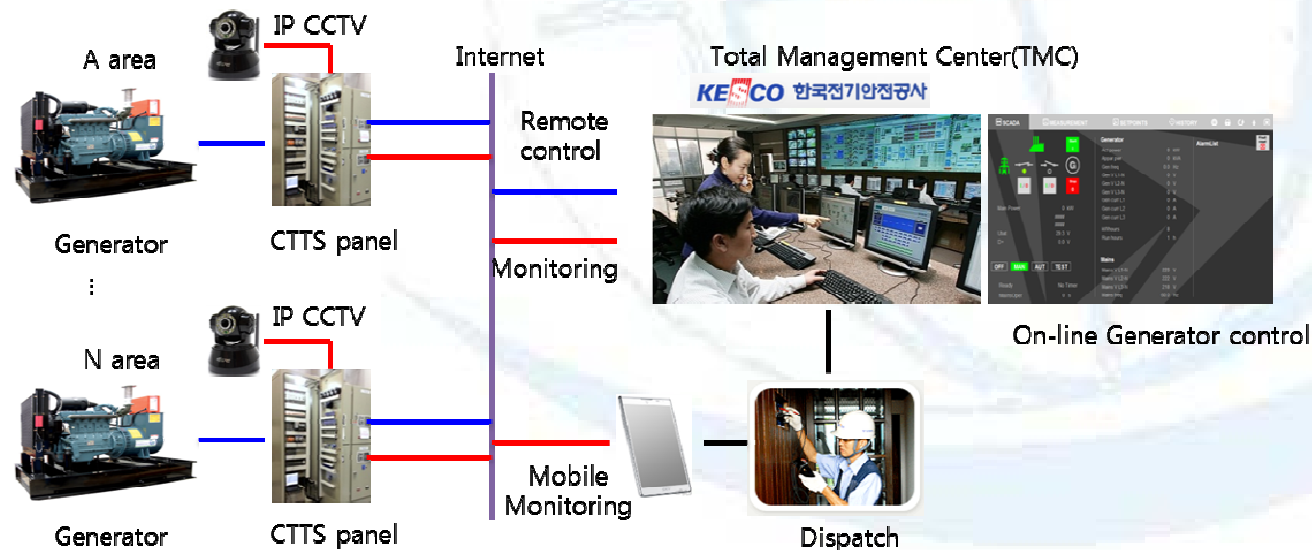
➔ **Repayment term : under 8 year**

5. Constructing social electric safety network

■ The electrical safety management system

✓ Conducting the electrical safety management System

- Necessity for conducting the electrical safety management system to control the distributed resource
 - To preparing the next generation electrical environment
(ex : diesel generator, next generation hydrogen generator, electric vehicle)
 - The new technic is necessary for maintaining the advanced system



5. Constructing social electric safety network

■ Total management system of distributed resource

- ✓ Necessity for the total management system by conducting the distributed resource network



<Status of total management system of distributed resource>

THANK YOU



<Future technology research team>

- **Team leader : UnKi James Han**
- **E-mail : power@kesco.or.kr**
- **Mobile Phone : +82) 010-8366-8864**