

# **Strengthening emergency management measures: Lessons learned from Korea's response to massive wildfires**

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## **1. Introduction**

The recurrence of disasters from natural and social factors adversely impact national development, causing substantial property damage, hardships, suffering, as well as loss of life. However, such negative impacts can be mitigated or even prevented by assessing the underlying risk factors and taking necessary disaster prevention measures, such as establishing disaster management plans and systems, improving relevant laws and regulations and conducting facility safety inspections.

In this light, the Board of Audit and Inspection (BAI) of the Republic of Korea strives to propose improvements that will reduce risks by examining the national disaster management system in how the government establishes measures and executes budget for prevention, response, and recovery based on the types of disasters.

Many Supreme Audit Institutions (SAIs) have advised their respective governments or parliaments to enhance their management systems to reduce disaster risks. Meanwhile, the International Organization of Supreme Audit Institutions (INTOSAI) and the Asian Organization of Supreme Audit Institutions (ASOSAI) have formulated related standards, such as the ISSAI 5510 “Audit of Disaster Risk Reduction,”<sup>1</sup> and shared their audit experiences through cooperative relations to develop audit methodologies for disaster mitigation.<sup>2</sup>

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<sup>1</sup> <https://www.issai.org/?s=issai+5510>

<sup>2</sup> The SAIs discussed audit methodologies for disaster prevention and management under the theme of “Emerging Issues and Emergency Situations” at the 3<sup>rd</sup> EUROSAI-ASOSAI Joint Conference held in Jerusalem (Israel) on March 10-14, 2019.

This paper presents the audit case on how the BAI delved into the causes of the recent massive wildfire that was caused by a broken power line and provided the auditees with recommendations to prevent future wildfires.

## 2. Audit Background

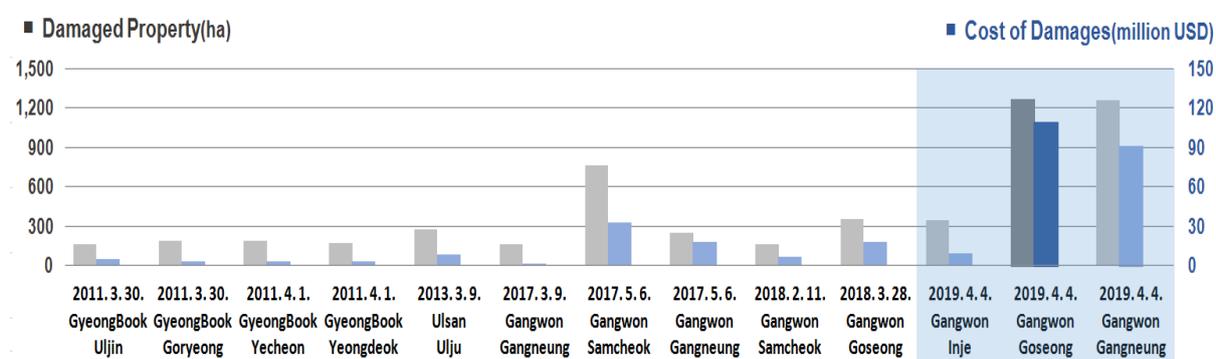
### a. Massive wildfires caused by power lines

While some wildfires occur naturally, such as by lightning, other massive wildfires result from human causes. In recent years, there has been an increase in human-caused wildfires, mainly due to poor management of high-voltage power lines.

In November 2018, Butte County in northern California experienced the deadly Camp Fire, named after Camp Creek Road where the fire originated, due to sparks from uninsulated power lines. The fire resulted in 102 casualties (85 deaths and 17 injuries), and incurred USD 16.5 billion in property damage (over 60 thousand hectares of land burned). In October 2019, a massive wildfire in Sonoma County, known as the Kincaid Fire, was found to be caused by a broken jumper cable, which led to four injuries and USD 600 million in property damage from over 30 thousand hectares (ha) of land being burned.

In Korea, a broken high-voltage wire caused a large wildfire in Sokcho, Gangwon Province, in March 2004 burning 180ha of land. After the incident, the government developed various countermeasures to prevent such wildfires. However, on April 4, 2019, another wildfire resulting from a broken jumper cable hit Goseong county of Gangwon Province (“Goseong Fire”), and was recorded as the largest wildfire in the past 10 years.

[Table 1] Damages caused by wildfires in Korea for the past 10 years

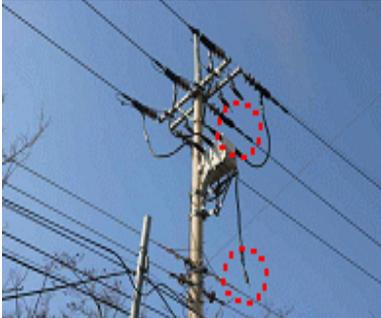


Source: Korea Forest Service

**b. Goseong Fire: Cause and impact**

On April 4, 2019, around 19:00, an electric arc from a fallen high-voltage jumper cable started a massive wildfire in Goseong County, leading the Korean government to declare a state of emergency.<sup>3</sup>

[Figure 1] Goseong Fire caused by broken high-voltage wires

Broken jumper cable	Electric arc (CCTV image)	Goseong Fire
		

Source: Goseong Fire Station

The fire spread from its point of origin to the city area for two days from April 4-6, causing 2 deaths and 11 injuries, and destroying buildings, vehicles, and 1,267ha (12.67km<sup>2</sup>) of forests, resulting in a total of KRW 129.1 billion (USD 110 million) in property damage.

**3. Audit plan and audit approach**

**a. Objectives and key audit matters**

In the wake of the Goseong Fire, the BAI conducted an audit to examine and eliminate risk factors for the overall power supply facilities to better secure the safety of their operation and to prepare for disasters, such as massive wildfires, that can undermine public safety.

Key audit matters included a cause analysis of large wildfires caused by power lines, risk assessment of facilities, and compliance with wildfire response measures. Safety of power supply facilities and the power supply system were also examined to prevent nationwide blackouts (but this article only contains contents regarding the Goseong Fire).

<sup>3</sup> This is the third state of emergency declaration after the legislation of the Framework Act on the Management of Disaster and Safety on June 1, 2004, following the Yangyang Fire in April 2005 and Oil Spill in Taean in December 2017.

## **b. Audit methodologies**

The audit team visited the location where broken high-voltage wires started the Goseong Fire and examined the maintenance status of the power lines. To find out the causes behind broken power lines, the BAI requested external experts to perform a numerical analysis through a computer simulation to identify the possibilities of power lines breaking based on the condition of the clamps (e.g. missing clamp components, proper fastening of clamps, etc). The BAI also reviewed the regulations regarding standards and procedures to restore electrical power through the activation of reclosers<sup>4</sup> and conducted interviews of the workers in charge of managing the equipment needed to ensure the stability and safety of power supply facilities (such as clamps and reclosers) to assess whether the workers complied with the proper response measures to prevent massive wildfires.

## **4. Lessons learned**

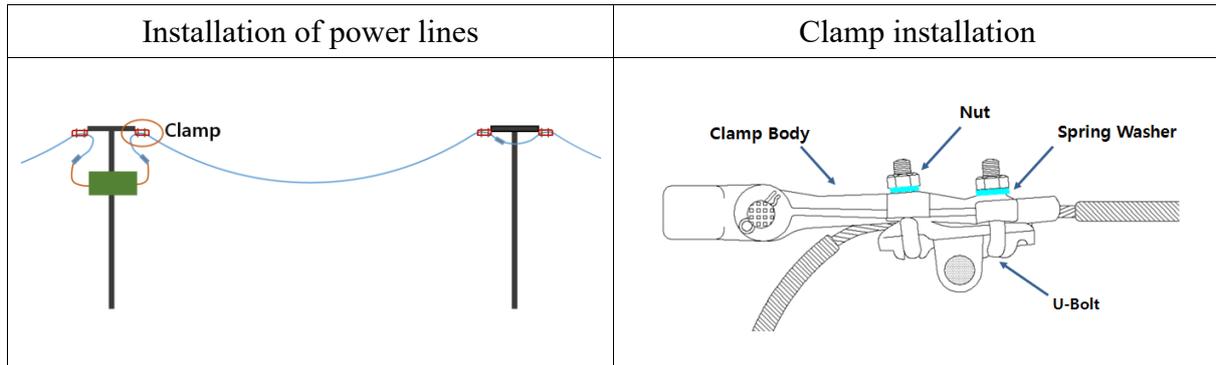
### **a. Proper installation, maintenance and management of clamps**

When installing high-voltage distribution lines, the lines should be able to support its own weight and withstand wind loads. The clamps connecting the lines to the utility poles (using bolts, nuts, spring washers, etc.) should be tightly fastened to keep the tension at rest, as there is a gravitational force pulling the line downward. If the clamps become loose, the tension of the jumper cables weaken, causing them to sway (especially with strong winds) and clash with the clamps, creating fretting fatigue. As fretting fatigue can result in broken cables, the tension of the jumper cables should be properly maintained. In case of the Goseong Fire, the jumper cable near the clamp had been broken, igniting the fire. After analyzing the fastening conditions of the clamp and the jumper cables, the BAI found that the clamps had become loose because the spring washers had not been installed, which can increase the possibility of the jumper cables breaking.

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<sup>4</sup> A recloser shuts off the electrical power when it senses any problems with the power lines. Once it senses that the problem has been resolved, the recloser then restores the electricity.

[Figure 2] Drawing of power line and clamp installation



Source: Korean Society of Steel Construction

Therefore, in an effort to reduce the risk of massive wildfires caused by broken jumper cables, the BAI notified the CEO of Korea Electric Power Corporation, KEPCO (which is responsible for managing the national electric power supply and demand), to tighten the loose clamps and replace the old clamps in order of priority based on the level of disaster risk.

**b. Measures to properly regulate reclosers during wildfire season**

In detecting faults on high-voltage power lines, the power supply facilities are supposed to shut off the power supply to prevent fires and electrical accidents. In case of power outages stemming from temporary faults caused by contact with foreign objects (birds, vegetation, etc.), reclosers are installed and operated within the power distribution system to avoid unnecessary power outages.<sup>5</sup>

Countries that have experienced massive wildfires originating from broken high-voltage cables temporarily disable reclosers during times when high winds and dry conditions enhance the likelihood of wildfires. Taking this into consideration, and as a result of the Goseong Fire (March 2004), KEPCO established measures to control the operation of reclosers based on the Forest Fire Danger Index (FFDI).

However, the BAI found that in 2018, KEPCO had abandoned the FFDI-based standards for the recloser operation to minimize unnecessary power outages and has since then been operating their reclosers at all times, even during wildfire season, contributing to the increased risk of wildfires. This led to five incidents of arc discharge in the Goseong Fire, as the recloser continued the flow of electricity even after the jumper cables were broken. The BAI notified

<sup>5</sup> A recloser repeats the reclosing cycle up to three times at fixed intervals to clear a temporary fault. In case of permanent faults (when the problem remains after three attempts), the recloser shuts off power.

the CEO of KEPCO to establish measures to regulate the operation of their reclosers during periods that are high- risk for wildfires to prevent reclosers from restoring power after permanent faults (broken power lines) to prevent additional arc discharges from encouraging more wildfires.

## **5. Conclusion**

In the wake of the Goseong Fire, the BAI advised the CEO of KEPCO to conduct periodic checks on all power supply facilities to prevent disasters, such as wildfires by analyzing their causes and further recommended the strengthening of the national safety management system. Disasters that pose a threat to public safety and national development, are becoming increasingly complex and diverse, making it difficult to predict new risk factors. Under these circumstances, the BAI plans to strive toward reviewing measures to prevent and mitigate disasters by assessing risks on each type of disaster and conducting facility inspections. Together with such efforts, the BAI will continue to maintain and strengthen international cooperation with respective SAIs by sharing audit cases on disaster responses and developing effective methodologies in this area.