

## *Safe and Efficient Nuclear Plant Operation with HanPHI*

### **Korea Hydro and Nuclear Power**

Korea Hydro and Nuclear Power (KHNP) is the largest Korean electric power company, generating approximately 31.5% of the total generated electric power in Korea. KHNP operates 82 units, including nuclear, solar, hydro, geothermal, bio, and hydrogen power plants, with a total production capacity of 27,857 MW. Approximately 80% of production comes from KHNP's 24 nuclear power plants.

#### **Challenges**

With growing public interest in nuclear plant activity and the increase in operational data available at plants, KHNP focused on ensuring the technical safety of the nuclear facilities and managing data at a centralized control and monitoring center. With the limitations of their current system, KHNP needed additional solutions to achieve their goal of improving enterprise-wide plant operation.

##### **1. Short Lead Time**

Every second of a nuclear power plant's operation is critical. Assets across the plant floor transmit vast amounts of data. Using this real-time data, traditional alarms alert plants when a value exceeds a high or low limit. These alarms alert a plant before equipment enters a critical state that can lead to destruction, part failure, or unplanned outages. Unfortunately, this limits the lead time a plant has to plan and act. To find the problem earlier, KHNP could adjust the alarm set point, but for KHNP, the alarms would occur so frequently that the alarms would lose their meaning. KHNP needed smart early warnings that gave them enough lead time.

##### **2. Data Infrastructure for Predictive Maintenance**

KHNP understood the necessity of predictive maintenance as maintenance based solely on the age of the equipment ignores the fact that a majority of equipment failures are random. KHNP needed a proven early warning system that predicts plant condition, is able to interface with their plant monitoring system, and integrates with other existing systems. KHNP wanted to manage critical and operational equipment data through a predictive monitoring infrastructure, enabling enterprise level collaboration at their centralized center at headquarters.

#### **HanPHI**

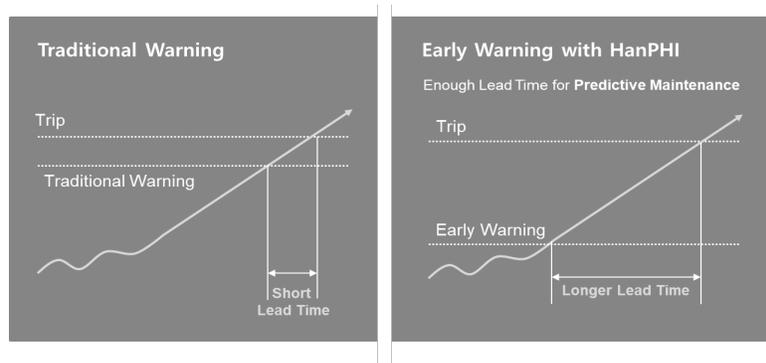
In 2016, KHNP installed HanPHI in its Centralized Monitoring and Diagnostics Center at the Center Research Institute. KHNP then implemented HanPHI into its central monitoring at headquarters. HanPHI captures valuable information embedded in the ocean of KHNP's 24 nuclear power plant data. HanPHI predicts upcoming equipment failures based on dynamic analysis of expected and real-time values. HanPHI's innovative and patented intelligent predictive modeling technology enables the prediction of potential and hidden failures at KHNP's 24 nuclear power plants. Every day, KHNP leverages this powerful solution to achieve operational excellence. Understanding its value, KHNP will install HanPHI in its 4 new plants currently under construction.

## Benefits

### 1. Increased Lead Time

With a clear view of impending equipment failure in advance, KHNP prepares for critical failures beforehand. With extended lead time, KHNP actively maintains valuable assets, eliminating failures that previously led to costly downtimes. By analyzing the current operation status of the plants, HanPHI generates early warnings that KHNP uses to act or plan maintenance.

HanPHI also monitors all the equipment in real time, constantly learning the normal patterns of individual equipment, and identifies even the slightest sign of impending failure in advance. Once HanPHI detects any sign of failure, KHNP uses the SuccessTree to view the relevant equipment and do root cause analysis. With this valuable information, KHNP utilizes predictive maintenance days or weeks before the critical event.



### 2. Optimize Operation and Maintenance

With HanPHI, KHNP established their predictive maintenance process. The innovative central early warning system HanPHI enables KHNP's headquarters to monitor all power units and provide operating and maintenance recommendations to their sites at the right time. Operators and management access an intuitive and clear overview of entire plant floors, including abnormal conditions. This enables optimal plant operation and maintenance and, more importantly, operational excellence.

For example, HanPHI helped prevent a potential failure at a 1000-MW nuclear power plant by detecting a pressurizer safety system issue in advance. HanPHI generated an early alarm and an operator performed valve gagging maintenance before a serious problem occurred.

#### Challenges

- Limited use of the current plant operation and plant variability when predicting failures in advance
- Inadequate lead time to plan and implement the necessary maintenance

#### HanPHI

- Collects normal, fault-free data to create unique patterns
- Identifies small deviations in equipment and operation behavior that are precursors to potential and/or hidden failures
- Displays information in an intuitive hierarchical order to help focus the user on the root cause sensor variable
- Generates an early warning when detect an anomaly

#### Benefits

- Increased lead time to plan and execute the necessary maintenance
- Provide early detection of abnormal conditions to enable effective decision-making
- Reduce operation and maintenance costs by utilizing preventative maintenance and reducing reactive maintenance
- Utilize centrally-located expertise across all 24 plants