INTEGRATED OPERATION WITH MAINTENANCE ALARM ON AN ASSET MANAGEMENT SYSTEM

MORI Hiroshi [*1] ***HAYASHI Shunsuke*** [*2]

Recently, with the digitization of field devices and advancement of diagnostic functions of equipment, it has become possible to predict equipment breakdowns. Prediction information is notified to remote integrity staff as messages, and is used for early integrity maintenance of equipment. Sometimes it may be more effective for operational quality to inform the operator. With the integration of alarm management which notifies various alarm messages appropriately and plant equipment management which manages the state of equipment, Asset Excellence (AE) achieves seamless maintenance and operation as well as Lifecycle Excellence. This paper introduces the merits of combining the plant resource management function of Plant Resource Manager (PRM), which is an AE platform, with operations.

INTRODUCTION

As field instrumentation devices become increasingly digitized and computerized, interactive and remote access to a large quantity of field information becomes possible. This will increase the efficiency of plant equipment maintenance by reducing labor requirements in field patrol work for example. Numerous other advantages are also anticipated, such as remote surveillance which will contribute to reduced field operations. Moreover, prediction alarms which are spontaneously output by devices enable the early detection of potential problems. With the progress of diagnostic technology, preinstalled diagnostic functions in devices make it possible to detect device and process interface trouble at an earlier stage.

As operation efficiency is expected to be enhanced by device and process diagnoses, conventional breakdown maintenance and preventive maintenance will be replaced by predictive maintenance due to the diversification of plant information. Meanwhile, the problem arises as to how this wide variety of information (messages) will be managed and by whom. Taking into consideration the current situation where maintenance personnel already deal with a staggering amount of information due to labor reduction, this diversification of plant information approaches overwhelming proportions. Trouble alarms are closely connected to maintenance; however prediction alarms, unless appropriately managed, can cause new problems with the inherent deluge of information.

This paper outlines a system to appropriately manage plant information that contributes to operation efficiency, and that shares management information with the operators.

DIAGNOSIS AND PREDICTION ALARMS

The progress that has been made with diagnostic functions makes it possible to predict trouble with devices. While conventional self-diagnosis is limited to the detection of hardware/sensor trouble, process interface diagnosis such as the blocking diagnosis of a differential pressure transmitter's impulse line is available, today. Moreover, It is anticipated that diagnosis and prediction alarms will be capable of diagnosing entire facilities, including steam piping.

The installation of an on-line diagnostic system in devices is an example of the evolving form of plant operation. Such a system makes it possible to predict trouble (using prediction

*1 Marketing Center, Industrial Automation Business Headquarters
*2 System Business Center, Industrial Automation Business Headquarters

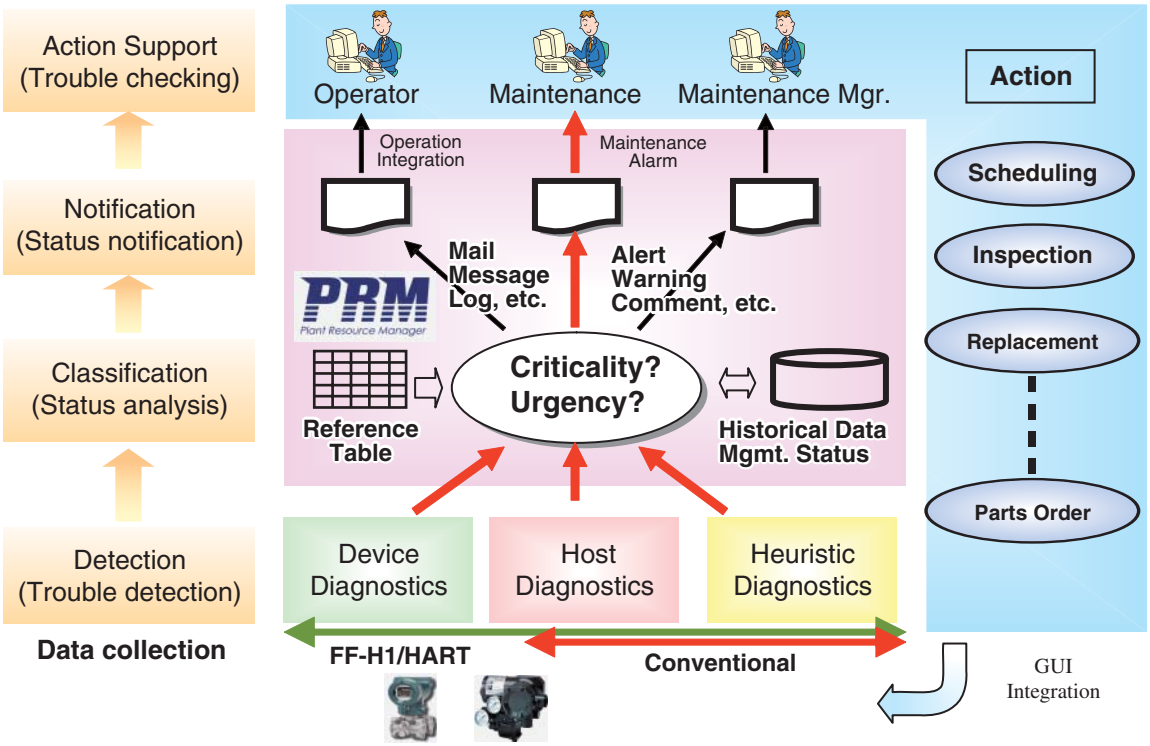

Figure 1 Concept of PRM Maintenance Alarm (Operation Flow from trouble detection to action support)

alarms) by sequentially monitoring device data trends which enables the optimization of maintenance timing. Specifically, prediction alarms realize the following advantages: the lead time required for taking necessary action is streamlined, which in turn simplifies the planning of well balanced maintenance operations.

PLANT CONDITION MANAGEMENT

Although the advent of digitized instrumentation and intelligent field devices helps to promote the reform of plant management methods, the creation of a system that consolidates the management of plant information and history in conjunction with the newly developed prediction alarms is essential.

Prediction alarms are expected to accelerate response time to device trouble and to save field patrol labor. However, if current systems remain unchanged, maintenance workloads increase.

For example, while the devices, loops and units differ even though the message type is the same, the weight of each message varies, and maintenance personnel are required to specify the actual cause of the trouble from several messages based on their experience and knowledge. If maintenance personnel are provided with appropriate information to determine which device is prioritized, it will become possible to balance maintenance levels. Moreover, the operator will be able to obtain appropriate information in a timely manner. The PRM Plant Resource Management Software Package models the message transaction system as a maintenance alarm concept, and this has been incorporated into the software as the maintenance alarm function (Figure 1).

Trouble Detection

With progressing technological development, the application of the diagnostic function that has been incorporated into field devices has come to be incorporated into a wide ranging variety of devices and equipment. The diagnostic functions used in rotating machinery, pumps, and the like are being provided by different companies. Thus there are compound, advanced diagnoses of units that comprise the plant based on diagnostic results given by these functions. At the same time, it is essential to conduct field patrol checks of non-intelligent devices, including conventional analog transmitters. Collectively speaking, diagnostic functions can be roughly classified as follows:

- Diagnosis by devices' internal functions (Device Diagnostics)
- Diagnosis by application software (Host Diagnostics)
- Diagnosis by operator (Heuristics Diagnostics)

(1) Diagnosis by devices' internal functions (Device Diagnostics)

Diagnostic results obtained from the internal functions of a device are usually recognized as a status or message. FOUNDATION™ fieldbus devices can spontaneously issue a message, but some devices, such as HART devices, however, do not have this capability. Therefore, PRM is equipped with the function to poll and detect diagnostic results if necessary (Device Patrolling Function), providing various methods to respond to a broad range of communication interfaces.

(2) Diagnosis by application software (Host Diagnostics)

Diagnosis by application software applies to the following situations:

Advanced diagnosis of a unit/device comprising the plant

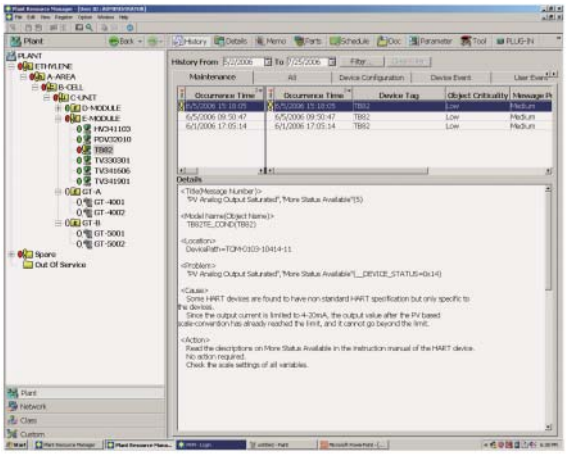

Figure 2 Maintenance Alarm

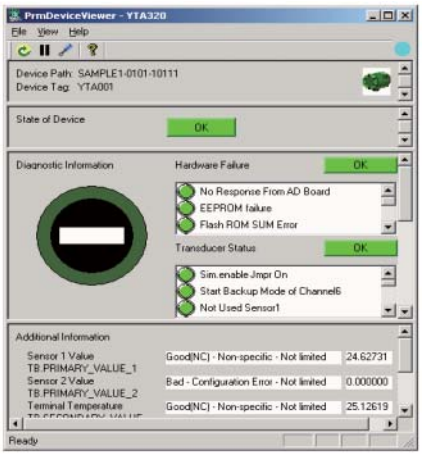

Figure 3 DeviceViewer

Diagnosis of several consolidated process values

PRM provides an advanced diagnostic function (PAA) that can create a diagnostic algorism by a simple Graphical User Interface (GUI), and these results are also possible to control.

(3) Diagnosis by operator (Heuristics Diagnostics)

Even though the self-diagnosis of devices has evolved, field patrol is still indispensable in order to detect trouble in conventional facilities equipped with 4-20 mA devices which are in use throughout the plant. If the results of these field patrols can be managed in a unified format, it will then become possible to manage the status of facilities in a unified manner without relying on a device's capabilities. Accordingly, PRM is equipped with an interface which can register the status of each trouble spot.

Status analysis and notification

Detected trouble is initially analyzed and classified according to the appropriate maintenance level (Urgent, Next inspection, Regular inspection, etc.) in relation to the priority and urgency of the situation at the facility (1st judgment). If information about the priority and urgency of the situation at the facilities is received in advance, trouble notification transactions can be optimized in accordance with the user's maintenance operation standards. Moreover, unnecessary non-urgent maintenance will be reduced, thereby improving overall maintenance efficiency.

The analyzed and classified device status is communicated to the appropriate maintenance personnel and operator through the alarm distribution function. PRM facilitates distribution methods such as maintenance alarms, an operation guide, e-mail, and the like. The board operator is informed of personnel status via the operation guide which can be checked at the operator station (HMI, etc.), and can disconnect the loop containing such devices from ongoing operation, designating it as a process requiring attention. Furthermore, the maintenance personnel concerned are effectively informed of such occurrences by e-mail.

An alarm filtering function has been incorporated into PRM as the initial judgment and communication system. This function has a similar concept to so-called AI (Artificial Intelligence). Analysis and initial judgment are conducted according to a group of rules to analyze messages. It is also possible to communicate different contents to maintenance personnel and to the operator respectively.

Trouble checking and response

In order to check and respond to trouble when it is communicated, the maintenance personnel are provided with the most suitable tool (Device Viewer) for each device. With this tool, the operating status of a device (Normal, Diagnosis Failure, Communication Failure, etc.) can be checked.

(1) Status checking with maintenance alarms

Maintenance alarms include initial analysis results with the details, causes, and handling measures for a problem. The maintenance personnel specify the appropriate devices subject to maintenance in reference to the maintenance alarm and implement the appropriate operation. (Figure 2)

(2) Checking device condition details with Device Viewer

Device Viewer facilitates the trend display of the operating status of devises, as well as the display of device self-diagnosis results. If process trouble is attributed to trouble with a device, it is possible to correctly identify the function with the trouble by checking the device status. This significantly reduces working hours and the maintenance workload required for checking the trouble. (Figure 3)

(3) Execution of adjustment operation with DTM, etc.

Once the cause of trouble is identified, maintenance operation such as device adjustment is executed. Device Type Manager (DTM) is software that has been developed in accordance with Field Device Tool (FDT) specifications. It is specific to each device and is capable of high-level, complicated settings and adjustments.

COLLABORATION WITH OPERATION

In the foregoing section, we explained the process by which maintenance personnel are informed of a device failure or its symptoms by prediction alarms, and the subsequent execution of

maintenance (ACTION).

Subsequently PRM also communicates the device failure and prediction information to the operator, thus making it possible to instantly check device conditions. Enabling the operator to correctly determine device conditions facilitates safety operations such as device failure prevention.

The following are three important factors for the information sharing required for collaboration with operation.

Device status notification

One of the advantages of visualizing the device condition is to enable the operator to know it. Communicating prediction information regarding device deterioration to the operator makes it possible to correctly determine the procedure to take to adjust plant conditions.

The operator is informed of device conditions as the operation guide in the PRM maintenance alarm management system. As a result, it has become possible for operators and maintenance personnel to share alarms (other than conventional DCS alarms) that affect processes, for example those indicating process interface trouble.

Device operating status

Once a prediction of trouble is received, the operator knows what influence the device trouble will have on the entire operation and processes. The condition of the device can be ascertained by PRM client, and the device operating status can be checked as well at the operator's Human Interface Station (HIS) with Device Viewer for HIS. Moreover, the integrated use of wireless technologies such as Wi-Fi makes it possible to check maintenance management information (device condition check) on site.

Maintenance work requests

Usually operators issue work requests to maintenance departments when device trouble is detected. As an alternative to paper-based documents such as work request sheets, PRM has a direct entry and communication method for indicating the detected trouble, which is then communicated to the maintenance personnel by means of its maintenance alarm function.

Once a work request has been issued by the operator, a work schedule for the maintenance personnel is determined using PRM or the plant asset management system, and the work request is communicated to the maintenance personnel.

It is possible to check the progress of the maintenance work as well as the device operating status using PRM's device navigator. Previously equipment maintenance progress was managed using only the operation mark function. In future, operators will be able to more accurately monitor maintenance progress using the device navigator.

RESPONSE TO STANDARDIZATION

In this section we would like to briefly mention the movement toward standardization, including the collaboration with Enterprise Asset Management (EAM). The OPC-UA (Unified Architecture) standard proposed by the OPC Foundation was developed in order to enable safe and reliable mutual operability when data and information are communicated from a plant level to a management level. Other industry standards such as EDDL, FDT, MIMOSA and the like have decided to adopt OPC-UA standards for an external interface. OPC standards have been introduced to collaboration between both diagnostic and management systems regardless of the company. Taking these facts into consideration, it can be said that OPC-UA has penetrated the field, serving as a basic interface to interconnect plant asset management and equipment diagnosis systems.

What becomes key to making AE feasible is to provide a means of collaboration with other companies' software and systems, and to develop an integrated system with high added value. Given that it becomes possible to offer an integrated system more expediently by adopting standards that can be flexibly connected to other companies' equipment diagnosis systems, we intend to continue aggressively promoting standardization in the future too.

CONCLUSION

To summarize, with the advent of intelligent field devices and the progress that has been made in diagnostic technology, the visualization of plant equipment conditions has been dramatically improved. As a result, it has become possible not only to predict equipment trouble, but efficient maintenance has also been realized based on the enhanced PRM maintenance alarm concept. Moreover, operation efficiency has been improved by rendering operation and maintenance seamless. Asset Excellence is realized by using PRM as the platform, and operation efficiency and process stability can be enhanced through Lifecycle excellence.

In future, the visualization of plants will be further advanced in order to achieve Overall Equipment Effectiveness (OEE). This is the target of InsightSuiteAE, discussed in another paper in this special edition. In other words, it will be possible to comprehensively identify plant problems in their entirety through efforts made to understand each aspect and potential problem of the whole plant, and ways will be developed to facilitate improvements. Our future endeavors will be focused on organically combining and further developing PRM and InsightSuiteAE. ◆

REFERENCE

(1) SAITO Yoji, et al., "FOUNDATION Fieldbus Devices Today and Tomorrow", Yokogawa Technical Report, No.38, 2004, pp. 1-4