Quality Assurance Activity Focused on Achieving Nuclear Safety

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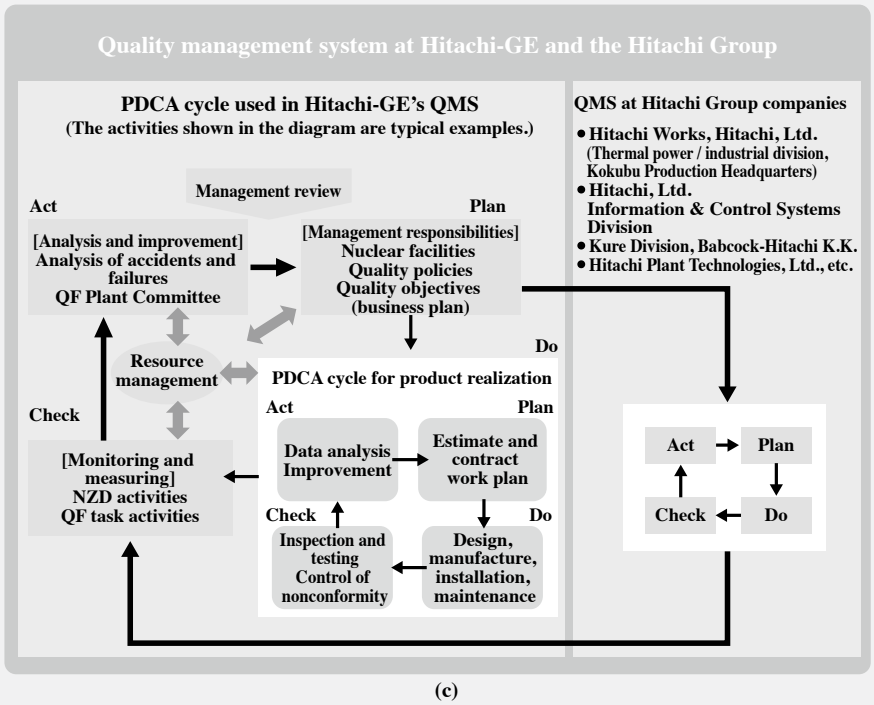
OVERVIEW: With the demand for safety and security at nuclear facilities having become even stronger in recent years, the role of the plant manufacturer has become much more important. In order to supply nuclear facilities with top-class safety and reliability and conduct itself with a high level of accountability and transparency, Hitachi-GE Nuclear Energy, Ltd. has put in place a comprehensive quality management system to ensure that quality assurance is handled in a planned and systematic fashion across the entire Hitachi Group. The system covers every stage from product development through to design, manufacture, installation, trial operation, and inspection and maintenance. Hitachi-GE's current aim is to make continuous improvements in the effectiveness of its quality management system and to enhance the safety and reliability of nuclear facilities by reinforcing the measures it is taking to enhance its nuclear safety culture and prevent any deterioration.

INTRODUCTION

HITACHI-GE Nuclear Energy, Ltd. (Hitachi-GE) has established a QMS (quality management system) based on the ISO 9001:2000 international QMS standard (JIS Q 9001:2000 "Quality Management Systems—Requirements") (ISO 9001) to ensure that quality assurance is handled in a planned and systematic fashion. The system covers every stage

(a)

(b)



(c)

PDCA: plan, do, check, and act QMS: quality management system QF: quality first NZD: nuclear zero defect
QF task activities: activities of individual task teams in the QF plant committee

Fig. 1—Overview of Quality Management System and Quality Assurance Activities for Nuclear Facilities.
These photographs and diagrams show: employees reading the Corporate Ethics Compliance Card at morning assembly at the site of a regular inspection (a), posters encouraging thorough implementation of safety and quality control programs and the like (b), and the comprehensive quality management system used at Hitachi-GE Nuclear Energy, Ltd. and the Hitachi Group (c).

from product development through to design, manufacture, installation, trial operation, and inspection and maintenance in order to ensure the safety and reliability of nuclear facilities.

Based on a philosophy that effective quality assurance is inseparably linked to the fostering of an excellent safety culture, Hitachi-GE plans to include measures aimed at preventing any deterioration in the safety culture or organizational climate in its QMS program with the aim of ensuring that activities such as managing compliance, improving communications, and fostering a work environment where people feel free to report any problems are handled in a planned and systematic manner.

This article discusses the characteristics of the QMS used for nuclear power facilities at Hitachi-GE and the Hitachi Group to ensure nuclear safety and what the companies are doing to continuously improve the effectiveness of the system (see Fig. 1).

QUALITY MANAGEMENT SYSTEM

Hitachi-GE has put in place a standardized QMS for nuclear facilities (referred to below as the "nuclear QMS"). The quality system, which incorporates requirements specific to nuclear facilities, has ISO 9001 as its basis and was established with reference to JEAC 4111-2003 "Quality Assurance Code for Safety in Nuclear Power Plants," the nuclear power section of the Japan Electric Association Code (JEAC 4111).

Moreover, in response to the globalization of the nuclear power business, the QMS for exported products incorporates the requirements from Appendix B "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" in Part 50 of Title 10 of the Code of Federal Regulations (10 CFR 50), and Hitachi-GE has obtained a certificate of accreditation for construction of nuclear power plant equipment under Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) (commonly known as "N-stamp certification").

CHARACTERISTICS AND ACTUAL OPERATION OF NUCLEAR QMS

An "emphasis on nuclear safety" is a particular feature of the nuclear QMS which stipulates in relation to managerial responsibility that "top management shall ensure that operational requirements are determined and satisfied based on a policy of giving top priority to nuclear safety." This stipulation was inserted with reference to JEAC 4111.

Ensuring quality is a prerequisite for ensuring nuclear safety and an integral part of quality assurance is that everyone from top management to the frontline work force recognize the significance of nuclear safety and share an organizational objective of ensuring nuclear safety.

Management Responsibilities (Quality Policies for Nuclear Facilities): Plan

In view of the criticality accident at a uranium-processing plant in 1999, Hitachi-GE's Quality Policy for Nuclear Facilities stipulates that employees shall give top priority to ensuring nuclear safety and shall comply with QMS processes to ensure that the requirements are met. The company has made efforts to ensure that all concerned parties are informed of and familiarized with these policies (see Fig. 2).

In April 2008, Hitachi-GE established an additional provision that aimed to foster a culture of safety in response to the notice entitled "Guidelines for Evaluation by the Regulator of Measures Taken by Businesses to Prevent the Deterioration of their Safety Culture and Organizational Climate" issued by the Nuclear and Industrial Safety Agency of the Ministry of Economy, Trade and Industry (METI) to parties involved in installation work in December 2007.

In line with its quality policy for nuclear facilities, the company is working hard to ensure that measures aimed at fostering its safety culture are included in day-to-day quality assurance activities.

Hitachi-GE has also carried out activities aimed at maintaining its safety culture and organizational climate in the past, centered on its compliance

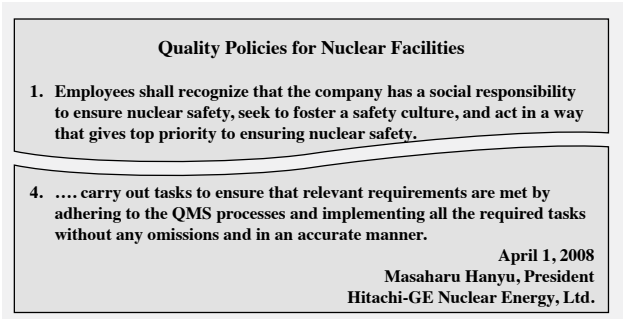


Fig. 2—Quality Policies for Nuclear Facilities.
In line with the Quality Policies for Nuclear Facilities, Hitachi-GE carries out activities to foster its safety culture in day-to-day quality assurance activities.

activities. Examples include raising ethical awareness by distributing a Corporate Ethics Compliance Card [see Fig. 1 (a)] and having staff read through this, compliance education at regular monthly "Basics and Ethics" meetings, presentations by executives on the importance of thorough compliance, carrying out preventive ethics education stressing the need to perform work in such a way that "Basics and Ethics" are the primary criteria for decision making, and holding meetings of the Promotion and Liaison Committee for Fostering a Safety Culture with the involvement of other Hitachi Group companies (see Fig. 3).

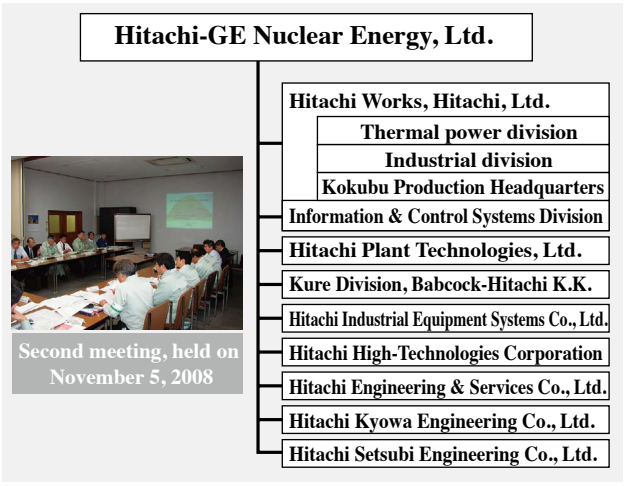


Fig. 3— Promotion and Liaison Committee for Fostering a Safety Culture.
Organization chart and a scene from a meeting of the Promotion and Liaison Committee for Fostering a Safety Culture run by Hitachi, Ltd. and Hitachi Group companies are shown.

TABLE 1. Example Requirements Specific to Nuclear Facilities
The table lists examples of specific requirements added to the nuclear QMS processes and carried out to ensure nuclear safety.

Process	Requirement
Customer-related processes	Smooth communication and coordination with customers to ensure that there are no unreasonable processes that may affect quality.
Design and development	Carry out sufficient reviews and exchanges of information when adopting special materials or new technologies.
	Ensure that design and development verification is performed by a person other than the original designer.
Procurement	Apply procurement management requirements to internal procurement also.
Production and service provision	Verify the adequacy of new construction methods in an appropriate manner.
	Confirm the qualifications of personnel engaged in special processes such as welding.
Inspection and testing	Determine the level of independence of the personnel who conduct inspection and testing.

Product Realization: Do

The level of reliability with which nuclear safety is maintained is further enhanced by adding requirements specific to nuclear facilities to the various processes within the nuclear QMS with reference to JEAC 4111 and other standards (see Table 1).

Hitachi-GE uses the PDCA (plan, do, check, and act) cycle to continuously improve the appropriateness and effectiveness of QMS processes such as product realization through activities that include product inspection and testing, internal audits, remedial actions, and preventive actions and that cover these requirements specific to nuclear power.

Monitoring, Measuring, Analysis and Improvement: Check and Act

An important part of the continuous improvement of safety and reliability at nuclear facilities is for Hitachi-GE to be involved in quality assurance activities at other parts of the Hitachi Group. This includes those divisions of Hitachi, Ltd. responsible for the manufacture of steam turbines, generators, central control panels and other components, and also other Hitachi Group companies such as Hitachi Plant Technologies, Ltd. which manufactures the main pumps used in emergency core cooling systems and Kure Division, Babcock-Hitachi K.K. which manufactures nuclear reactor pressure vessels [see Fig. 1 (c)].

Hitachi-GE aims to improve the quality of the products it manufactures itself and those from other group companies by undertaking NZD (nuclear zero defect) and QF (quality first) Plant Committee activities under the nuclear QMS with the aim that the benefits from these activities will lead to improvements in the safety and reliability of the full range of nuclear facilities.

(1) NZD activities

Hitachi-GE works on NZD activities to prevent nonconformity from recurring, extend measures to other parts of the organization, and ensure that necessary operational process improvements are performed in a thorough way by collecting and analyzing nonconformity data from nuclear facilities in and outside Japan.

NZD meetings play a key role in NZD activities.

An incident of nonconformity is chosen by the quality assurance division and the department that caused the nonconformity compiles a report in a prescribed format indicating what led to the nonconformity, the nature of the nonconformity, its cause, what was done about affected items, what is being done to prevent recurrence, the extent and nature of measures to be taken in other parts of the organization, and other similar information. Senior management consider this information at the NZD meeting and make a final decision on matters such as the action to prevent recurrence and the extent and nature of measures to be taken in other parts of the organization.

In addition to the direct cause of nonconformity, the NZD documents are also concerned with the psychology and background of the people involved and how this led to this particular nonconformity in order to reveal the motivational causes and so that a wide range of measures to prevent recurrence can be considered, including those relating to similar nonconformity incidents. The accuracy with which such motivational causes can be identified is a key discussion point at NZD meetings.

(2) QF Plant Committee

Monitoring practices are put in place by establishing a QF Plant Committee made up of the Construction QF Plant Committee and the Operational QF Plant Committee to ensure that quality is built-in at each individual process from design through to production, trial operation, and inspection and maintenance (see Fig. 4).

In each committee, the work performed by each department is evaluated and checked by technical staff from the quality assurance and project management divisions and by task teams comprised of technical experts based on the stage to which the work has progressed (see Fig. 5).

For the Construction QF Plant Committee's overall design review task, the task team visits the relevant departments in Hitachi-GE and other Hitachi Group companies (approximately 40 departments) once per half a year to monitor a range of areas including whether design changes are being correctly identified and verified, including that the measures for preventing recurrence and the measures to be taken in other parts of the organization identified by the NZD activities are actually being carried out in the construction plants, that DR (design review) meeting decisions are being implemented, and the level of compliance with important work processes.

Similar monitoring activities are performed during the regular inspection at each plant by the Operational QF Plant Committee's task team for preventing problems in regular inspections and reconstruction. In 2007, monitoring was undertaken for the regular inspections at 12 plants and covered about 160 departments.

Hitachi-GE has made efforts to continuously improve the effectiveness of the NZD and QF Plant Committee activities by developing and utilizing an information system to support these activities (see Fig. 6).

The nonconformity data finalized at the NZD meeting is registered in the nuclear plant reliability management system together with other nonconformity data from nuclear facilities in and outside Japan. As part of its various task activities, the QF Plant Committee refers to this nonconformity data as well as to other information such as new

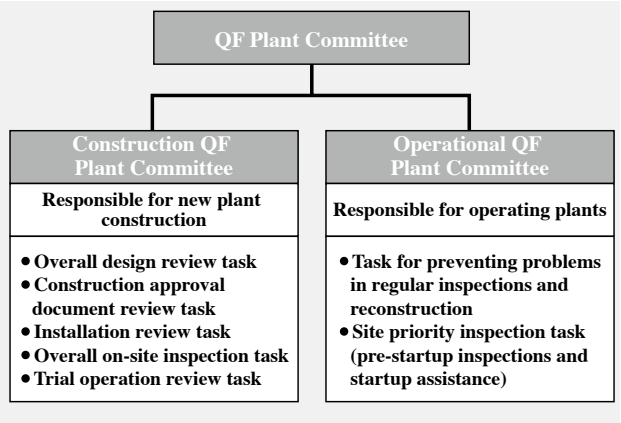


Fig. 4—Activity System of QF Plant Committee. Monitoring is performed by the QF Plant Committee which consists of the Construction QF Plant Committee responsible for new plant construction and the Operational QF Plant Committee responsible for operating plants.

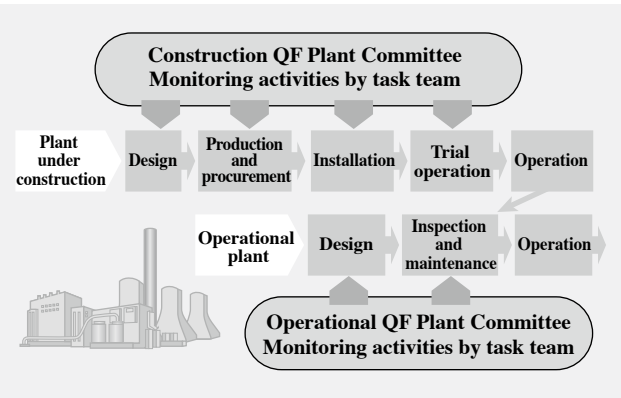


Fig. 5—Activities of QF Plant Committee Task Teams. The committee task teams examine and check the work of individual departments.

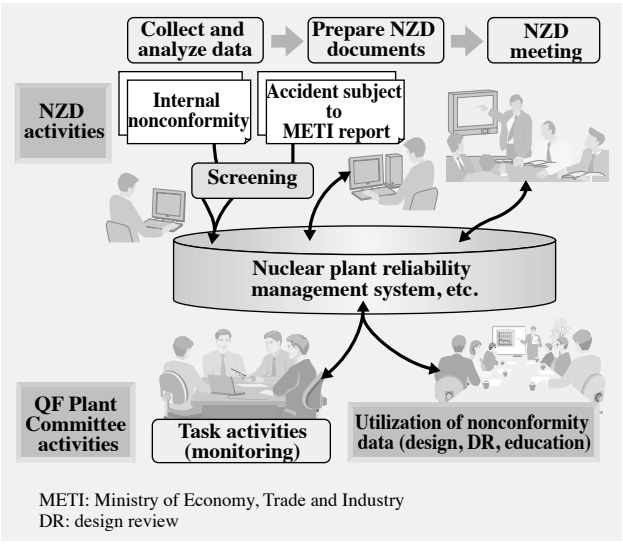
designs, information from DR meetings, and design change notices to improve the effectiveness of its monitoring work.

The QF Plant Committee compiles an annual report on the work process problems that monitoring has identified in each department, their countermeasures, and outcomes from other QF Plant Committee tasks. After taking any necessary actions such as giving improvement instructions to the relevant departments, this report is used as input to the management review. Similarly, outcomes from the NZD activities are compiled by the quality assurance division and input to the management review.

Management Review

Information on the status of quality assurance activities and actual quality performance in the entire Hitachi Group obtained from the QF Plant Committee and NZD activities is input to an annual review by the President which is carried out to maintain the appropriateness, adequacy, and effectiveness of the nuclear QMS. The operational status of nuclear facilities, occurrence of accidents and failures and their details are also considered to establish improvement policies for safer and more reliable nuclear facilities.

Hitachi-GE also holds discussions on its efforts to maintain its safety culture and organizational climate. In its 2008 review, the company decided in response to an evaluation of current activities based on the 14 elements for safety culture stated in the "Guidelines for Evaluation by the Regulator of Measures Taken by Businesses to Prevent the Deterioration of their Safety Culture and Organizational Climate" to use a questionnaire to undertake a self-evaluation on the level to which it fosters a safety culture as a way of reinforcing the use of the PDCA cycle (see Table 2).



METI: Ministry of Economy, Trade and Industry
DR: design review

Fig. 6— Nuclear Plant Reliability Management System.
The effectiveness of activities is continuously improved by developing and utilizing an information management system to support the NZD activities and QF Plant Committee activities.

TABLE 2. 14 Elements for Safety Culture
The table lists the 14 elements for safety culture stated in the "Guidelines for Evaluation by the Regulator of Measures Taken by Businesses to Prevent the Deterioration of their Safety Culture and Organizational Climate" from the Nuclear and Industrial Safety Agency of METI.

No.	Element for safety culture	No.	Element for safety culture
1	Commitment of top management	8	Compliance
2	Defined policies and execution by senior management	9	Learning organization
3	Measures to avoid wrong decision making	10	Organization working on proactive measures against accidents and failures
4	Constantly questioning attitude	11	Self-evaluation and third-party evaluation
5	Reporting culture	12	Work management
6	Good communication	13	Change management
7	Accountability and transparency	14	Attitude and eagerness

CONCLUSIONS

This article has discussed the characteristics of the QMS used at Hitachi-GE and the Hitachi Group for nuclear facilities to ensure nuclear safety and what is being done to continuously improve its effectiveness.

Everyone from top management to frontline workers will work together to continue promoting quality assurance activities in order to improve further the safety and reliability of nuclear facilities. Moreover, Hitachi will seek to continuously improve the appropriateness and effectiveness of its nuclear QMS to ensure nuclear safety by following the PDCA cycle.

REFERENCE

(1) Nuclear and Industrial Safety Agency, Ministry of Economy, Trade and Industry, "Guidelines for Evaluation by the Regulator of Measures Taken by Businesses to Prevent the Deterioration of their Safety Culture and Organizational Climate," NISA No. 1, 12/03/07 (Dec. 2007) in Japanese.

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