

Operational Safety Performance Indicators and Balanced Scorecard in HANARO

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1. Introduction

Research reactors need an extensive basis for ensuring their safety. The importance of a safety management in nuclear facilities and activities has been emphasized. The safety activities in HANARO have been continuously conducted to enhance its safe operation. Last year, HANARO prepared two indicator sets to measure and assess the safety status of the reactor's operation and utilization. One is Safety Performance Indicators (SPI) and the other is Balanced Scorecard (BSC). Through reviewing these indicators, we can obtain the following information;

- Plant safety status
- Safety parameter trends
- Safety information, for example, reactor operation status and radiation safety

HANARO will continuously pursue the trends of SPI and BSC.

2. Safety management system and safe operation in nuclear facilities

An operating organization should conduct its operation and utilization important to the safety in accordance with approved procedures and regulations [1]. The general aims of a management system for nuclear facilities are to improve the safety performance of the plant through a planning, control and supervision of safety related activities and to foster a strong safety culture [2],[3]. The effectiveness of a management system can be monitored and measured to confirm the ability of its processes to achieve the intended safety performance by an assessment of the operational performance. The Operational Safety Performance Indicators, also known as SPI, help an organization define and measure a progress with regard to safety activity goals. The elements of a SPI are quantifiable measurements that reflect the critical success factors of an organizational safety. The SPI can be used as a performance management tool, and also as a carrot. Since 1995, efforts have been directed towards the elaboration of a framework for the establishment of an operational safety performance indicator program in nuclear power plants (NPP). IAEA-TECDOC-1141, "Operational safety performance indicators for NPP" attempted to provide a frame work for an identification of performance indicators which have a relationship to the desired safety attributes, and therefore, to a safe plant operation. Three key attributes of a smooth operation, an operation with a low risk, and an operation with a positive safety attitude, were recommended,

which are associated with a safe operation. Because these attributes cannot be directly measured, an indicator structure is expanded further until a level of easily quantifiable or directly measurable indicators is identified [4].

Fig.1 shows the hierarchical structure of a NPP operational safety performance [4]. The intention of this approach is to use quantitative information provided by the specific indicators and to analyze performance trends relative to established goals.

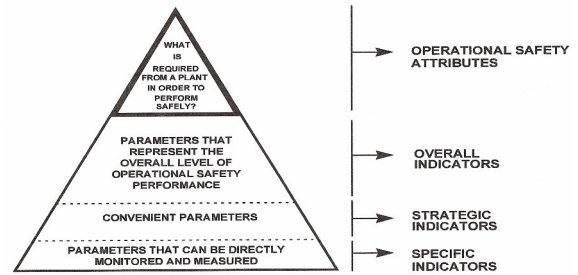


Fig.1 An approach to monitoring NPP operational safety performance

3. Operational Safety Performance Indicators in HANARO

HANARO has made an effort to select operational safety performance indicators which are specific for a research reactor operation and utilization. The main frame is nearly the same structure recommended by IAEA-TECDOC-1141 except for the attitude of reactor utilization for a research and an application. The measuring elements of the HANARO Operational Safety Performance consist of 4 safety attitudes, 10 overall indicators, 22 strategic indicators and 42 specific indicators. Table 1 shows the elements of the operational safety attributes, the overall indicators and the strategic indicators for HANARO.

Table 1. Operational Safety Performance Indicators

Safety Attributes	Overall and Strategic Indicators
A. Plant operates smoothly	1) Operating performance : Forced power reduction and outages
	2) State of SSC : Corrective work/Material condition/State of the barriers
	3) Events : Reportable events and incidents
B. Plant operates with low risk	1) Challenges to safety systems : Safety systems actuations
	2) Plant ability to respond to a challenge : Safety systems performance/Operator preparedness/Emergency preparedness
	3) Plant configuration risk : Risk during operation

C. Plant operates with a positive safety attitude	1) Attitude towards safety : Compliance with procedures, rules and licensing requirements/ Attitude towards procedures, policies and rules/Radiation protection program effectiveness/Human Performance/Safety Awareness
	2) Striving for improvement : Self-assessment/ Operating experience feedback
D. Plant operates with a safe utilization	1) State of experimental equipment : Corrective work/State of safety barrier/Operating performance
	2) User ability to respond to a challenge from field work : User preparedness/Emergency preparedness

42 specific indicators were selected to cover the most adequate parameters to monitor the safety attributes in HANARO as shown in Table 2.

Table 2. Specific Indicators

Safety Attributes	Specific Indicators
A. Plant operates smoothly <i>13 specific indicators</i>	No. of forced power reduction and outages due to internal causes/No. of forced power reduction and outages due to external causes/Unit capability factor (% of Max. power gen.)/ Unplanned capability loss factor/No. of NCR issued/No. of work orders issued/Ratio of corrective NCR&WO programmed/No. of pending NCR&WO for more than 3 months/Conductivity index/Reflector TK ageing index/Confinement leakage/Significant events & incidents due to internal causes/Significant events & incidents due to external causes
B. Plant operates with low risk <i>10 specific indicators</i>	No. of automatic scrams/No. of demands on RPS, ECCS/No. of failures in safety systems/ No. of hrs devoted to training/Findings during emergency drills/Findings during emergency plan audits/No. of hrs devoted to training on the emergency plan/No. of staff receiving training on the emergency plan/No. of tech. spec. violation/No. of LOC entries
C. Plant operates with a positive safety attitude <i>13 specific indicators</i>	No. of violations of licensing requirements, SAR and tech. spec/No. of violations of procedures/No. of violations found through QA audit of regulatory body /No. of workers receiving doses above limits/Corrective radiation exposures/Effluent activity vs. allowed limit/% of events due to human errors/% of staff trained in safety management/ safety culture/No. of seminars on safety related matters/No. of plant safety committee and executive committee meetings/No. of independent internal QA audits/No. of findings from QA audits/No. of events at other facilities that undergo review and analysis
D. Plant operates with a safe utilization <i>6 specific indicators</i>	No. of work order and NCR issued/No. of high radiation alarms /No. of reactor scram due to abnormal condition of experimental equipment/No. of training/No. of hrs devoted to training on the emergency plan/No. of findings during internal and external audit or survey

4. BSC in HANARO

The Balanced Scorecard (BSC) is an approach for a strategic management which was developed in the early 1990's. It is a management and measurement approach designed to enable a clarification of a vision and strategy and a translation into an action, or in other words, a method to align a performance with an organizational strategy. It provides feedback about both the internal processes and external outcomes in order to continuously improve a strategic performance and results. Last year, HANARO developed several indexes for the BSC to evaluate its operational results and to develop the SPI in parallel. The indicators of BSC and SPI are not exactly matched each other. Table 3 shows the specific indicators of the BSC which are identical with the SPI.

Table 3. Indicators of BSC for HANARO

Division	BSC Indicators	Database
A. Reactor Operation	1) Unplanned capability loss factor	Operation record
	2) No. of NCR issued	Maintenance report
	3) No. of work orders issued	Maintenance report
	4) Ratio of corrective NCR&WO programmed	Maintenance report
B. Safety Management	1) No. of seminars on safety related matters	Education report
	2) No. of plant safety committee and executive committee meetings	Committee Meeting report
	3) No. of independent internal QA audits	QA audit report

5. Conclusion and future plan

HANARO has developed two kinds of indicators for ensuring its operational safety. The Operational Safety Performance Indicators represent the plant safety status and the Balanced Scorecard shows a part of the operational results. The BSC measures are effective for managing the projects because they can be applied to all groups in the institute. On the other hand, the SPI is particularly essential to review and evaluate the safety performance of HANARO. The above two measuring tools can be operated in parallel. But it is desirable that most parts of the SPI and BSC are systematically unified for an effective management of HANARO's safety.

REFERENCES

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