The calculation of amount in Quality Elements of Nuclear Research Projects

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1. Introduction

To achieve various quality assurance goals, it have been known there are many tools and principles to obtain productive effectiveness or efficiencies in quality fields. It is very difficult to search the conformance point to reduce to minimum level in any process to prevent the defective products. Quality documents are made to meet this goals and objectives. So, it is necessary to assume the optimum points between the need of amount in quality requirements and quality control process to prevent the quality failures

2. Quality Methods to reduce Quality Cost

Above of all, quality tools and principles have been developed several centuries through the 1st world war and the 2nd world wars. To introduce them in their conceptual meanings, representative tools to reduce quality costs are Cost-Benefit Analysis,[1] Cost of Quality,Control Charts(CC).[2] Bench marking, Design of Experiments(DOE), Statistical Sampling Method, Flow Charting, Quality Management Methodologies(i.e. Six Sigma, CMMI, etc), Cause and Effect Diagrams (i.e. Fishbone Diagram), Histogram, Pareto Chart, Run Chart, Scatter Diagram.[4] Such quality tools developed to achieve quality program implementation effectively.

2.1 Design of Quality Goals

In almost codes and standards and representative standards in the world, the designs of these quality goals and objects to reduce quality cost in quality programs can be summarized as followings; a)~ i)

a) Consistency with quality policies

The quality policy should provide a framework for setting quality goals. In this case, the frame refers to the orientation, so the quality policy and the quality goal must be in line. For example, if there is a reference to improvement of process quality in the quality policy, the process quality goal should be established to achieve their goals

b) Must be measurable

When it comes to being measurable, it means being numerically measurable. Therefore, the quality target and the measure should be expressed as 90 percent customer satisfaction, 0.03 percent process defect rate, 0.25 percent component content, 80 percent attainment rate, and should not be expressed in abstract terms such as insufficient, good or excellent.

c) Applicable requirements must be considered

Requirements are customer, stakeholder or legal or regulatory requirements. For example, the client requires a lot quality of 0.5% or less, and if the organization has a product quality target of less than 1%, it is inappropriate.

d) Must be related to the suitability of products and services and the enhancement of customer satisfaction.

One of the most important objectives of the quality management system is continuous improvement. Quality objectives should move toward continuous improvement and improvement in the suitability and satisfaction of products and services. If the previous year's process defect rate was 0.5%, this year's quality target should be set to less than 0.5%, so that the indicators can be increased and the organization can continue to improve.

e) Must be monitored

Monitoring can be understood as measurement and evaluation. In other words, quality should be measured through continuous inspection & audit of the product's dimensions, performance, and content. Similarly, in the case nuclear fields,customer satisfaction including regulatory bodies should also be identified periodically and reflected by assessing its achievement or suitability.

f) Must be communicated

The quality objectives, the value of the goals, and the monitoring should not be kept secret within the quality assurance organization, but shared publicly within the organization to achieve the goals and the other tasks .

g) Must be renewed as required

Quality objectives are typically to be established annual goals. Also,it analyzed and evaluated their achievement on an annual basis. However, the progress achieved has to be analyzed by checking monthly, quarterly, and half-yearly without being left untouched. Although the analysis determined support to achieve the goal, it was too much to achieve the initial goal. Moreover, it can also reduce the target when there is a variable in the middle that cannot be achieved. Conversely, it can increase target when one need or have the potential to achieve it by increasing it. It is not reasonable to never renew even when the goal needs to be made, and it is much more reasonable and desirable to renew and pursue as needed.

h) It also requires documented information and quality documents to show its evidences in all processes, including establishing, implementing, evaluating and analyzing quality objectives.

i) In order to establish and achieve quality objectives, clear, reasonable methods and strategies must be followed, and implementation activities will increase

the likelihood of achieving them. The organization must establish a quality goal and clearly define how to achieve it. Thus, almost these quality codes&standards require all members of the organization must do their best to achieve their quality objectives.

2.2 Nuclear Quality Element & Quality Documentation

To satisfy such quality goals and objects for proper quality systems, quality programs and quality manuals should be established to implement these objectives. Especiallly, there are many quality manuals and quality procedures to introduce and explain their quality goals and objects. So, in nuclear industries, almost quality implementation organizations in the world have several dilemma how much manuals and requirements are to be needed to achieve these various quality goals. Therefore, these all quality goals should be expressed by only nuclear quality elements and requirements of all quality assurance codes & standards in the world

2.3 Calculation Model on Elements & Requirements

In the case of nuclear industry, the safety and the risk management have been increased for past several decades with 3 large critical nuclear accidents named Threemiles, Chernobyl and Fukusima accidents. The calculation model to minimize and simplify the nuclear quality elements and requirements from all the prime QA codes & standards in the world can be suggested like below table Ⅰ.

```
a'= x[z(y1'+y2')]  a': amount of element
x = Risk level1/safety class1: 4
    Risk level2/safety class2: 3
    Risk level3/safety class3: 2
    None Risk level/none safety class : 1
y1'=TLC of R&D project
    basic research : 4
    applied research : 7
    development research : 8~ 10
    engineering research : 11~ 18
z'= complexity of R&D project
    licensing need + industrial need = 3
    licensing need, industrial need each: 2
    scientific need : 1
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Table Ⅰ : Calculation of QA Elements amount

In this paper, the risk level and safety classification of each step of nuclear research & industry can be suggested as Table Ⅰ in the view of numerous applicable codes and standards analyses in nuclear fields. So, in the case of research and development field, especially the quality organizations such as KAERI QA are often held the responsibilities of serious decisions for quality elements and requirements selection. Moreover, Quality organizations are to be compelled to keep all the requirements in accordance not to these several nuclear codes &standards for research but to industrial codes & standards by the regulatory agencies.

2.4 Safety Factor & Risk Coefficient

Since nuclear critical accident like Fukusima NPP has occurred, nuclear field in the world have been increased the safety factor and risk securement coefficients. Ironically, these two factor cost are almost same as the cost of design and construction. Thus, safety factor became the absolute concept in nuclear division because nuclear accident results has been effected immensely to all nations in the world. Risk securement coefficients also has been increased geometrically in nuclear fields. The risk and safety have divided several classes by the strength in nuclear power facilities, systems,components, structures, equipments, instruments and apparatus.

The division methods depend on multiful factors calculated and analyzed statistically in several accidents. Each field requirements in quality aspect to secure the safety and reduce the risk will be expressed as followings in table Ⅱ

Table Ⅱ : Extension of Field Requirements[5]

FIELD	ELEMENTS	REQUIREMENTS
INDUSTRY	40	800
DEVELOPMENT	20	200
RESEARCH	15	90
BASIC	10	30

2.5 The assumption of element & requirements amount

The calculation of amount in Quality Elements of Nuclear Research Projects depend on above factors weighed by the nuclear power plants facilities; so to speak- the systems, components,structures, equipments, instruments and apparatus.

For example, if the research project is subjected to a basic research, the requirements and elements will be step1,so it can be applied to simple procedures and few requirements. The quality assurance program would be established more costless system. On the other hand,some project are to be subjected in the industry aspect, the quality system will be more rigid in their documentation system and the requirements & elements will be increase to the extend to be controlled in the level to be meet their codes and standards as Table Ⅱ. Thus, we can assume the quality elements and requirements will be required near to the exponential growth level by the each field steps because the each steps require a more rigid safety security level and risk satisfaction level of nuclear fields.

3. Conclusions

Finally, we can decide the amount of quality elements and requirements depend on various factors. Especially, risk level, safety classification and the research steps in nuclear fields can be suggested as the serious effect factors in the view of various applicable codes and standards analyses. In the case of basic, research and development step in the nuclear fields, the quality documents can guide the quality goals or quality policies effectively and will be prepared with some elements&requirements. On the other hand, this means the documentations for quality goals in industry field and licensing should be prepare a lot of QA systems and its documents. It is required a higher quality cost than research step or development step. In the future, to reduce the quality elements and requirements will be a important topic to study with quality system including quality organizations in the world. Also, the optimum points between the quality elements selection and quality requirements amount should be searched and considered as a serious tasks in the future.

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