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Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
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INDEPENDENT ASSESSMENT TO CONTINUOUS IMPROVEMENT: STATISTICAL PROCESS CONTROL IMPLEMENTATION

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ABSTRACT

A Quality Assurance independent assessment has brought about continued improvement in the PUREX Plant surveillance program at the U. S. Department of Energy's Hanford Site. After the independent assessment, Quality Assurance personnel were closely involved in improving the surveillance program, specifically regarding storage tank monitoring. The independent assessment activities included reviewing procedures, analyzing surveillance data, conducting personnel interviews, and communicating with management. Process improvement efforts included: (1) designing data collection methods; (2) gaining concurrence between engineering and management; (3) revising procedures; and (4) interfacing with shift surveillance crews. Through this process, Statistical Process Control (SPC) was successfully implemented and surveillance management was improved.

The independent assessment identified several deficiencies within the surveillance system. These deficiencies can be grouped into two areas: (1) data recording and analysis and (2) handling off-normal conditions. By using several independent assessment techniques, Quality Assurance was able to point out program weakness to senior management and present suggestions for improvements. SPC charting, as implemented by Quality Assurance, is an excellent tool for diagnosing the process, improving communication between the team members, and providing a scientific database for management decisions. In addition, the surveillance procedure was substantially revised. The goals of this revision were to (1) strengthen the role of surveillance management, engineering and operators and (2) emphasize the importance of teamwork for each individual who performs a task. In this instance we believe that the value independent assessment adds to the system is the continuous improvement activities that follow the independent assessment.

Excellence in teamwork between the independent assessment organization and the auditee is the key to continuing improvement. This paper will address (1) resistance to change; (2) the detail of assessment and implementation; and (3) the effect of the continuous improvement is consistent with the Quality Assurance organization's new role as project facilitation. Furthermore, this process proved to be useful, efficient, and instrumental in creating a win-win situation.

1.0 ASSESSMENT VS AUDIT

To meet customer's needs, traditional audit processes has recently been changed. The audit process has become more focused on continuous improvement instead of pure compliance (Ryder 1993, McVay 1993), because pure compliance will not catch up with the pace of change, the pressure of competition, and the need for improvement. The new audit process emphasizes (1) programmatic investigation; (2) applying best management practice findings; and (3) adding value. The general trend of the audit process is using compliance as a baseline and seeking opportunities for continuous improvement.

To understand the status of the project, system, or facility, there is another useful method called assessment, which is less formal but can be very powerful. While the assessment process is similar to the audit process, the assessment process takes more ownership and requires more involvement in the overall system. The assessment process emphasizes analyzing and diagnosing the facility or project, which in turn brings about improvements in addition to finding deficiencies. Assessment provides more friendly, positive feedback and adds real values to the system or auditee. When requested by facility management, an independent assessment group provides independent verification while also being a team player. From these features, it is not difficult to imagine how independent assessment can lead to continuous improvement. As a team player, the cycle of identifying the problem and improving the system is part of meeting the customer's needs.

The definition of independent or internal assessment depends on the organization you belong to. In our case, as a Quality Assurance (QA) organization, we can perform the independent assessment for the support facility under the facility manager's direction. There are several good reasons for QA to implement independent assessment.

- QA is looking for compliance to Federal and state laws or commercial QA rules and industry standards.
- QA focuses on the overall quality of the whole process instead of each individual function in the facility.
- QA is relatively independent from other functions or organizations within the facility.
- QA is part of the facility body and takes ownership of any hazard or problem within the facility.

Through the independent assessment, QA can analyze the root cause of the deficiencies and noncompliance, diagnose the missing function of interface between organizations, and communicate the concept throughout the management chain. Because of their responsibility, QA organizations are strongly motivated to implement useful improvement processes.

In our experience, independent assessment is more than just more paper work. To us, independent assessment has resulted in an improvement process that has added value to our customer. Particularly, for nuclear facility management, the QA rule has become a Federal law, 10 *Code of Federal Regulations* (CFR) 830.120, and independent assessment is a provision of this law. We would like to share our experience with the process of Independent Assessment to Continuous Improvement (IA-TO-CI). This paper will describe in detail the IA-TO-CI process.

2.0 MISSION CHANGED

At the U.S. Department of Energy's Hanford Site, the QA Department within Westinghouse Hanford Company (WHC) has their own organizational standards, including a quality policy, a quality manual, an organizational structure, and personnel arrangement. To promote QA, each facility has been assigned a QA group or Rep by the QA Department. In keeping with the company's project-oriented policy, all support groups such as Safety and QA were aligned with facility/plant. The facility plant manager provides the financial resource to the QA support group and treats QA as part of his/her organization. However, the support QA has their own QA channel to communicate with upper level management. This type of structure provides QA sufficient freedom and authority from the facility but also functions in a role as a team player in conducting independent assessments for facility management.

Recently, we performed an independent assessment of the surveillance program at the Plutonium-Uranium Extraction (PUREX) facility. The PUREX facility is one of the first deactivation projects at the Hanford Site. The assessment was initiated by facility management. After a storage tank leakage incident, the facility manager called in QA to assess the plant surveillance program. This could be seen as a burden or a frustration if you think in terms of finding deficiencies or completing paper work for compliance. But this was also an excellent opportunity for us to experience the concept of IA-TO-CI. To improve the system however, the immediate challenge was to break through a long-standing culture barrier at the Hanford Site.

Government facilities or contractors, in particular nuclear facilities, primarily focus on compliance. Historically, most nuclear projects were classified and thus were concerned with the project's safety and security. They had no pressure from commercial competition and were relatively insensitive to financial resources in general. Basically, they are a huge isolated community as far as having concern for information and technology exchange, concepts of management, conduct of operations, or the concept of cost effectiveness. Hanford Site employees are proud of the way they ran the business for the last fifty years, and tend to have the same attitude today.

Now, the Hanford Site's mission has changed and the business environment has changed as well. After the cold war, most of the DOE nuclear facility sites were shut down and faced environmental clean-up or conversion for other uses. The Hanford Site clean-up mission must consider cost-effectiveness, Federal and state environmental regulations, information and technology exchange, commercial environmental expertise, and public involvement. Therefore, this is a totally different approach and philosophy from our previous mission. Many barriers exist in administrative control, management, conduct of operations, conduct of maintenance, scheduling, and budgeting. All of these items need improvement. However, because the culture has been in place for so long any change is subject to tremendous challenges. Yet another barrier to break through is changing the perception that QA has of being primarily for checking compliance, conducting inspections, and issuing write-ups to that of as a process for promoting continuous improvement.

3.0 INDEPENDENT ASSESSMENT PROCESS

As the concept of IA-TO-CI, the product of independent assessment should be continuous improvement. In such a model, independent assessment has a bigger work scope and is faced with a more valuable task because there are always opportunities for improvement. In our case, the independent assessment was carried out by reviewing the documents and procedures, interviewing people, and analyzing the available data. Our goal was to identify weaknesses and recommend improvements. For QA compliance, we were looking for (1) an effective and logical work process cycle; (2) document control and record traceability; and (3) preventive trend analysis. The approach we used was to carry out the cycle from the static office study to dynamic field verification, then back to office study and analysis. This static-dynamic model is shown in Figure 1.

We started by reviewing surveillance procedures, technical documents, training and certification programs, and document and data control. We then went to the field and observed how the surveillance crew performed the job. We interviewed shift operators, engineers, shift managers, and file clerks; and also checked the data sheets, shift log-books, and turn-over records in the field. Back at the office, we analyzed the data and brain-stormed the logic and effectiveness of work processes. After several iterations of this static-dynamic study cycle, we identified the system's strengths and weaknesses. We then presented and discussed our observations and findings to surveillance management and engineering and received their concurrence, and a report issued. In the report, we addressed the deficiencies and listed the expectation for follow-up corrective action.

Throughout the process, we encountered frustrations and resistance, however the learning experience and encouragement from our small successes provided the energy to continue the task. It was worthwhile to share what we learned from our experience in the assessment process.

Attitude of Seeking Improvement. The only acceptable attitude is to (1) show people that you want to help to improve the system; and (2) be enthusiastic in analyzing, diagnosing, and improving the weaknesses. This attitude can be a turning point in the whole process.

Challenge Procedure/Manual. Keep the big picture in mind. You must always question the procedures and look to see that the job fits logically and effectively is in a self-contained closed loop. Often the procedure only covers a segment of the circle, and has no beginning and no end.

Solid and Complete Evidence. To support your analysis and conclusion, collect sufficient and accurate information, whether it is a note from a conversation, numerical data, or documentation. Confirm your information with facility people, facility standards, and site-wide manuals.

Analytical Mind. Do not rely on impressions, feelings, guessing, or other peoples opinion. An analytical mind is very important to understand the complexity. Always keep several analytical tools handy to help diagnose, analyze, survey, and evaluate the situation. The tools available (Johnson 1994) include the affinity diagram, critical activity deployment chart, brainstorming, fishbone diagram, histogram, structure tree, force field analysis, and control chart.

Static-Dynamic Cycle

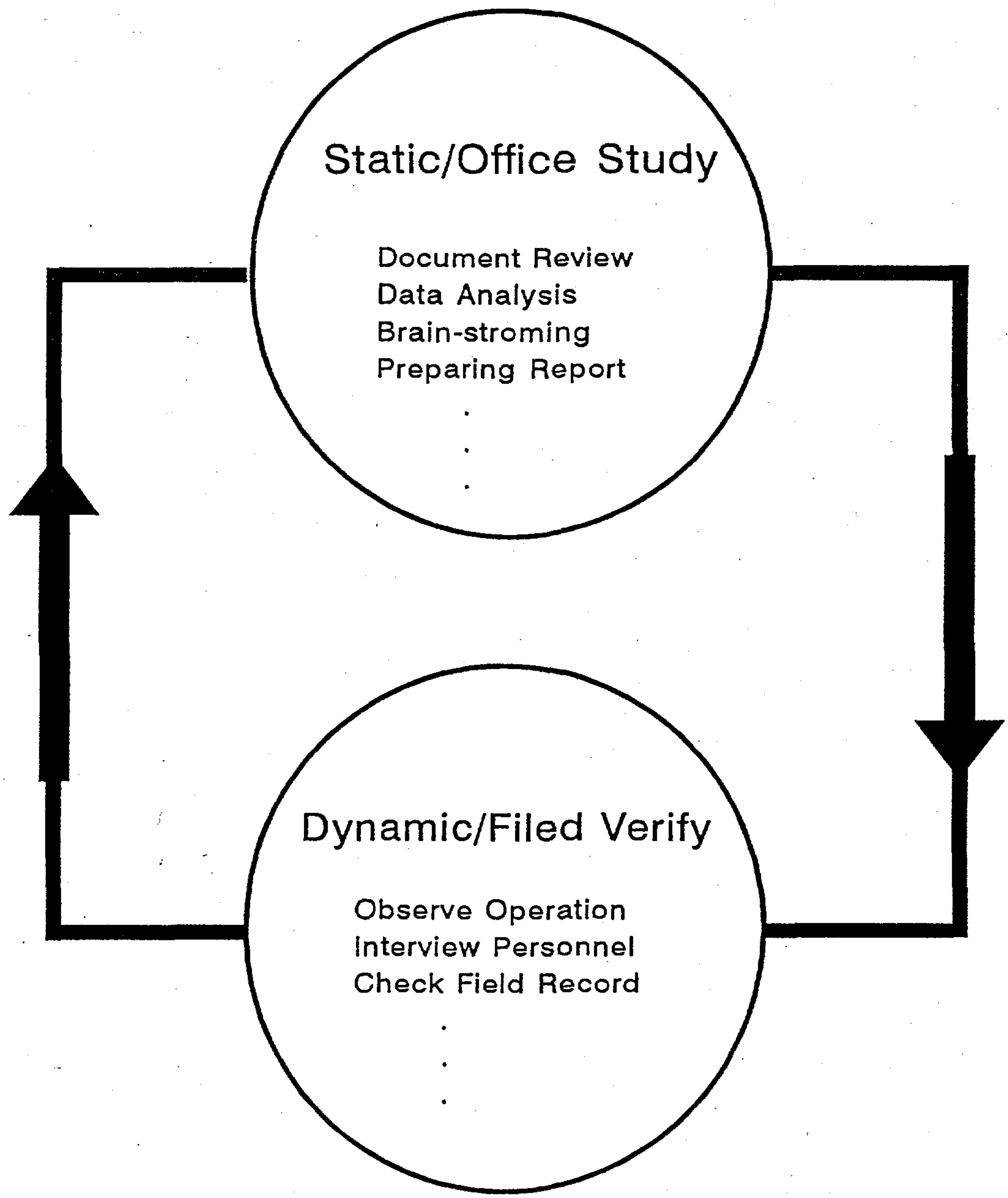

Figure 1. A Static-Dynamic Cycle, the mechanism used in the indendent assessment.

System Engineering Approach. Sometimes even though each individual function is perfect, the integrated test may not work well. System engineering establishes the architectural structure for a systematic function check to ensure the best job performance.

Rational/Healthy/Positive Conclusion. Ask yourself many in-depth questions about the deficiencies you observed. This will help you to identify the root cause that is responsible for the deficiency. Provide a meaningful, valuable, constructive conclusion that touches on the weaknesses of the system yet also improves the system for short and long-term considerations.

4.0 CONTINUOUS IMPROVEMENT:STATISTICAL PROCESS CONTROL IMPLEMENTATION/PROJECT-ORIENTED TEAM WORK

After distributing the report, the auditor will usually wait for the response and corrective action. To us, however, the most valuable part of the process has just begun. Because the surveillance crew and QA work well together in the assessment process, QA personnel and facility staff members also work together on the improvement process.

Two types of problems were characterized to recover several deficiencies identified in the report. One is the administrative control and the other is the method used to handle surveillance data. For surveillance data handling, a statistical process control (SPC) chart was introduced. For administrative control, the concept of a project-oriented work team was enhanced in every aspect of the system. SPC charting continually monitors the system in the real time window and shows areas where the system can be improved. A project-oriented team is focused on the functions and function coordination to complete the project and perform the best quality work.

Possessing a good diagnosis tool to indicate the problem and a sound, functionally structured team to perform the job helps to put the system into an improvement mode. With the efforts of the surveillance crew, safety, health physics, conduct of operations, and QA's independent assessment, the surveillance program has dramatically improved. A performance indicator shows that the program is deficiency free after the improvement process.

4.1 STATISTICAL PROCESS CONTROL CHARTING IMPLEMENTATION

SPC charting is a well known approach for identifying in advance the problems of a process. Shewhart and Deming (1986) created and applied this method to create a revolutionary development of Japanese industry and economy in the late fifties until now. In the past two decades, SPC has been implemented in the United State's automobile industry, allowing them to regain the ability to compete in the world market. SPC charting has been especially useful in manufacturing production lines and analytical laboratories.

SPC, which has been used at the Hanford Site's Analytical Laboratory for several years, has recently been enhanced. This manual plot enhancement has greatly improved quality control. In addition, there are individuals using SPC charting as a performance indicator for the facility. However, implementing SPC charting to monitor the waste storage tank was subject to a great deal of resistance. We tried to implement SPC charting in the bench level with the manual plotting instead of having engineers plot and analyze the data in a computer. Most often, the resistance we heard included the following comments.

- Control charting/data analysis is an engineering job. Control charting/data analysis is not an operator's job.
- Control charting is unnecessary because we are performing clean-up work, not production.
- We are worried about the extra work load for operators because we are short on workers.
- We do not want too much math or statistics for operators.

Fortunately, we were able to overcome these obstacles and received full support from management. The program started on a trial basis by identifying several essential and more dynamic tanks to chart. Shift operators were asked to plot each single data in a chart in addition to writing it down in the table. The merit of this manual plot is that operator will take ownership to identify the potential problem and the possible trend. Furthermore, the control chart is a much better communication tool when presenting a problem to management and engineering. Summarized below are the advantages the surveillance system gained after SPC control charting was implemented.

- Present the surveillance data graphically in a simple, quick, and clear format.
- Serve as preliminary data analysis.
- Establish facility standards and limit of normal condition.
- Enhance compliance with trend analysis in 10 CFR 830.120.
- Continue improving the surveillance activities in a cost-effective and time-efficient manner.
- Provide a scientific, statistic data base for management decision-making and team communication.

The chart demonstrates the data graphically, which makes it easier for engineering and management review and preliminary diagnosis. As shown in Figure 2, we put several monitor parameters in one chart so the correlation between parameters can be seen immediately. In addition, any trend or non-statistical control data will be recognized right away.

A great deal of effort was put into this implementation process. To get management and engineering to support SPC is essential to the whole process. The best and most straight forward way to get them to indorse the process is to show them how SPC works in their real work. To do this, we first

PUREX SURVEILLANCE CONTROL CHART

DOCUMENT No.	FACILITY	CHART No
PO-040-305	TK-P2	

Action Level 59

WF

Temp

Action Level 1°C

Action Level 2"

Dike (SPB)

Date (Dayshift)	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
WF																																											
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Figure 2. Illustration of Surveillance Control Chart

reviewed and analyzed their data using SPC charting. From the trend of the chart we are able to point out some problems that they had not found in their previous way of doing business. This practice provides them with an attractive picture of how SPC charting can be applied to their work. Once we get management to buy in, we designed several charts for individual tanks and plotted data for them. An informal SPC charting introduction training session was presented to each shift operator group before they started. As a result of the independent assessment process, the control chart has been put in the surveillance procedures, and SPC charting is now included in the surveillance certification training program.

4.2 PROJECT-ORIENTED TEAM WORK

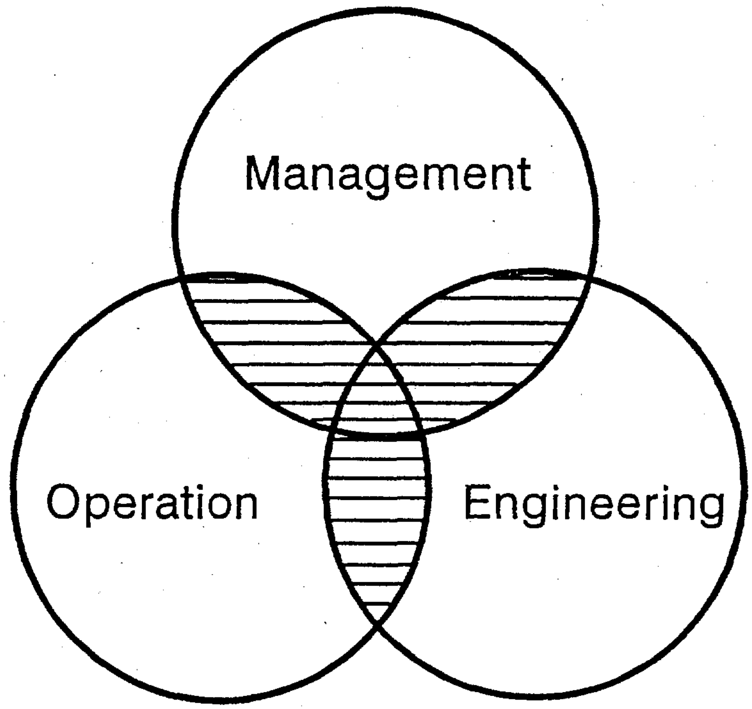
Because SPC charting is only an indicator of the problem, performing the job and fixing the problems requires a competent work team. As Deming points out (Deming 1986, Neave 1990), implementing SPC without good work management will not succeed. Besides team building is essential to every single task/project, but a survey(Dyer 1987) shows that less than ten percent of management will spend time to make this effort. We found that team management was one of the weaknesses of the system. The deficiencies indicate a lack of communication between organizations, poor function interfacing, procedure ambiguity, poor data review and traceability, and slow management response to off-normal conditions. To strengthen those weakness, we employed the concept of project-oriented team work. While this concept is nothing new, it focuses on strengthening the team's structure, function, and responsibility for job performance.

To perform a task or project often requires two or more organizations to work together closely. However, interfacing between organizations was usually left out or not well defined. For surveillance, we emphasized that the team to accomplish the job included surveillance operators, surveillance engineers, shift managers, and the surveillance management. As shown in Figure 3a, every player has a separate function and responsibility that overlaps with other players' responsibilities. However in reality, often the players have only line overlapping in the team (see Figure 3b). The worse case is that sometimes the line becomes a barrier for the project. To strengthen team work, we communicate this concept to the surveillance crew and rewrite the surveillance document. We define each player's responsibilities and interface, using a flow chart to examine the logical, complete, and follow up of the whole process. A different shape of matrix diagram is used to analyze the gap between the functions.

5.0 EVALUATION AND FOLLOW-UP

Following the assessment, involvement in the corrective action and improvement process is valuable to ensure that the continuous improvement modules are in place. Following this effort, an evaluation and follow-up is essential to maintain the continuous improvement mode. Continuous education, follow-up surveillance, and periodic assessment were the tools we used to uphold the continuous improvement cycle. Conducting performance measurements and customer needs evaluations are important in the process.

(a) Team Work



(b) Line Overlap

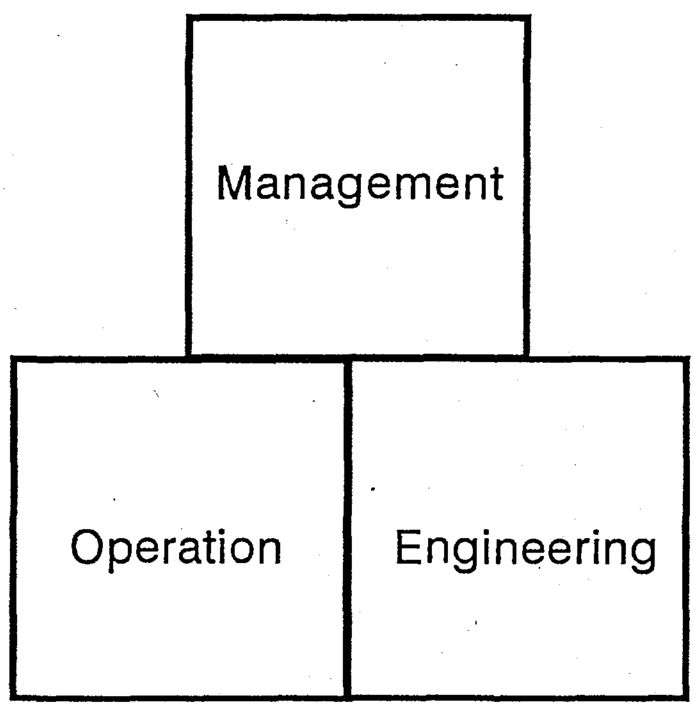


Figure 3. Demonstrate the difference between the real team work and project line overlap.

6.0 CONCLUSION

While we used to think that quality costs money, it has been proven that quality saves and makes money. One can choose to pay a limited amount of money initially or pay for mistakes and failure later. Continuous improvement is the way to achieve the goal of quality. Because change is the only universal constant, only continuous improvement can keep up with the pace of change. In our experience, independent assessment is an excellent tool to lead to the process of continuous improvement. Implementing SPC in addition to having good work management are also useful tools and provides conducive environment for keeping up with continuous improvement.

7.0 ACKNOWLEDGEMENT

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