LIQUID RADWASTE PERFORMANCE IMPROVEMENT BY DATA ANALYSIS

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ABSTRACT

The rising cost of processing liquid radwaste and a push to reduce offsite isotopic contributions has drawn greater attention to the liquid waste area. As a result, the need existed in Duke Power Company for a better understanding and awareness of liquid waste system performance. In 1990 INPO recommended that quarterly data analysis needed to be performed in the Chemistry group at its three nuclear stations: Oconee, McGuire, and Catawba. Along with the implementation of the data analysis in Duke Power Chemistry, the Radwaste group saw this as a mechanism to meet the need for improved understanding and awareness in the liquid waste area. This paper discusses the liquid waste data review system that was set up to meet this need and the details surrounding its advantages.

The quarterly data analysis system has three major parts: centralized data collection and organization, analysis by station personnel, and response actions. Data is collected for each of Duke Powers nuclear stations by the corporate office. The data is arranged into four categories: Curie trends/fluctuations and inputs/volumes, offsite dose, process media usage/performance and isotope trends. It is then presented to each station for evaluation of the individual areas. Response items are generated from the data analysis and assigned to individuals for completion by the next quarter. Goals are then set for the future year based on the anticipated performance.

Duke has benefited by this system in multiple ways.

- Major offsite Curie contributors not previously tracked have been identified and are now targeted for reduction. Examples are Fe-55, Sb-125, Mn-54, and Cr-51.
- System performance fluctuations are documented creating a historical data base where by future problems may be solved by a decision tree based on this data.
- Liquid waste inputs and volumes are now identified and tracked enabling Radwaste to direct Operations in liquid waste volume reductions.
- By tracking offsite dose the direct effect of process improvement can be evaluated. For example the use of clinoptilolite zeolite for Cesium removal was directly related to a decrease in offsite doses to which cesium is a major contributor.
- Optimization of liquid waste ion exchange media has resulted from these evaluations. In 1991 Catawba Nuclear Station used 602 ft^3 of resin, processing 2.1 million gallons of floor drain wastes. In 1992 they only used 305 ft^3, processing 1.8 million gallons without compromising effluent quality. This is due to a change in management philosophy brought about by the data analysis program.
- Accountability and documentation of this program are keeping important ideas from being lost in day to day activities. These reviews include all levels of Radwaste workers (technical staff, technicians, and supervisors). The awareness and understanding has created a willingness for active involvement in projects and goal achievement throughout the ranks. For example, it was discovered thatthe laundry water releases accounted for 38% of the cesium released at Oconee Nuclear Station. A Radwaste technician developed an idea to reroute this water through used secondary powdex in storage tanks. The cesium contribution from this source has now been significantly reduced.

This paper will provide details on the building blocks of a liquid radwaste performance analysis program and its benefits. A data analysis program can provide other industry members with similar results.

INTRODUCTION

An essential part of improvement is the evaluation of past performance and the outlook or goal for the future. In 1991 the Duke Power Company (DPC) Radwaste Section decided a systematic approach to evaluating liquid radwaste performance at its three nuclear sites Catawba (CNS), McGuire (MNS), and Oconee (ONS) was a first step to process improvement. In previous years persons at each site were looking at only a small portion of the liquid radwaste data available to them and at a random frequency. The need was for a centralized routine of data collection, distribution and evaluation. The Radwaste Section found a good example of such a program being developed in DPC Chemistry Section as the result of an INPO recommendation in 1990. Using the Chemistry program as an outline the liquid waste data review system was developed. The corporate office technical support staff serves as the central means of data collection, organization, and distribution to each station. The report is generated on a quarterly bases and in conjunction an evaluation meeting is held with each station's radwaste personnel. The program described in the following has given a foundation for improving liquid radwaste processing.

Liquid Radwaste Data Review System

Although the format of the review system has undergone minor changes since its conception, it basically has remained the same. The liquid data review system is composed of two parts: a quarterly report which is composed of various liquid radwaste data for each station and a quarterly review meeting where the data is analyzed and evaluated.

The quarterly report is a compilation of data which is retrieved from two DPC data bases, one held in a VAX mainframe and the other in an IBM mainframe. The data is organized into four categories which are Curie source and volume data, offsite dose, resin usage, and isotope trend data. These categories represent key indicators in liquid radwaste performance evaluation.

First, the Curie source and volume data is arranged in the report by each major source of radioactive release pathway. In Table I, for example, at CNS there are three major sources: 1) the station as a whole including all sources, 2) the auxiliary monitor tanks (AMT) which release water from the processed floor and equipment drains, and 3) waste monitor tanks (WMT) which release water from the wet wash laundry and hot shower drains. Total Curies released from each source are reported as well as their top contributing isotopes. Also reported are the volumes released with the associated sources. The data is arranged in columns by quarterly numbers and year to date numbers. On a separate data sheet Curie source and volume data is arranged from the past four years. This allows for comparisons and goal setting.

Second, data for the offsite dose is gathered for the second category. It consists of the past four years offsite dose numbers which are compared to the present year. The numbers are arranged by type, i.e. wholebody, liver, skin, and bone pathways.

Third, process media usage numbers are included in the report to analyze media efficiency and performance relative to the volume amount used in an evaluating period. The total volume of media and media by type used in radioactivity removal is listed for the quarter and year-to-date. Contaminant removal efficiency is calculate by dividing the volume of waste processed by the media used and is reported as a throughput in gallons per cubic foot of media.

Finally, isotope trend graphs, which are of the major contributing isotopes, are plotted in concentration vs. date. Figure 1 gives a typical example. These included graphs serve to identify fluctuations in process performance and causes of the variations over the reporting period.

TABLE I

Source Curies and Volume Data

Curie Data and Sources	Curies (qtr)		(YTD)Curies
1. Total all sources	.301		.908
Top contributing isotopes			
Total Co58	1.77e-1	Total Co58	3.64e-1
" Fe55	4.30e-2	" Fe55	2.43e-1
" Sb125	2.86e-2	" Co60	1.16e-1
" Co60	1.90e-2	" Sb125	5.84e-2
" Cr51	1.12e-2	" Cr51	4.72e-2
" Sb124	3.11e-2	" Mn54	2.32e-2
Other isotopes of interest			
Total Cs137	2.88e-3	Total Cs137	8.89e-3
" Cs134	1.64e-3	" Cs134	4.32e-3
2. Total for AMT	.291		.815
Top contributing isotopes			
Total Co58	1.75e-1	Total Co58	3.53e-1
" Fe55	3.65e-2	" Fe55	1.80e-1
" Sb125	2.86e-2	" Co60	1.07e-1
" Co60	1.85e-2	" Cr51	4.48e-2
" Cr51	1.10e-2	" Sb125	5.82e-2
" Sb124	5.16e-3	" Mn54	2.12e-2
Volume Processed	417,000 gallons		1,830,000 gallons
3. Total for WMT-A	.0067		.0586
Top contributing isotopes			
Total Fe55	5.15e-3	Total Fe55	3.92e-2
" Co58	8.35e-4	"Co58	8.22e-3
" Co60	3.30e-4	"C o60	5.97e-3
" Cr51	1.14e-4	" Cr51	2.27e-3
Volume Processed	60,900 gallons		434,000 gallons

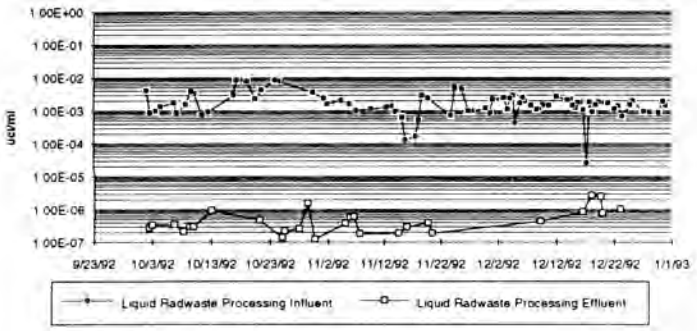

Fig. 1. Data review isotope trend chart.

The data is compiled into a single report which serves as a basis of discussion for the second part of the data review system, the quarterly review meeting. The purpose of the meeting is to review the liquid processing performance, compare it to past history and record any significant events which occurred over the reporting period. Essential to the success of the meetings is to have persons in attendance with a wide range of responsibilities in the radwaste area. Typically in attendance are corporate technical staff, site technical staff, general supervision, and technicians. With this wide experience base, many of the whys in liquid radwaste processing can be answered.

The agenda for the review meeting is composed first of a data analysis of process performance. The second task of the agenda is the action item assignments and updates. In each meeting tasks are given which will improve system performance or increased efficiency in the area. The assigned tasks from the previous meeting are updated by those assigned the project. A sense of ownership by individuals for each project ultimately creates a better product. The third agenda item is system strategies. This is geared at giving short term direction to the liquid radwaste area such as the need for new equipment, any foreseen compliance issues, and new media testing. The final item is goal setting, for example, project completion milestones and reduced effluent Curies. By having a wide range of people at these meetings problems of the past are better communicated thus reducing the chance of recurrence, and common goals are established for all positions thus a better understanding of how each person's job relates to the overall scheme.

After the review meeting, all the data, ideas, performance analysis information, and strategic plans are all summarized into a memo for future reference. Some of the benefits to this program are obvious, but many unforeseen benefits have arisen after the system was put into practice.

System Benefits

The obvious benefit of the data review system is awareness through having a wide range of data consolidated and available in a report form. Some of the first reports showed surprising results in the area of Curie contributors. Traditionally the isotopes evaluated were those with the most offsite dose concern such as Cesium and Iodine. With an increased focus by regulators and auditing agencies on effluent Curies, DPC needed to bring its sites total effluent Curies into view. Through the data review DPC found that many isotopes, which are typically lost in the myriad gamma isotopic numbers, are major effluent Curie contributors. Isotopes like Sb-125, Fe-55, Mn-54 and Cr-51 were *identified* and are now tracked in liquid radwaste effluents. Administrative criteria for releasing water is now being set with these isotopes in mind. Also resin exhaustion criteria is taking these isotopes into account. Figure 2 shows the overall reduction in curies released to the environment from DPC site before and after the data review system was initiated.

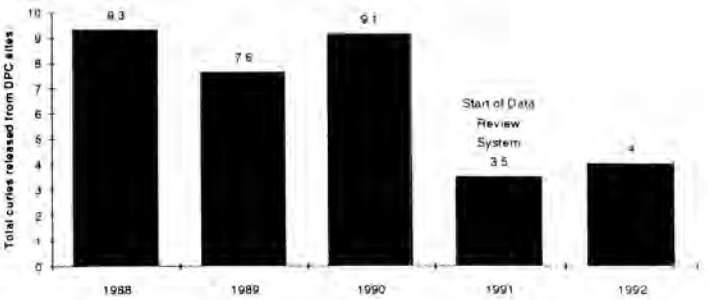

Fig. 2. DPC total system curies for past 5 years.

By creating the data review system documentation, an ongoing historical data base is set in place. Such a data base serves as a reference source for the future. Many times history repeats itself and knowing how a situation was dealt with in the past can be of great benefit in the present. In having the review information, decision tree problem solving can be developed enabling quick decision making in system troubleshooting.

Historically volume inputs to the liquid radwaste systems in DPC have gone relatively unnoticed if they fell within a normal leakrate setpoint or were a known input no matter how large. The data review through tracking volumes has been able to put a finger on excessive volume inputs. Heightened awareness has allowed Radwaste personnel to better direct Operations in volume reduction. For example outage and non-outage liquid radwaste volume goals are in place at MNS. Through education at CNS, component cooling waters which have high concentrations of anti-corrosion chemicals are no longer let down to radwaste. With volume reductions such as these has come a reduction in resin use, saving burial and resin costs.

Using the data review to compare station to station performance on the DPC system large resin usage inequities were identified between CNS and MNS, which are very similar Westinghouse design stations. In 1991 CNS used 602 cubic feet of ion exchange resin and released .763 curies of activity. In the same year MNS used 127 cubic feet of resin and released 2.11 curies of activity. The discrepancy prompted a suggested goal for each station in between the CNS excessive resin use and MNS excessive curies released. By changing the resin exhaustion criteria the two stations fell within the previous years station performances with excellent results. CNS used 306 cubic feet of resin which is almost half of that used in 1991 and released only .908 curies. MNS used 175 cubic feet of resin while releasing only .664 curies. In the resin performance category at ONS in early 1992, resin performance was very erratic in comparison to previous performance and the other two stations. It was speculated in the review meeting that some spent resin had been left in the vessels. Upon investigation by video scope inside the vessel after the next resin sluice, spent resin was found in the vessel. After changing the resin

sluice procedure to ensure removal of spent resin, the resin performance has returned to a more predictable pattern.

Not only has the data review system been the mechanism for *beneficial change* but it has also helped verify improvements which are already in place. Previous to the data report the data from past years was not trended, only the present operating performance was evaluated. With the trending verifications, using the data review system, these improvements can be seen. For example, MNS and CNS switch to using the cesium specific media, clinoptilolite zeolite in 1991. Its success was based solely on the current process information at the time. Through the trending of past years offsite doses for each station there was a verified reduction in the offsite dose contribution from cesium. One of the larger successes of the media was not realized until the data review.

Probably one of the greatest benefits of the program is the contribution from every level of radwaste worker and the accountability which is set forth. It is common sense that the best ideas come from those working closest with the system. Many times in the past, technicians opinions were bypassed in DPC radwaste pursuits. This program allows everyones opinion to be voiced on the liquid radwaste issues. Proper credit is thus given to the individual with the idea and if its a merited idea that person is given accountability for bringing the project to pass. One example, was the idea of a new way to process laundry given by an ONS technician. Through the data review it was discovered that 38% of the cesium released from the site came from laundry. Laundry water was at the time only being processed through a deep bed carbon filter and cartridge filters. The idea was to reroute the laundry water through the used secondary powdex storage tanks thus taking advantage of the unexhausted portion of the resin. The laundry water was then batch contacted and decanted off to find almost complete removal of cesium. An overall reduction in the cesium contribution can be seen in Fig. 3. This was to the benefit of the station as a whole. As one can see there are many benefits to the data review program and still more to come.

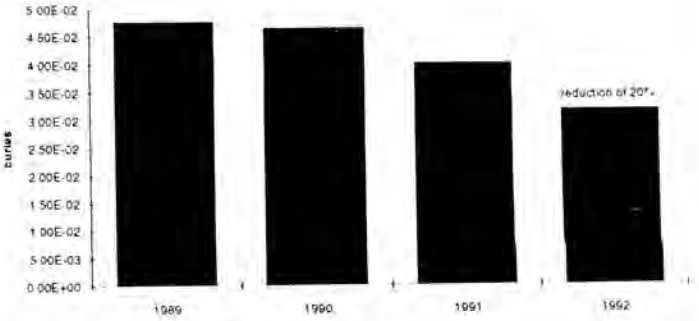

Fig. 3. Curies from Cesium at ONS.

CONCLUSION

The liquid radwaste data review program has no great complexity to it. It is basically a common sense approach which many times is bypassed due to the so called hassle or lack of time. The simple program of data collection, organization, and analysis by all levels of radwaste personnel has proven fruitful. The awareness and ownership gained by involved personnel has given a boost to productivity and cost savings in the area. The data report has provided goals to shoot for and has enhanced a friendly competition between the stations. Duke Power Company has found the program very beneficial and counts on its positive results to continue.

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