Date of Issue: February 1983

Y/DD-318

REDUCTION IN AIRBORNE CONTAMINATION LEVELS
AT THE 9201-5 ARC MELT
SAWING OPERATION.

A Y-12 PLANT 1982 ALARA GOAL

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Prepared for the Department of Energy
Under U. S. Government Contract W-7405 eng 26

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SUMMARY

Lowering the uranium airborne contamination level at the two saws in the 9201-5 Arc Melt Area was chosen as a Y-12 Plant As-Low-As-Reasonably-Achievable (ALARA) goal for 1982. Line supervisors put a high priority on meeting this goal. This priority was convincingly communicated to those involved by giving specific instructions to suspend saw operations any time there was evidence of a problem until that problem could be corrected.

Using control charts on air flow rates into the saw enclosures and pressure drops across filters in the saw ventilation (Delta Phase I) exhaust system, it was possible to decide when filter changes or other adjustments were necessary to maintain the exhaust flow rates needed for improved airborne contamination control. The keeping of these charts, along with the actions taken on the basis of the data gathered, made it possible to meet the goal of reducing airborne contamination levels in 1982, as compared with 1981, although production in the Arc Melt Area increased significantly.

These data also showed that use of one brand of filter in the prefilter system resulted in the need to change filters more frequently than when another brand was used. This fact triggered an investigation which revealed the cause for the shorter useful life of that filter and a request that only specifically approved filters be purchased for use in this system.

Use of these control data also made it possible to establish that the exhaust system operated more effectively without the Roto-clone hydrostatic precipitators because exhaust air flow was increased without reduction in filter life.

INTRODUCTION

Late in 1981, the Oak Ridge Y-12 Plant* established some specific As-Low-As-Reasonably-Achievable (ALARA) radiation safety goals for CY 1982. Since the airborne contamination levels at the two saws in the 9201-5 Arc Melt Area were higher than the airborne contamination associated with other depleted uranium operations, one of the ALARA goals chosen was: "Reduce the airborne contamination levels at the 9201-5 Arc Melt Sawing Operation, although workloads are expected to increase."

It was agreed that the achievement of this goal would be judged by the comparison of 1981 and 1982 results of the general air sampler closest to each of the saws as to average level and percent of air samples greater than the Plant Action Value (PAV) of 22 disintegrations per minute per cubic meter of air. Responsibilities were assigned, and an action plan was developed to help reach this ALARA goal.

*Operated for the U. S. Department of Energy by Union Carbide Corporation, Nuclear Division, under Contract W-7405-eng-26.

DESCRIPTION OF SYSTEM

Each saw is contained in an enclosure which is approximately 15' 5" high x 15' 0" long x 5' 9" wide. A conveyor, located on the side of each saw, is used to move the workpiece into and out of the saw enclosure. A steel frame with a hydraulically operated sliding center section is located on top of the conveyor rollers and is used to position the workpiece. The saw consists of a 48-inch diameter abrasive wheel which oscillates up and down and cuts through the depleted uranium workpiece. During the sawing operation, a coolant/cutting fluid is sprayed on the workpiece and abrasive wheel to cool and lubricate the saw and to wet down fine particles that tend to become airborne. This sawing operation generates heat which vaporizes some of the coolant. This vaporized coolant is entrained in the exhaust air stream and clogs the prefilters in the exhaust system.

The Delta Phase I Exhaust System, used to control and evaluate airborne contamination around the abrasive saws, consists of the following: (1) enclosures around the saws; (2) duct work and a fan to exhaust the enclosures; (3) hydrostatic precipitators, prefilters, and final filters to collect solids and liquids from the air; and (4) air samplers to measure the level of airborne contamination (see Figure 1).

ENCLOSURES

The saw enclosures (see Figure 2) are primarily sheet metal sealed with rubber gaskets at access points. Several large doors on two sides are used for maintenance and operation access. All doors are equipped with limit switches to prevent operation of the saw with the doors open. It is a strict rule that access to the saw is permitted only after the air is visually cleared in the

enclosure and the saw blade motor is off. Air flow at the enclosures is measured every workday in linear feet per minute using a hand-held, direct-reading velocity measuring instrument. Representative air velocities at one location are shown for each saw in Figures 3 and 4.

DUCT WORK AND FAN

Metal duct work is used to exhaust the air from the enclosures to the filter banks. A 65,000 cubic feet per minute fan is used.

HYDROSTATIC PRECIPITATORS

A hydrostatic precipitator is used for each saw. These devices, commonly known as Roto-clones, are located on the mezzanine level above the abrasive saws as shown in Figure 5. The Roto-clone is designed to clean the air by combined action of centrifugal force and a thorough intermixing of water and dust laden air. The Roto-clones are backed up with demisters to remove water particles. After the exhausted air from the saws passes through the demisters it is merged with other exhaust air from the area before it is filtered.

The prefilter system is designed to hold sixty-four 8-inch thick by 24-inch square filters. These filters have a sturdy exterior frame and many folds of fibrous filter media to increase the surface area (see Figure 6). The water pressure drop across these filters is measured every eight hours using a 4-inch range incline tube manometer. A graph of daily pressure drops is shown in Figure 7.

The final filter bank holds sixty-four 12-inch thick by 24-inch square filters. These filters are 90 percent efficient. The water pressure drop across these filters is measured using a U-Tube. Daily pressure drops are shown in Figure 8.

AIRBORNE CONTAMINATION SAMPLING

To evaluate relative air contamination levels, samples are taken by drawing air through a filter on a continuing basis at permanently installed air samplers. Each sampler has a calibrated rotameter. The volume of air sampled is calculated from the time of the sample and the volume of air per unit time from the rotameter calibration.

The results used to judge progress relative to this ALARA goal were from a sampler (see Figure 9) located about 6 1/2 feet off the floor at the control panel of each saw.

The sample filters are contained in a computer card which has prepunched basic information such as the time, flow rate, location, etc., of the sample. The samples are changed twice weekly. The Y-12 Plant Laboratory counts these filters with an automated alpha counter. The count and additional information needed to calculate the airborne contamination level in units of disintegrations/minute/cubic meter of air are punched into the card at this time. Computer Sciences Division personnel calculate and report airborne contamination levels.

A problem associated with this alpha analysis for uranium is the naturally occurring alpha emitters in the air. These emitters elevate the count rate and the apparent uranium airborne contamination level if the count is made shortly after the sampling is completed. These alpha emitters have short half-lives, and the problem with them is circumvented in this area by waiting three days after sample removal before making the count. This procedure and the time required to process the sample and computer reports delay the results of the air analyses so that it is impractical to use them for timely decisions as

to when exhaust system filters should be changed or adjustments made. For this reason, air velocities at the saw enclosure have been used to make such decisions. The results of the air samples taken at each saw are shown in Figures 10 and 11.

INTERPRETATION OF DATA

As noted, air exhaust velocity measurements have been used for filter change decisions in the belief that maintaining the optimum ventilation practical with the system would assure improved air contamination levels, which proved to be the case. As an illustration, statistical comparison of the data from exhaust air velocity measurements and the airborne contamination levels shows a significant negative correlation.

Actions were taken on the basis of air velocity measurements. If they fell below established levels and pressure across a set of filters was higher than normal, the filters would be changed. This approach resulted in 21 prefilter changes and six final filter changes during the year. For comparison, 12 and 6 changes were made in 1981, respectively. It is noted, however, that this increase in the frequency of filter changes reflects, in part, the problem experienced with one brand of prefilter and experiments with the system, as explained later in this report.

On a few occasions, velocities were below optimum levels and pressure drops across the filters were normal. Investigations were made to find the cause(s) of the problems. On one such occasion, it was found that an exhaust ventilation damper had shaken loose and was partially closed. It might have taken weeks to discover this problem had velocities not been measured and timely actions taken.

CHANGES AND THEIR EFFECT ON THE SYSTEM

Numerous changes were made during 1982 in the Delta Phase I Exhaust System in Building 9201-5. Some changes were specifically made to improve air contamination levels at the saws. Changes made for other purposes also affected saw air contamination levels.

ENCLOSURE MODIFICATION

The enclosures of both saws were improved. Based on Engineering Division recommendations, the enclosures were sealed to minimize inward "leaks." This sealing improved the air flow velocities slightly.

COOLANT

The coolant used in the saws was changed from a nonrecyclable, contaminating triethanolamine/sodium nitrite/water mixture to a noncontaminating, recyclable, water-based corrosion inhibitor coolant containing morpholine and fluorescein. This change was made to reduce contaminated waste but also appeared to improve filter life to some extent and thus maintained higher average air flows.

COOLANT DISPERSAL

A method of increasing the coolant dispersal in the saw was tried. This change was designed to reduce airborne particulates directly at the cut, and resulted in slight improvements.

FILTER QUALITY

An unplanned change in prefilter quality happened in early July. Through the first part of the year one brand of filter (Brand 1) was used. Purchasing had difficulty with on-time delivery of these filters and changed to an apparently equal quality filter from another vendor. The second filter (Brand 2) did not last as long as the original type, although specifications were equivalent.

Other types of prefilters were tried in November and December, with poor results in final filter life. A small quantity of Brand 1 filters was purchased and tried again in late December with good results like those prior to July in both pre-filter and final filter life.

An extensive evaluation of filter binders and materials was made to determine the cause of filter life differences. Obviously, longer filter life results in increased average air flow and thus better exhaust and reduced air contamination.

REMOVAL OF ROTO-CLONES

The Roto-clones were installed in 1980. During their use large amounts of water were found in the prefilters. Samples showed that only small amounts of material were being removed by the Roto-clones. It was hypothesized that they were doing more harm than good. Engineering designed a retrofit panel that allowed removal of the water from the Roto-clones and thus effectively removed their cleaning capability while still utilizing their small booster fans. This system modification had the largest effect on the reduction of air contamination. Air flows increased dramatically after this change in mid-October. Although the pre-filter quality was not as good at this time, these higher air flows improved the air sampler data.

DISCUSSION

ALARA OBJECTIVE, REDUCTION IN AIRBORNE CONTAMINATION, ACCOMPLISHED

A formalized specific objective was written as an aid in accomplishing the ALARA objective of reducing airborne contamination levels at the saws. Desired results listed were to reduce (1) the average airborne contamination levels at each saw for 1982 to below the average levels for 1981 and (2) the percent of individual results exceeding the PAV of 22 disintegrations per minute per cubic

meter of air at each saw for 1982 to below the percent shown for 1981. The following summary of 1981 and 1982 air sample results shows that the desired results were obtained. It is noteworthy that these decreases were achieved in spite of a significant increase in production in 1982 over 1981.

Summary of 1981 and 1982 Air Sample Results

<u>Location</u>	<u>Type of Result and Units</u>	<u>Result</u>	
		<u>1981*</u>	<u>1982</u>
Tysaman Saw	Average - d/min/m ³	20	13
Tysaman Saw	Samples > PAV - %	32	11
Savage Saw	Average - d/min/m ³	33	19
Savage Saw	Samples > PAV - %	57	28

ENGINEERING PROPOSAL FOR CHANGES IN THE VENTILATION SYSTEM

Heating, ventilation, and air conditioning engineers were asked to recommend changes to reduce airborne contamination levels at the saws. Their study of the problem and the exhaust ventilation system led them to conclude that the keys to solving the air contamination problem could be solved by: (1) better sealing of the saw enclosure system and (2) increasing exhaust air flow from the saw enclosures. They judged that any permanent increase in exhaust air flow could best be achieved by a new, separate system. The cost of such a system, with its own fan, scrubber, and filter, was estimated to be over \$200,000. It was decided not to install a new exhaust system because the money was not readily available and there were uncertainties as to the effectiveness of the suggested system. Instead, a decision was made to improve the enclosure and to attempt to maintain exhaust system velocities high enough to reduce airborne

*1981 numbers omit those samples taken during the strike period in June and July.

contamination by optimizing the frequency of filter changes and making the modifications described earlier in this report.

FILTER PERFORMANCE INVESTIGATION

An extensive investigation was made of the types of prefilters used in the Delta Phase I System. Two brands of filters were evaluated. Brand 1 had a longer useful life than Brand 2. The filters were checked at the Oak Ridge Filter Test Facility at ORGDP for efficiencies. Brand 2 tested slightly less efficient than the Brand 1 filters. This indicated that, for smoke, media in Brand 2 filters were not as restrictive as Brand 1 filters. From actual filter life results, the opposite efficiencies were expected.

New and used filters of both types were further evaluated using x-ray diffraction, the scanning electron microscope (SEM), and chemical analyses. Engineering studies had previously shown that most of the particles entrapped were oxide particles ranging from 0.06 to 1.3 microns in diameter. The SEM photographs shown in Figure 12 illustrate a difference between Brand 1 and Brand 2 filters. The media binder in Brand 1 filters at 1000 X magnification clearly is thinner and restricts flow of particles less than the binder for Brand 2 filters. The composition of the two binders was found to be different for the two filter types.

From the above results, it is obviously advantageous to use Brand 1 filters for longer life and better average exhaust flows. Consequently, Stores was requested to stock only Brand 1 filters or a specifically approved substitute for use in the system.

CONCLUSIONS

1. The generation of ventilation system data and the use of control charts were invaluable in the delineation of problems and in measuring the effects of changes. Personnel were able to separate problems with special causes from those requiring system modification.
2. Timely changing of filters kept air exhaust rates up and air contamination levels down.
3. One brand of filter shows a longer useful life in this ventilation system than did the other filters, largely because of the difference in their binders.
4. Removal of the cyclone separators from the exhaust ventilation system resulted in increased exhaust air velocity and lower airborne contamination levels without any shortening of prefilter life.

RECOMMENDATIONS

1. The measurements described above should be maintained and used in a continuing program to evaluate and control airborne contamination at these saws.
2. The use of the approaches which led to the successful achievement of this ALARA goal should be considered for other applications.
3. Line supervision should put a high priority on achieving goals and communicate that priority to others involved.

ACKNOWLEDGMENTS

The following people helped in many ways to achieve the ALARA goal or to make the investigations reported here.

B. G. Bowers, Health Physics
O. K. Clotfelter, Utilities
E. T. Creech, Plant Laboratory
J. L. Disney, Health Physics
M. H. Eager, Plant Laboratory
J. D. Gass II, Health Physics
J. W. Hatfield, Metal Preparation
H. E. Hawn, Utilities
F. P. McHenry, Engineering
J. M. Napier, Development
W. G. Northcutt, Development
R. E. Stubblefield, Metal Preparation

Figure 1. Delta Phase I System Diagram

Figure 2. Saw Enclosure

Figure 3. Air Velocity at Tysaman Saw

Figure 4. Air Velocity at Savage Saw

Figure 5. Roto-Clones and Ductwork

Figure 6. Filter Used in Prefilter Bank

Figure 7. Delta Phase I Prefilter Pressure Drop

Figure 8. Delta Phase I Final Filter Pressure Drop

Figure 9. Air Contamination Sampler

Figure 10. Air Sample Results at Tysaman Saw

Figure 11. Air Sample Results at Savage Saw

Type I

1000X

Type II

1000X

Figure 12. Magnified Prefilter Media (Scanning Electron Microscope Photographs)

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