PROTECTIVE CLOTHING SELECTION EXPERIENCE MILLSTONE U-3 SPRING 2004 OUTAGE

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ABSTRACT

Over the past year, Millstone Station we has been evaluating options for our protective clothing program due to an increase in the number of Personal Contamination Events (PCE's). As a result of the detailed cost evaluations and a review of our PPE program as compared to the industry, Millstone Station moved to a dedicated synthetic coverall inventory with reversible nylon shoes, color-coded rubber shoes and gloves. Additionally, more restrictive automated laundry monitor limits were instituted and all of our old clothing was removed from use. This report outlines the experiences of this transition and highlights the expected and unexpected benefits.

Clothing Selection

A review of the condition of our pre-existing coverall inventory indicated that the average age of the garment was over ten years old, often torn, stained and looked very unprofessional. The garments had been monitored to fixed contamination levels that were higher than the industry average and were suspected of contributing to personnel contamination events. As a result, it was decided to replace the entire coverall inventory.

During our search for replacement coveralls we looked at the following types of clothing:

1. Single Use – Poly Vinyl Alcohol
2. Single Use – High Barrier Laminate
3. Multiple Use – Synthetic Fabric

Any of the three clothing types could have been utilized to help achieve our goal of reducing the number of PCE. A cost analysis of a typical outage was then performed. The results are listed below in Figure 1 and Table I.

Clothing Data Set: 20,000 coveralls; 20,000 pairs of inner shoe covers; 2,000 hoods

Table I. Clothing Cost Options

Option Number	Option Description	Outage Cost
1	Single Use - PVA (Vendor 1)	$120,000
2	Single Use - PVA (Vendor 2)	$110,000
3	Single Use - High-Barrier Laminate (Vendor 2)	$130,000
4	Launderable, Synthetic Fiber, Lease tied to use, New Clothing, Lower Monitoring Limits	$83,000
5	Launderable, Synthetic Fiber, Lease tied to use, Used Clothing, Lower Monitoring Limits	$63,000
6	Launderable, Synthetic Fiber, Purchase New, New Clothing, Lower Monitoring Limits	$392,000
	*Options 1,2,3 Include Disposal Costs.	

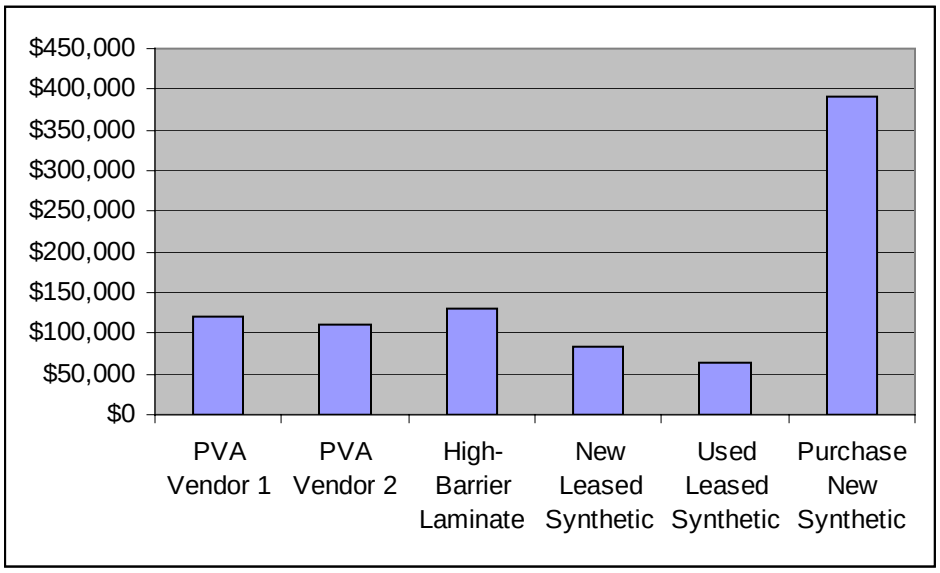

Fig. 1. Graphical Summary of Clothing Option Costs

Within these options there was considerable price and protection variability. As compared to using our old clothing inventory, single use clothing options approached two times our traditional clothing cost. If we decided to lease previously worn synthetic fiber coveralls our outage laundry cost would not change. In addition, the data set only represented approximately half of the typical outage cost. The other half of the cost came in the form of rubber shoes, rubber gloves, slings, safety harnesses, fire retardant coveralls, bags, wipers, mops, and FME covers. Based upon our decision on which option to select our total outage cost would range from about $90,000 to potentially $175,000.

After a detailed analysis, we decided on Option 4, a form of lease using launderable synthetic fabric. Our traditional outage laundry cost was increased by approximately twenty five thousand dollars. However, we would start the outage with all new protective clothing, which would lead

to a higher probability of reducing the number of PCEs for the outage. Our workers had used these garments before and liked the fit and feel better than our old poly cotton and cotton garments. In addition, they could be maintained at a much lower residual contamination limit, could be used in higher contamination areas, and imposed less heat stress on the work force.[i]

Outage Observations

Faster dress outs

The color-coded coveralls, rubber shoes, and rubber gloves made a noticeable decrease in worker dress out time. Our old clothing was either not color-coded or had multiple color codes within the sizing. In addition, the synthetic fiber coverall slipped on easier/faster than the cloth coveralls

Stocking Change Areas

The ProTech coveralls and hoods weighed less than half as much as our poly/ cotton garments and took up approximately one-half of the space on the shelves. This doubled the amount of clothing that could be stocked in the dress out area, and significantly reduced the stocking labor as workers could move twice the volume in the same cart space. In addition to this reduction in stocking labor, housekeeping in the change area was significantly reduced. With our old inventory, workers would pull a coverall from the shelf and find it was not the proper size or didn't look very nice and drop it on the floor and get another one. This did not happen with the full color-coded inventory.

Worker/Change Area Appearance

Our old inventory was quite tattered and stained from years of use. The new inventory gave the appearance of a more professional workforce and reflected a positive step forward. Senior management recognized the change. In addition, the change areas looked more professional and stayed neat with much less effort. The overall look and feel of our protective clothing seemed to have a positive effect on the outage.

ALARA

The new garments supported the ALARA initiative to wear electronic monitoring devices on the outside of the coverall. Workers could read their exposure off of their Electronic Dosimeters (ED) without unzipping the coverall. Many of our older style coveralls did not have a pocket or tag that allowed for easy self monitoring of exposure.

Protective Clothing Limits

Due to the leasing of all new protective clothing, lower limits for residual fixed contamination were established to the values depicted below:

Table II. Pre-existing and Revised Fixed Contamination Limits

	ProTech Coverall & Nylon Shoe	Reversible Nylon Shoes	Rubber Gloves & Other Cloth Apparel	Rubber Shoe/Non-Apparel items
Old Limit	48,750	48,750	130,000	130,000
New Limit	10,000	10,000	25,000	50,000
% Decrease	80%	80%	80%	60%

The 80 percent lower limit did not result in an increased garment rejection rate. There was a zero rejection rate for the coveralls and reversible nylon shoes. The reject rates for gloves and rubber shoe covers were 6.5% and 4.3% respectively. These rejection rates were in-line with previous outage even though the contamination limits were significantly reduced. For the few non-apparel items that we now leased, only the wipers (7%) and tarps (16%) experienced a higher than normal first wash fail reject rate. These items were rewashed and reintroduced for use. Rewash was negotiated in the contract as a no charge service.

Personnel Contamination Events:

Our goal for PCE's for the spring of 2004 outage was $\leq$ 10 PCEs per 10,000 person-hours. The actual rate was 10.5 per 10,000 man-hours. As compared to the last outage where the PCE rate was 20.2 per 10,000 man-hours.

Not all of the PCE reduction could be attributable to the new protective clothing program. However, some of the PCE reductions were directly attributable to the new protective clothing. Lower monitoring limits lead to a much less likelihood of perspiration causing the fixed contamination on the protective clothing to leach out onto the individual and causing a PCE. Additionally the new weave of the synthetic fabric is much tighter than the replaced coveralls, resulting in a significantly improved barrier against loose contamination. This was apparent due to the reduction in the number of PCEs that were observed where loose contamination migrated through the coverall onto the individual.

SUMMARY

Using a new, leased, color-coded inventory of protective clothing the following has been achieved:

- Reduction of PCE's through:
  - Better Clothing

  - Lower monitoring limits

- Reduction in heat stress issues with ProTech Coveralls
- No clothing failures (rip outs) or situations where the workers had to leave the job site due to problems with protective clothing.
- Professional appearance of workforce
- Reduction in worker dress-out time.
- Reduction in housekeeping activities in dress-out area.
- Upgraded the quality of the protective clothing without a substantial monetary investment. Increased outage cost $25,000.

FOOTNOTES

[i] ProTech 2000 coveralls are listed in the EPRI study, "Heat Stress Management Program for Power Plants," Clothing Update of NP-4453-L, 1991 Report, listed as P2, that do not add thermal loading to the worker, thus a one is assigned as a clothing adjustment factor. This significantly increases worker stay time during high temperature jobs.