SESSION 18

# PANEL SESSION: VENTILATION AND AIR CLEANING DESIGN AND APPLICATION FOR CONTROL OF RADIOACTIVE CONTAMINANTS DURING DECONTAMINATION AND DISMANTLEMENT OPERATIONS

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| Thursday: | July 28, 1994 |
| Co-Chairmen: | J. E. Williams III |
| | R. Palmer |
| Panel Members: | D. Edwards |
| | R. D. McCullough |
| | K. Tschaenn |

OPENING COMMENTS OF SESSION CO-CHAIRMAN WILLIAMS

VENTILATION SYSTEM DESIGN FOR CONTROL OF RADIOACTIVE AIRBORNE PARTICULATES DURING THE DECONTAMINATION AND DISMANTLEMENT (D&D) OF THE PLANT ONE ORE SILOS
J. E. Williams

PANEL DISCUSSION

## OPENING COMMENTS OF SESSION CO-CHAIRMAN WILLIAMS

Good morning. My name is James E. Williams, I am with Parsons Environmental Services, Inc. We are an architect-engineering firm under contract to Fermco, manager of the Frenald project. The panel, from Fermco, is here to talk about ventilation system design for control of radioactive airborne particulates during the decontamination and dismantlement of the plant one ore silos.

# Ventilation System Design for Control of Radioactive Airborne Particulates During the Decontamination and Dismantlement (D&D) of the Plant One Ore Silos

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## ABSTRACT

Fernald Environmental Management Project (FEMP) is owned by the Department Of Energy (DOE) and was used for the processing of uranium metal products for the nations' defense programs. The facility is a 1,050-acre site located in southwest Ohio. In July 1989, production was discontinued. The Fernald site has completed its site wide Remedial Investigation/Feasibility Study (RI/FS) which is pursuant to the Comprehensive Environmental Responsibility Compensation and Liability Act (CERCLA) and the Amended Consent Agreement between the US EPA and the DOE. In the RI/FS, a variety of response actions where identified for various Operable Unit (OU) areas at the FEMP. Of the many response actions in progress at the FEMP, removal action #17 (in OU-3), known as the Decontamination & Dismantlement (D&D) of the Plant One Ore Silos, exemplifies a "state of the art" nuclear air cleaning system. Constructed in 1953, Plant 1 was the "Sampling Plant" for the FEMP site and the receiving point for incoming ores and residues to be processed for the production of uranium metal. The contents were removed except for small amounts of residue. The objective of the removal action is to mitigate the potential for release of contaminants or potential hazards (radiological and safety) presented by the Plant One Ore Silos until total remediation of the OU-3 area is performed.

All D&D work activity is controlled to prevent the release of contamination. The work areas are isolated with physical barriers and a ventilated containment system. The containment for the silo structures consists of scaffolding and polyethylene fabric sheeting (area containment). The containment material is flame-retardant and corrosion resistant in compliance with DOE Order 6430.1A.

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Ventilation air is filtered through portable air cleaning devices equipped with pre-filters and High Efficiency Particulate Air (HEPA) filters and monitored before discharge to the atmosphere.

Contamination control is provided by local ventilation at work stations, and area containments of the silo structures and the size reduction building. Routine radiation and surface contamination surveys are performed on all work levels of the containment structures. Access into the area of containment and size reduction building are controlled by radiological technicians. Control point step off pads are provided at the access locations for personnel and material monitoring. The ventilation system is designed for a minimum of seven air changes per hour.

This paper will illustrate the design of the ventilation in compliance with ASME codes AG-1, N509, N510, and DOE order 6430.1A. The materials of construction and design of the ductwork, stack, portable nuclear air cleaning units, and the type of air sampler used will be addressed. Also, this paper will describe the phase approach to dismantlement and ventilation that resulted in reduced costs and waste minimization.

## INTRODUCTION

Plant 1 was the "Sampling Plant" for the FEMP site and the receiving point for incoming ores and residues to be processed, and for FEMP's own waste for further processing. The Plant 1 Ore Silos were constructed in 1953 for the purpose of sampling and blending ore concentrates to feed the refinery (Plant 2/3) after sampling was completed. This system proved to be inefficient and was terminated. In approximately 1955, the silos were temporarily used as overflow storage for the cold metal oxides stream which was a by-product of ore processing. The silos have not been in use since late 1962. The contents were removed except for small amounts of residue.

The Plant 1 Ore Silos include the two groups of silos in an area directly south of Building 1A (see figure 1), consisting of the six reinforced concrete silos to the east and the eight glazed tile silos to the west. Four of the glazed tile silos are 44 feet tall and the remaining four are 10 feet tall. The six reinforced concrete silos are 10 feet tall. The eight tile silos sit on separate superstructures which are approximately 38 feet tall and are connected by a mezzanine. The estimated height of residual material in each of the eight tile silo cones ranges from 1-4 feet. The residual material that was located in the concrete silos was minimal.

On February 6, 1991, a spill was observed on the ground under the northwest tile silo during routine inspections by plant personnel. It is hypothesized that heavy rain on the previous day wetted the residues to the point of flow from the silo. Inspections indicated that residues had also accumulated on the lower platform under both western tile silos and the northwest small tile silo (see figure 2). The residue release caused the start of what is now known as the Plant 1 Ore Silos Removal Action. The objective of the removal action is to remove the source and any potential hazards (radiological and safety) presented by the Plant 1 Ore Silos until they are addressed under final site remediation.

### Ventilation System

All D&D activities are controlled to prevent the spread of contamination. The work areas are isolated with physical barriers and a ventilated containment system. Ventilation air is filtered through pre-filters and High Efficiency Particulate Air (HEPA) filters before discharge to the atmosphere. The DOE Order 6430.1A "General Design Criteria"[B.1] was used as the governing design guide. The DOE Order 6430.1A provided guidance into what standards were to be used in obtaining our final design. A listing of the standards and guides can be found in Appendix A.

Our first step in the design process was to determine types of radionuclide contaminants and the level of radioactivity given off by the contaminants in the areas inside and surrounding the Plant 1 Ore Silos. Samples of the types of radionuclide contaminants and their respective radioactivity can be reviewed in the Table 1-1 below.

| Radionuclide | Concentration in Sludge or Debris (pCi/g) |
|---|---|
| TH-230 | 140000 |
| RA-226 | 210 |
| TH-232 | 2500 |
| RA-228 | 29 |
| TH-228 | 660 |
| U-238 | 1100 |
| U-234 | 1000 |
| U-235 | 49 |
| U-236 | <2.1 |
| Np-237 | 13 |

Table 1-1

The radionuclide contaminants in combination with the deteriorating structure of the Plant 1 Ore Silos dictated that a ventilation system be employed to not only provide dust control during D&D operations, but most importantly to mitigate the emissions of radionuclide dust particulates to the environment. The above contamination concentration values listed in Table 1-1 range from low to high contamination levels. Based on this information the entire ventilation system for the D&D of the concrete and tile silos was designed in compliance with the ERDA 76-21 "Nuclear Air Cleaning Handbook"[C.1] level 4 construction standards. The ventilation system design accommodated the phased sequence of the D&D operation. There are 5 phases of ventilation to support the tile and concrete silos D&D (Figure 3). The phasing of the ventilation system optimized the original concept of ventilating the entire Plant One Ore Silo area, which was not feasible.

A scaffolding/containment system was erected (Figures 4 and 5) to totally enclose the working areas. The silo containment sheeting is a reinforced woven vinyl polyethylene sheeting. Also, a polyethylene vinyl sheeted aluminum framed building, known as the Size Reduction Building (SRB), was also erected. The SRB was used for size reduction of large equipment and structural steel. Size reduction of various silo materials was necessary in order to put the contaminated debris into storage containers. At various size reduction work stations, local ventilation of torch cutting operations are employed. Local ventilation is provided by use of a hand held portable HEPA vacuum with flexible duct and attachable hood.

Within the silo containment and the SRB, backdraft dampers were used to provide make-up air to the structures during ventilation exhaust operations. All backdraft dampers, ductwork, volume control dampers, air cleaning devices, duct supports and accessories were made of stainless steel. The stainless steel material that was used for the ductwork system and accessories was chosen due to its ease of decontamination, and the potential for reuse on future D&D projects. In Figures 6 and 7, the exhaust volume flow rates of the various containments sizes and the SRB can be observed. The minimum number of air changes required by the DOE design guidelines is typically 6 air changes per hour for personnel occupied areas. The minimum numbers of air changes for both the tile and concrete silo containments is 8. The SRB is designed to maintain a minimum of 11 air changes per hour.

To maintain the above stated number of air changes required state of the art, modular, mobile HEPA filtered air cleaning devices (ACDs) that are in compliance with standard ASME N509[A.1]. Each ACD needed to be equipped with prefilters as apart of its assembly including the industry standard bagin/bagout housing and be in place DOP testable. The three ACDs providing exhaust ventilation to the concrete and tile silos were fabricated by Charcoal Service Corporation. Each ACD provides a nominal 4000 CFM exhaust. The system total nominal exhaust volume flow rate is 12,000 CFM. The ACDs supporting the SRB containment structure were fabricated by Bartlett Nuclear. Each of these ACDs provides a nominal 1,000 CFM exhaust. The system total nominal exhaust volume flow rate is 5,000 CFM.

## Radiological Control Data

Due to the effectiveness of our ventilation system on this project, routine contamination surveys performed on the perimeter of the D&D project area revealed that removable surface contamination have not exceeded 20 dpm/100 $cm^2$ (alpha), which is significantly below the DOE regulatory limit. All containment areas are posted as High Contamination Areas.

Perimeter air monitoring is performed on the project boundary to confirm the integrity of the containment structures and to ensure the adequacy of radiological controls. Average airborne concentrations have not exceeded 2% of the Derived Airborne Concentration (DAC) at the project perimeter. A representative portion of personnel working in the area are equipped with Personal Air Sampling (PAS) devices to monitor exposure to airborne radioactivity. Elevated airborne concentrations have been measured within the SRB and the silo containment areas, but have been well below 4 DAC-hours (per man per week) when considering a protection factor of 50 for full-face air-purifying respirators. The air samplers used on both the exhaust stacks for the SRB and silo containment structures collect particulate samples on a glass fiber filter which is continuously monitored by a Ludlum Model #177 G-M probes. Since the beginning of the D&D operations on this project, this sampler has not indicated that there is any notable contaminant emissions from the ventilation exhausts.

## CONCLUSION

The design, fabrication, and installation of this ventilation system does meet all the requirements of ASME N509. All in-place DOP testing of the ACDs and pressure decay testing of ductwork and stacks comply with ASME N510[A.2]. All the stainless steel material and equipment that was used on this project will be decontaminated to the extent necessary for future re-use on other D&D ventilation projects. This exemplifies the cost effectiveness and waste minimization of our design when applied to other Fernald site D&D projects. When applicable, exemptions form DOE Order 6430.1A should be considered and reviewed at site DOE level to allow for deviation from the order. This will keep project costs down by introducing and implementing new technologies or ideas that are not currently addressed in the order but would satisfy environmental, safety, and health requirements.

Parsons Environmental Services and FERMCO are committed to ensuring that all D&D ventilation system designs comply with DOE Order 5400.5 "Radiation Protection of the Public and the Environment"[B.2].

## APPENDIX A

A. American Society of Mechanical Engineers (ASME):

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|---|---|
| 1. ASME N509-89 | Nuclear Power Plant Air Cleaning Units & Components. |
| 2. ASME N510-89 | Testing of Nuclear Air Treatment Systems. |
| 3. ASME/ANSI AG-1-88 | Code on Nuclear Air & Gas Treatment. |

B. Department of Energy (DOE):

| | |
|---|---|
| 1. DOE Order 6430.1A | General Design Criteria. |
| 2. DOE Order 5400.5 | Radiation Protection of the Public and the Environment. |

C. Energy Research and Development Administration (ERDA):

| | |
|---|---|
| 1. ERDA 76-21-79 | Nuclear Air Cleaning Handbook. |

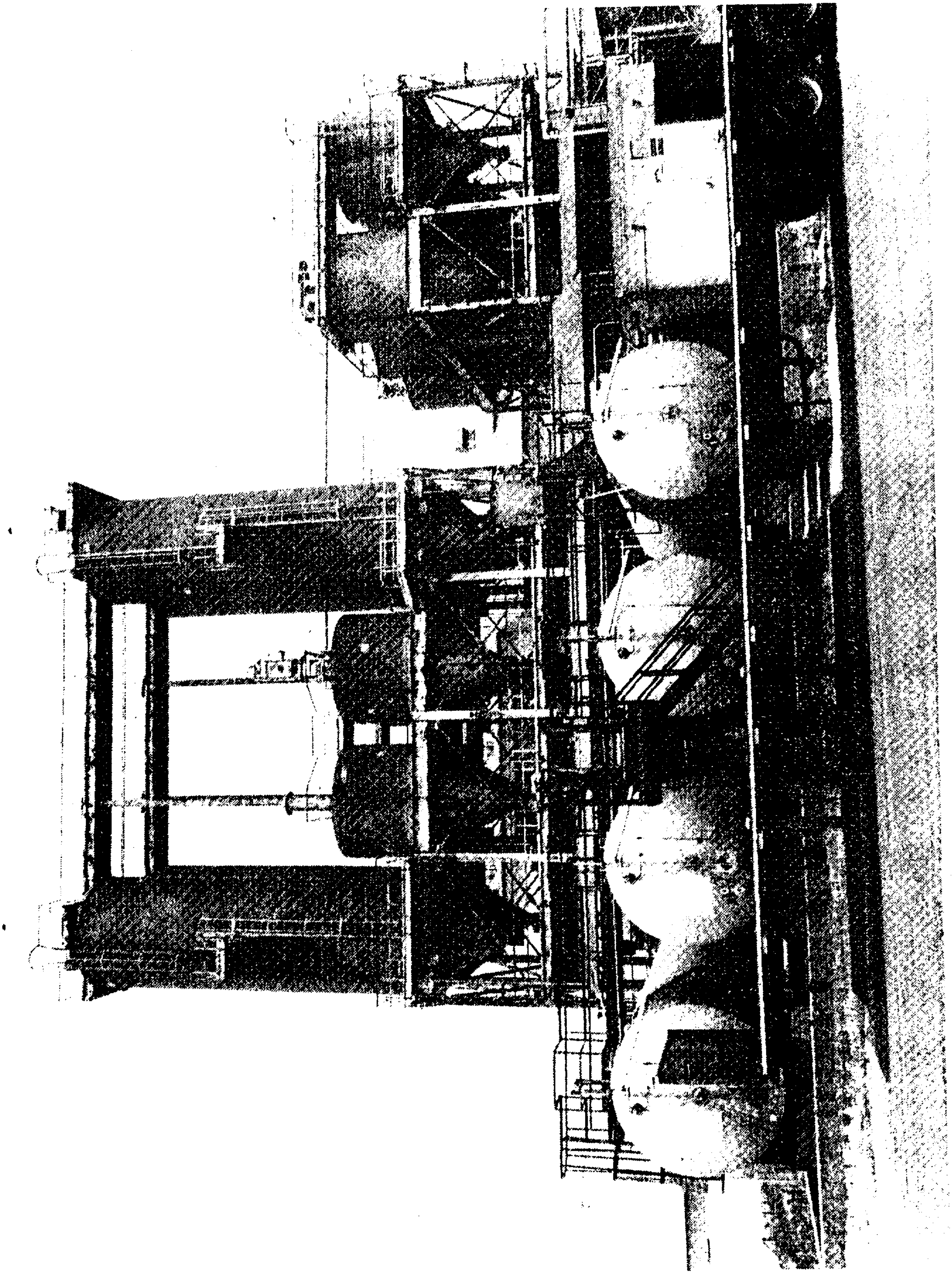

Figure 1 - Overview of Plant 1 Silos Looking North

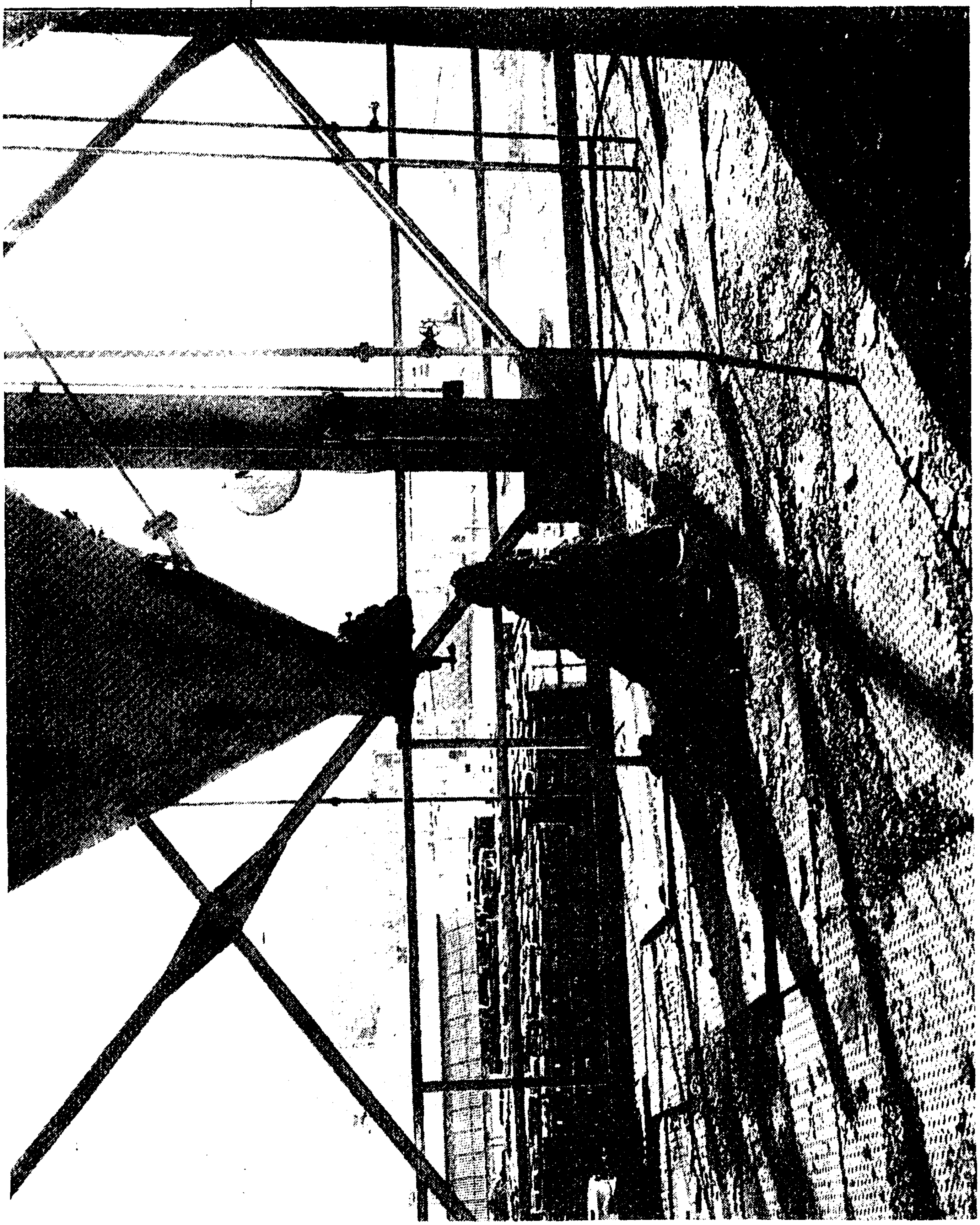

Figure 2 - View Under One of the Tile Silos Showing Accumulated Debris on the Steel Deck

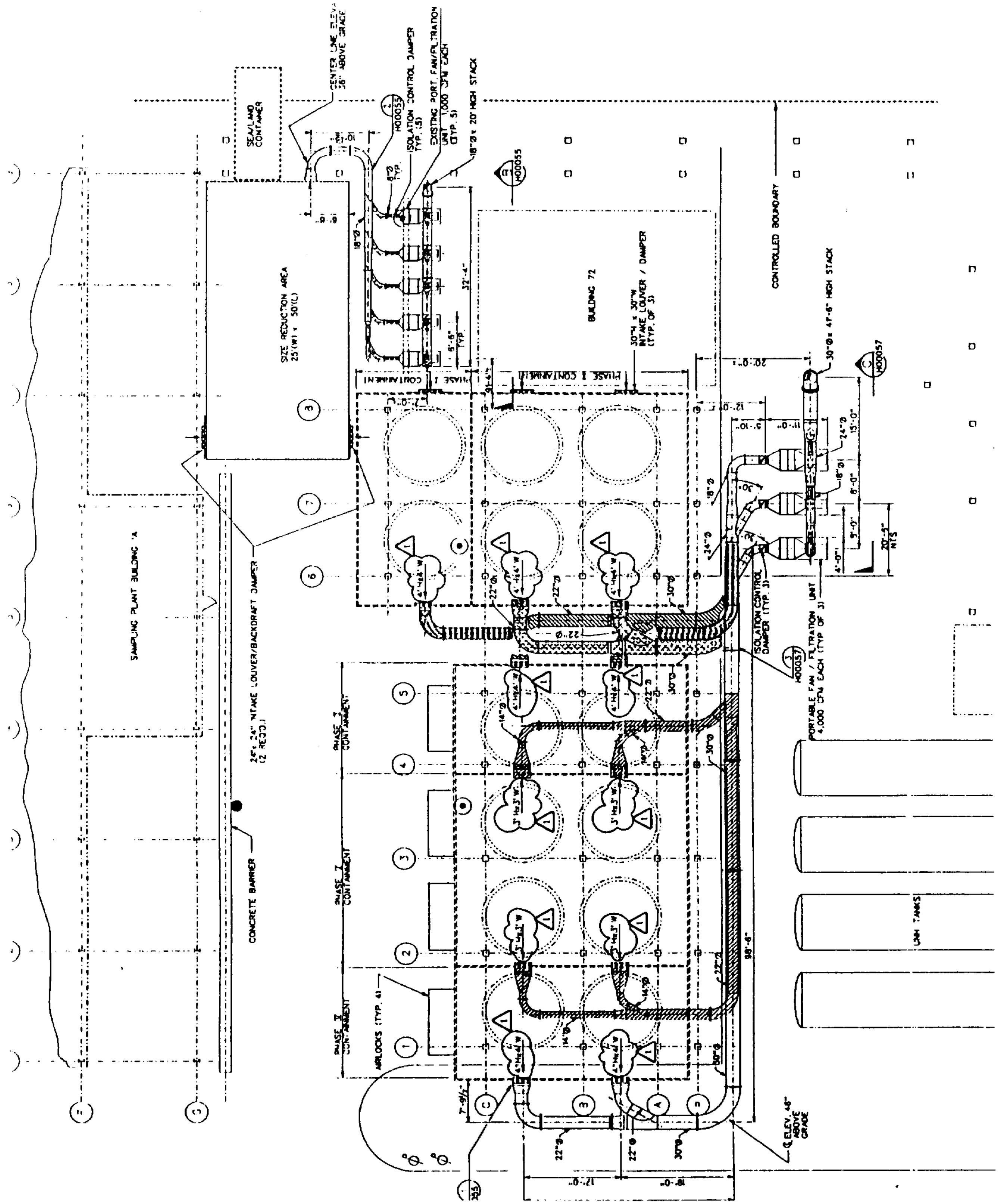


Figure 3 - Plan View of Ventilation Phases

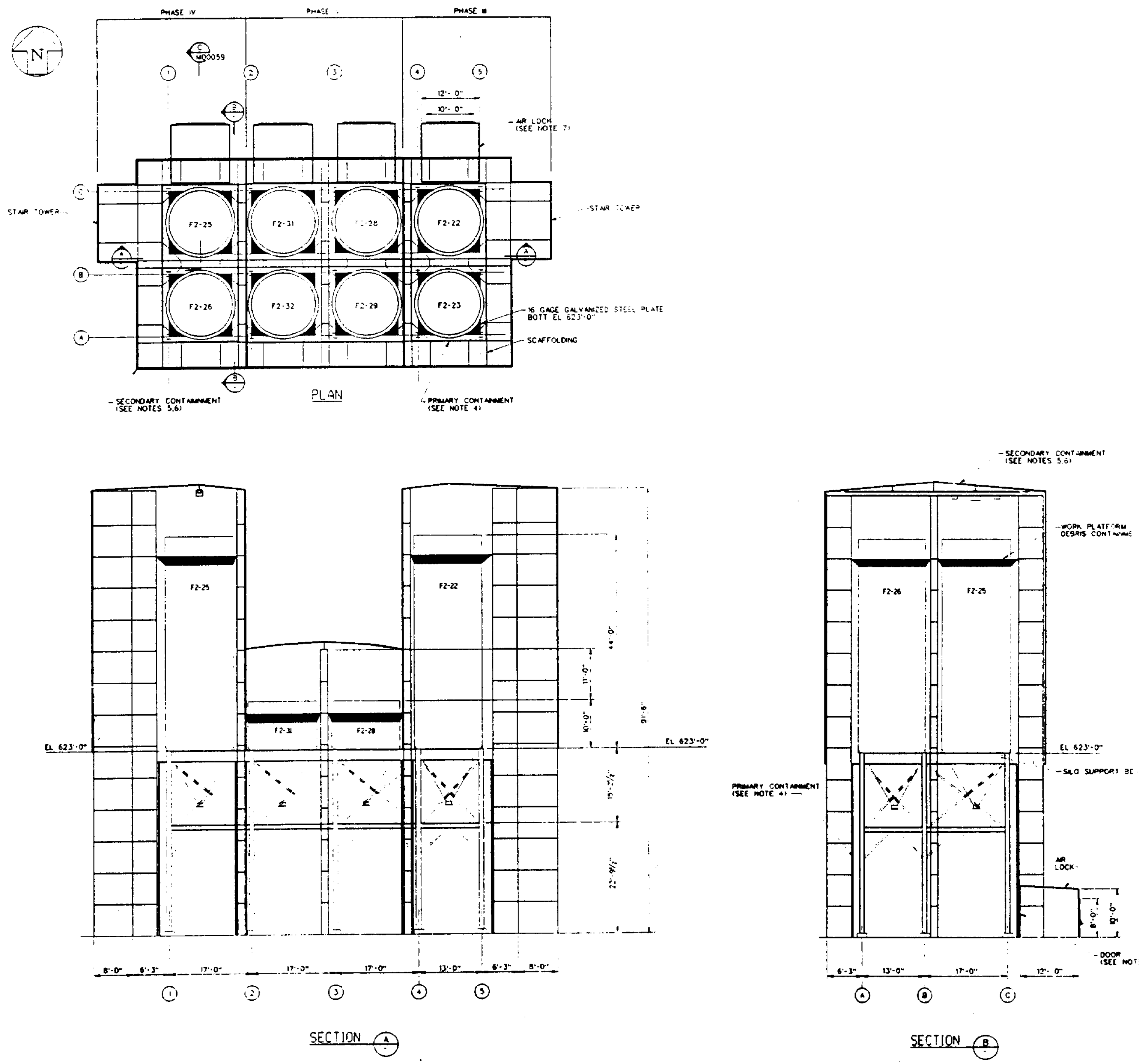

Figure 4 - Tile Silos Scaffolding and Containment

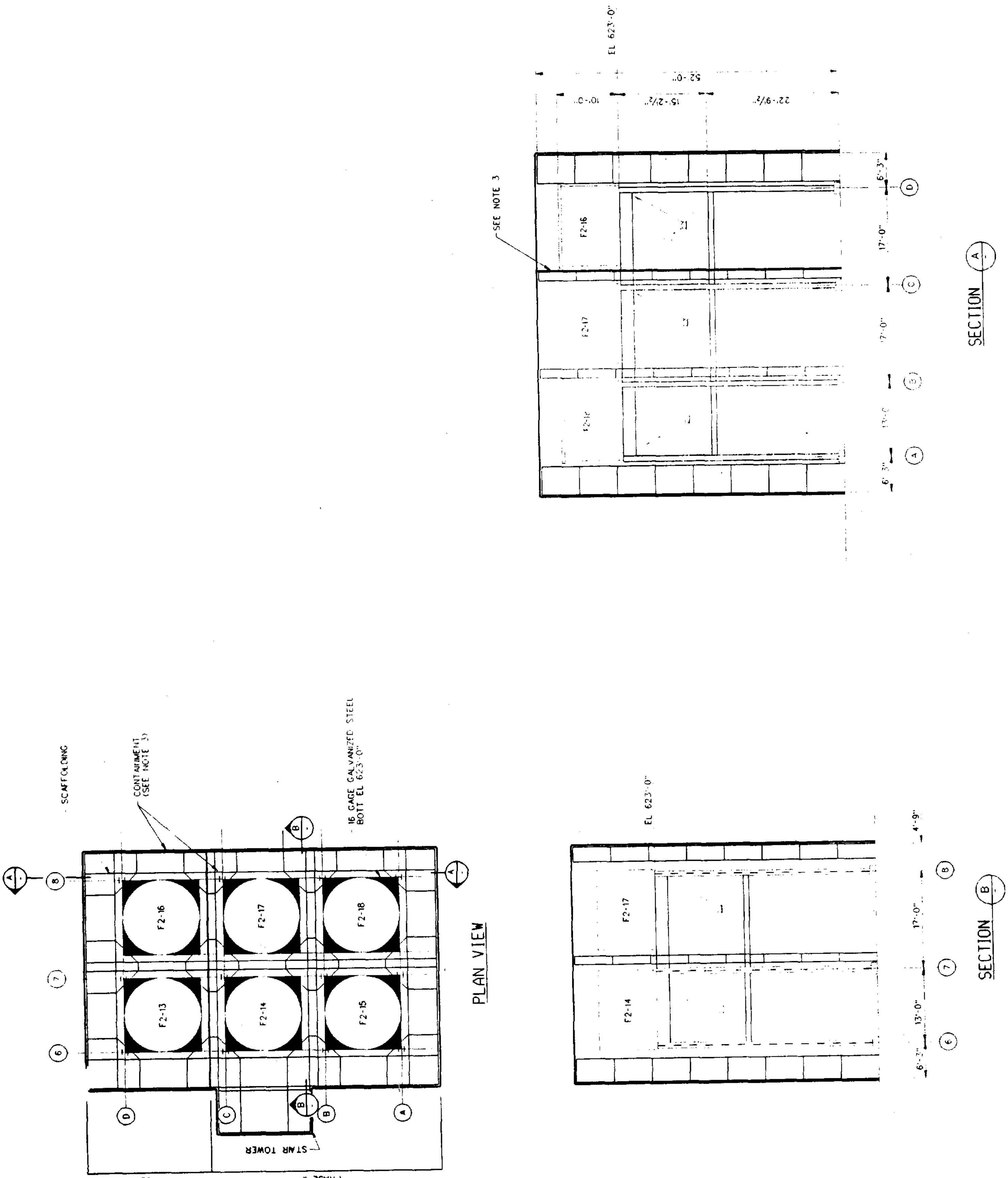


Figure 5 - Concrete Silos Scaffolding and Containment

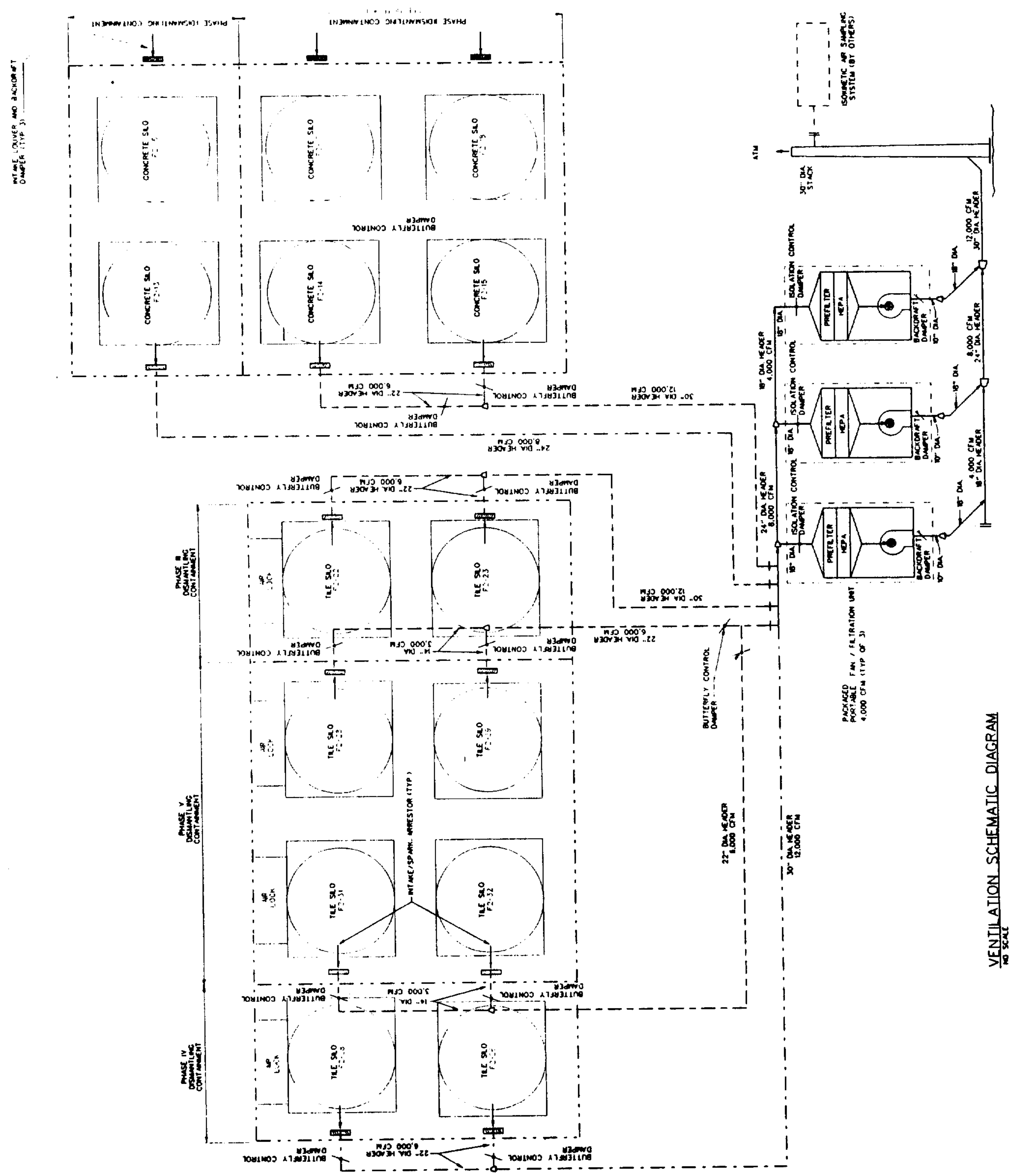


Figure 6 - Ventilation Schematic Diagram for Silos

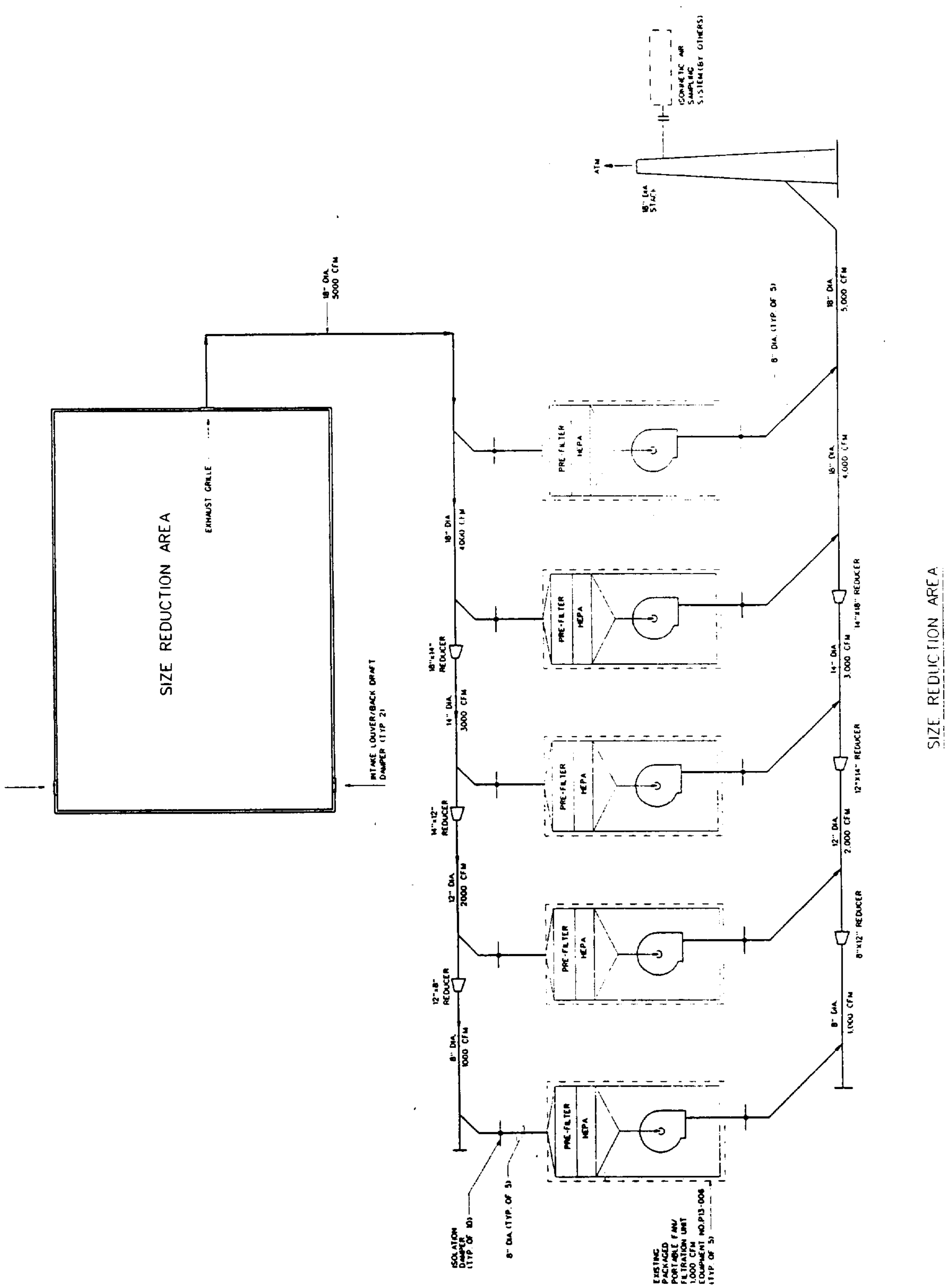


Figure 7 - Ventilation Schematic Diagram for SRB

## PANEL DISCUSSION

**WRIGHT**: I have two comments of a slightly different nature, but related. From my safety and health perspective, I saw that you have a high risk operation, but it is gravity that seems to be your primary risk. You can fall or something can fall on you. Gravitational energy seems to be your predominant risk. The DOE Office of Safety and Health has responsibility for safety and health activities, not programmatic activities, involved in EM operations. We have twelve people to attend to all of these things, so our domain is a lot bigger than the personnel would indicate. Needless to say, I have been directed to look at D&D, to look at HEPA filters, to look at certain SAR issues, etc. We have another working group dealing with hazard categorization. They look at remediation sites, D&D sites, deactivation sites, and look at source terms so that we do not overclassify facilities. You may, with minimal contamination, get the tag "nuclear," and then you do have to worry about nuclear grade equipment and everything, but it may not be appropriate. That is the kind of issue we are trying to deal with. We have to find ways to assure good protection for the worker and the environment without gold plating safety, because nobody wins on that. I would like to say that if you feel we are not protecting the environment, the worker, or the public, let us know. If we are doing things that seem ridiculous and expensive, for which you get no gain, let us know that also, because we cannot solve problems we do not know about. So I would like to give everybody my name and phone number. If something is coming up with which headquarters can be of assistance, please let me know. I am Tom Wright, Department of Energy, EM 23/Quince Orchard, Washington, DC 20585, and my phone number is (301) 427-1629. Forget hierarchy, forget protocol, this is a case where it is easier to get forgiveness than permission. Call and get the communications started and we will look at it and if there is something we can do we will address the issue. We want to work together on this and we will coordinate with your program office for your individual operations.

**WILLIAMS**: I appreciate your comments. Perhaps we can put together a "lessons learned" brief summary for this program so we can start working together.

**HAYES**: It seems from the presentation this morning that you all have been very proactive in terms of getting the public informed about what is going on, the potential impact, etc. With respect to the sharing of risk, you indicated that you have to have DOE and EPA buy off on the particular approach you are taking. Where does the public fit in with respect to this sharing of risk? Have you included them prior to going to DOE, after going to DOE, or after going to EPA? Where do they fit in this decision making process?

**EDWARDS**: All interactions are approved through the Fermco management. We are now using what are known as DEC teams, design engineering and construction teams, where construction is involved very early. We even have DOE representatives on the DEC teams. By the time a plan is written, DOE is already familiar with it and we have a buy in. Then, we generally have a public comment period. Our DOE folks have been a lot more active with the EPA. They regularly scheduled meetings, and I think they do a lot of informal discussion of what will be in the written plan. A lot of things are happening at the same time, but you want to have your plan pretty much in its final form before you have the public comment on it. The last thing you want to do is have them comment on it and make a lot of changes. But you do have to allow time to incorporate their comments.

**HAYES**: And this meeting, Doris, is something that normally is put in the newspaper?

**EDWARDS**: Yes it is put in the newspaper and the documents are available for review in public information centers.

**MCCULLOUGH**: We also have a very organized public out at the Frenald. They have their own group called Fresh Organization, and then there is the Citizens Advisory Committee. The public does review all these documents in advance. There was a lot of talk with the public before a final decision was made on how building 7 was going to come down. I would say that the public is involved because they are fairly well organized. And DOE has given the public another avenue of bringing up their concerns about the site and getting responses; this is called the ENVOY program.

**WORTHINGTON**: I have a question regarding your operations. You had several slides that dealt with aerosol generation. Did you have any unique problems? For instance, did you have to spray down containments and did it pose any unique problems with respect to the HEPA filters? Were there other activities or lessons learned that you might want to share with us regarding such problems and the ways that you resolved them?

**PALMER**: The biggest problem with HEPA filters occurred in the size reduction building when we cleaned the surfaces by hosing down the inside of the building. Moisture was a problem that caused us to change prefilters. Big problems occur also during acetylene torch cutting operations. A HEPA filter is not a dust holding device. There were times during the project when we were cutting steel beams and we would have to shut down after just a few hours operation to change all our prefilters because they would be plugged up. So HEPA filters and prefilters were not always user friendly, even though they were protecting the public. I would say, on average, we got a two week life out of our prefilters for the size reduction building, and about four to six weeks for the silo containment structure. We have been fortunate, we have only had to replace the HEPA filters once on the size reduction building. Because we use a 90% ASHRAE filter on the 4000, we have not seen a significant rise in differential pressure across the HEPA filters.

**MISHIMA**: I think you have a wonderful opportunity because you are the first group of people doing a large scale project-by-project dismantlement or decommissioning, and you have made a fairly good characterization of what is present. Has any attempt been made to correlate what is on the ground with what gets into the air? It has a significant impact on the level of concern you would have during activity. If you could get some idea about the fraction of radioactivity and any amount of material made airborne, and in what form, when you are knocking down your tile or concrete silos, or torch cutting inside your buildings, it would be very useful.

**TSCHAENN**: We do continuous surveys of the work area and the perimeter of the work area and we have not observed contamination problems outside the containment areas. There is a lot of uranium-bearing surface activity from past operations. We have not seen any increase above baseline levels at the perimeter air monitoring stations. We have not characterized the particle size of the material but assume a particle size of 1 $\mu$m. We have not done any particle size studies and we have used the most limiting DAC for this project, a total inventory of 425 mci, 405 from thorium-230. The material is a by-product of the uranium extraction process in oxide form.

**MISHIMA**: I think you are looking at this from a health physics perspective, i.e., to protect the public and workers. What is important is to know what comes off while you are doing the job so you can determine what level of protection is necessary for future jobs. For instance, are respirators needed when there are very coarse particles that do not go anywhere? When you know ahead of time that there will be nothing to cause problems, or in Randy's case, to clog prefilters, it might be more advisable to use high loading capability dust collecting cyclones as opposed to prefilters, which are atmospheric dust air cleaning devices.

**SEEL**: I have two questions, the first of which I have had some informal discussions with Randy about, but I will now pose formally. Has FERMCO or DOE considered publishing guidelines for the use of portable ventilation equipment similar to those used by commercial utilities such as Regulatory Guide 1.140 or the new 10CFR20 guidelines for engineered controls? Second, what consideration is being given in these D&D activities to the reduction of waste by sorting of contaminated vs clean wastes, volume reduction activities, or incineration?

**PALMER**: We have developed internal procedures for operating portable devices and we are in the process of developing site-specific requirements for vacuum cleaners, HEPA filters, and things of that nature that we are buying. Getting the information to all the different sites represents a problem, but it is nothing we could not overcome. We have developed a few guidelines for people to use based on this project. They are probably going to be like specifications. The other thing that I am glad to see is that DOE is starting to talk about portable devices. That is where we are looking for guidance. The April 1994 revision to the RAD manual is also very helpful in giving us guidance on what is expected of us in the way of testing and HEPA filter selection when using portable equipment. These are the best answers I have got for your questions.

**MCCULLOUGH**: Regarding the second part of your question, you may remember the slide of the whole plant where everything on the process side is usually considered to be contaminated. We have been working hard on this, because in our hearts we think there is stuff there that is not contaminated, and if we can prove it, it does not have to go to Nevada, it can go to a local landfill. This is a hard nut to crack.

**TSCHAENN**: We have a very active waste minimization program and we are currently segregating contaminated from non-contaminated materials. It usually involves office trash and other materials which have a low potential for volume or indepth contamination. We have tried to prove that there is no radioactive material added to other materials that are targeted for treatment, storage, or disposal as well. We have implemented a very rigid free-release criteria for materials leaving our site. A technician has to fill out several forms and get approvals from radiological control management to release an item. In addition, when there is a potential for hazardous constituents to be involved, other criteria for release are kicked in for treatment, storage, and disposal options. There are a lot of special circumstances that impact our ability to segregate items for free-release. Does that answer your question?

**SEEL**: Yes it does. I was pointing out that Fermco is the first remediation project of this nature in the DOE. Has there been emphasis at other DOE sites that they will very shortly be experiencing the same situation that Fernco is in now, and that they need to utilize the lessons learned, from you and from the commercial sector, to fully implement the same kinds of waste minimization? I am fairly certain they are not currently the top concern at DOE sites.

**MCCULLOUGH:** We had been involved with some user groups from the DOE community and I believe they interface with the commercial world as well.

**WILLIAMS:** I would like to add to that. Last October Fernco sponsored a waste recycling workshop at the Greater Cincinnati Airport where the waste minimization program was described by Jerry Motl, the manager of the recycling program at the site. Available DOE guidance states that there are no real free release criteria. What we mean by free release is being able to sell our scrap metal to any scrap metal recycling facility. We had a scrap metal pile on the site that we had to get rid of. Through a category exclusion, we sent it to SEG at Oak Ridge, where they smelted it and made it into waste containers. Now, we are reusing the same metal from our site as waste containers. There was some question whether all the metal that was smelted was contaminated and that's still being looked into. Nevertheless, the waste metal we sent out was recycled and shipped back to us. Unlike the NRC Regulatory Guide 1.86, there is no established free-release criteria for DOE sites.

**TSCHAENN:** I can add that we use R. G. 1.86 for our free release contamination limits although we take exception to the 100 d/min average. We use a 300 d/min maximum total activity for transuranics, thorium-230, and radium-226. The DOE criterion for free release currently has these limits reserved. We use the most limiting regulatory driver with the exception of the 100 d/min value. Our free release is also very restrictive for common materials brought on site. We go through very rigid free release criteria to get basic materials, such as heavy equipment, off the site.

**MCCULLOUGH:** Perhaps we should communicate what we have learned, so far, to other DOE sites, but keep in mind that we are only about half way through the project. We hope to learn more before we are done.

**DAVIS:** As the first into this activity, what you are doing is very interesting. I have a question on your HVAC system. You are apparently going to use it for each one of your projects as it is very portable, from what I could view in the slides. What did it cost to put the system together and what are the future plans for using the system?

**WILLIAMS:** The costs of the 3000 and 4000 CFM air cleaning units plus the 5000 CFM units came to a total of $81,700. The cost of the associated duct work and installation is still being estimated because the project is only 60% complete. We are still in the process of estimating how many labor hours are involved in tear-down, and setting back up again. The duct work material, in 1991 dollars, was $2.50/lb for stainless steel.

**PALMER:** I do not know if that equipment has been designated for any other projects yet, but I think it has not, because this project is not over yet, it should be completed in September. Later this year we will know what other projects can used it. It is also likely that these eight systems could be segregated and used on several projects, not just one. We do plan to use every one of them again. They are nice equipment, and we are happy with them.

**WILLIAMS**: The equipment was designed for the most contaminated areas on the site and it is very expensive compared to some of the other operations we had. Building 7 on the slide we showed was the tallest structure on the site. It is in the process of going through the D&D process. We are removing the transite panels. Then we are going to pull down the structural steel. We do not have radiological concerns in that building, our major concern was asbestos abatement. So we utilized cheaper asbestos abatement units that did not require a leak rating of 0.1% of volume capacity as specified in the Nuclear Air Cleaning Handbook. The units were not all-welded construction, they used pop-rivetted housings. The equipment that you saw will be utilized again. Determining where, is something that we work out with Kevin Tschaenn's group when they go in and do their initial characterizations of the buildings that we have to D&D. I hope it is not the same at other sites, but when this plant was shut down in 1989, they just went in and threw the switch. There is process material still in the piping and in some of the reactor furnaces. They did not finish processing all the material, they simply stopped operations as they were flowing, so, in some cases, we are not sure what we are dealing with. That is why we have to go through a very slow step-by-step analysis to ensure that we protect the environment and personnel doing the D&D operations.

**ISZKIEWICZ**: I have two brief questions, what type of air makeup system did you use for your various containment areas and did you use any internal air cleaning devices in areas of high dust or fume generation as a protection for your prefilters on the main system?

**EDWARDS**: For phases one and two, we used gravimetric dampers for the makeup air. For phases three, four and five, and the tile silo, the original design used containment sheeting on the outside and interior of the scaffold for the upper levels, giving us makeup air around the entire perimeter. Phases one and two were so successful that we changed three, four and five, and are bringing the sheeting all the way to the ground. We believe that will give us better containment of debris when the brittle tile falls. And we will go back to using gravimetric dampers at worker elevation, so the workers will get the benefit of the makeup air. As for your second question, we are changing the method used to demolish the tile silo. At one point, it was a very complicated process, but we decided to take advantage of gravity and just throw it all down the middle using some chutes. We are going to put some additional point source HEPA air filtration devices right at the base of the chutes.

**PATEL**: Most of my experience is on nuclear power, not on DOE types of operation, I only have a little bit on that. I have three questions. Two are simple and one may be complicated. First, do you have iodine filtration like power plants do? I have seen prefilters and HEPA filters but no charcoal adsorber.

**PALMER**: No, we do not have any charcoal beds in any of these devices.

**PATEL**: You mentioned that you are only 50 % finished on your project schedule right now but you have a facility for breaking up the equipment, I think I got lost on that. My second question is, where do you send the scrap after you process all the small pieces of concrete or metal? Where do you send it for waste storage? What waste storage facility do you use?

**EDWARDS**: The way the plan is written right now, we are using a separate size reduction facility, so we do not impede the workers in containment. The concrete and tile will go in white metal boxes designated to be shipped to DOE's Nevada Test Site. The structural steel is being cut into lengths of about nineteen feet to fit the size of the trailers we have and it will go to another D&D facility where it will be cleaned to make it eligible for free release. Right now, they are struggling with free release issues. The steel will be set aside until the issues are resolved.

**PATEL**: Will it be underground or above ground storage?

**EDWARDS**: It will be pad storage above ground.

**PATEL**: How long will it be stored on the site?

**EDWARDS**: It is not known. A change that I think will take us a step farther is to leave all the foundations in. The original removal order was to take the foundation out with the steel, i.e., complete demolition of the whole area. CRU-3 has gotten an Interim Record of Decision (IROD) approved. We are deferring decisions on foundations until it is determined whether materials such as concrete, which may not have a lot of activity, but some surface contamination, will stay on the site. It is not known right now but it is a big issue.

**PATEL**: The third question that I have is, you mentioned certain codes and standards you follow and they include DOE 6310.

**EDWARDS**: DOE 6430.1A contains the general design criteria.

**PATEL**: You are also supposed to meet EPA regulations, plus N-509 and N-510. I believe you said you have some questions about whether you should use nuclear grade materials. Basically, R. G. 1.52 and 1.140 were used at nuclear power plants before we went to N-509 and N-510. If the AG-1 code is approved by NRC, it will replace N-509 and N-510. My question is, do you have exemptions from DOE that you do not have to comply with N-509 and N-510? What are the exemptions you have on N-509 and N-510 compliance?

**WILLIAMS**: We have no exemptions for meeting the requirements of N-509 in the design criteria or of N-510 in the testing, because we have met them. We do not want to have to comply with them but we need documentation to justify deviating from the standards. The standards required spending some $80,000 for air cleaning devices that may not have been needed. For the full site cleanup we are looking at $20 billion over the next 15-20 years. That is how long they think remediation will take. Therefore, we want to reduce expenses as much as possible. These requirements in the standards you cited are for NRC regulated nuclear power plants, but they do not really apply to non-reactor nuclear facilities. Because there is no other guidance available, and we have to be legally responsible for our designs, these standards are the only thing we can use.

**PATEL**: So, you meet material requirements, you meet testing requirements, you meet design requirements, but you do not qualify the equipment and you do not require seismic qualification. Are these the exceptions you take?

**EDWARDS**: We took an exception in building where we were doing asbestos abatement. We looked for guidance on how to build the containment and what equipment to use in the asbestos standard, because that was the type of work we were doing. The first activity, what we call safe shutdown, will be to get the residual production material out, and that will call for one kind of equipment. After all the radioactive materials have been removed, we will get to a new stage, which will be more like a normal construction phase, where there will be hazards. When you are dealing with asbestos, for example, you should look at different standards for the guidance.

**PATEL**: So, you totally do not meet N-509 and N-510, but you are meeting the intent of N-509 and N-510?

**WILLIAMS**: We totally meet the applicable regulations.

**EDWARDS**: This project met all regulation; we took an exception on another project based on the type of work we were doing.

**PATEL**: I still get lost, when you meet the regulatory requirements of N-509 and N-510 literally, you meet the nuclear standard.

**WILLIAMS**: Exactly right. But we do not want to have to, we do not want to be required to meet standards that may not be necessary in D&D work. And that is where we are at at this stage.

**PATEL**: Do you send your HEPA filters to a DOE filter test facility before you use them?

**PALMER**: Yes.

**PATEL**: Do you use commercial equipment which is cheaper than nuclear grade?

**PALMER**: Yes, even in the commercial equipment used for the asbestos abatement projects in plant 7, we used nuclear grade HEPA filters, and UL approved prefilters. That is part of the problem. We made those devices operate at 1,000 CFM instead of 2,000 CFM because we couldn't find a supplier that would certify a 2,000 CFM nuclear grade HEPA filter. That is why I brought up the last issue, although it was associated with a different project. The devices used for asbestos abatement have two speeds, we operated them at the lower speed.

**WILLIAMS**: I would like to add that all the duct work was sized to maintain a transport velocity of 2,500 fpm and qualified for use in a reactor. For the low levels of radioactivity that we are dealing with in the D&D operational mode, we do not want to have unnecessary expense.

**WILLIAMS**: To summarize, we would like to reflect on whether we are going overboard on what we are doing. As I remarked, we may have gone too far, and it might be in everybody's best interest to consider the use of more appropriate criteria.

**DUVALL**: The D&D process that you described with the associated ventilation systems and monitoring controls seem to be designed to address removal of particulate material such as uranium and thorium. I suspect that radon is emitted, also, and I wonder if it is a matter of concern?

**TSCHAENN**: At this particular project we had some radon activity, but it was at levels that were not above NESHAPS standards. Our largest radon generators are at silos one and two. I believe them to be the largest radon generators in the world.

**DUVALL:** Subpart H of NESHAPS addresses sources of radionuclides other than radon. However, subpart Q does address radon emissions but the standards associated with subpart Q particularly address piles, where there is a flux standard. It would not be an appropriate standard for this type of operation. If you are considering compliance under subpart Q for this particular project, how would you demonstrate it?

**TSCHAENN:** I really cannot answer your question, but it was considered by our compliance group. We do not have a representative here, but your question can be directed to Kip Klee, at our plant.

**DUVALL:** Would it be a major concern for activities where there is uranium?

**TSCHAENN:** We have thoron and radon concerns at our site and they have been characterized. The measurements collected at the Ore Silos indicate that we have been in compliance with subparts H & Q.

Radon fluxes have been modeled to be below the 20 pCi/m$^2$ flux limit in the NESHAPS standard. Thoron is not a regulatory issue to my knowledge, but is an occupational concern.

**FARRIS:** What have been the heat stress related time limits for workers wearing protective gear, during various seasons of the year?

**WILLIAMS:** The heat stress related time limit for workers wearing full personal protective equipment is approximately 3 hours, but this varies for different workers.

**EDWARDS:** Last month we found we were getting heat stress effects starting about 11:00 a.m. Early in the summer we implemented an earlier start for the shift whereby they would be taking their first lunch break at about then, and we had continuing activities after lunch. We have rescheduled so that we are doing more safety meetings and training in the afternoon. When heat is worst, we use 15 min in the work area, 45 min out. Individuals are monitored by pulse rate. We bought an air conditioner for the cool down area, we have got an area zoned for water. Getting an air conditioner ended up being more of a challenge than we thought it would be because of the World Cup. No one had the size we needed. Starting Monday, we will go to a second shift for the demolition of the tile so we can work during the cooler hours. Where lighting and access may be more of a hazard consideration, we will use a limited day shift to support the second shift.

**FARRIS:** Have you considered using a blow-back type stainless steel filter to protect the HEPA filters from heavy loadings and to concentrate the contaminants? They are used in the chemical process industry in similar situations.

**WILLIAMS:** No, we have not considered stainless steel filters for protection of HEPA filters used. We have used two prefilters with spark arresters upstream of the HEPA filters to prevent premature dust loading of the HEPA filters. This method has been proven successful for this application.

**LILLYMAN**: Are the materials you are dealing with in the silo natural uranium mill tailings? Presumably, this is material from the processing of uranium through solvent extraction. So what you have is mainly thorium and uranium.

**TSCHAENN**: Exactly. We have seen some radium in this material, but mainly it was thorium-230 that was concentrated in this by-product material. And it is termed K-11 metal oxides, the historical name given to it. It is a by-product of the extraction process.

**LILLYMAN**: Please define the DAC. What is it related to?

**WILLIAMS**: Derived Airborne Concentration (DAC) is the amount of airborne radiating particulates that could be considered an inhalation hazard. DAC federal limits are set forth to limit radiation exposures through inhalation by workers. (See 10CFR, part 835.) As stated in my paper, the air within the containment was well below 4 DAC-hours (DOE limit) per person per week.

**LILLYMAN**: What units is the DAC in?

**TSCHAENN**: It's in microcuries per cc.

**LILLYMAN**: You do not use bequels?

**TSCHAENN**: We are supposed to, we are slowly implementing it.

**LILLYMAN**: You were citing averages of 0.5 of a DAC. By the ICRP definition, half a DAC is a very high dose rate. We normally work to less than 5% of a DAC, and preferably 1%, the standard working limits in UK facilities, especially plutonium facilities. What is your definition?

**TSCHAENN**: In answer to your question, we do have a bioassay program which complements our air monitoring program for occupational exposure. The DAC is referenced in DOE 548011, it is the DAC for thorium-230 class W material. It is the most restrictive DAC that we could apply. Material makeup shows 95% of the activity due to thorium-230. We assumed 1 $\mu$m AMAD, we were very conservative. Our bioassay program consists of routine fecal sampling.

**LILLYMAN**: What is your DAC in alpha activity/m$^3$, of air that you are breathing? I am trying to relate what your material is with, say, plutonium.

**TSCHAENN**: It is an alpha emitter.

**LILLYMAN**: I am trying to relate it to plutonium. The next question is, what sort of surface contamination levels are you getting in your tent and in your facility? Because that is a good guide to what material is being disbursed from your operation.

**TSCHAENN**: Inside the containments themselves, we have seen a maximum of several thousand D/M of loose contamination. The area was posted as a high contamination area.

**LILLYMAN**: What were the surface contamination levels on the tent and surfaces?

**WILLIAMS**: Surface contamination levels did not exceed 20 dpm/100 $cm^2$ (alpha), during the ventilation system operation.

**LILLYMAN**: How active are the inside surfaces of your tent going to be when you are finished?

**EDWARDS**: It will be above releasable limits. We take steps to control generation at the source of the contamination and we enforce housekeeping to maintain the area free of contamination as best we can during the D&D. It is a very difficult task, you are working in a containment and yet you are not. Engineering controls on this particular D&D activity are very difficult to employ. We would have liked to have put the 165-ton crane inside the containment, but could not. Those are some of the things we have had to deal with.

**ANON**: Have you taken wipe samples of the inside of the tent?

**EDWARDS**: We rented the scaffolding that is in the containment. The scaffolding we took down at phases one and two is being surveyed right now. It will all go to the D&D disposal facility, but it is believed that most of it will be cleanable. The spray from the washdown is limited to areas where the work was being performed. We were not getting that much spray. The water ran down the side of the cylinder and into the cone, in the center of the structure.

We use water for decontamination and HEPA filter portable vacuums. We enforce good housekeeping and good radiological work practice.

**LILLYMAN**: Your big danger is in removing activity from inside the vessels under your tent and structure. It does not get you very far in real terms.

**EDWARDS**: In construction projects, we usually end up buying some part of the vendors material when we rent it, but it is very small compared to the overall cost if we had bought all the scaffolding.

**LILLYMAN**: Has the use of ventilated suits been considered?

**WILLIAMS**: Ventilated suits are too cumbersome, and due to elevated platforms, a lack of space, and sharp angles on the scaffolding, they would have been impractical.

**LILLYMAN**: Concerning this matter of heat stress, as a person from a northern clime, I find even 80° rather stressful at times, and so do our footballers. When working in these conditions, we would normally be using airline suits. Have you considered airline suits? With airline suits, you have nice cold air coming in at a high rate and it is much more comfortable to work. If you ask the boys doing the job, they will prefer an airline suit anytime to just a respirator and a PVC suit.

**EDWARDS**: One of the slides showed concrete cutting where we had water and the workers were fully dressed. The workers building the scaffolding were in a suit, but not in a respirator. We had ice vests for them. You are talking about a vortex cooled suit that we use in other buildings. But it was so difficult building the scaffold with 100% tie-off, they are in two lanyards as it is. There are only certain parts of the scaffold they are allowed to step off. They have to have one lanyard hooked on, and they have to reach across, get the next one, and do this monkey tail business all across there. To complicate the whole thing by adding an airline would have made that job extremely difficult. That is why we chose the option of changing the entire work shift. In another building with asbestos work, we have used the vortex suits. They work great, no question about it.

**ANON**: We use cooling vests and vortex suits. And we also use powered air purifying respirators. The air in the mask gives some relief although it is not quite as nice as an airline hood.

**GLISSMEYER**: It seems like your DOE office does not give you a lot of guidance on requirements for your ventilation systems. Are you able to use local air cleaning devices in your metal and concrete cutting? Something similar to the wet device that has a demister and some kind of bag filter, or one of these elephant nose exhaust hoses with an electrostatic precipitator on it for your metal cutting? That might cut down your dust loading inside the containment.

**PALMER**: In the size reduction building, we would have had the room but we just did not think of it. We do use standard industrial vacuum cleaners with HEPA filters to clean up. We use Wet-Vacs to pick up liquids and we use a dry vacuum to pick up dry solids. I do not know if they had enough room with all the scaffolding in the containment to be able to do what you suggest. When we do metal cutting, we only have a problem with oxy-acetylene cutting. When we do concrete cutting, we wet it down. It does not seem to cause much of a problem to the HEPA filters, if you call a 4-6 week maximum prefilter life not much of a problem. We are pretty happy with over four hours prefilter life.

**MCCULLOUGH**: That is another valuable lesson learned for the future. We thank you very much for your attention. You have given us a lot of good ideas and we hope we have given you some.

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