Improvements At Allied Corpcration's Metropolis Works In the Handling Of Cylinders Containing Liquid UF_6

November 1985

Matthew D. Kosmider
Technical Supervisor - UF_6

The purpose of the following report is to describe in detail the investigations performed and the actions taken at Allied Corporation's Metropolis Works (MTW) to reduce the potential for and/or mitigate the effects of a massive UF_6 release which might result from the handling of hot UF_6 product cylinders. This report is organized into three main topics: Movement of Hot UF_6 Cylinders, Sampling of UF_6 Cylinders, and Miscellaneous.

To accomplish the risk reduction program detailed in this report, Allied Corporation's Metropolis Works has invested in excess of $155,000 plus hundreds of hours of laboratory analyst and plant engineering time.

I. Movement of Hot UF_6 Cylinders

Historically, Metropolis Works operating procedures have required five distinct moves, four of which require elevated lifting, for each UF_6 cylinder while the UF_6 is in a hot, liquid state. They were:

1. Cylinder moved to weigh buggy for gross weighing.
2. Cylinder moved from weigh buggy to sample position.
3. Cylinder moved from sample position to weight buggy for final weighing.
4. Cylinder moved from weigh buggy to mobile storage buggy.
5. Mobile storage buggy transported to designated cooling area at ground level (no lifting of cylinder).

Engineering and operating personnel investigated various methods to eliminate or reduce hot cylinder movement.

The investigation first centered on the total elimination of hot cylinder movement. To accomplish this, however, MTW would be required to modify the four existing fill locations plus add enough additional cylinder fill locations to provide for filling, gross weighing, sampling, and solidification in each position without sacrificing the capacity of the plant. To calculate the number of fill locations that would be required, we first determined the length of time required for a typical cylinder to solidify with normal air cooling. The vapor pressure of a 48Y cylinder versus time was measured and the results are shown in Attachment #1. Approximately 86 hours were required for the cylinder pressure to fall below atmospheric pressure (14.7 psia) and 142 hours were required for complete solidification. On the basis of 90 hours minimum solidification time, MTW would need to construct a minimum of 12 additional cylinder fill locations to eliminate hot cylinder movement.

The next step in the investigation was to determine whether we could accelerate the cooling of a UF_6 Cylinder through simple water contact. A full, 48Y UF_6 cylinder was cooled by spraying approximately 30 gallons/minute of 65°F cooling water on it through the entire cooling process. The vapor pressure of the cylinder versus time was measured and the

results are also shown in Attachment #1. In this case, approximately 46 hours were required for the cylinder pressure to fall below atmospheric pressure (14.7 psia) and 70 hours were required for complete solidification. Using 50 hours minimum solidification time with water cooling, MTW would need to construct at least 6 additional fill locations with water cooling and draining capabilities. Each of these options were considered unfeasible because the complexity of such a system would create additional potential for a large UF6 release.

We then began investigating the conversion of the four existing spots to combination fill/sample spots and the possible purchase of a crane scale for gross weighing hot product cylinders.

Actions Taken

1. A Measurement Systems International Model MSI-4260 crane scale was purchased and permanently mounted to the cylinder strongback in the distillation area. Since it's installation in August, each cylinder has been gross weighed by simply lifting it until it no longer touches any of the fill position support (a lift of approximately 4 inches). The cylinder's gross weight is read directly from the digital display on the crane scale.
2. The four existing fill positions were modified to enable cylinder filling and sampling at each position.

Work performed included modifying the structural steel of each location, rebuilding all load cells and adding digital weight displays and a weight recorder in the control room, and modifying the sample manifold to allow sampling from all four positions. All work was completed during the 1985 annual shutdown in October. During the second week of November, filling and sampling was accomplished from all four positions. This is now standard operating procedure.

The result of the above two actions has been the elimination of moves #1 and #2 of the four historical elevated lifts required in the weighing and sampling of a hot product cylinder. These modifications reduce the probability of a dropped cylinder accident by 50%.

II. Sampling of UF_6 Cylinders

Historically, after a UF_6 cylinder had been filled at MTW, it was gently heated and turned (homogenized) for 6 hours then liquid sampled with the cylinder valve in the 6 o'clock position.

1. "Cold Sampling" was attempted with the cylinder valve in the 9 o'clock position on one lot. It was found that a sufficient sample (1500 grams) could not be obtained before the UF_6 solidified and blocked sample flow within the cylinder. It was then decided to convert the cylinder positions to fill and sample positions; therefore, "cold sampling" would not eliminate

hot cylinder movement so testing was discontinued.

2. "Line Sampling" was performed on 70 product lots in addition to normal sampling. It was found that the "instantaneous" line sample analysis differed greatly from the homogeneous or "average" cylinder sample. As a result, testing was discontinued.

3. Normal sampling was attempted with the cylinder valve in the 9 o'clock position instead of the 6 o'clock position and the results were satisfactory.

Actions Taken

Since June of 1984, all UF_6 cylinders have been sampled with the valve in the 9 o'clock position to reduce the potential loss of liquid UF_6 in the event of a valve or sample line failure. This will continue to be standard operating procedure.

III. Miscellaneous

1. Verification of Product Cylinder Weight

Actions already taken, such as the installation of accurate load cells on each of the four fill positions and the use of a crane scale to verify load cell readings (gross weight) has significantly improved weight measurement to allow elimination of moves #1 and #2. In addition, an instrument has been ordered that will continuously monitor and totalize UF_6 product flow rate from the existing product takeoff flowmeter, and compare the totalized weight with the weight of the cylin-

der currently being filled (from the load cells). It is estimated that this instrument will be installed and operational by March 1986. This backup instrumentation will provide additional assurance that cylinder movements #1 and #2 may be safely eliminated.

2. Providing Protection to UF6 Distillation Crane Operator

It has long been realized that the distillation crane operator is most vulnerable in a massive UF_6 release. As a temporary measure, self-contained breathing apparatus has been provided in the crane cab since July of 1984. Since then, plant engineering personnel have attempted to design an escape platform for the crane operator; however, no design could be found that would guarantee the operators safe escape regardless of crane position. Instead, MTW has decided to convert the crane to remote control operation. A Control Chief Model MDR-8400 remote control unit has been purchased and was received at MTW the first week of November. It is estimated that installation and testing of the remote control unit will be completed by February 1986. The unit will allow the crane to be operated from ground level instead of in the crane cab. This system will significantly reduce the exposure risk to the crane operator by providing for a rapid ground level exit in the event of a massive UF_6 release.

3. Limiting Access To Distillation Area

"Authorized Personnel Only" signs have been posted at

all three distillation doors and operating and maintenance personnel have been instructed to limit traffic in this area. This will minimize the danger to other plant personnel in the event of a massive UF_6 release.

Attachment No. 1

Full UF6 Cylinder Pressure Profile

Initial Temperature = 200 deg F

With Water Cooling ——·——

Without Water Cooling – – – –