UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GEORGIA 30303-8931

June 2, 2006

Mr. David Edwards
Plant Manager
Honeywell Specialty Chemicals
P.O. Box 430
Metropolis, IL 62690

SUBJECT: SPECIAL INSPECTION TEAM REVIEW OF THE APRIL 4, 2006 PLANT EMERGENCY (INSPECTION REPORT NO. 40-03392/2006-003)

Dear Mr. Edwards:

This report refers to a special inspection by an NRC Special Inspection Team (SIT) on April 6-10, 2006, at the Honeywell Specialty Chemicals facility. The purpose of the AIT was to review the circumstances regarding the April 4, 2006 uranium hexafluoride (UF_6) leak in the Feed Materials Building (FMB) and the subsequent Plant Emergency. A copy of the SIT Charter is included as Enclosure 1. The inspection consisted of a selective examination of procedures and representative records, observations of activities in progress, and interviews with personnel. Subsequent to the conclusion of the inspection, the NRC inspectors discussed the findings with members of your staff during a public meeting on May 3, 2006.

The objectives of the Special Inspection were to: (1) review the facts surrounding the UF_6 leak in the FMB on April 4, 2006; (2) assess the licensee's safety planning and controls, particularly considering the corrective actions that were to be implemented by the licensee as a result of previous events and performance improvements; (3) assess the licensee's response and investigation into the event; (4) assess the safety significance of the event; (5) conduct an independent review of the licensee's extent of condition review; and, (6) identify any generic issues associated with the event.

It is not the responsibility of an SIT to determine compliance with NRC rules and regulations or to recommend enforcement actions. Compliance and enforcement aspects will be reviewed in a subsequent inspection.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

If you have any questions concerning this inspection, please contact Jay L. Henson at (404) 562-4731.

Sincerely,

/RA/ T. Decker acting for

Douglas M. Collins, Director
Division of Fuel Facility Inspection

Docket No. 40-03392
License No. SUB-526

Enclosures:
1. SIT Charter w/attachment
2. NRC Inspection Report No. 40-3392/2006-003

cc w/encls:
Gary Wright
Emergency Management Agency
Division of Nuclear Safety
1035 Outer Park Dr., 5th Floor
Springfield, IL 62704

Distribution w/encls:
L. Reyes, EDO
M. Virgilio, DEDMRS
J. Strosnider, NMSS
W. Travers, RII
S. Lee, RII Regional Coordinator
J. Henson, RII
J. Pelchat, RII
B. vonTill, NMSS
M. Raddatz, NMSS

X PUBLICLY AVAILABLE ☐ NON-PUBLICLY AVAILABLE ☐ SENSITIVE X NON-SENSITIVE

ADAMS: X Yes ACCESSION NUMBER:_____

OFFICE	RII:DFFI	RII:DFFI	RII:DFFI	RII:DFFI			
SIGNATURE	JP 6/2/06	JP for 6/2/06	JP for 6/2/06	JLH 6/2/06			
NAME	JPelchat	Jjimenez	MThomas	JHenson			
DATE	6/ /2006	6/ /2006	6/ /2006	6/ /2006	6/ /2006	6/ /2006	6/ /2006
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY DOCUMENT NAME: E:\Filenet\ML061560025.wpd

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REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GEORGIA 30303-8931

April 6, 2006

MEMORANDUM TO: Jay Henson, Leader
Honeywell Special Inspection Team

FROM: William D. Travers, Regional Administrator
/RA by Harold Christensen Acting For/

SUBJECT: SPECIAL INSPECTION TEAM CHARTER FOR HONEYWELL INTERNATIONAL - DOCKET NO. 40-3392 (INSPECTION REPORT NUMBER 40-3392/2006-003)

A Special Inspection Team has been established for Honeywell to inspect and assess the facts and circumstances surrounding the inadvertent leak of UF_6 into the Feed Materials Building on April 4, 2006. The event resulted in Honeywell declaring a Plant Emergency (below NRC emergency classifications) and a telephone report to NRC Region II. The Team composition is as follows:

Team Leader:	Jay Henson
Team Members:	Jose Jimenez
	John Pelchat
	Mary Thomas

The objectives of the inspection are to: (1) review the facts surrounding the UF_6 leak into the Feed Materials Building on April 4, 2006; (2) assess the licensee's safety planning and controls, particularly considering the corrective actions that were to be implemented by the licensee as a result of previous events and performance improvements; (3) assess the licensee's response and investigation into the event; (4) assess the safety significance of the event; (5) conduct an independent review of the licensee's extent of condition review; and (6) identify any generic issues associated with the event.

For the period during which you are leading this inspection and documenting the results, you will report directly to me. The guidance in Inspection Procedure (IP) 88003, the applicable provisions of IP 93812, Management Directive 8.3, and Manual Chapter 2600 applies to your inspection.

If you have any questions regarding the objectives of the enclosed Charter, contact Douglas M. Collins at (404) 562-4700.

Enclosure: SIT Charter

cc w/encl: (See page 2)

Enclosure 1

cc w/encl:
L. Reyes, EDO
M. Virgilio, DEDO
S. Lee, EDO
C. Miller, EDO
J. Strosnider, NMSS
R. Pierson, NMSS
D. Ayres, RII
G. Janosko, NMSS
D. Hartland, RII
M. Raddatz, NMSS

X☐ PUBLICLY AVAILABLE ☐ NON-PUBLICLY AVAILABLE ☐ SENSITIVE **X**☐ NON-SENSITIVE

ADAMS: X Yes ACCESSION NUMBER:_____

OFFICE	RII:DFFI	NMSS											
SIGNATURE	***/RA/***	by e-mail dmc											
NAME	DCollins	GJanosko											
DATE	04/06/2006	04/06/2006	6/ /2006		6/ /2006		6/ /2006		6/ /2006		6/ /2006		
E-MAIL COPY?	YES NO	YES NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	

OFFICIAL RECORD COPY DOCUMENT NAME: E:\Filenet\ML061560025.wpd

SPECIAL INSPECTION TEAM (SIT) CHARTER
UF_6 LEAK ON APRIL 4, 2006, AT HONEYWELL INTERNATIONAL

Basis for the Formation of the SIT - On April 4, 2006, there was a UF_6 leak, estimated to be 8 grams of UF_6, into the Honeywell Feed Material Building. The leak occurred while two operators were replacing a gauge on a line from a nitrogen purge gas supply to a distillation column. While removing the gauge, the operators observed a leak apparently from the gauge fittings. There was no indication of release of the UF_6 cloud outside the building. Honeywell declared a "plant emergency" which is a level below that required by the NRC and took actions to stop the leak.

Objectives of the SIT - The objectives of the inspection are to: (1) review the facts surrounding the UF_6 leak into the Feed Materials Building on April 4, 2006; (2) assess the licensee's safety planning and controls, particularly considering the corrective actions that were to be implemented by the licensee as a result of previous events and performance improvements; (3) assess the licensee's response and investigation into the event; (4) assess the safety significance of the event; (5) conduct an independent review of the licensee's extent of condition review; and (6) identify any generic issues associated with the event.

To accomplish these objectives, the following will be performed:

a. Develop a complete sequence of events related to the event.

b. Identify and evaluate the effectiveness of the immediate actions taken by the licensee in response to the event.

c. Evaluate the worker and public safety significance of the event.

d. Evaluate the licensee's process and process implementation for the planning, conduct, control, and oversight of the activities that led to the leak and for actions after the leak was detected, including processes that were revised as a result of previous events.

e. Evaluate the adequacy of and effectiveness of the licensee's safety controls for the work, including safety controls that were revised as a result of previous events.

f. Evaluate the level and effectiveness of the training of the maintenance staff and operators for the actions that led to the release, including training as a result of previous events.

g. Review and evaluate the licensee's root cause analysis for adequacy of scope, depth, and identification of causal factors.

h. Determine if there are any generic issues related to the event.

i. Identify additional actions planned by the licensee as a result of this event and the licensee's resultant extent of condition review, including the time lines for action completion.

Attachment

j. Document the inspection findings and conclusions in an inspection report within 30 days of the completion of the inspection.

U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.:	40-03392
License No.:	SUB-526
Report No.:	40-03392/2006-003
Licensee:	Honeywell International, Inc.
Facility:	Metropolis Works
Location:	U.S. Highway 45 Metropolis, IL 62960
Dates:	April 6-10, 2006
Inspectors:	Jay L. Henson, Chief Mary Lynne Thomas, Senior Resident Inspector, Paducah Gaseous Diffusion Plant John M. Pelchat, Senior Fuel Facility Inspector Jose Jimenez, Fuel Facility Inspector
Approved by:	Douglas M. Collins, Director Division of Fuel Facility Inspection

Enclosure 2

EXECUTIVE SUMMARY

Honeywell International, Inc.
NRC Inspection Report 40-3392/2006-003

The purpose of this Special Inspection was to inspect and assess the facts and circumstances surrounding the inadvertent leak of uranium hexafluoride (UF_6) in the Feed Materials Building (FMB) on April 4, 2006. The event resulted in Honeywell (licensee) declaring a Plant Emergency (below NRC emergency classifications) and notifying NRC Region II, by telephone.

The objectives of the Special Inspection (SIT) were to: (1) review the facts surrounding the UF_6 leak in the FMB on April 4, 2006; (2) assess the licensee's safety planning and controls, particularly considering the corrective actions that were to be implemented by the licensee as a result of previous events and performance improvements; (3) assess the licensee's response and investigation into the event; (4) assess the safety significance of the event; (5) conduct an independent review of the licensee's extent of condition review; and, (6) identify any generic issues associated with the event.

The Special Inspection established the following findings with regards to the subject event:

1. Event Description

On April 4, 2006, as distillation operators were removing a defective pressure gauge from a utility air line, the air pressure in the line expelled UF_6 that had inadvertently leaked into the line. The area near the utility air line rapidly filled with uranyl fluoride (UO_2F_2) and hydrofluoric acid (HF) vapor dense enough to totally obscure the vision of the distillation operators. The distillation supervisor ordered all personnel present to evacuate the area. However one operator, apparently not hearing the evacuation order, remained in the area to attempt to mitigate the leak. The other operator, upon discovering that her partner had not left the building, reentered, found the replacement gauge on the floor and installed the replacement gauge without further difficulty. Subsequent entries by properly-equipped mitigation teams verified that the gauge was in place and that the leak had been stopped. Licensee personnel appropriately classified the event and declared a plant emergency condition in accordance with licensee procedures.

2. Probable Contributing Causes

a. Equipment Failures

The two barriers designed to prevent the flow of liquid UF_6 from the process line into the utility air line failed. The primary barrier, a single Alloyco block valve, had some UO_2F_2 built up on its seating surfaces which allowed UF_6 to leak past the valve. While the precise mode of failure for the valve was not determined, the presence of UO_2F_2 on the seating surfaces of the valve suggested that the valve would have been unable to seal properly, allowing additional UF_6 to leak into the utility air line. The presence of UO_2F_2 in the inlet to the defective pressure gauge was another sign that UF_6 had previously entered the air line. The secondary barrier, which involved the establishment of greater than 80 psi of air pressure in the 18 inch section of the utility air line between the Alloyco block

valve and two quarter-turn valves, had decreased to a pressure that was below the routine pressure of UF_6 in the process line. This allowed the UF_6 that got past the Alloyco valve to enter the utility air line.

An electrically-powered heat trace was installed on the utility air line to prevent the cooling and resultant solidification of any UF_6 that should enter the line. However, the heat trace's electrical power supply had failed and the heat trace was not functional. The solid UF_6 that may have been in the line could have potentially created a blockage in the utility air line and in the air pressure gauge, causing the gauge to fail.

The inspectors noted that the licensee had not established a process to ensure the integrity of the Alloyco valve, the air pressure barrier or the heat trace.

The utility air line carried dry fluidizing air. While containing measurably less moisture than other sources of service air in the plant, the dry fluidizing air may have contained sufficient quantities of water to react with any UF_6 that may be present in the air line to form UO_2F_2. This material would also have had the potential to create a blockage in the utility air line and in the air pressure gauge, causing it to fail.

The air pressure gauge on the utility air line was the only way to qualitatively determine the pressure in the line. Malfunction of the gauge represented a single point of failure and there was no established alternate method to determine pressure in the utility air line in the event that the gauge failed. The performance of the gauge was initially degraded due to the presence of solid UO_2F_2 in the inlet to the gauge. It completely failed after an air hammer was used to vibrate the utility air line in an attempt to break-up any restrictions in the air line.

b. Human Factor and Procedural Issues

The presence of UF_6 in the utility air line and the erratic performance of the air pressure gauge required the conduct of an unscheduled and infrequently-performed task to address a complex problem. Although the licensee recognized the potential for UF_6 to be present in the line, neither licensee procedures nor skill of the craft provided a process for resolving the problem in a manner that provided the same margin of safety as provided for UF_6 line breaks.

Once the control room was notified of the leak, the licensee implemented its emergency response procedures as required and the emergency response staff conducted activities as required by these procedures. However, the decision by one distillation operator to remain in the area and try to mitigate the leak and the decision by the other operator to return to the area after she had safely exited demonstrated that the licensee had not established clear expectations for the staff when confronted with this type of event.

c. Radiological Issues

The maximum, calculated quantity of UF_6 that could have been contained in the 18 inch section of utility air line from which the UF_6 escaped was eight grams.

No UF_6 was observed escaping from the FMB nor was any UF_6 measured at the licensee's property line. The release of UF_6 had no impact on members of the public.

Bioassay samples were taken to assess the uptake of uranium experienced by individuals involved in the release or the subsequent mitigative actions. No individuals had bioassay results that exceeded the licensee's investigational limit, which is below regulatory requirements.

A distillation operator who remained in the area to try and mitigate the leak experienced minor reddening of the skin on the inside of his left wrist as an apparent result of HF exposure. The operator was examined by medical personnel and provided calcium gluconate to apply to the reddened skin. The reddening cleared in two days. There were no other apparent injuries as a result of this event.

d. Safeguards Issues

No issues related to safeguards or security were identified as a result of this inspection.

Attachment
Partial List of Persons Contacted
Inspection Procedures Used
Partial List of Documentation Reviewed
List of Acronyms

REPORT DETAILS

1. Event Description

The Honeywell Speciality Chemicals (licensee) uranium conversion facility (known as the Metropolis Works or MTW) is located on a 1100 acre site (60 acres within the fence line). The licensee is authorized to possess 150 million pounds of natural uranium ore and to convert this material to uranium hexafluoride (UF_6) . The uranium conversion process occurs in the Feeds Material Building (FMB). When released to the atmosphere, UF_6 reacts with moisture in the air and produces hydrofluoric acid (HF) vapor which is corrosive and toxic, and uranyl fluoride (UO_2F_2), a yellow solid.

A Special Inspection Team (SIT) was established to inspect and assess the facts and circumstances surrounding the inadvertent leak of UF_6 into the FMB on April 4, 2006. In response to the leak, the licensee declared a Plant Emergency (below NRC emergency classifications) and telephoned a report to NRC Region II. The objectives of the inspection were to: (1) review the facts surrounding the UF_6 leak into the FMB on April 4, 2006; (2) assess the licensee's safety planning and controls, particularly considering the corrective actions that were to be implemented by the licensee as a result of previous events and performance improvements; (3) assess the licensee's response and investigation into the event; (4) assess the safety significance of the event; (5) conduct an independent review of the licensee's extent of condition review; and (6) identify any generic issues associated with the event.

On April 4, 2006, licensee personnel were preparing to repair a valve on a bypass line that was part of the distillation system in the FMB. As part of that preparation, it was noted that a pressure indicating gauge mounted on an associated utility air line was apparently reading 80 pounds per square inch (psi) in that line. After attempting to purge the line it was concluded that the line was clogged and it was decided that the gauge was malfunctioning and would be replaced prior to proceeding with the valve repair. Staff and supervisors from the licensee's maintenance mechanics group and instrument and control group indicated that they would not proceed with the valve repair or gauge replacement until it could be demonstrated that the air line was not pressurized. Distillation operators were convinced that the line was not under pressure and undertook replacement of the gauge. Despite concluding that the air line was likely clogged with UF_6, the operators did not approach the evolution as a UF_6 line break and did not don the appropriate personal protective equipment (PPE). Despite observing white "smoke" indicative of the presence of UF_6, the operators continued to remove the gauge until the device was loose enough for the trapped air pressure to force it out of the air line and cause the UF_6 to be rapidly expelled from the line. The area near the utility air line rapidly filled with HF vapor that was sufficiently dense enough to totally obscure the vision of the distillation operators. The supervisor present ordered all personnel present to evacuate the area. However one operator, apparently not hearing the evacuation order, remained in the area to attempt to mitigate the leak. The other operator, upon discovering that her partner had not left the building then reentered, found the replacement gauge on the floor and the operators installed the replacement gauge without further difficulty. Subsequent entries by properly-equipped mitigation teams verified that the gauge was properly in place and that the leak had been stopped. Licensee personnel appropriately classified the event and declared the plant emergency condition in accordance with licensee procedures.

2. Sequence of Events

The event description was independently developed and validated by the inspectors using a review of control room logs and interviews with personnel directly involved with activities prior to and during the release.

On or about April 1, 2006, licensee operations and maintenance personnel determined that a Process Pipe 2 (PP2) bypass valve in the distillation system located in the FMB had a broken collar and required repair (see Figure 1). Licensee personnel began to prepare the required work package documenting the work to be done and the safety precautions to be followed during the planned work.

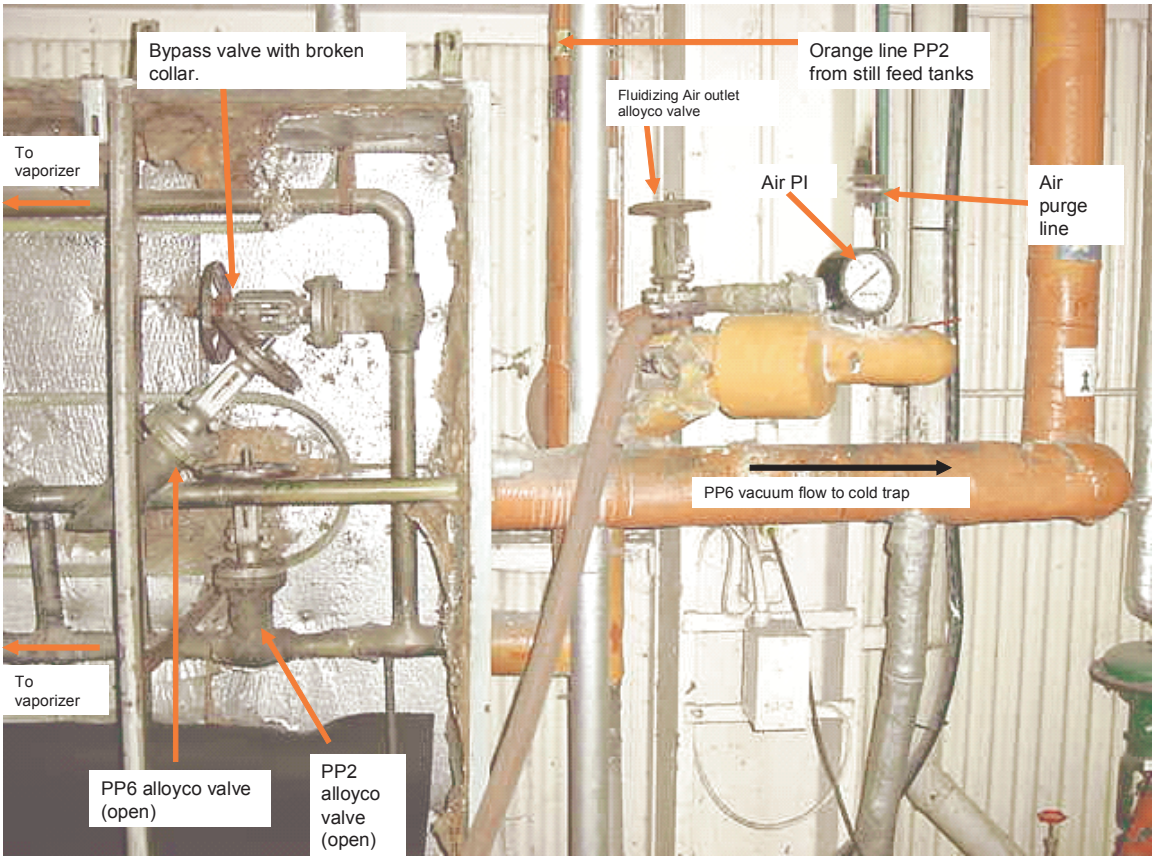

Figure 1: Air Line and Process Piping

On April 2, a distillation operator was dispatched to clear a blockage in the Number 1 Still Feed Tank. The operator went to the dry fluidizing utility air line located on the first floor. When the operator opened the valve downstream of the gauge, to allow dry fluidizing air into the PP2 UF_6 line to blow-out the blockage, he observed that the gauge (noted in Figure 1 as "Air PI") on the utility air line did not indicate the expected decrease in pressure. The operator concluded that the fluidizing air in the utility line was blocked. The operator then opened the Process Pipe 6 (PP6) vacuum line leading to a cold trap and opened all of the fluidizing air valves on the utility air line, and eventually

the blockage in the Number 1 Still Feed Tank was cleared. After clearing the line, the operator returned the still feed tank to operation. The operator stated that he thought, but was not certain, that he reported the line blockage to his supervisor.

At about 9:30 a.m., on April 4, three distillation operators began to prepare the PP2 lines for repair of the broken bypass valve. As part of these preparations, the Distillation Operations Supervisor (DOS) walked down the system and placed lockout locks and tags on the system.

At about 10:30 a.m., the DOS and the Mechanical Maintenance Supervisor (MMS) then walked the system down to verify that the system was properly configured for replacement of the broken bypass valve. The MMS noted that the gauge on the dry fluidizing utility air line indicated 80 pounds per square inch (psi) of air pressure in the line. This gauge was a compound gauge that measured pressure in psi and vacuum in inches of mercury (inches-Hg) with a single needle indicator. The MMS stated that he would not allow maintenance personnel to repair the bypass valve until it could be verified that the air pressure in the utility air line had been relieved.

At about 11:00 a.m., distillation operators cycled the valves upstream and downstream of the pressure gauge several times in an attempt to remove the apparent blockage in the utility air line. During each cycle, the distillation operators observed that the indicated pressure would increase to 90 psi as the outboard valves were opened and the line was pressurized with dry fluidizing air. When the Alloyco isolation valve downstream of the gauges was opened to vent the utility air line to the PP6 line, the operators observed that the indicated pressure dropped to 80 psi. The operators interpreted this to indicate that there was flow through the utility air line. The distillation operators concluded that the gauge was defective and contacted the Instrument Mechanic Supervisor (IMS) to arrange for replacement of the gauge.

At about 11:30 a.m., an instrument mechanic arrived and observed that the gauge on the utility air line indicated 80 - 90 psi of air pressure in the line and declined to replace the gauge while the system may be under pressure. The IMS was contacted and upon arrival at the utility air line, requested that the distillation operators cycle the valves as had been done before to clear the apparent blockage. Each time the valves were cycled, it was observed that the gauge still read 80 psi. The IMS concluded that the system remained under pressure, rendering it unsafe, and that he would not allow the instrument mechanic to replace the gauge.

At about 11:45 a.m., the MMS and the DOS discussed options to clear the apparent blockage. After additional cycling of the valves failed to clear the line, it was decided to “massage” the line with an air hammer. Massaging the line entailed impacting the line and the surrounding insulation to create shocks or vibrations to attempt to dislodge whatever was creating the line blockage. During this process, the indicated air pressure on the utility line was observed to drop to between 30 and 40 psi. As the air hammer was used closer to the gauge, the gauge needle was observed to move clockwise past the maximum value all the way around, and come to rest near zero. At this time, the distillation operations staff noted that the utility air line was cooler than expected and concluded that the heat trace on the line had failed.

Between about 12:10 and 12:20 p.m., the DOS and the distillation operators present conducted on-the-spot pre-job planning for removing the gauge. They decided to remove the gauge taking the following issues into consideration:

- the gauge was defective;
- the UF_6 blockage is believed to be in a small section of pipe about 18 inches long and with an inner diameter of about 0.8 inches, and thus inferred that only a small amount of UF_6 was available for release;
- the heat trace had failed and the line was at ambient temperature, and thus inferred that any UF_6 present would be frozen into a less-hazardous solid form (Note: UF_6 freezes at about 147E Fahrenheit); and
- the observed decrease from 90 psi to 80 psi on the gauge indicated flow and that a vacuum was established in the utility line.

The DOS and the distillation operators decided that one of the operators (OP1) would remove the gauge by rotating it a half turn at a time. After each half-turn rotation, the operators would observe the gauge and its fittings for the presence of any UF_6 vapor. It was decided that any short duration, visible quantity of vapor not exceeding the amount of smoke that would be observed from a burning cigarette would not be cause to stop work. The operator would continue to repeat this until the gauge was removed from the utility air line. The second operator (OP2) would hold a vacuum hose in the immediate vicinity of the gauge being removed to capture any UF_6 that might be released during the removal.

No specific PPE was stipulated for the gauge removal. OP1 elected to wear the upper half of the chemical suit that she had pre-positioned to wear when assisting the broken bypass valve along with chemical gloves, hood and a full face respirator. OP2 found a full face respirator in the vicinity and wore it along with a hard hat, leather gloves and coveralls.

At about 12:20 p.m., OP1, stood on a short ladder to facilitate access to the gauge, and began removing it as planned with OP2 assisting with the vacuum hose (see Figure 2). Both operators noticed wisps of “smoke” after each half turn and then further observing the vapor release stop, decided to continue removing the gauge. When nearly all of the six threads of the gauge’s fitting were disengaged, a third distillation operator (OP3) approached OP1 and OP2 with a new replacement gauge. OP3 was wearing a half-face respirator, safety glasses, coveralls, and a hard hat and before approaching the operators, had been standing about 10 feet away with the DOS. Licensee procedures allow the use of half face respirators for escape only and under circumstances when a UF_6 release is not expected. Licensee procedures require personnel involved in any activity that poses a possibility of a UF_6 release wear at a minimum, a full-face respirator.

Figure 2: OP1 and OP 2 removing gauge (from reenactment)

OP1 then continued to remove the gauge until it was thrown from her hands as air and UF_6 contained in the utility line were rapidly expelled by the pressure in the line. Although OP1 had no specific memory of doing so, her next memory was that of being on the floor on her hands and knees after she apparently fell from the ladder.

The area near the utility air line rapidly filled with HF vapor that was sufficiently dense enough to totally obscure the vision of the distillation operators. The DOS immediately ordered all present to evacuate the area and OP1 and OP3 exited the FMB. OP2, apparently did not hear the evacuation order, continued to hold the vacuum hose and felt along the utility air line with his free, gloved hand to locate the opening in the pipe from which the material was escaping.

Upon exiting the FMB, OP1 could not find OP2 and concluded that he had not exited the building and immediately reentered the FMB to find him. By this time the leak had subsided and the area had begun to clear. OP1 observed that OP2 was holding the vacuum line over the release point. OP1 then observed the replacement gauge on the floor, picked it up and moved to install it. There was no further pressure at the release point and the new gauge was installed without any additional difficulty. OP1 and OP2 then left the FMB.

At 12:37 p.m., FMB control room personnel received a radio message from the DOS and activated the site area alarm to notify plant personnel of the leak.

At 1:14 p.m., the first mitigation team, dressed out in required PPE, was dispatched from the FMB control room and entered the 1st floor of the FMB. The team tightened the newly installed pressure gauge on the utility air line and exited the FMB.

At 1:47 p.m., a second mitigation team entered the first floor of the FMB and observed a very slight haze in the area. The second team then exited the FMB.

At 2:02 p.m., control room personnel sounded the "All Clear." Licensee personnel carried out recovery activities including accounting for all plant personnel, precautionary decontamination and medical examination of OP1 and OP2. OP2 experienced minor reddening of the skin on the inside of his left wrist as the apparent result of HF exposure. He was provided with calcium gluconate to apply topically and the reddening cleared within two days. There were no other apparent injuries as a result of this event.

2. Equipment Failures/Performance

Members of the SIT walked down the affected systems in the FMB, examining the systems such as the utility air line, the bypass line, and parts of the PP2 and PP6 lines that had a role in the event. The inspectors also examined either components, or photographs of those components, such as the failed pressure gauge. The inspectors observed a re-enactment of the event to better understand the actions taken by licensee employees and determine the approximate time and sequence of events. Members of the SIT interviewed licensee personnel that were involved in the event, its investigation, and the development of corrective actions.

The utility air line is isolated from the UF_6 line running from the still feed tanks to the vaporizer by a single Alloyco block valve. The utility air line is used on an occasional basis to provide dry fluidizing air to purge UF_6 lines prior to system maintenance. Interviews of licensee personnel and review of "as built" drawings indicated that this was the only instance in the distillation system where a single valve isolated a UF_6 line from a non-UF_6 line. The valve apparently leaked permitting UF_6 to enter the utility air line where it would have been available to interact with any available moisture in the air to create UO_2F_2. While the precise mode of failure for the valve was not determined, licensee personnel stated that tear down of the valve revealed the presence of yellow material on the seating surfaces of the valve which may have allowed UF_6 to leak into the utility air line.

Located upstream from the isolation valve and the pressure indicating gauge were a pair of quarter-turn ball valves (most of these valve's structure is covered in insulation and they are not visible in Figure 1). Interviews of licensee personnel indicated that these valves were normally closed. After use of the air line for purging activities, it was licensee practice to close the isolation valve, pressurize the line to 90 psi, then close the two quarter-turn valves. This pressure is greater that the approximately 70 psi nominally found in the UF_6 line leading from still feed tanks to the vaporizer and the differential pressure would notionally serve as a secondary barrier to prevent the intrusion of UF_6 into the utility air line. However, interviews of licensee personnel indicated that the amount of air pressure forming this secondary barrier was not routinely inspected or examined to ensure that positive pressure was in place upstream of the isolation valve.

Over time, air leakage upstream of the isolation valve could result in a negative pressure differential relative to the UF_6 line allowing the intrusion of UF_6 into the air line if the valve were to leak.

An electrically-powered heat trace was installed on the utility air line to prevent the cooling and resultant solidification of any UF_6 that should enter the line (a heat trace is a heating element designed to keep a piece of equipment within a preset temperature range). Interviews of licensee staff indicated that, prior to removing the gauge from the utility air line, it had been initially believed that the heat trace was functional based on the line being warm to the touch. The actual temperature of the utility air line was not measured by licensee personnel. However while "massaging" the line with an air hammer to dislodge potential blockages, it was determined that line's heat trace was not functional. As licensee personnel considered the gauge removal, they speculated that any UF_6 present in the line would have frozen into its solid state and as a result, would not pose the same level of hazard as it would have if the UF_6 was in either its gaseous or liquid phases.

As designed and installed, the air pressure gauge on the utility air line was the only way to qualitatively determine the pressure in the line. Malfunction of the gauge represented a single point of failure and there was no established alternate method to determine pressure in the utility air line in the event that the gauge failed. Examination of photographs the licensee had taken of the failed gauge documented significant quantities of yellow solid material accumulated in the valve's pressure port. However, licensee personnel stated that the failed gauge was subsequently soaked in water to dissolve the accumulated material without an examination of the gauge's internals to gather further information regarding the gauge's mode of failure.

During the course of the inspection, the inspectors noted that plant personnel frequently referred to the utility air line as a nitrogen line. However, other interviews, review of "as built" drawings, and walk down of plant systems verified that the utility line actually carried dry fluidizing air. While containing measurably less moisture than other sources of service air in the plant, the dry fluidizing air may have contained sufficient quantities of moisture to react with any UF_6 that may have been present to form UO_2F_2. Solid UO_2F_2 in the line could plug the air line and the air pressure gauge, causing it to fail.

3. <u>Human Factors/Procedural Errors</u>

The presence of UF_6 in the utility air line and the erratic performance of the air pressure gauge resulted in an unscheduled and infrequently-performed task to address a complex problem. Although the licensee recognized the potential for UF_6 to be present in the line, neither licensee procedures nor skill of the craft provided a process for resolving the problem in a manner that provided the same margin of safety as provided for UF_6 line breaks.

As noted above, the broken bypass valve was located on a part of the process line that carries UF_6 from still feed tanks to the vaporizer in the distillation portion of the FMB. This was within the area of responsibility of the distillation operations staff. Throughout numerous interviews with all levels of licensee personnel, the concept of system

ownership was frequently described where the distillation operations staff "owned" this portion of the plant and were ultimately responsible for its operation and to an extent, its maintenance. This was manifested in the sense of urgency on the part of distillation operators and their supervisor to correct the malfunctioning gauge issue so that it would not further delay repair of the original broken bypass valve. Interviews of distillation operators and their supervisor indicated that while they felt no production related pressure, they did feel a strong sense of ownership for the system and as a result, felt that they needed to resolve the issue of the malfunctioning gauge before the mechanics returned from lunch to repair the bypass valve and prevent any further delays in completing that repair.

While maintenance mechanics and instrumentation mechanics would typically replace an air pressure gauge, operations staff were also permitted by licensee procedures and union work rules to make this type of repair. As noted above, interviews of licensee personnel indicated that the distillation operations staff had felt that they had extensive experience in replacing similar gauges mounted on UF_6 lines in other portions of the distillation plant. Further, the distillation operations staff concluded for the reasons documented above, that the gauge replacement task posed a very low risk that any UF_6 present in the line would create a significant release.

Interviews of the distillation operations staff indicated that prior to the attempt to replace the pressure indicating gauge on the utility air line, it was decided that any short duration, visible quantity of vapor not exceeding the amount of smoke that would be observed from a burning cigarette would not be cause to stop work. However, licensee personnel stated that they did not discuss or plan what actions would be taken in the event of an unexpected contingency such as a larger-than-anticipated UF_6 leak. When asked why they continued to remove the gauge after noting white vapor that indicated the apparent presence of UF_6, the distillation operations staff noted that the quantity of vapor observed was not markedly greater than what is observed when replacing gauges on other UF_6 lines in the distillation system and was not indicative of an increased risk.

The distillation operations staff concluded that while the gauge was malfunctioning, the apparent decrease noted on the gauge when a vacuum was applied to the system indicated that there was air flow through the utility air line and that the pressure had been reduced to operating levels. Despite having reached the conclusion that the pressure gauge on the utility air line was malfunctioning, the distillation operations staff continued to use the gauge to infer the pressure in that line. As noted above, there was no alternate means for determining the pressure in the utility air line.

As previously noted, the distillation operations staff indicated that other than the earlier conversations with the maintenance and the instrument mechanics, they did not consult with any other plant staff including plant engineers or managers prior to proceeding with the gauge replacement. Further, interviews of licensee personnel and review of licensee procedures revealed that the distillation operators were not required to consult with other plant staff or managers when faced with an unusual and unanticipated situation.

4. Licensee Response

At the time that the release began, the DOS ordered all present to evacuate the area. All licensee personnel with the exception of OP2, who apparently did not hear the evacuation order, immediately evacuated the area of the release. Upon exiting the FMB, the DOS radioed the FMB control room and directed operators to activate the site area alarm to notify plant personnel of the release. Review of logs and interviews of licensee personnel indicated that control room personnel completed these tasks in a timely manner including announcing over the plant public address system that a UF_6 release was in progress on the first floor of the FMB.

Interviews of emergency response team members indicated that several qualified individuals assembled in the FMB control room in accordance with licensee procedures and began dressing out in appropriate PPE to form mitigation teams to complete any required actions to contain the release. At 1:14 p.m., the first mitigation team, dressed out in required PPE, was dispatched from the FMB control room and entered the 1st floor of the FMB. The team tightened the newly installed pressure gauge on the utility air line and exited the FMB. At 1:47 p.m., a second mitigation team entered the first floor of the FMB and observed a very slight haze in the area. The second team then exited the FMB.

A census of plant personnel was successfully completed to account for all individuals present on site. In accordance with licensee procedures, the emergency response team set up stations outside the release area to decontaminate and administer medical assistance to licensee personnel as required.

The licensee established its Crisis Management Center in accordance with licensee procedures. After assessment of plant conditions and consultation with the on-scene incident commander, the crisis management center commander directed FMB control room personnel to sound the “All Clear” at 2:02 p.m. Interviews of licensee personnel and review of records indicated that the licensee’s emergency response organization properly characterized the release and carried out mitigative actions in accordance with licensee procedures.

The inspectors reviewed the actions taken by the distillation operators involved in the actual gauge removal that resulted in the release including OP1's decision to reenter the FMB while the release was in progress, and OP2's decision to remain in the FMB after the onset of the release until the replacement gauge had been installed on the utility air line. Interviews of OP1 and the DOS indicated that upon exiting the FMB at the DOS’s direction, OP1 observed that OP2 had apparently not left the FMB. Without consultation with other plant personnel, and without donning any additional PPE, OP1 reentered the FMB in search of OP2. As noted earlier, OP1 observed that OP2 was holding the vacuum line over the release point and that the replacement gauge was on the floor. OP1 then picked the gauge up and moved to install it. There was no further pressure at the release point and OP1 and OP2 installed the new gauge without any additional difficulty, after which they left the FMB.

Licensee procedures required that entries into areas in which releases have occurred should only be made by mitigation team personnel wearing adequate PPE including a full chemical suit, along with a Self-Contained-Breathing-Apparatus (SCBA) to safely enter an area where UF_6 or HF may be present. Interviews of licensee employees and review of training materials revealed that it was generally understood that only properly trained and equipped mitigation teams would reenter an evacuated area to carry out repairs or otherwise mitigate an ongoing release. However the licensee did not provide a consistent expectation to licensee employees of the criteria or circumstances under which reentry into an evacuated area may be considered for lifesaving purposes. Interviews of OP1 indicated that the individual was not aware of any criteria that allowed, or the PPE required, for an individual to reenter an evacuated area. Rather, OP1 indicated that reentry into the FMB was based on an impulsive decision based on the inability to account for OP2 and a sense of the need to "find my buddy."

OP2 was interviewed regarding his decision to remain in the FMB after the release. OP2 apparently did not hear the DOS direction to evacuate the area. OP2 stated he felt he was able to deal with the release and that he had a strong personal sense of how long he was able to remain in an HF cloud. OP2 further added that it was his understanding that it was safe for him to remain until his respirator clogged. This was based on the individual's understanding that the respirators worn by plant personnel would continue to provide filtered air to the wearer until the device becomes saturated with UO_2F_2 at which point the respirator will suddenly fail in such a manner as to totally prevent any further inhalation.

Interviews of licensee personnel indicated that there was no common or consistent understanding that in the event of an HF release, the proper action was to "see and flee." Several employees stated their feeling that there was an expectation for licensee employees to attempt to stop any release in progress. One licensee employee cited a specific explicit expectation of a former licensee manager that stated "if you break it, you fix it." Interviews of licensee personnel and review of training program materials indicated that the licensee's occupational training program, including skill specific training provided after the completion of initial training, did not provide a common and consistent understanding of what actions an employee should take in the event of a UF_6 release.

The inspectors also examined the level and effectiveness of the training of the maintenance staff and operators for the actions that led to the release, including training as a result of previous events. Interviews of the maintenance staff, including instrument mechanics revealed an awareness of the potential for UF_6 to be present in plant systems and the precautionary steps to be taken to prevent the inadvertent release of UF_6. However, interviews of distillation operations personnel indicated that some individuals were not aware of the potential for UF_6 to be present in a non-UF_6 system line. Additionally, interviews of several operations and maintenance personnel indicated that many licensee personnel only had a superficial knowledge of previous releases that the licensee had experienced and were generally unaware of any lessons learned as a result of those events as well as how to incorporate those "lessons learned" into their own decision making.

5. Radiological and Chemical Consequences

The licensee possessed and handled only natural uranium that contains approximately 0.711% U^{235}. Uranium that is less than 10% enriched in uranium 235 (U^{235}) poses a toxicological hazard as a heavy metal rather than a radiological hazard. When released, UF_6 reacts with moisture in the air and produces vaporous HF and UO_2F_2. HF is an extremely corrosive acid and therefore the primary hazard posed by exposure to UF_6 or HF at the licensee's facility is chemical rather than radiological.

The maximum, calculated quantity of UF_6 that could have been contained in the 18 inch section of utility air line from which the UF_6 escaped was eight grams.

No UF_6 was observed to escape the FMB nor was any UF_6 measured at the licensee's property line. The release of UF_6 had no impact on members of the public.

Bioassays samples were taken to assess the uptake of uranium experienced by individuals involved in the release or the subsequent mitigative actions. No individuals had bioassay results that exceeded the licensee's investigational limit or that would indicate an exposure to licensed materials in excess of regulatory requirements.

One of the two distillation operators who were present in the immediate vicinity at the time of the leak experienced minor reddening of the skin on the inside of his left wrist as the apparent result of HF exposure. The operator was triaged, received initial treatment at the licensee's medical facility and was subsequently transferred to a local hospital for observation. He was provided with calcium gluconate to apply topically and the reddening cleared within two days. There were no other apparent injuries as a result of this event.

6. Probable Contributing Causes

The inspectors determined that as designed, there were a number of barriers to keep UF_6 out of the utility air line. These barriers included the single Alloyco valve that isolated the utility air line from the adjoining UF_6 line and creation of a positive pressure barrier of dry fluidizing air between the Alloyco valve and the two quarter-turn valves. Licensee mechanics who examined the Alloyco valve after it was replaced noted apparent accumulation of UO_2F_2 on the valve seating surfaces. Although the valve was not available for examination by the inspectors, the inspectors concluded that it was probable that the accumulation of UO_2F_2 prevented the valve from sealing properly and allowed UF_6 to enter the utility air line. As was noted above, this sub-system was the only known instance in the distillation system where a non-UF_6 line was isolated from a UF_6 line by a single valve. In addition, the inspectors determined there were several barriers to prevent any UF_6 present from plugging the utility air line including the installation of a heat trace to maintain line temperature above UF_6's freezing point and the use of dry fluidizing air to minimize the amount of water available for reaction with any UF_6 to form uranyl fluoride. However, review of records and interviews of licensee personnel revealed that the licensee had no program or procedures in place to examine the utility air line on a periodic basis to ensure the integrity of any of these barriers.

The inspectors determined that the pressure boundary formed by dry fluidizing air isolated between the single Alloyco valve and the two quarter-turn ball valves apparently decreased over time diminishing the positive pressure barrier that prevented the leakage of UF_6 beyond the Alloyco valve. As the pressure barrier diminished over time, a negative pressure relative to the UF_6 line would have been created increasing the possibility of UF_6 intrusion into the utility air line.

As previously discussed, the inspectors determined that at some time prior to the release, the heat trace power supply failed, allowing the temperature of the utility air line to decrease to the point that any UF_6 that may have leaked into the line would potentially freeze and create a blockage.

The inspectors determined that while the dry fluidizing air carried in the utility air line contained relatively little water, only small amounts of moisture would be required to react with any UF_6 that had seeped into the line to create uranyl fluoride. The resultant solid uranyl fluoride would then be available to mechanically contaminate the Alloyco valve's seating surfaces and interfere with the pressure indicating gauge's internal mechanism. This determination was supported by photographs of the failed pressure indicating gauge that documented the accumulation of yellow-colored material in the orifice of the gauge. The final clockwise rotation of the gauge needle beyond its maximum reading to zero when utility air line was "massaged" with an air hammer to dislodge any potential blockages, suggests that the forces created by the air hammer led to the pressure indicating gauge's ultimate failure.

The failure to maintain the integrity of barriers was the cause of UF_6 being present in the utility air line. This failure led to the accumulation of solid UF_6 and uranyl fluoride in the utility air line which in turn resulted in the failure of the Alloyco valve and the pressure indicating gauge and the formation of solids that greatly restricted or prevented air flow from the utility air line to the UF_6 process line.

The presence of UF_6 in the utility air line and the erratic performance of the line's pressure gauge resulted in licensee personnel having to cope with an unscheduled and infrequently performed task to address a complex problem to support a scheduled repair of a process valve. The inspectors further determined that there were no procedures in place to guide licensee staff through the diagnosis and repair of components in the utility air line. Rather, the licensee relied on "skill of the craft" to address any matter that might arise as the result of a malfunction or blockage of the utility air line. The term "skill of the craft" as used in this context is defined as the set of tasks that may be routinely carried out by trained personnel without the extensive use of detailed procedures.

The inspectors determined that although the gauge on the utility air line was not accurate, the relative increase in indicated pressure when the line was pressurized, along with a corresponding decrease in indicated pressure when a vacuum was applied to the line, suggested to members of the distillation operations staff that there was flow through the line and that pressure in the line had been reduced to operating levels.

The inspectors determined that the distillation operations staff continued to base decisions regarding conditions within the utility air line on pressure gauge readings after they had concluded that the gauge was malfunctioning. Further, there was no engineering basis to believe that the pressure gauge could be relied on in a qualitative sense after it had been concluded that the gauge had failed in a quantitative sense. Finally, the inspectors determined that there was no other apparent method to determine pressure in the utility air line and that the pressure gauge was a single point of failure.

The inspectors determined that management above the first level of supervision was not notified of the unforeseen problem involving the utility air line, nor was management advised of the disagreement between work groups regarding pressure in the line. Additionally, the inspectors determined that despite the unfamiliar nature of the apparent pressure in the utility air line, the distillation operations staff did not consult with plant engineers or plant management, nor were they required to do so. It appeared that the sense of system ownership along with the pressure not to delay the repair of the bypass valve directly contributed to the apparent reluctance to push the issue for consideration by the plant engineering staff or management.

The inspectors determined that previous experiences with replacing pressure indicating gauges mounted on UF_6 lines may have desensitized the distillation operations staff to the presence of white vapor as they removed the gauge from the utility air line. The distillation operations staff indicated that skill of the craft dictated the technique of slowly rotating the gauge one-half of a complete rotation and then pausing to look for white vapor. So long as any released vapor was captured by the vacuum hose and was of a short duration, it was considered safe to proceed. One of the individuals added that skill of the craft suggested that if any significant quantities of UF_6 under pressure were in the utility air line, that the pressure gauge fitting would begin to continuously vent from the threads after two or three rotations. In the minds of the distillation operations staff, the lack of continuous venting during this gauge removal continued to affirm their earlier determination that line pressure had been reduced to operating levels and that no significant quantities of UF_6 were present.

The inspectors determined that the over-reliance on skill of the craft along with the failure of plant personnel to respond to multiple cues (e.g.: pressure indicating gauge, broken heat trace, presence of vapor) was the root cause of the distillation operations staff's decision to continue the gauge removal. Lack of prior consultation with plant engineers and managers, and the perceived pressure to quickly resolve the issue of utility air line pressure were significant contributing factors.

The inspectors determined that licensee personnel did not have a consistent understanding of what conditions defined a UF_6 line break and as a result, inadequate precautions were taken prior to the gauge removal. The inspectors further determined that the distillation operators removed the gauge were not wearing adequate PPE for a UF_6 line break. Licensee procedures require, as a minimum, licensee personnel wear a full face respirator, a chemical hood, a full chemical suit and chemical gloves for any activity that involves breaking into a UF_6 line. The intent of the requirement was to ensure that licensee personnel were sufficiently protected to successfully escape an accidental HF release in their immediate work area. A greater level of PPE, including

use of a SCBA, along with appropriate training is required for licensee personnel carrying mitigative actions. As noted above, OP1 elected to wear the upper half of the PPE that she had pre-positioned to wear when assisting with the repair of bypass valve which consisted of a chemical coat, gloves, hood and full face respirator. OP2 found and used a full face respirator in the vicinity and wore it along with a hard hat, leather gloves and coveralls.

As stated above, the inspectors determined that licensee staff had no common or consistent understanding of when to "see and flee" in the event of a UF_6 release. This was evidenced by the statement of a number of licensee employees that they should make some (unspecified) level of effort to stop or mitigate a release before leaving. The statements of OP2 indicating that he thought he knew when to leave; that he could continue to remain in the vicinity of a release until the filter cartridges of his respirator clogged; and, his ongoing attempt to mitigate an ongoing HF release sufficiently large enough to completely obscure his vision without the proper PPE are also evidence of the lack of a common or consistent understanding of when licensee personnel should "see and flee" in the event of a UF_6 release.

The inspectors determined that licensee staff had no common or consistent understanding of the criteria or circumstances under which reentry into an evacuated area may be considered for lifesaving purposes. Interviews of OP1 indicated that the individual was not aware of any criteria that allowed, or the PPE required, for an individual to reenter an evacuated area. Rather, OP1 indicated that the decision to reenter the FMB was impulsive, and based on the inability to account for OP2 and a sense of the need to "find my buddy." The inspectors further determined that this issue along with lack of understanding of when to "see and flee" was not solely a failure to provide adequate training but rather was a result of licensee management's failure to fully develop, communicate and implement specific policies regarding employee actions in the event of an HF release.

7. Findings and Conclusions

In accordance with the SIT Charter dated April 6, 2006, the inspectors made the following findings and conclusions:

a. Develop a complete sequence of events related to the event.

A detailed sequence of events may be found in Section 2 of this report.

b. Identify and evaluate the effectiveness of the immediate actions taken by the licensee in response to the event.

The immediate actions taken by the licensee's emergency response personnel after the control room was notified of the emergency were performed in accordance with the emergency program policies and procedures. The actions taken by these personnel were effective in announcing the event, preparing the

control room for safe habitation, establishing command and control, classifying the emergency, accounting for personnel, assessing and responding to plant conditions during the emergency, and assessing the conditions that supported the decision to declare an end to the emergency.

Actions taken by two distillation operators were not conducive to ensuring their safety after the leak began. One individual remained in the area to try and mitigate the leak and the other, after safely exiting the area, returned to look for the operator that had remained in the area. Neither of these individuals were wearing the PPE required to perform such activities.

c. Evaluate the worker and public safety significance of the event.

The maximum, calculated quantity of UF_6 that could have been contained in the 18 inch section of air utility line from which the UF_6 escaped was eight grams.

The worker safety significance was minor in that there was only one minor injury due to the slight chemical burn to the wrist of one operator and the results of bioassays which indicated that no individuals exceeded the licensee's investigational limit or experienced an exposure to licensed materials in excess of regulatory requirements.

No UF_6 was observed to escape the FMB nor was any measurable UF_6 measured at the licensee's property line. Therefore the leak of UF_6 had no impact on members of the public.

d. Evaluate the licensee's process and process implementation for the planning, conduct, control, and oversight of the activities that led to the leak and for actions after the leak was detected, including processes that were revised as a result of previous events.

The presence of UF_6 in the utility air line and the erratic performance of the line's pressure gauge resulted in licensee personnel having to cope with an unscheduled and infrequently performed task to address a complex problem to support the scheduled repair of a process valve. The maintenance and instrument mechanics considered the 80 psi indication on the defective pressure gauge an unsafe condition and would not attempt to replace the gauge under these conditions. This was based in part on their understanding of previous events that resulted in leaks as maintenance personnel were working on process valves. There were no procedures in place to guide the distillation operations staff through the diagnosis and repair of components in the utility air line. Rather, these personnel relied on skill of the craft based on operational experience performing similar repairs on the UF_6 fill stations to determine the process and precautions needed to replace the pressure gauge on the utility air line. Some of the distillation operations staff lacked sufficient knowledge of

previous events to incorporate any “lessons learned” into their own decision making. Licensee personnel involved in the attempt to replace the pressure indicating gauge on the utility air line did not discuss or plan what actions would be taken in the event of an unexpected contingency such as a larger-than-anticipated HF release.

e. Evaluate the adequacy and effectiveness of the licensee’s safety controls for the work, including safety controls that were revised as a result of previous events.

Licensee personnel did not use any circumstance-specific safety controls for replacing the pressure gauge on the utility air line and therefore relied on skill of the craft based on operational experience performing similar repairs on the UF_6 fill stations to establish the process and precautions needed to replace the pressure gauge on the utility air line. As noted above, some licensee personnel lacked sufficient knowledge of previous events to incorporate any “lessons learned” into their own decision making. Licensee personnel involved in the attempt to replace the pressure indicating gauge on the utility air line did not discuss or plan what actions would be taken in the event of an unexpected contingency such as a larger-than-anticipated HF release.

f. Evaluate the level and effectiveness of the training of the maintenance staff and operators for the actions that led to the release, including training as a result of previous events.

The distillation operations staff did not have specific training to remove and replace the pressure gauge under the conditions that existed before the leak. The distillation operations staff depended upon their skill-of-the-craft abilities to determine how to safely remove the defective pressure gauge.

Several apparent deficiencies were observed with regards to employee safety training. These deficiencies included:

- the lack of consideration of what actions during the course of work should be taken in the event of an unexpected contingency such as a larger-than-anticipated HF release;

- an apparent lack of a consistent understanding of when to “see and flee” in the event of HF release;

- an apparent lack of understanding that the intent of routinely worn PPE is to ensure the safe escape of licensee personnel in the event of a release rather that to afford licensee personnel some safety margin to attempt to mitigate that release; and,

- an apparent lack of understanding of the criteria or circumstances under which reentry into an evacuated area may be considered for lifesaving purposes.

The inspectors concluded that these training deficiencies were the direct result of licensee management's failure to fully develop, communicate and implement specific policies regarding employee actions in the event of an HF release.

g. Review and evaluate the licensee's root cause analysis for adequacy of scope, depth, and identification of causal factors.

On April 21, 2006, the licensee provided the NRC with the Apollo Incident Report documenting the licensee's investigation of the release on April 4, 2006. The Apollo Root Cause Analysis method is commonly utilized in the chemical industry for determining the root causes and related causal factors of an event. Review of the report indicated that the licensee followed its own established process for conducting internal root cause investigations.

The licensee identified the following root causes with regards to the April 4, 2006 HF release:

- The failure of licensee personnel to believe the pressure indication gauge on the utility air line until proven unreliable.
- The failure of licensee personnel to stop when unexpected conditions occurred.
- Inadequate guidance for performing work at process-utility interface boundaries.

With regards to the first two root causes, the licensee indicated that it would complete training of operations and maintenance personnel regarding the conduct of operations with emphasis of principles of stopping work in the event of unforeseen circumstances. With regards to the third root cause, the licensee described the immediate action that had been taken to require senior plant management review and approval of proposed line breaks as an interim step and the plan to develop and implement guidance regarding performing work at process-utility interface boundaries.

The licensee also identified two "inappropriate action issues" regarding:

- Improper use of PPE; and,
- Unnecessary risk taken by plant personnel in response to the event.

The licensee's report indicated that management actions had been assigned to address these issues with no amplifying detail.

The inspectors determined that the licensee's root cause analysis was completed in accordance with licensee procedures. The licensee's findings generally agreed with the findings of this report. However, the licensee did not identify the apparent failure to clearly establish and communicate policies regarding:

- the actions to be taken when plant personnel should "see and flee" in response to a UF_6 release; and,

- when may plant personnel reenter an evacuated area for lifesaving versus mitigation activities.

h. Determine if there are any generic issues related to the event.

The inspectors did not identify any generic issues related to the event.

I. Identify additional actions planned by the licensee as a result of this event and the licensee's resultant extent of condition review, including the time lines for action completion.

At time of this report, the licensee had not identified any additional actions planned as a result of this event.

ATTACHMENT

1. PARTIAL LIST OF PERSONS CONTACTED

Honeywell Specialty Chemicals

*David Edwards, Plant Manager
*Sean Patterson, Health Physicist Supervisor
*Joe Johnson, Safety Supervisor
*Darren Mays, Safety and Environmental Manager
*Jack Reilly, Acting Regulatory Affairs Manager
*Ron Erickson, Production Manager
Calvin Blanding, Nuclear Services Leader (Mitigation Response Team)
*Don Heine, Operations Specialist
Melodee Cooper, Distillation Assistant
Gary Hines, Distillation Operator
Mike Hillebrand, Distillation Operator
Darrell George, Distillation Supervisor
Tim Cox, Instrument Manager
Smith Freeman, Maintenance Supervisor
Gary Holder Maintenance Shift Supervisor

* Denotes those present at the exit meeting on April 10, 2006

2. INSPECTION PROCEDURES USED

IP 93812	Special Inspection
IP 88003	Reactive Inspection for Events at Fuel Cycle Facilities Program

3. PARTIAL LIST OF DOCUMENTATION REVIEWED

Honeywell MTW Preliminary Investigation Results
Process Checklist - System Shutdown Total Reflux In Hand Procedure
Breaking Lines/Cleaning Blockages procedure (MTW -SAF-LS-0007)
Bioassay Results
Bioassay Procedures
HF Acid Facts
New Employee Hazmat Training

4. LIST OF ACRONYMS USED

ADAMS	Agency Document Access and Management System
CFR	Code of Federal Regulations
DFFI	Division of Fuel Facility Inspection
DOS	Distillation Operations Supervisor
FMB	Feed Materials Building
HF	Hydrofluoric Acid
IMS	Instrument Maintenance Supervisor
IP	Inspection Procedure
IR	Inspection Report
MMS	Mechanical Maintenance Supervisor
NRC	Nuclear Regulatory Commission
OP	(Distillation) Operator
PARS	Publicly Available Records
PPE	Personal Protective Equipment
psi	Pounds per square inch
SCBA	Self Contained Breathing Apparatus
SIT	Special Inspection Team
U_{235}	Uranium 235
UF_6	Uranium Hexafluoride
UO_2F_2	Uranyl Fluroride