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**241-SY-101 AIR LANCE REMOVAL
LESSONS LEARNED**

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October 1994

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ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
CWC	Central Waste Complex
DOE	U.S. Department of Energy
HP	Health Physics
OR	Occurrence Report
PDC	Packaging Design Criteria
QTP	Qualification Test Procedure
SWD	Solid Waste Disposal
SWM	Solid Waste Management
SY-101	241-SY-101
TC	Thermocouple
TE	Text Exception
TF	Tank Farm
WHC	Westinghouse Hanford Company

241-SY-101 AIR LANCE REMOVAL LESSONS LEARNED

1.0 EXECUTIVE SUMMARY

T. L. MOORE/P. A. TITZLER

An emergency task was undertaken to remove four air lances and one thermocouple (TC) tree (fabricated from 2" schedule 40 pipe) from tank 241-SY-101 (SY-101). This resulted from video observation that these pipes were being severely bent during periodic gas release events that regularly occurred every three to four months. At the time, the gas release events were considered to be the number one safety issue within the U.S. Department of Energy (DOE) complex. This emergency removal task was undertaken on an extremely short schedule that required all activities possible to be completed in parallel. This approach and extremely short schedule, while successful, resulted in some undesirable consequences from less than desired time for design, reviews, equipment testing, operations training, and bad weather conditions. These consequences included leakage of liquid waste from the containers to the ground, higher than expected dose rates at the container surface, difficult field operations, and unexpected pipe configuration during removal. In addition, changes to environmental regulations and severe winter weather impacted the packaging and shipping activities required to prepare the removed pipes for storage at the Central Waste Complex (CWC).

The purpose of this document is to identify lessons to be learned for future activities. In context of the emergency conditions that existed at the time and the urgency to remove these pipes, their removal was successfully completed under extremely difficult conditions and schedule. The success of the task should not be overshadowed by the desire to identify areas needing improvement and lessons to be learned. Many of the lessons identified in this document have already resulted in improved conduct of operations and engineering.

2.0 SCOPE

T. L. MOORE

As an expedited, emergency activity, many tasks in support of the air lance removal/storage activity were required to be completed in parallel. This approach always results in risks, and the responsibility of Westinghouse Hanford Company (WHC) management is to manage these risks in such a manner as to minimize any consequences which might result from them. The tasks associated with removing the air lances and TC tree from the tank and preparing them for storage or disposal resulted in a number of relative minor occurrences and incidences. The scope of this document is to identify those occurrences and incidences and determine lessons that can be learned to prevent or significantly reduce their recurrence. In addition there were some tasks that went especially well and these will be described for future use.

3.0 BACKGROUND

T. L. MOORE

In late March 1992, the WHC Safety Program Office requested that the four air lances installed in SY-101 be removed and prepared for disposal. This request

was the result of observations with the in-tank television camera that the air lances were being bent by the movement of the waste during the periodic gas release episodes. Concern was expressed by WHC as well as other organizations that the repeated bending of the air lances could result in sparks which could be an ignition source during the gas releases, damage to the tank, or breaking of the air lances. All of these possibilities were considered unacceptable and so the removal of the air lances was requested as an expedited, emergency activity. The equipment was designed, fabricated, tested, and ready for use during Window G in September/October 1992.

The video tape of the gas release event just before Window G showed that the TC tree was hit by a large mass of solid waste, resulting in a bend of approximately 40°. The same concern for safety was expressed with respect to the TC tree as had initiated the action to remove the air lances. The decision was made to remove the TC tree during the same window, Window G, as the air lances were being removed. This decision added further schedule pressure on activities that were already extremely tight.

In addition, review of the video tapes taken just after the gas release event showed that one of the four air lances, the only one assembled from more than one section of pipe joined with a screwed coupling, had broken just below the riser at the threaded joint. Consideration of possible responses to this discovery, along with the decision to remove the TC tree, added more pressure to the window schedule especially since the staff most familiar with the air lance/TC tree removal options were the ones best able to consider the possible retrieval of the broken air lance.

By the time the window closed, the three remaining air lances had been successfully removed. In addition the TC tree was successfully removed after having broken twice during the removal attempt. Each time the TC tree broke additional equipment and procedures were required.

Because of the extremely short schedule for removing the air lances from the tank, no hardware was designed and fabricated prior to removal from the tank to facilitate storage of the air lances if they were determined to be mixed waste. The assumption was that they would be "triple rinsed" to qualify them as low level waste that could be direct buried. The triple rinse was not successful during the removal operation. During preparation for disposal/storage, the option to complete a second triple rinse was eliminated due to a regulatory change that became effective in mid-November. All sections of the air lances that had been in contact with the tank waste were rinsed to reduce the dose rate, overpacked, and shipped to the CWC in January 1993, closing out the activity.

4.0 SUMMARY OF FINDINGS/CONCLUSIONS

T. L. MOORE/P. A. TITZLER

4.1 SUMMARY OF FINDINGS

This document was generated by several people who worked on the air lance and TC assembly removal and disposal tasks. Their input has been included in this document, with minor editing, and gives details of the problems

associated with the removal and disposal efforts. It should be noted that even though there were several problems associated with the tasks, many hours of hard work and personal dedication to the tasks were required to complete the efforts within the schedule and work window restraints. Some personnel errors were made; however, performance was very good when considering the schedule restraints, demanding field conditions, increasing scope of work by adding the TC tree removal, and increasing job pressures resulting from the broken TC tree. In addition, final flushing of the air lances and placing them into storage containers were accomplished under field conditions of cold weather and large snow accumulations.

The following is a summary of problems encountered while completing the removal of three air lances and one TC tree. The information also includes the problems associated with the preparation and placement of the air lances into CWC for storage. This information is presented in more detail later in the document, mainly by individuals involved in the process. Several individuals have described similar problems from their perspective and these have been combined and summarized below.

The problems associated with the subject program were grouped into six major areas:

1. Lack of design criteria requirements
2. Problems with equipment design
3. Insufficient funding
4. Problems with the field work plan
5. Insufficient communications
6. Poor working conditions

4.1.1 Design Criteria

The design criteria requirements for the removal equipment were defined by engineering and industrial experience and preliminary testing. However, three areas had inadequate available information and could not be defined sufficiently to establish a basis for the design. These areas were characterization of the waste, containment barrier requirements, and waste disposal requirements. The schedule restraints required that the development of the design continue while the criteria for these items were being developed. Waste characterization was needed to establish the shielding requirements for both removal and disposal operations. This information was also needed to establish the effectiveness of the air lance internal flush and external spray systems. Several design changes were made late in the equipment development effort, including stacking three receivers end to end because the characterization information was not established.

Solid waste disposal (SWD) requirements were needed to design the receivers and later the storage containers. Work on the equipment removal and disposal efforts were separated during the design phase because agreement could not be reached on the requirements. Also, funding was not provided to finish the disposal effort until after the air lances and a TC tree were removed from the tank.

4.1.2 Equipment Design

Equipment design problems resulted in the receivers leaking radioactive waste. A decision to stack three receivers end to end to allow the assemblies to be removed in one piece resulted from the uncertainty of the assembly flushing effectiveness. The uncertainty resulted from the lack of waste characterization information because it was unknown whether the water flush would wash the waste off the internal diameter of the assemblies. Stacking the receivers required gaskets and heavy stiffeners at each flanged joint. The stiffeners were analyzed for deflection and proved to be sufficient to maintain gasket integrity. However, the joints either were worked during the removal operation or the shop assembly sequence of attaching the stiffeners to the receivers should have been changed. Another leak path was in the area of the piston locking dog caps. The caps were designed to be sealed through a metal to metal contact and tightening was not specified on the drawings. Consequently, the caps were only hand tightened in the field. The design should have provided gaskets and specified a torque requirement for tightening. In addition, the receiver assembly design should have had a pressure test following fabrication and during the performance of the Qualification Test Procedure (QTP).

Additional problems during the design phase included the lack of full scale mockup facilities for development and testing of the removal equipment. Also, major design comments were not received on the removal equipment until after the equipment was fabricated and being tested in the field. The disposal equipment didn't have enough schedule time allocated for testing.

4.1.3 Funding

Funding problems delayed the engineering, procurement, and fabrication efforts of the removal program. The program was started prior to establishing an engineering estimate for the entire program. The work was started in parallel to providing the estimate because safety concerns resulted in the establishment of an aggressive schedule to remove the damaged hardware. When the engineering estimate was completed, it exceeded the initial amount established for the program. Since full funding was not available, the program was shut down for approximately five weeks until the full amount was provided. However, funding was only provided for the removal effort. The disposal portion of the effort was shut down until the next fiscal year. There was also a problem with entering the allocated funding into the financial system which further delayed procurement activities for a program with an already short schedule.

4.1.4 Work Plan

The field work plan had several problems during the preparation and execution of the document. Work plan preparation problems included insufficient lead time for preparation, difficulty in establishing hold points, and document reviews and approvals. The document reviews and approvals were especially difficult and time consuming because of the heavy workload of individuals involved in the program.

Field problems were also encountered during the removal and disposal efforts. Problems included difficult change control process and insufficient testing of the disposal equipment prior to using it in the field. Other problems were encountered with Quality Control and Health Physics (HP) technician hold points being missed in the field copy during work activities. The work plan was not clear to field operations personnel as to the intent of the hold points or where they were applicable. The work package for the TC assembly removal became difficult to use because of the major changes required to the package resulting from the TC breaking twice during the removal operation.

4.1.5 Communications

Some communication problems were encountered during the air lance and TC tree removal field operations and during the equipment disposal preparation and field work. Heavy workloads, short schedule requirements, and lack of criteria made the disposal effort difficult to accomplish. For example, review meetings were scheduled and not everyone needed for the review could attend. Field communication problems resulted in some work being performed before the actual changes were entered in the field copy of the work plan.

4.1.6 Working Conditions

Working conditions during the removal effort included long hours for the engineering and operations personnel for designing, developing equipment, testing, training, and field activities at the SY-101 site. In addition to supporting the removal and disposal effort, operating personnel were also supporting other tank farm (TF) activities such as training for the installation of the SY-101 mixer pump. Work conditions were extremely bad during the final flushing and packaging of the air lances. Cold weather and a large amount of snow on the ground made disposal of the air lances difficult.

4.2 CONCLUSIONS

Decisions were made during the completion of the removal and disposal tasks that may have been different if not for the schedule restraints and long working hours associated with the SY-101 window requirements. However, work plan documentation and change control need to be improved for future programs by making them easier to use. Communications and document reviews and approvals should be streamlined and priorities established so personnel can effectively support the emergency tasks. Full funding should be established at the start of the program to avoid schedule delays. Design criteria should be defined, reviewed, and approved prior to starting the program. Time spent at the start of the program to provide well defined criteria is important since the information affects the program from beginning to end. For example, including a pressure test of the receivers may have prevented the leakage problem and defining SWD requirements may have prevented the 90-day accumulation period problem. Part of the problem with defining the waste disposal criteria was the changing regulatory requirements following the removal of the assemblies from the tank.

5.0 PROJECT MANAGEMENT

T. MOORE/D. B. COLE

5.1 SCHEDULE/TIME LINE OF EVENTS

This entire effort was undertaken on an extremely fast-tracked schedule. The effort began in April and was scheduled for completion in time for air lance removal during Window G in September 1992. The tasks which were identified early in the planning phase pointed to the fact that design engineering staff would have a difficult time meeting the schedule, even if they had nothing to concentrate on but the design, fabrication, and testing. For this reason, a request was made to WHC Projects for support in the form of one full-time project engineer to coordinate all activities necessary for success. This decision resulted in freeing the design engineering staff to concentrate on their main role without other required supporting tasks suffering due to lack of support.

The project engineer chaired weekly status meetings which included representatives from all WHC organizations involved in the project. This worked extremely well in that communications were timely and well documented. These meetings were a key factor in keeping the schedule on track. All WHC organizations were involved very early in the project and no organization was required to get involved at the last minute, without benefit of advance knowledge. There were no major schedule problems due to the way this project was organized.

The up-front involvement of all required WHC organizations provided the means to expedite reviews of documents and design media. This was primarily due to the weekly meetings at which a current status of tasks was reported to the entire team.

There are three areas in project management in which improvement can be made. One is an earlier involvement in the team by a DOE representative. This likely would have minimized some of the issues raised at the last minute during preliminary field testing. However, this is an area where issues still exist and require an agreement between WHC and DOE management as to the scope of the DOE representative's involvement and how they will document their participation in the early phases of the project. During the air lance removal effort, criticisms made during procedure development and debugging were carried through and reported upline to DOE management as if the comments were still valid for the final procedure. Some of these comments were used to evaluate the WHC performance during the project without any consideration of the extremely tight schedule. This approach was discussed between the cognizant manager and DOE Monitor for whom the contract DOE representatives work. The response of the DOE Monitor was that he wants the field representative to become involved as early as possible. He did not want to stifle the field representative's comments and, rather than asking them to verify the accuracy of their statements and be more professional in their reports, his inclination was to tell them not to let WHC staff see their comments. This approach is counterproductive and definitely not conducive to developing teamwork between the DOE and WHC.

The second area of improvement is the ability to make decisions in some areas. The team had a difficult time determining what was required for disposing of the air lances after they were removed from the tank. This had to be resolved at a higher level. As a result, the disposal issue was separated from the removal task during the design phase to provide for a concentrated effort for removing the air lances from the tank. This, in addition to the funding issue below, caused problems later, since all of the effort required to dispose of or store the air lances had to be completed in an extremely short time.

A third area involves the available funding to complete the removal effort. The initial budget to complete the effort had enough funding to complete several phases of the program, but not enough to complete the entire program. Midway through the program, the effort was shut down for five weeks until additional funding was provided. However, when the effort was restarted, only funding for the removal task was provided. No additional funding for the disposal portion of the program was provided. The five-week shutdown was a major impact because it reduced the time available for technical design and development. It also sent the wrong message on the importance of the program to the Design and Fabrication groups.

5.2 ORGANIZATIONAL INTERFACING/COMMUNICATION

5.2.1 Weekly meetings were held to keep all team players informed of activities planned for the week.

5.2.2 These meetings were a factor in keeping the schedule on track.

5.2.3 There were very few schedule changes during the project.

5.2.4 It was difficult to identify all the specific key players up front. Maybe a list of people that were team players on past projects on this tank would be helpful in getting started.

5.2.5 At the start of this job, management's support for the estimated funding was very difficult to get. A more supportive stand should be taken by management if they want these tasks started and completed on time.

5.2.6 Identify the DOE person up front so that they could be included in the meetings. This would keep them informed of what we are doing.

5.2.7 DOE showed up during our shakedown testing. They did not have the foggiest idea of what we were doing or the reason for it. Lack of information is very dangerous to a fast track design when the observers do not know how the design came about. If they were with us all the way through and were part of the team, then they would not find additional problems at the end.

5.2.8 The use of a project engineer helped take the load off engineering by helping with the schedule, cost, estimate, coordination, planning, troubleshooting, running interference, and chairing the meetings.

5.2.9 Having a contact out in the area where the job is going to take place helped keep things moving.

5.2.10 Sometimes I would feel I needed to do more and have more control of what was going on. More control over engineering, cost, schedule, and design. This is normally how projects is involved in a job. The way this task was run and quickly activated it would be impossible to run it that way like a standard project. In this situation everyone did their part and worked great together.

5.2.11 A happy medium of involvement was implemented. Jobs like this need somebody to coordinate and keep things moving and not necessarily take on the actual tasks.

5.2.12 Documents that need to be reviewed should be limited to those that have the expertise and not the whole project team. This eliminated unnecessary comments that could have clouded the issue. This project did just that. Document reviews and sign-offs were streamlined by limiting them only to the essential personnel.

5.2.13 The prototypical design procedure worked great. It enabled this project to stay on schedule. It takes a considerable amount of the engineer's time to follow the fabrication process. If the standard system were used, it is doubtful that we would have held to our final schedule due to the many changes required during fabrication.

5.2.14 Having safety (nuclear, industrial, assessment), National Environmental Policy Act, Quality Assurance, and environmental on board from the beginning is essential for having very few problems in these areas.

5.2.15 A problem from the start was the characterization, packaging, and transportation of the waste. The characterization part should have been established for this tank before our project. Methods of transporting the air lance always came up. They were based on uncertain characterization data.

5.2.16 Keeping packaging and transportation as separate from this effort saved our schedule. Those problems had to be solved at a higher level so we decided to handle them as a separate issue for this project. Even though packaging and transportation were on board, they were not allowed to begin. This effort began only after the assemblies were removed.

5.2.17 With limited allocated funds to start with, engineering and procurement had to continually over spend their budgets. This caused delays by starting and stopping design and procurements.

6.0 SOLID WASTE SAFETY

D. J. MEYERS

6.1 Problems of occurrence reports (ORs) at TFs did not convey to Solid Waste Management (SWM) to provide air lance package characterization information for acceptance, storage, handling, contamination control, etc., at CWC (e.g., which air lance packages had leaked, which had absorbent placed and

before/after spill). Spills observed of absorbent placement witnessed by Solid Waste Acceptance representative included: how much liquid in package, does air lance package conform to final approved Storage/disposal Approval Record (SDAR), some contamination discovered when SWM received, etc. Reference Don G. Hay cc:mail of February 9, 1993.

6.2 Coordination of the safety analysis report for packaging/SDAR/work plans with the final status of air lance package was not possible due to late change in packaging/flushing approach.

6.3 Coordination of packaging approach with container fabrication, transporter availability and CWC handling/space planning was not possible for some reason or two.

6.4 A safety review of the TF work plan questioned the need for surveys during plug removal for installation of flush system.

6.5 The approach for sectioning the air lance into two packages was changed without consideration for impact on solid waste classification, solid waste facilities, utilization, disposal processing complications, etc.

6.6 How much tank waste remains in the air lances with free liquids which can affect waste classification (radioactive mixed waste, transuranic).

6.7 TF could not share work plan, rigging plan, SDAR, and safety analysis report for packaging in advance for SWM planning and document preparation (without weather delays, they would have been hard pressed to meet original receipt schedule).

6.8 The formal request for receipt/storage of air lance packages was not received by SWM until a couple of days before initial scheduled ship/receipt date.

6.9 SDAR preparation was not reviewed by the generator/transporter and receiver.

6.10 Waste minimization package size and thorough flushing was included in the original approach and indicated a good coordination/planning effort in early stages. It also had involved most players.

6.11 TF work plans lacked detail when not provided by standard approved procedures or consistent/planned direction by persons in charge.

6.12 TF, SWM, Disposal Waste Acceptance, and Waste Packaging Design must combine in integrated team effort to implement the requirements of safety analysis report for packaging, SDAR, and WHC-EP-0063-3 to make this successful disposal effort.

7.0 RADIOLOGICAL (As Low As Reasonably Achievable (ALARA))

7.1 PACKAGING/SHIPPING DESIGN

J. W. THORNTON

The radiological source term of the payload determines the amount of shielding necessary for transportation and/or storage. The shielding weight and type (i.e., lead, steel, concrete) must be determined prior to the start of the structural design. The first problem encountered in the shielding design was a complete lack of knowledge of the radiological source term. The second problem was that the final disposition and waste acceptance criteria of the package was not established. If the package was to be buried, little or no shielding would be required for transportation. If the package was to be stored at CWC, shielding would be required to lower the dose to 100 mr or less.

The first meeting attended by Packaging Design Engineering personnel was in October 1992. At this meeting the radiological source term was unknown. Jim Lee, of the 200 West Area, provided a survey map of the air lance receivers dated September 23. Using this data, a source term was extrapolated and a shielding analysis was performed on November 3. The results of this analysis indicated that 3/8 inch of lead would attenuate the radiation to less than 100 mr at the surface of the package for possible storage at CWC. However, shielding was not required for transport to the burial ground where the package and payload would be stabilized with concrete and buried.

Uncertainties regarding shielding requirements caused a worst case shielding configuration to be assumed. A package total weight was then determined based on the worst case assumption so that the structural design could proceed and the material needed for fabrication could be ordered.

On November 17, a list of shielding options and package weights was prepared based on the different disposal scenarios. A worst case source term was determined by Don Calmus of Packaging Safety Engineering and put into the Packaging Design Criteria (PDC) document. Another shielding analysis was performed on December 9 using the source term from the PDC. This analysis indicated that 3/4 inch of lead, 2.25 inches of steel, or 8 inches of concrete would be needed to provide adequate shielding. The package design was then fixed for the shielding. The worst shielding case for structural design was determined to be the 3/4 inch of lead, with the best case being no shielding (which is how it turned out). The structural design and analysis was performed based on each of these shielding cases. Lead shielding was selected as it could be added to the package only where the shielding was needed with the least cost, lost time, and additional weight.

The lessons learned are as follows.

7.1.1 Considerable time, money, and material can be saved if the radiological source term can be accurately predicted and if the final disposition of the package can be determined early in the design stage.

7.1.2 The sharing of all radiological data is critical for the design of the shielding. All radiological data should be kept in a common data base where it can be accessed by all. This common data base would ensure that everyone is working with the same information.

7.1.3 A simpler method for source term determination should be developed such as: include in the rinse procedure a maximum acceptable dose limit (i.e., source term) that must be achieved prior to placement of the articles removed from the tanks into the packaging for transportation and/or storage. This would ensure that the design would be cost effective.

7.1.4 A systems approach for the removal, packaging, and disposition of long items removed from the tanks would result in significant cost and time savings as questions would be answered early in the design stage and the packaging would meet each division's requirements.

7.2 FIELD WORK

W. K. LACEY

7.2.1 Time Line - Air Lance Evolutions

DATE	ITEM
07/23/92	Operations had concerns regarding the HP specification of primary containments in the Window G work plans instead of the usual "wind breaks" for contamination control.
08/06	cc:Mail - HP Analyst "ALARA Management Worksheets are required prior to issuance of RWPs." (RWP - radiation work permit)
08/10	HP Supervisor and Analyst rescind signature from two work plans.
08/11	Readiness Review Board Chair - "Why HP signature recision?"
08/12-13	HP, operations, and engineering inserting radiological controls and HP hold points into work plans.
08/14	Engineering manager halts the work plan process. Plans are issued by engineering without HP approval.
09/03	TANK BURP - 1445 High Pressure Alarm 101-SY.
*****	REMOVAL OF AIR LANCES FROM TANK SY-101*****
09/10	10 gallons of water added to air lance 1-A, 17-C and 1-B internals.
09/11	Certified containments for riser 1-A and 14-A.

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09/12 Removed flanges from risers 1-A and 14-A.
 Short air lance removed from 14-A - to waste box.

09/13 Cut off valve assembly and raised air lance 1-A about 60".
 Installation of jack and doghouse.

09/14 Air lance 1-A stuck at 56 feet in air. 8 R/hr on contact.
 Stuck again - removed nipples with chisel.

09/14 Air lance 1-A into receiver.
 Set up jacking device. Water flush removed most of the sludge
 stuck on end of air lance.

09/15 Post-job cleanup - set up for next air lance removal.

09/16 Prep work to put jacking device on riser 17-C for removal.
 New jacking device has cutter for cutting nipples off air lance.

09/17 Air lance 17-C out - 4.8 R/hr @ 2".
 Decon jacking device, 100,000 dpm beta/gamma, cleanup.

09/18 Air lance 1-B in receiver - 5 R at 2".
 Cleanup after air lance removal.

AIR LANCE RINSE and REMOVAL SEQUENCE:

<u>Lance</u>	<u>Soak (Vol)</u>	<u>Internal Rinse</u>	<u>External</u>	<u>Out-of-Tank</u>
1-B	9/10 (11)	9/13 (40)	9/15 (110)	9/18
17-C	9/10 (15)	9/12 (40)	9/17 (142)	9/17
1-A	9/10 (11)	9/11 (40)	9/13 (360)	9/14

09/22 Clean up of jack 1-A.

09/23 Survey of air lances - (map) - top and bottom, every 2 feet.
 Max values: 17-C = 1.6 R, 1-A = 2 R, 1-B = 1.5 R/hr.

AIR LANCE STORAGE AND PREPARATION FOR DISPOSAL

09/23-26 High winds - Farms place ON MASK.

09/28 Unposted High Radiation area, air lance receiver end (Radiological Problem Report W-92-029).

Survey performed of the air lances - max 4.5 R/hr contact.
Smear taken underneath air lance read 250 mr/hr.

The air lance end was bagged and area was reposted.

09/29 HP will institute a daily survey to verify the High Radiation boundary.

09/30 Doubling of dose rates at the High Radiation boundary in two days.

Air lance container 17-C now reads 5 R/hr at 7 inches.

Shift Operations informed as was Operations Manager.

10/01 12 R/hr dirt found under leaking air lance overpack (OR 92-74).

Receiver 17-C tilted to drain liquid down to the shielded end.

Air lance dose rate was 7 R/hr on contact.

10/04 Installation of camera in SY-101 delayed until day shift - windy.

10/05 Leaking air lance flange - smear 800 mr/hr (Radiological Problem Report W-92-033).

10/06 Another air lance leaking = 800 mr smears.

Foil tape placed on joints; bagged known leakers.

10/07 cc:Mail, D. L. Kelly on Hot Air Lances in SY
(To: D. G. Hamrick, G. L. Dunford, P. Hinojosa, J. S. Lee)

10/07 Updated dose rate/smear survey of air lances: 1.8 R/hr
25,000 dpm.

Wrapping leaking air lances and surveying surrounding area.

10/15 Air lance smears verification done twice/shift; all negative.

10/16 Window G closed at 2305 hrs.

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- 10/14 cc:Mail concerning necessity for removal of highly radioactive air lances from SY Farm from Safety Assurance to M. A. Payne, J. S. Lee, P. Hinojosa, D. G. Hamrick, G. L. Dunford, R. W. Reed, J. C. Wiborg, R. E. Heineman, et al.
- 10/19 cc:Mail from DOE to Safety Assurance regarding air lances. DOE is concerned that they are still classifiable as mixed waste and that they should be reported on an OR as a potential Comprehensive Environmental Response, Comprehensive and Liability Act spill.
- 11/10 First meeting held on air lance disposal.
- 11/17 Second meeting chaired by Central Engineering and attended by all of the necessary WHC organizations and DOE Richland Operations Office.
- 12/10 Survey of dirt in overpack-install area < D.
- 12/16 Snow. Smears on air lance externals in High Radiation area < D.
- 12/17 Farms are again extremely ICY.

***** AIR LANCE OVERPACK, FLUSH, AND SHIPMENT TO CWC *****

- 01/13/93 Air lance 1-A into overpack and back into High Radiation area.
Snow went into overpack with air lance. Work plan did not tell them to put on 4" flange so they stuffed the opening with absorbent and bagged it. (The flange and bolts were on hand to button it up...put into bag.)
- 01/14 SNOWING - Early release for personnel at 14:30.
Air lance 1-A from High Radiation onto truck and over to 241-SY-102.
- 01/15 Air lance 1-A hooked up to 241-SY-102.
Flush piping LEAKED. Work stopped.
- 01/16 Air lance 17-C into overpack and back into High Radiation area.
Snow into overpack with air lance. Bagged it up, did not put flange on. (Drip pan read 100,000 dpm/dm sq.)
Bag of liquid = 5 R/hr @ 6"!!! (from end of receiver).

- 01/17 Air lance 1-B into overpack and back into High Radiation area.
Snow into overpack with air lance. Bagged 4" end again!!
90 mr smears on receiver flange after removing plastic.
- 01/18 Air lance 1-A, replaced leaky ball valve.
First flush @ 1800, readings went up 120 mr/hr.
(NOTE: On 1/20 it warmed up and the snow melted in air lances 17-C and 1-B.)
- 01/21 Bags on ends of 17-C and 1-B leaked onto dirt in High Radiation area.
4" flanges installed. 80 mr dirt. (OR 93-10).
Air lance 1-A flushes complete ready to ship to CWC.
Started to hook up air lance 17-C, plug BURPED. EXIT.
(Note: Overpack had been heated prior to removal of the plug.)
Contamination: 1 RAD/HR AND 400 MR/HR (brown goo). OR 93-12
One pipefitter work boot contaminated to 5,000 DPM beta/gamma.
- 01/22 Air lance 1-A to CWC.
First flush of air lance 17-C.
- 01/23 Air lance 17-C disconnect and ship.
Air lance 17-C contaminated on arrival at CWC. OR written.
Air lance 1-B hook up and start flush.
- 01/24 Final flush/disconnect of air lance 1-B - Shipped to CWC.
- 01/25 Removed drain device from riser 1-B on 241-SY-102. Cleaned up.

7.2.2 Radiological

W. K. LACEY

7.2.2.1 Background

The process of removal and disposition of the three air lances from tank SY-101 resulted in the issuance of five ORs and five Radiological Problem Reports. Personnel exposure was 1.5 person-rem for removal from the tank and 3.0 person-rem for the flush/ship. Investigation of the causes for the

problems encountered and sharing of the lessons learned may assist others in avoiding a repetition of the errors encountered.

7.2.2.2 Scope

The scope of this lessons learned exercise is to investigate the preparations, removal, temporary storage, reflushing, and shipment to the CWC of the tank SY-101 air lances.

7.2.2.3 Summary

Window G - Air Lance Removal

1. The ALARA pre-job planning for Window G air lance work was inadequate.
2. There were problems with signature documentation for the required steps in the work plan.
3. The air lances were not adequately rinsed during removal from tank SY-101.
4. Direction and instructions for the disposal of the air lances were not addressed in the pre-job planning or the work plan.

Contamination/Radiation Problems

5. The shielded air lance receivers leaked after air lance installation.
6. Tank Waste Remediation System management did not adequately respond to the problem of the highly radioactive leaking air lances.
7. The preparation of the work plan for the overpacking, flushing, and shipment of the air lances was inadequate.
8. The field conditions were not conducive to good contamination controls.
9. Conduct of operations during the work was deficient.
10. There were some improvements in the second evolution.

7.2.2.4 Discussion

The Window G work plans were the first at Tank Waste Remediation System to include HP's direction, including HP hold points, within the body of the work procedure. There was a lack of understanding by engineering and operations of the necessity for including hold points and HP directions in the work plan. Since HP also was new to this process, it was a learning experience for all.

Window G - Air Lance Removal

1. The ALARA pre-job planning for Window G air lance work was inadequate.

HP was not consulted on radiological controls until very late in the planning process.

Only two of the work plans were approved by HP.

During the work plan writing process, there was a lack of understanding of all of the steps necessary to complete the air lance removal evolution. Most of the contributors had not seen the equipment to be used and there was no time for a walk-through to verify the correctness of the plan for actual field work.

The air lance removal work plan was not completed by the group trying to input HP requirements. The HP hold points were placed into the plan by engineering based upon requirements placed into the two Window G work plans that were approved by HP.

HP was not given work plan copies in advance of the actual performance of the work, resulting in a lack of adequate planning for meeting requirements in the field.

There were no recovery actions specified in the work plan for a stuck air lance, necessitating a work stoppage and generation of a recovery plan.

The first air lance became stuck while being removed: the nipples on the air lance were longer than the drawings indicated. Recovery actions resulted in approximately 750 mr personnel exposure.

2. There were problems with signature documentation for the required steps in the work plan.

Many changes were made to the work plan between issuance and work.

Some step numbers on the air lance removal sign-off sheets did not match those in the work plan.

The sign-off sheets were located in the back of the work plan, which resulted in confusion during the work.

Steps for removal of all the air lances were numbered the same, with the only differentiation between air lances being handwritten on the top of the pages in the back of the work package. As verified by a review of shift logs and survey reports, there were errors in signature location on the data sheets.

The HP technicians had never been required to sign for work plan steps, and several were signed on the wrong date or page. Documentation that

the required actions were taken by the HP technicians to comply with the hold points for all of the air lances was found in the 20 Radiation Survey Reports covering the air lance removals.

For Window G work plans, the pre-job briefings did not include step-by-step coverage of the hold points in the work plan.

3. The air lances were not adequately rinsed during removal from tank SY-101 to qualify them as non-mixed waste.

The triple rinse procedure, TO-100-052, referenced in the work plan is specific for small items and clearly states that larger items must have a job specific work plan or procedure developed to comply with state requirements. This specific procedure was not developed.

The rinse sequence was deficient in that the rinse was performed while the air lances were still immersed in the tank waste. Up to five days elapsed between the internal rinse and removal from the waste in the tank.

Dose rates from the air lances during removal were in excess of 5 R/hr, indicating that the rinse was not sufficient. The air lances were removed and placed in the receivers anyway.

4. Direction and instructions for the disposal of the air lances were not addressed in the pre-job planning or the work plan.
5. The shielded air lance receivers leaked after installation of the still wet, highly radioactive air lances.

The receivers were not leak tested to verify integrity prior to use.

6. Tank Waste Remediation System management did not adequately respond to the problem of the highly radioactive leaking air lances.

On September 28, an air lance receiver was discovered to be leaking. A smear was taken which read 250 mr/hr. The air lance end was bagged. Also, the radiation levels on the air lances were noted to be increasing. The High Radiation area boundary was increased to be in compliance with requirements. Operations was notified and Radiological Problem Report W-92-029 was issued.

On October 1, a sample of dirt reading 12 R/hr was discovered under the north end of one of the air lances. The leaking air lance end was bagged to contain the contamination. Radiation levels had again increased up to 7 R/hr contact on one of the air lances. The air lances were tilted to encourage the liquid to flow to the shielded end of the receivers. The High Radiation area boundary was again expanded. TF OR 92-74 was issued.

On October 6, another air lance was discovered to be leaking (800 mr/hr smears). Foil tape was placed on the receiver joints, known leakers were bagged, and rubber matting was placed on the ground to contain contamination.

Repeated efforts by HP, Safety Assurance, and DOE representatives urging TF management to address the leaking air lances began on October 7.

The first meeting to address air lance disposal was held on November 10, nearly two months after removal of the first air lance from the tank, following pressure from the Washington State Department of Ecology.

7. The preparation of the work plan for the overpacking, flushing, and shipment of the air lances was inadequate.

The work plan was written in extreme haste; there was great pressure to issue the work plan by close of business on January 8. It was impossible to perform an adequate review of the plan with incorporated changes prior to signing the approval sheet.

The plan was generated by personnel who had never seen the equipment.

The decision not to cut the air lances into three pieces following removal was made after the first draft of the work plan was written and involved changes to the flushing equipment, drawings, and work steps.

The fabrication of the equipment had not been completed prior to generation of the work plan, and the plan writers had not seen it.

There was confusion about the steps required and their sequence.

Changes were made to the work plan after HP signed it. HP recommended deletion of redundant surveys that were left in after removal was promised.

8. The field conditions were not conducive to good contamination controls.

There had been snow and ice on the ground since December 26.

It snowed over a foot more while work was in progress.

Temperatures dipped below 10°F.

The plastic and tape over the leaking flanges came unstuck, allowing contamination to dissipate when the air lances were lifted over the High Radiation fence.

9. Conduction of operations during the work was deficient.

Work was not stopped when workers found no work plan instructions to install the 4 blank inch flange on the first overpack. (Flange and

bolts were on hand.) A resolution was not sought prior to work on the second and third overpacks three DAYS later.

The plastic covering over the 4 inch flanges leaked contamination to the ground when the snow melted. OR 93-10 issued.

Glove bags were not used as specified in the work plan.

OR 93-12 was issued when ammonia-like gas "burped" when the plug was removed during hook-up to the riser of 241-SY-102 for rinsing. The work plan called for heating the overpack prior to plug removal in order to facilitate the rinsing.

Changes were made per telecon to the work plan regarding decontamination criteria that were radiologically incorrect. HP did not approve of this change, which was 60 times the release limit stated in the work plan.

Two of the overpacks arrived at CWC with smearable contamination. OR SLW 93-004 was issued.

Controls for exit from the area where the air lances were placed into the overpacks were inadequate. Contamination was carried into a riggers truck and onto the crane. OR 93-15 was issued.

10. There were improvements in the second evolution.

HP was brought into the process from the first meeting on air lance flush/disposal.

HP hold points and requirements were included in the work plan without the strong resistance encountered during Window G.

Hold point verification signatures were located within the procedure at the proper work step.

The steps for the three air lances were placed in the procedure in a serial manner, eliminating confusion as to air lance and step being verified.

Pre-job briefings included step-by-step discussion of the work plan and hold points.

Radiation Survey Reports were more detailed and included more notations of air samples taken during work. (Window H was even better!)

Documentation of HP hold point actions and compliance with WHC-CM-4-10 requirements had greatly improved.

8.0 REGULATORY COMPLIANCE

M. J. LA BARGE

During the planning phase, the regulatory impacts of the air lance removal were discussed with WHC Regulatory Support staff. Regulatory Support provided guidance that was based on a previously negotiated agreement with the Washington State Department of Ecology regarding the decontamination of spent equipment that had been in contact with tank wastes. The agreement allowed equipment contaminated with listed wastes to be decontaminated by being triple rinsed. After decontamination, the equipment could be disposed as low level waste, not mixed waste.

During the removal process, a triple rinse of the air lances was performed. Disposal of the air lances as low level waste was not scheduled until a later time. While the air lances were stored in the 241-SY Tank Farm, the U.S. Environmental Protection Agency promulgated a new regulation. The new regulation, known as the "Debris Rule," changed the way contaminated equipment should be managed. The triple rinse decontamination procedure was no longer valid. Consequently the removed air lance retroactively became mixed waste subject to the 90-day accumulation period. Efforts were immediately refocused towards getting the air lances into an appropriate storage configuration at the CWC within the original 90 days. Weather and other delays eventually resulted in the original 90-day period plus a 30-day extension and an additional 10-day grace period to lapse without the air lances being received at the CWC.

Initially Regulatory Support staff had felt that the air lance would not be subject to the upcoming Debris Rule standards. Regulatory Support had also been given indications that disposal of the air lance would have been completed prior to the Debris Rule becoming effective. The result was a regulatory change that unexpectedly impacted the management of the removed air lances.

9.0 CONDUCT OF OPERATIONS

9.1 PROCEDURAL COMPLIANCE

See Appendix A for this information.

9.2 PROCEDURAL CHANGES

See Appendix A for this information.

9.3 COORDINATION OF FIELD OPERATIONS

L. E. EYRE

9.3.1 Weather

Weather conditions encountered during field activity covered the entire spectrum with the air lance removal, storage at SY-Farm, and eventual overpacking, flushing, and transport to the CWC for interim storage. The Window G venting occurred on September 2, 1992, and the first air lance was removed on September 12, with the air lance and TC removal effort continuing

through October 14. The weather during the removal period was typical Hanford fall weather, with afternoon ground temperatures to 100°F and cooling at night to near freezing. The thermal temperature cycles caused internal pressure cycles which contributed to the receiver leak problems. Time delays caused by last minute changes in removal plans, unclear and changing decontamination, packaging, shipping, and storage requirements slipped the field work on air lance disposal into mid-December 1992. By mid-December, weather conditions had degraded to freezing with several inches of accumulated snow for the field personnel to work in at SY-Farm. These weather conditions, coupled with the time constraint pressure coming from a hazardous waste violation and the pending Window H, put the performing field crews under extreme duress. It is the personal opinion of this author that we were extremely lucky to have gotten through these activities with only minor incidence and that we did not incur serious personnel, equipment, or environmental damage.

9.3.2 Containment/Contamination Control

Although considerable efforts were directed toward contamination and exposure control, it is evident from the spills, exposure incidents, and contamination spreads that we missed our goal of zero occurrence or incidence and that we must improve performance on future jobs. Again, this author would like to make the point that not requiring our field personnel to work under the worst case field conditions is part of the formula to zero occurrence or incidence.

9.3.3 Others

This author has elected to use this section to remind all parties that we are doing a lessons learned on an effort that is not yet complete. Two shielded receivers still remain in SY-Farm and, although exposures are low and most of the liquid has already leaked out, these receivers still remain as potential release problems and as obstructions to future SY-Farm activity. These remaining receivers could also again become issues with our "regulators" and should be dealt with expeditiously. The second incomplete issue is the 40-foot section of the broken air lance laying at SY-101's bottom. This issue has been analyzed and found acceptable for the 150 hp mitigation mixer pump, but W-211A project is gearing up for SY-101 retrieval using two 300 hp mixer pumps and the air lance may have to be removed for this operation evaluation and deemed acceptable for the large mixer pump operation.

10.0 CRITERIA DEVELOPMENT

10.1 DESIGN OF REMOVAL EQUIPMENT

P. A. TITZLER

The functional design criteria was provided in the air lance work plan, WHC-SD-WM-WP-149. The criteria included the following information.

10.1.1 The air lance removal hardware shall be designed to be intrinsically safe per National Fire Protection Agency code.

10.1.2 All parts installed in or around the tank riser shall be electrically bonded to the tank riser. Also, all equipment was grounded per applicable National Electric Code Article 70 codes.

10.1.3 The air lance removal hardware shall be used for the removal of air lances on tank SY-101 risers 1A, 1B, 14A, and 17C. All hardware was removed from the risers following the air lance removal and a blind flange installed.

10.1.4 Removal hardware and tooling shall be designed to minimize damage to the bottom of the riser as the air lances are removed.

10.1.5 A mobile crane, receiver, and air lance pulling mechanism shall be used to remove the air lances. An air lance pulling mechanism shall be provided to apply additional capability to force the air lance through the riser. The reaction force during the removal process using the pulling equipment shall be applied to the riser only to prevent damaging the riser to tank dome weld. An engineering analysis was performed to determine the allowable maximum force that can be applied to the air lances during the removal operation.

10.1.6 A mobile crane shall be used to position removal hardware over tank risers. It will also be used to control the position of the top of the air lance during the removal operation.

10.1.7 Gas monitoring for hydrogen in the riser and removal hardware shall be completed prior to and during the removal operation, as required.

10.1.8 Air lances shall be cleaned with a water spray system during the removal operation to remove sludge and/or caking material.

10.1.9 Caking material on the air lances shall be removed or reduced in size enough to allow the air lances to be pulled through the risers. Tooling shall be provided to prevent the riser from being plugged by caking material on the air lances.

10.1.10 A greenhouse shall be installed around the riser area to provide confinement during the removal process, if required. Part of the confinement system may be provided by closures designed into the removal equipment.

10.2 CRITERIA FOR DISPOSAL/STORAGE

H. L. ROACH/J. C. BIAGINI

Criteria for disposal/storage were not determined until air lances and TC tree had been removed.

10.3 CRITERIA FOR DESIGN OF OVERPACK/STORAGE CONTAINERS

J. W. THORNTON

The design criteria for packaging is normally given in the PDC document issued by Packaging Safety Engineering. In this design effort the PDC and the package design were developed concurrently. Packaging Design Engineering based the design on the worst case scenario which was the storage of the package at CWC.

Based on correspondence that had been forwarded concerning the effectiveness of the triple rinse, it was decided that the worst credible design case would be a payload classified Mixed-Category 3 waste. The transportation packaging would be designed for storage at CWC and meet the 20-year lifetime criteria. The shielding requirement, the transportation classification (e.g., Type A or Type B), and the CWC requirements determined the design criteria.

The package size was determined by the length and outside diameter of the air lance receiver payload. Provisions in the design had to be made for stabilization and direct burial. The design criterion as pertained to the payload length changed three times during a three-month period. The change in design of the transportation/storage packaging for rinsing the payload added extra time and effort to the development of the design criteria. The PDC reflected all of the various and contradictory requirements based on the different disposal scenarios. The hesitance of CWC to make decisions as to the acceptability of the design criteria delayed the design process unnecessarily adding time and cost.

The lessons learned are:

1. All parties involved in the development and/or acceptance of the design criteria must get on board early in the development process and be working toward the solution of the problem as delays in decision making, such as establishing the waste acceptance criteria, only adds to the problem and increases costs.
2. The design criteria should more closely represent actual requirements instead of what is the worst conceivable case or cases.
3. The review of the PDC by the various organizations should be performed in a timely manner which would mitigate unnecessary delays resulting in time and cost savings. The reviewers should limit their review and comments to their area of expertise so that time is not wasted answering superfluous comments.

11.0 EQUIPMENT DESIGN

11.1 INTRODUCTION

T. L. MOORE

Three full length air lances, approximately 55 feet in length, one upper section of a temporary air lance, approximately 18 feet in length, and one TC tree, approximately 55 feet in length were removed from tank SY-101 in September and early October. The 18-foot section of the temporary air lance has never been in contact with tank waste and is being handled as low level radioactive waste.

Initial planning for disposal of the air lances and TC tree went as far as identifying a schedule and rough cost estimate to prepare the air lances for storage as mixed waste. This schedule showed approximately 12 months would be required after removal from the tank before the air lances could be prepared

for mixed waste storage. The actual removal from the tank went as planned with the exception of two areas: 1) after triple rinsing, weather prohibited the removal of the air lances for several days which allowed waste to seep back into the inside of the air lances, and 2) leakage occurred after the receivers were positioned on the ground in the TF. In addition, in early October the decision was made that the TC tree should also be removed. This was done using the same equipment as was used for the air lances with some minor changes. Window G closed in early October, nearly 30 days after removal of the first air lance.

The effort to store/dispose of the air lances was begun after Window G closed. Storage of the air lances required design and fabrication of qualified shipping/storage containers as well as preparation of packaging and shipping documentation. These activities normally take 9 to 12 months after a conceptual design has been completed. Completion of all activities required to package and ship the air lances was accomplished in approximately 4 months, a noteworthy accomplishment under normal conditions and especially in light of adverse weather conditions which affected both fabrication of equipment and field work. WHC was not as responsive to Washington Administration Code 173-303 requirements as desired in two areas: 1) a proper 90-day storage area was not prepared until mid-December; and 2) a 30-day extension to the 90-day requirement for transport to a permitted facility was missed by 9 days. In addition, the contingency plan referred to in WHC Readiness Review "Tank 241-SY-101 Window G Activities Readiness Review Checklist," Action Item 3.7, was not implemented in a timely fashion. During the 4-month period that storage activities were in progress, communications with DOE and the Washington State Department of Ecology were maintained and an excellent spirit of cooperation was experienced as the organizations worked together to resolve issues.

11.2 AIR LANCE REMOVAL EQUIPMENT

P. A. TITZLER

11.2.1 Engineering and Design Tasks

The air lance removal equipment consists of pullers for jacking out the bent air lances, cutoff tools for removing the top (above ground) section of the air lance, washer system for the decontamination of the air lances, and a receiver for the final disposal of the air lances.

The equipment associated with the air lance removal task was developed as a facility-use prototype in accordance with WHC-CM-6-1, Standard Engineering Practices, EP-2.4, Development Control. The fabrication was completed using "Development Control" design sketches followed by releasing approved as-built H-2- drawings. Changes to the "Development Control" design sketches were controlled by either marking the changes in "red" or preparing additional sketches and identifying traceability with the affected sketch. All changes were approved by the cognizant engineer by signing and dating the changes. Through field inspection, the drawings were verified that they accurately reflected the fabricated items. The drawings were released prior to using the equipment at the SY-101 Tank Farm.

The air lance work plan provided instructions for removal of the air lances and was later changed to remove the TC tree. The assemblies were bent inside the tank and were removed directly into a steel receiver using a hydraulic jacking device.

11.2.2 SY-101 Air Lance Removal Description

The SY-101 Air Lance and TC Removal Program was completed basically in six phases: site preparation, air lance manifold removal, upper air lance flange assembly removal, air lance removal, waste cake ball removal, and air lance packaging for disposal. Hardware was designed to be installed on the tank dome risers for the removal of currently installed air lances. The air lances had been damaged due to crust or fluid movement and could not be removed using the existing lifting bails. Additional force was required to pull the air lances through the risers. Cleaning equipment to remove sludge and caking material from the air lances as they were retrieved from the tank was also provided with the removal hardware. The reaction force during the removal process using the pulling equipment was applied to the riser only to prevent damaging the riser to the tank dome attachment weld.

11.2.2.1 Phase 1, site preparation, involved transporting the removal equipment to a staging area at the SY-101 tank site. This phase included the positing of the crane and providing plastic ground cover, greenhouse, and electrical power for small equipment. A hydraulic power pack was available to operate the air lance pulling equipment and an air supply was used to actuate air pipe clamps. Hydrogen monitoring equipment was used to monitor the tank atmosphere before and during the air lance removal operation.

11.2.2.2 The second phase involved the removal of the manifold at the top of the air lance assembly. The manifold was cut off using an external pipe cutter and was disposed in drums.

11.2.2.3 Phase 3 removed the upper air lance flange assembly which was welded to the 2-inch air lance pipe. The welded flange interfered with the installation of the washer assembly and the 18-inch pulling equipment. Therefore, a 12-inch puller was used with specific steps to get the flange high enough to be removed while allowing enough of the air lance pipe remaining above the riser for the installation of an 18-inch puller and water spray assembly. Since the movement of the air lance during this phase was expected to result in the highest removal loads in possibly the weakest section of the air lance, a safety cable and mandrel was pushed down the air lance to a position below the bend in the pipe. If the air lance broke during the pulling operation, it would be restrained by the safety cable. The safety cable attached another mandrel near the top of the air lance, and this mandrel attached to the crane to provide a backup method of holding the air lance if the pulling equipment didn't hold. Once the flange was moved high enough, the pipe was cut just below the flange using an external pipe cutter. The cut section of pipe with the flange and the air lance rotating device was then disposed in drums. The internal diameter of the air lance was flushed by plugging the air lance at the top and providing pressurized water to flush the air lance.

11.2.2.4 The fourth phase removed the air lances from the tank. This method was changed at the end of the initial design phase from cutting the air lances into three pieces to stack three receivers end to end and remove the assemblies in one piece. The water spray assembly was installed to decontaminate the air lance as it was pulled from the tank riser. Also, the air lance internal diameter was flushed prior to starting the removal operation. The spray and flush equipment was supplied by a tank truck containing hot water.

An 18-inch puller was used during this fourth phase to jack the air lance from the riser and push it into the three receiver stack positioned over the riser in a stand. The receiver had 1-inch walls to provide shielding during the removal operation and disposal of the air lances. The receiver had a floating piston with rigging and water attachments to provide a backup method of holding the air lance to prevent it from going into the tank if the puller equipment didn't hold the air lance. The piston also provided shielding at the top end of the air lance. After the air lance was removed from the stand, it was sealed with a flange. The bottom of the air lance was fitted with a ball valve which could be closed remotely. If radiation levels were low, the valve would have been removed for reuse and the receiver sealed with a flange.

11.2.2.5 The fifth phase of the operation was completed in combination with Phase 4. A ball of waste material was expected to be attached to each of the air lances in the area of where they entered the waste surface. The size of the waste material balls varied but they had to be removed to prevent plugging the riser during the water spray decontamination process and to reduce the radiation levels. Tools fitted with scrapers and spray nozzles were used to remove the waste material balls from the air lances. The tools were used through the riser manipulating it between the riser internal diameter and the air lance outside diameter walls.

11.2.2.6 The last phase, Phase 6, involved the solid waste packaging of the removed air lances and was completed. The air lance manifolds and the flange assembly section were low radiation levels and packaged in drums. The remaining section of the air lance assemblies were packaged in the stack of three receivers. The ball valve remained on the receiver and the sealing flange was placed on the valve.

Backup equipment was designed along with the air lance removal equipment to be used in the remote case of a work stoppage due to a stuck air lance or other circumstances. The equipment would cap and seal the riser following an air lance cutting operation which left approximately three feet of the air lance above the riser flange which could be used to pull the air lance at some future date.

11.2.3 Design Uncertainties

The following design uncertainties were provided in the air lance work plan.

11.2.3.1 Sludge Weight Cable or Other Items Tangled Around Air Lances

An engineering evaluation would have to determine if the material could be pulled out with the air lance. If not, the air lance would have to be capped off and secured.

11.2.3.2 Air Lance Jams in Riser and Loading Limits Were Reached

An engineering evaluation would have to be completed to exceed the limit but remain below the yield strength. If the pipe had to remain in place, the air lance would be cut off above the riser and capped off.

11.2.3.3 Air Lance Breaks While Attempting to Remove It from the Tank

A backup device was designed to be inserted inside the air lance prior to the start of pulling the air lance. This equipment could be used to secure the broken air lance to the bottom of the riser but would not have the strength to pull the air lance from the riser.

11.2.3.4 High Radiation Levels

Portable shielding should be available at the site while the removal operation was in progress.

11.2.3.5 Contamination of Riser Internal Diameter with Crust Material

The riser was flushed with the air lance washer apparatus.

11.2.3.6 Effectiveness of Air Lance Internal and Outer Diameter Flush

The air lance could have had high radiation levels if the washer was not effective. Portable shielding might have had to be used during the removal operation. Air lance disposal containers would require additional shielding and probably high storage costs.

11.2.4 Design Verification

The final design of the subject system was verified per the requirements of an independent review and qualification testing per EP-4.1, Design Verification Requirements.

11.2.5 Engineering Analysis

An engineering analysis was performed to determine the force required to pull the bent air lances from the tank risers. Removal difficulty of the caking material on the air lances and shearing of the orifices was considered in determining the removal force. Also, a structural stress analysis of the removal hardware was completed to determine the maximum allowable removal force. This limit was determined to prevent unacceptable damage to the risers or breaking assemblies during the removal operation.

11.2.6 Equipment Design and Development Lessons Learned

The following is a list of the major design and development problems associated with the removal equipment.

11.2.6.1 Sufficient waste characterization information was lacking during the preparation of the design criteria and through the design effort. This lack of information resulted in receiver design problems to satisfy ALARA and SWD requirements. The effectiveness of the external spray wash and the internal flush could not be determined. This resulted in changing the removal concepts at the end of the initial design. The concept of cutting and packaging the assemblies in three pieces was dropped. The design was then changed to stack three receivers end to end to allow the assemblies to be removed in one piece. The receivers were to be split apart later at TFs away from the tank and repackaged into the individual receiver sections (22 feet long) like the original design. The approach was again changed after the assemblies were removed to transfer them into overpacks (26-inch pipe) for storage due to the high radiation readings and the original receivers were not acceptable to SWD for storage.

11.2.6.2 SWD and/or storage requirements were not available during design criteria preparation and could not be established during the design effort. This added to some of the receiver changes indicated in the above paragraph.

11.2.6.3 Sufficient containment barrier requirements were lacking in the design criteria. Containment requirements and barriers were determined during the equipment development phase.

11.2.6.4 Waste material leaked from the receivers containing the removed assemblies. The stacking of three receivers end to end in order to remove full length assemblies resulted in the flange gaskets not sealing. Even though the flange sections were stiffened, the leaks resulted from either assembly problems during fabrication or the joints were worked during the receiver handling operations. A second place leaks were found was at the caps covering the piston locking assembly. These leaks resulted from not providing gaskets for the caps and relying on metal to metal contact. In addition, moisture absorbent was not placed inside the receivers during the removal process.

11.2.6.5 The program was shut down for approximately five weeks due to lack of funding. This shutdown resulted in less time to complete the equipment development, testing, and training phases of the program. Also, funding was not always sufficient to prevent overruns which delayed some procurements.

11.2.6.6 Mockup facilities on site limited the use of test assembly lengths to less than full length (less than half the length assembly to be removed). This resulted in testing and training being completed in mockups less than prototypic.

11.3 AIR LANCE STORAGE EQUIPMENT/CONTAINERS

R. W. BARKER

It is very important to establish the basic functional requirements of a system prior to establishing specific design criteria of a system. In the case of the SY-101 air lance disposal/transportation containers, the basic functional criteria were:

1. The radiological source term determination.
2. The CWC acceptance criteria.
3. The waste classification.
4. The ALARA restrictions.

None of the four basic functional criteria were established early in the design phase of the disposal/transportation containers. Two of the criteria changed late in the process due to a change in the Washington State Department of Ecology and the U.S. Environmental Protection Administration's approved cleaning process (triple rinse versus the debris rule). However, in our judgement two criteria, the radiological source term determination and the ALARA restrictions, could have been established early in the process.

Considerable time was wasted in performing design and analysis activities that had no input to the final design because of the changing source term estimates and because of a late decision to forego disassembling the air lance receivers because more conservative ALARA restrictions were imposed.

In summary, the radiological source term, the ALARA restrictions, waste classifications, and waste acceptance criteria need to be defined earlier in the process. It is very difficult and expensive to design when requirements are constantly changing. Some changes are inevitable, but some can be alleviated with proper planning.

Communications between the various organizations must be established and maintained in a frequent and continual manner. It's my opinion that short semiweekly meetings, for a program as dynamic as the SY-101 air lance receiver removal task, would not be too often. The purpose of these meetings would be to bring everyone concerned up to date on the latest status of the task.

11.4 AIR LANCE TRANSPORTATION/STORAGE PACKAGING

J. W. THORNTON

The packaging was designed to meet the requirements of any of the various disposal scenarios. The package design and the PDC were developed concurrently. The changing payload lengths, shielding requirements and type, radiological decontamination procedures, and disposal criteria made for a myriad of different package designs. Each packaging design option was analyzed for all possible configurations. The design requirements changed repeatedly which led to numerous drawing changes and a large amount of man-hours being spent on analysis and engineering.

Not all of the packaging requirements that were determined by the various departments were transmitted to Package Design Engineering in a timely manner which resulted in design changes late in the fabrication process. Although it is not unusual during the design phase for additional requirements to be imposed and for a design to evolve, in this case the basic PDC changed three times.

The original package design initiated on October 26, 1992 was for a 70-foot long cylindrical packaging with a maximum of 3/8 inch of lead shielding with an option for stabilization with concrete for burial. This packaging was to be used in conjunction with a 70-foot rinse tube.

The second design initiated on December 1, 1992 was for cylindrical packaging of two different lengths, 26 and 48 feet, with 3/4 inch of lead shielding and with the option of stabilization and burial. There was the option of using these packages in conjunction with a rinse tube.

The final design initiated on December 28, 1992 was for a 70-foot long cylindrical packaging in which the air lance and air lance receiver could be rinsed for radiological decontamination, transported, and stored. At this time the second design was in fabrication, one of the three 48-foot packagings was completed, the other 48-foot packagings were nearing completion, and the three 26-foot long packagings were partially completed. The change back to the 70-foot long packaging design was accomplished by cutting one each of the 48-foot long and 26-foot long packagings and welding them together to form one each of the 70-foot long packaging. This design could accept the 3/4 inch maximum of lead shielding anywhere along its length and qualify for onsite transport and storage at CWC. The final package design with no shielding was shipped to CWC for storage.

The lessons learned are:

1. The design and analysis of the different transportation/container configurations can be done in a very short time but at a cost in extra man-hours.
2. Designing for every contingency is not cost effective. Costs and man-hours could be better controlled if, at the start of design, the design criteria were clearly and realistically defined and all involved WHC departments were in agreement as to the final disposition of the packaging and payloads.

11.5 SHIPPING ANALYSIS/DOCUMENTATION

D. B. CALMUS

Due to the time restraints for this project, the design and fabrication of the packaging containers were completed prior to approval and issue of the Safety Evaluation for Packaging. The intent of the Safety Evaluation for Packaging was to evaluate the packaging design prior to starting fabrication to ensure that the packaging design was acceptable for containment and onsite transfer of radioactive materials. Although no major packaging changes were required after the Safety Evaluation for Packaging evaluations, it was a gamble to

start fabrication early and should be avoided whenever possible for future projects.

12.0 FABRICATION

C. G. KRUEGER/J. W. THORNTON

12.1 PROCUREMENT (An Observation)

Very few problems occurred for procurement of materials for the air lance packaging. The only noteworthy item is the organizational structure of the 200 Area Fabrication Shops Material Procurement and Control Services in comparison with past practices in the (now closed) 300/328 Building Fabrication Shop. The noteworthy item is that in the 200 Area five persons are assigned varying degrees of responsibility for material procurement and control. In the 300 Area Fabrication Shop, one person performed the following activities.

- 12.1.1 Reviewed the drawings and work package for needed parts and materials.
- 12.1.2 Performed any necessary market research relating to parts.
- 12.1.3 Interfaced with the cognizant engineer for materials and parts.
- 12.1.4 Prepared and issued the purchase requisition.
- 12.1.5 Arranged for approval signatures.
- 12.1.6 Coordinated with Procurement and Materials Management.
- 12.1.7 Performed follow-up as necessary.
- 12.1.8 Coordinated and interfaced with Receiving Inspection.
- 12.1.9 Received and staged the material in 328 Building.
- 12.1.10 Provided material control services.

This may be one of the causes of the high hourly liquidation rates for the 200 Area Fabrication Shops.

12.2 FABRICATION

12.2.1 Problem A

Stiffening rings were required for each container. All stiffening rings were to be identical. The work package required first article inspection by the cognizant engineer. The first article was fabricated and provided for inspection. The article was well done, met all of the dimensional requirements, had appropriate surface finishes, and was approved. A total of 53 more stiffening rings were made. However, 37 parts were defective in several dimensions. A nonconformance report was issued for the lot.

The nonconformance report disposition required: 1) additional stress analysis, and 2) an engineering change notice to alter the applicable weld symbol to compensate for out-of-tolerance inside diameters. Issuance of the nonconformance report, establishing the resolution, and performance of the additional welding required additional effort.

12.2.2 Lessons Learned A

The stiffening ring fabrication method was developed by one set of craftsmen for first article inspection. Another set of craftsmen was assigned to continue the production run. Obviously, the second set of craftsmen did not understand or know how the setup for the first article was made. Transfer of information was inadequate.

It is incumbent on workers and supervision to verify understanding of requirements. Perhaps workers did not know the equipment, do not know their craft as well as they should (other items given below suggest that some craftsmen are not as skilled at their craft as they should be expected to be), or do not have a quality conscious attitude. A method that could have been used is to have the follow-on crew perform the setup for review by the setup developer. Unfortunately, ignorance is bliss.

12.2.3 Problem B

As the design evolved through at least three major iterations, the number of stiffening rings required were increased, more material was ordered, and additional stiffening rings fabricated (but not all used).

However, the final container (design) was made from a combination of a section of the 48-foot long packaging joined to a section of the 26-foot long packaging (to provide a 70-foot length). But because the 48-foot and 26-foot packagings were in late stages of fabrication and assembly, more stiffening rings were in place than were actually required to meet packaging criteria. The net effect was an unnecessary expenditure of time and money for material, fabrication, assembly, and inspection.

12.2.4 Lessons Learned B

The lessons learned for this problem are related to the several design iterations caused by lack of source terms, which is adequately reported by others, and inadequate planning and/or lack of firm direction regarding rinsing/mixed waste/storage size requirements.

12.2.5 Problem C

During the final fabrication of the 70-foot long container, it was discovered that after rinsing, the blind closure flange could not be attached at the rinse inlet end without removing the bolting which held the rinsing spool in place. Also, the gasket between the spool piece and the slip-on flange would have to be replaced. Replacing the gasket would require either the rinse spool piece to be disconnected from the rigid receiver for removal, or the

entire rigid receiver would have to have been removed. Doing either would require additional personnel exposure, and would allow conditions to prevail which had a good probability of leakage and contamination of persons and/or property.

The design interface requirements between the design for the packaging and the design for the rinsing spool piece was obtained primarily from the responsible drafter (working in the same group as the container drafter). Efforts to contact the rinse spool piece cognizant engineer(s) during the work day were only partially effective as the designer(s) either were out in the area with no forwarding telephone number or were home sick. I called him/them at home in the evening at least three times. That was partially effective, but was no substitute for face-to-face discussions with a drawing placed between participants.

The design problem was resolved by the emergency issuance of engineering change notices to alter the final closure design. Note that emergency engineering change notices always add emergency fabrication, require more workers, or more overtime. The engineering change notices allowed the blind flange to be bolted in place with the rinsing spool before rinsing to allow pre-rinse access to connections after the blind flange and the rinsing spool was bolted in place. In addition, a bolted cover plate was added to restore the containment boundary after rinsing was complete.

12.2.6 Lessons Learned C

The cause was a result of insufficient coordination between the various design/cognizant engineers. My efforts to try to understand how the interface would be accomplished were not pursued strongly enough. My question to the other cognizant engineer(s) regarding how the interface would be accomplished was answered with, "I have it taken care of." The task leader should have encouraged discussion beyond the "I have it taken care of" statement.

Obviously, time was important to all and could not be wasted. Meeting length should be held to a minimum and unnecessary discussion omitted. However, my experience suggests that there is a time to hurry (and take shortcuts) and a time to go slow and touch all the bases. Wisdom suggests that interface details is one of those times when one should touch all of the bases and should be pursued until it can be verified that all parties achieve understanding and consensus. I feel that if the interface dialogue were required to continue, the deficiency would have been identified and resolved.

A technique which can be used when conducting meetings to allow each person's concerns to be aired is to "zip around the table." This provides a forum for questions, suggestions, and uncertainties to be aired and is accompanied by any necessary discussion. This provides needed cross talk. This method will add to the length of the meeting.

12.2.7 Problem D

An item was noted which related to stamping of the drawing number on the finished product. This item is identified here only because it relates to root causes steeped in employee attitudes which frequently produce less than "total quality" work.

The finished product was painted with a combined sequence of undercoats and top coats intended to provide/ensure 20-year outside storage life. As it turned out, the component drawing number was stamped on the first completed unit but after painting was complete. This disturbed the protective paint coatings. Instructions were then issued by the cognizant engineer to apply a final coating of paint over the number stamps.

12.2.8 Lessons Learned D

These problems are related to built-in quality and are caused either by worker indifference, ignorance, or lack of awareness. Some things should be understood and not require instructions. If an article is given a two-coat undercoat and a two-coat top coat, it should be obvious that the paint should not be damaged by impact stamping which will damage the rust preventative coatings applied.

12.2.9 Problem E

An incident was noted during the bolt-up of the bottom flange to the first 70-foot long container that was finished. After the 26-inch flexitallic gasket was put in place and bolts torqued "firmly hand tight" (as required as one of the steps of the procedure), one of the fitters brought out a screw jack to push the blind upward to a more concentric position with respect to the mating slip-on flange. I objected, as this would have damaged the flexitallic gasket. The other fitter agreed. The bolts were loosened, the flange was centered and bolts re-tightened by hand. Had I not been there because of my special interest, the flange undoubtedly would have been damaged, the assembly probably would have leaked, and my personal reputation would have been damaged.

12.2.10 Lessons Learned D and E

Just as with the gasket, if a craftsman is a journeyman (in this case a fitter), he ought to understand his craft and he ought to be aware. He isn't there just to tighten bolts!

The lessons learned is that the craftsmen must fully understand their craft. Knowledge of one's craft includes awareness. Survival in our highly visible arena requires "one to protect his personal reputation, the reputation of his craft, and the reputation of his industry!" This is accomplished by doing things right and with quality, which also depends on the little things.

12.3 OTHER FABRICATION ISSUES NOT COVERED ELSEWHERE

12.3.1 Problem A

The variety of shielding scenarios required the designer to plan for differing styles of storage supports. The difference was primarily one of a different radius required to account for different shielding material/thickness. Shielding 3/4-inch thick requires a different support radius than 2-1/2 inches of steel or 6 inches of concrete. Thus, a design for two styles of supports was prepared.

12.3.2 Lessons Learned A

The lessons to be learned from this item are related to the several design iterations caused by lack of source terms and are adequately reported by others.

12.3.3 Problem B

The variety of shielding scenarios required the designer to plan for venting and grouting access nozzles. Designs were prepared.

12.3.4 Lessons Learned B

The lessons to be learned from this item are related to the several design iterations caused by lack of source terms, which are adequately reported by others, and inadequate planning and/or lack of firm direction regarding rinsing/mixed waste/storage size requirements.

12.3.5 Problem C

It was found during field operations that the "rollers skates" bolt-up mechanism was poorly fitted to the rigid receiver. An erroneous hole diameter taken from one of the rigid receiver assembly drawings was used for roller skate design. The erroneous dimension was part of the basis for the method used to bolt the rollers to the rigid receiver. The field observation of the poor fit led to the erroneous dimension. In turn, this was followed by emergency fabrication of bushings to provide proper support for the rollers used to roll the rigid receiver into the 70-foot long container.

12.3.6 Lessons Learned C

Even after review of drawings by the designer, and the drafting and checking were performed, drawing errors still occurred. Drawings are usually not perfect. However, in this case, something could have been done which would have alerted the roller skate designer to the faulty dimension. See Section 12.3.8 below.

12.3.7 Problem D

During the field operations, it was decided to use more sets of roller skates than planned by the designer. This resulted in too few rollers for all three rigid receivers. This resulted in emergency procurement of additional bearings and emergency fabrication of more bushings.

12.3.8 Lessons Learned D

An extra rigid receiver was fabricated, ostensibly to be used as a prototype for test purposes. Unfortunately, it was inside the radiation zone at the TF. Thus, it was unavailable for checking of fit-up of the roller skates or for prototype testing of the rigid receiver insertion procedure. The ability to verify the mechanics of insertion may have prevented the desire to use more roller skates than the design provided and eliminated the need for emergency procurement of bearings and fabrication of bushings.

A mockup, prototype, or training unit should be kept out of radiation zones to enhance its utility. In the radiation zone, the prototype was useless.

13.0 TESTING

13.1 LABORATORY TESTING, 305 FACILITY

P. A. TITZLER

The air lance removal equipment consists of pullers for jacking out the bent air lances, cutoff tools for the sectioning of the air lances, washer system for the decontamination of the air lances, and a receiver for the final disposal of the air lances. The equipment was tested both in the 305 Building and in the tank mockup behind the UO3 Building in the 200 West Area. Equipment checkout and preliminary tests were completed in the 305 Building, then the equipment was shipped to the 200 West Area for final preliminary testing and then the qualification test. One of the final steps of the QTP provided for the acceptance and green tagging of the equipment for use in TFs. Qualification tests were completed to ensure that the design and fabrication of the hardware complied with technical, quality, and safety requirements before authorizing its use in the facility. Included in the qualification procedure was all testing and equipment acceptance requirements. The qualification test provided assurance that all equipment performed as designed. Following the qualification testing, fabricated equipment was validated against the engineering drawings per EP-2.4, paragraph 5.2, and accepted by engineering and Quality Assurance. The equipment was then tagged as accepted with a green tag for release to TFs for use. Details of the acceptance of the equipment was included in the QTP and was issued as a separate document.

The testing program was completed in planned steps by first checking out and testing individual components. Then all the air lance removal equipment was assembled in their final configuration and tested as a unit. All component testing was completed in the 305 Building and the final testing of the configuration was completed in the 200 West Area mockup.

1. Puller #1 - The puller was assembled and checked for parts interference and then operated with the hydraulic power pack to check performance.
2. Puller #2 - The puller was assembled and checked for parts interference and then operated with the hydraulic power pack to check performance.
3. Cake Ball Removal - This test consisted of removing a caking ball made of simulated tank waste material attached to a section of 2-inch schedule 40 pipe.
4. Pipe Cutoff Tool - A pipe cutoff tool was modified and tested to determine its effectiveness for cutting the air lance.
5. Washer - The washer test consisted of checking out and operating the washer for a short period of time using the washer pump to determine the pressure needed for the best spray pattern and/or least amount of blow by the washer wiper.
6. Nozzle Shear Test - The air lances were fitted with five nozzles, some of which were plugged with 1/8 inch pipe plugs.
7. Temporary Air Lance Coupling - The temporary air lance had been screwed together using pipe couplings. Tests were performed to determine the amount of force to move the coupling past the bottom of the riser.
8. Receiver Rigging - The fit-up of the receiver rigging was verified using one of the fabricated receivers.
9. Mandrel With Safety Line - The mandrel and safety line were installed into a length of 2-inch pipe schedule 40 to determine proper fit.
10. Temperature Measurement Test - A TC was installed at the bottom of the riser during three removal efforts, including the test involving the full length air lance.

Full Length Air Lance - The final test in the 305 Building was completed in conjunction with the removal sequence testing above. Two-inch pipe schedule 40, the approximate length of an air lance, was pulled using the removal equipment and the removal sequence test procedure. Since the 305 Building pit is not deep enough to accommodate the full length air lance, the bent bottom section would drag on the floor providing a worse case condition. All maximum and minimum loads were recorded along with air lance position.

13.2 FIELD TESTING

P. A. TITZLER

13.2.1 Field Testing of Removal Equipment

Preliminary testing of the air lance removal equipment was performed using a draft QTP. The draft was redlined and modified by the test engineer as needed to provide a procedure that was usable for TF Operations. Equipment problems

and modifications were resolved per EP-2.4, Development Control. After several dry runs, procedure changes were incorporated into the final QTP.

The purpose of the QTP was to provide a procedure for the qualification testing of the air lance removal equipment for the SY-101 tank. The qualification testing was intended to verify adequacy of hardware design and performance and the air lance removal procedure under simulated TF conditions.

13.2.1.1 Test Objectives

The QTP was provided for the validation, acceptance, and green tagging of the equipment for use in TFs. Qualification test was completed to ensure that the design and fabrication of the hardware complied with technical, quality, and safety requirements before authorizing its use in the TF facility. The air lance removal procedure was also used during the hardware testing to verify removal steps.

13.2.1.2 Test Methods

Equipment checkout and preliminary tests were completed in the 305 Building and the 200 West Area prior to performing the qualification test. Following the qualification testing, fabricated equipment was validated against the engineering drawings per EP-2.4, paragraph 5.2, and accepted by engineering and Quality Assurance. The equipment was then tagged as accepted and a green tag was attached to the equipment for release to TFs.

13.2.1.3 Test Condition Limits

If problems developed during the performance of the qualification test, the testing was stopped and the problem evaluated. The test was either resumed after documenting the problem with a test exception (TE) or the equipment was modified and retested. The retest may have involved a complete retest or just part of the procedure depending on the extent of the modification as determined by the cognizant engineer and Quality Assurance. TEs were documented on the TE data sheets.

The qualification test procedure was completed verifying the adequacy of hardware design and performance under simulated TF conditions. The removal equipment required one TE to the hydraulic pump assembly pressure relief installation. The air lance removal procedure required several step changes (four TEs) to accommodate the equipment operation or to provide an easier method of completing the required steps. Recommended hardware changes also resulted from the test which included providing an off/on switch to the washer pump assembly, a push rod to position the double mandrel, and spacers for the lifting eyes on the #1 casing puller. The switch has been ordered and the push rod has been fabricated. New lifting eyes without a shoulder have been provided to lift the #1 puller when the top plate is not in place.

13.2.1.4 Training of Operating Personnel

The tank mockup in the 200 West Area should also be used to train personnel on the operation of the removal equipment and procedures prior to use at the SY-101 Tank Farm. Engineering provided support for this activity.

13.2.2 Field Testing of Storage Containers

J. W. THORNTON

Field testing was performed by the staff of the Nondestructive Testing group centered in the 306E Building. The drawings required magnetic particle testing of longitudinal seam welds on procured pipe. Testing by the WHC/Nondestructive Testing group was planned by the cognizant engineer because it expedited acquisition of the pipe in the interest of the schedule, and may in fact have been less costly than requiring the vendor to contract magnetic particle testing of pipe at the warehouse (after having left the fabrication plant).

Testing of welds required as a consequence of in-house fabrication included visual test of fit-up, root-pass, and final pass; plus magnetic particle testing final pass; with the exclusion that visual test could not be performed on the fit-up and root-pass of the longitudinal seam welds made by the pipe fabricator.

Magnetic particle testing of the weld prep was not required by either the drawings or any applicable code. However, many such inspections were performed before the practice was ended. This was an abuse of the schedule crisis promoted by one of the inspectors. Some abuses of overtime to inspect welds was allowed to occur. One abuse that occurred initially was poor scheduling for inspection. Inspectors weren't "scheduled" but spent many unnecessary hours just "being there." Also, there was a strong appearance of the inspector driving the overtime schedule rather than having the work progress drive the inspector schedule.

13.2.3 Lessons Learned

Overtime abuses raise costs unnecessarily. Such abuses may take several forms in addition to those listed above. These include choosing to work on the second day of rest instead of the first day. More subtle abuses include refusing to work only a double shift when four hours will complete a needed task or working a double when two hours only is needed to get a part finished that is needed the next morning. Obviously, we do not have to provide dinner time for workers who only work an additional two hours. That is most efficient. The workers have the system buffaloed when it comes to overtime. Management needs to be more involved in controlling such costs. This can be a management controllable problem and should not be delegated exclusively to the line supervisor.

14.0 PROCEDURE DEVELOPMENT

14.1 REMOVAL EQUIPMENT

P. A. TITZLER

See Section 13.2.

14.2 STORAGE CONTAINERS

J. W. THORNTON

Packaging Design Engineering prepared the procedure for torquing of flange bolts for sealing metal gaskets. The preparation of the procedure was expedited (sooner than the planned sequence of design tasks to accommodate the field procedure writer, but it was good team work) and sent to the individual responsible for the field procedure for inclusion in the work package being prepared.

No problems were noted. However, it would have been appreciated, perhaps comforting, if feedback had been provided regarding success or lack of. Feedback, especially positive feedback, can promote feelings of mutual benefit and teamwork which lead to increased productivity and improved quality. None of us should ever feel we are too busy to take time to provide feedback to those with whom we work. Public acknowledgement should not always be required. Many times a simple telephone call to say "it worked well" will provide a source of satisfaction and further stimulation for quality work.

14.3 EQUIPMENT FABRICATION

J. W. THORNTON

14.3.1 Fabrication

Welding procedures and most other fabrication procedures used were those in place in the WHC system at the fabrication shops.

Grit blasting of pipe, stiffening rings, and subsequent painting, in accordance with the Steel Structures Painting Manual, is difficult when grit blasting must be done in undersized or makeshift facilities. Grit blasting to meet the intent of the Steel Structures Painting Manual is difficult in the winter if it is necessary to move the cleaned product in the wet, snow, and roadway splatter to get to the fabrication shop after blasting. Grit blasting can be hazardous to personnel. In addition, for the air lance project, a purchase order for blasting grit was processed which estimated cost at \$900+.

14.3.2 Lessons Learned (A Suggestion)

In a suitable facility, grit may be saved and reused. If blasting is performed in an outside or makeshift facility, the grit is lost in the dirt or blown away. Wind blown grit is a safety hazard. However, as additional packagings made of carbon steel are built for which a 20-year storage life is required, grit blasting should always be required prior to painting.

A surface blasting method using carbon dioxide gas was recently demonstrated in the 200 West Area. Perhaps this kind of equipment could provide a more accommodating method to prepare steel surfaces for painting.

14.4 TEST PROCEDURES

J. W. THORNTON

Nondestructive examination procedures used were those in place in the WHC/Nondestructive Testing group system. Procedures were adequate and examiners sufficiently qualified to perform the required tests.

15.0 WORK PACKAGE DEVELOPMENT

15.1 WORK PLAN/PROCEDURE

15.1.1 Work Plan Preparation

A. G. HANSON

Due to the lack of repetition in performing the window work activities, the work plans need to be written with added flexibility. On routinely performed activities, very specific procedures can be written and revised based on experience of the specific operation. In performing the window activities there is limited experience in the specific operation. The work plans are written based on performance of similar activities and mockups of the activities. This helps the work plans to be fairly accurate, but situations arise in the field that cannot be anticipated. An added bonus to providing flexibility to the work plans is that operations and maintenance personnel are required to think rather than to blindly comply with procedures.

One area that caused problems in completing the work plans was modifications to the design and safety assessment. This activity had numerous design and safety assessment changes at the last minute which required work plan changes. There needs to be a point when the design and safety assessment are completed and work plans can be written to that criteria.

15.1.2 Disposal

L. E. ROSS

15.1.2.1 Engineering should have taken the lead on development and technical support for the work plan.

An engineer should have been assigned to work directly with the engineering writer to provide technical support and guidance. Technical information must be developed by engineering and then given to the engineering writer to incorporate into the work plan. This work had the engineering writer deciding what technical material was needed for the work plan, ensuring the technical information was correct as well as formatting the work plan. This was totally out of the writer's job scope for an engineering writer.

Assignment of an engineer for this work plan could have provided a better work plan sooner.

15.1.2.2 The length of time for developing the work plan until the date that the work plan needed to be in place was too short.

The assignment to write the work plan was issued at the end of November 1992, with the actual work beginning on December 8 and completion on January 7, 1993. Development of the work plan should have been started when planning was

begun on the whole job, not as an afterthought. By the time I was assigned to write the work plan, the date for it to be completed was a little more than a month away, which is not nearly enough time to develop a work plan from scratch.

Better planning could have helped in providing more time for work plan development.

15.1.2.3 The lack of a central planner/leader made the development of this work plan difficult to prepare.

There were excellent meetings led by Tom Moore that were both informative as well as issue resolution oriented but they were not on a regular basis. What should have been started was a weekly planning and report type meeting that was guided by one person with all the principal people in attendance. Responsibility for this work must be done with one person in charge of seeing that it is accomplished on time and correctly.

15.1.2.4 The lack of a team concept made it difficult to determine who the principal players were.

The creation of an Air Lance Removal Team could have enhanced and speeded up the necessary development of the work plan initially. This team could have been the primary respondents at a weekly planning/resolutions meeting that would have further helped in the work plan development.

15.1.2.5 Technical assistance in developing the work plan was lacking.

As was stated earlier, technical support should have provided not only how the work was to be done but what technical information should be included to support the work as well as the technical material that is mandatory for TF work of any kind. All of this had to be assembled and developed by the procedure writer. Rinsing issues were still being changed and developed a few days before the work plan needed to be issued. The use of absorbent and the kind to use was also a last minute addition that was not provided by engineering at the proper time. Last but not least, the whole area of transport of the air lances was never really developed until a few days before the final sign-off of the work plan.

An assigned engineer could have helped provide the needed technical support.

15.1.2.6 Too many last minute design changes were made that greatly affected the work plan each time.

When design changes were made that affected the work plan, the drawings were not always incorporated in the work package to be used to develop the work plan. Since no mockup of the equipment was developed until after the work plan was in place, work plan development depended on the use of current drawings.

There were a total of seven revisions to this work plan. This required the assembly of the principal approval signers each time, which was very time consuming. Each new revision required that a new copy be provided to the approval signers for review and comment. This was way too much work in such a short time.

Better planning could have taken care of this area.

15.1.2.7 No actual mockup of the equipment for testing the work plan was completed before the work plan was to be in place.

Because of a major design change, much of the equipment was not fabricated in time for a complete field verification/validation of the work plan. Those that had been developed were changed after the initial work plan was in place, so revisions and changes had to be redlined even as the work was actually being performed in the field.

If the decision to begin work on this project would have been given sooner and if planning had been ongoing, time would have allowed for a mockup of the equipment for work plan development.

15.1.2.8 Several of the scheduled meetings for resolution of the comments and sign-off approval on the work plan were not attended by all the people necessary to resolve the issues or complete the needed sign-offs.

This made incorporating the necessary information at times impossible to complete and more time than necessary was given trying to reconvene the principal players at another time. Some of this can be attributed to the weather which was not too cooperative.

All principal people must be present for scheduled meetings involving comment incorporation and work plan sign-offs.

15.1.3 Results

As a whole the work plan did get signed off so that it could be included in the work package and the work started so no fines issued, but the way it was done could have been a whole lot better.

15.2 WORK PACKAGE

15.2.1 Work Plan Implementation

W. D. BANCROFT

The work plan provided a data sheet for obtaining information and verification sign-offs, and this was located in the back of the work plan. When the activities were being performed it was difficult to flip to the back of the work plan and obtain signatures, then flip back to the steps being performed. This caused signatures to be missed and added confusion to the work. Work plans being written now provide space for signatures below the step being performed. The data sheets also required additional signatures that were not required. These are now removed.

Additional problems were created by the addition of work scope when the decision was made to remove the TC tree. The directions for removing the TC tree were documented by use of J-7 forms. The J-7s used provided some instructions, then referenced existing steps in the work plans. A great deal of confusion was created by this since the referenced steps required signatures to complete but no signatures were provided. With the additional problems encountered during TC tree removal, the work package was very difficult if not impossible to follow. If a similar situation is encountered, rather than use J-7 to provide instructions, additional pages need to be added to the work plans or another work plan written.

15.2.2 Disposal of Air Lance

M. D. HARDING

We were given the responsibility of creating the work plan and work package that was to be used to package, rinse, and dispose of three air lances removed from SY-101 in September 1992.

15.2.2.1 Lesson A

This project should have never been proposed without a waste disposal plan in place prior to removal. This resulted in an ELEVENTH HOUR rush to produce a workable product. This was not cost effective or safe for the personnel who have to perform the work.

15.2.2.2 Lesson B

When engineering was started to dispose of this equipment, funding should never have been cut. A waste problem of this magnitude should carry a high enough priority to maintain funds to handle it, which means that had the funds remained in place, we may not have exceeded our 90-day clock which started on the date the air lances were removed from the tank.

15.2.2.3 Lesson C

We learned that if we do not have approved drawings from the engineering support from the beginning, the job of putting together a work plan and work package becomes a difficult task. This was a contributing factor in having so many revisions to the work plan. I believe there were seven.

15.2.2.4 Lesson D

When the meetings to get the input and buy in from the various groups were held, all interested parties should attend. This also was a contributor for the number of revisions and man-hours it took to produce a respectable product for the customer.

12.2.2.5 Lesson E

After we finally got to the field the task went well. As a result of this experience, when anyone begins talking about removing equipment from our tanks, I for one will be very insistent that a complete work plan and work package be set in place from the start.

WHC-SD-WM-LL-006
Rev. 0

APPENDIX A

**Westinghouse
Hanford Company**

WHC-SD-WM-LL-006
Rev. 0

**Internal
Memo**

From: Waste Tanks
Phone: 3-1273 2750E/C201 R2-50
Date: March 26, 1993
Subject: WINDOW G PROCEDURE VIOLATIONS

To: H. D. Harmon R2-52
D. J. Swaim B3-51

cc: R. W. Bloom B5-21
D. G. Hamrick R1-51
P. R. Praetorius B3-55
R. G. Slocum B5-21
J. D. Thomson R1-30
J. H. Wicks R2-88
MAP/LB-File

Attached are the results of the review of Window G procedure violations. The review indicated some systemic areas which contributed to the procedure violations. These areas include a poorly implemented change control process, inappropriate QC hold point design, lack of acceptance of the radiological control program as implemented by CM 4-10, and failure to compensate for the working conditions placed on the Person In Charge (PIC).

Original Signed by Tom Halvorson

M. A. Payne
Director

bmp

Attachment

REVIEW OF THERMOCOUPLE TREE REMOVAL PROCEDURE VIOLATIONS

EXECUTIVE SUMMARY

During Window G, occurrence report RL--WHC-TANKFARM-1992-007 was issued due to a procedure noncompliance. Other reports of procedure noncompliance during the same period resulted in a request for an evaluation of issues during Window G activities at Tank Farms be conducted to determine appropriate corrective actions. It is recognized that consistent verbatim procedure compliance is the goal of Tank Farms but under conditions of severe time pressure constraint, this goal represents a significant problem for the best of organizations.

The root cause associated with the event was personnel error. Human factors must be incorporated into the procedure design and change control process if success is to be achieved. This task is doomed to fail if the procedures or programs associated with the procedure steps are not viewed as necessary for the work being performed. The review indicated four areas which contributed to the root cause. These contributing causes were poorly implemented change control process, inappropriate QC Hold Point design, lack of acceptance of the radiological control program as implemented by Radiation Protection Manual, CM 4-10, and failure to compensate for the working conditions placed on the Person In Charge (PIC).

Due to the nature of the work, changes to the procedure must be anticipated. A clear understanding must be in place as to how changes will be implemented and agreement reached on what constitutes a change to the procedure. Implementing a change to the procedure should be a simple part of the field work process, but the formality of the change control must be maintained. The resources necessary to implement the changes need to be identified and made available to support the critical work path. Respect for Hold Points within procedures needs to be reinforced. It should be made clear to the PICs that any hold point modification requires formal procedure changes. This is true of both QC and HP Hold Points.

Validity of QC Hold Points needs to be reestablished. Inappropriate use of QC Hold Points has reduced their effectiveness. It is imperative that QC Hold Points are written and used in a manner where compliance with sequential procedure steps is logical. Use of alternate methods of QC inspection which allow for sequential variation, such as verification steps or witness steps, should be used where appropriate. These methods are not clearly defined as "points" within the Quality Assurance Manual, CM-4-2, and are poorly addressed within the Quality Assurance Instructions, CM-4-8. Uniform guidance on the use of these methods needs to be factored into these manuals and training provided to both the package preparers and the field crews.

Acceptance of the HP Hold Point as necessary for field activities is poor. Radiological control during window activities is not accepted as a primary mission by the field crew and lacks priority. While most HP Hold Points were clearly written, they are perceived as an excessive burden placed on the job performance. The requirements associated with the Hold Points need to be

logically integrated with the work activity. This can be accomplished through inclusion of radiological actions in mockup training and providing necessary HPT support. Continual HPT coverage of window activities within the farm should be mandatory. Hold Points requiring HPT supervisor approval need to be supported in an aggressive manner. Due to the lack of acceptance of the program, a system should be in place to decisively resolve conflicts between work activities and CM-4-10 on a real time basis.

The working conditions that the PIC is under must be considered. Communications with the field should be conducted in a formal manner. The duties assigned to the PIC which are extraneous to the essential field activities should be designed in a manner which minimizes potential distractions. Work package design should be consistent with field considerations. Control of activities that are tertiary to the actual field activities needs to be provided. External observers of activities separate from those incorporated into the work instructions via QC or HPT inspection points, has the potential of adversely affecting the performance of the field crew. Actions should be taken to ensure that these activities are conducted in a manner where distraction of the field work activities are minimized. Ground rules for conduct of visitors in and around the SY farm during the window activities should be established. Access to the farm should be controlled, and visitors briefed on proper conduct within the farm prior to entry authorization.

REVIEW OF THERMOCOUPLE TREE REMOVAL PROCEDURE VIOLATIONS

BACKGROUND

During Window G Occurrence Report RL--WHC-TANKFARM-1992-007 was issued due to procedure noncompliance. Other reports of procedure noncompliance during the same period resulted in a request for an evaluation of issues during Window G activities at Tank Farms be conducted to determine appropriate corrective actions. The following is an evaluation of procedure noncompliance during Window G activities at Tank Farms. Documents which were reviewed included the work package for removal of the instrument tree, 2W-92-00980/M, and Operational Safety Assessment (OSA) # 92012-WTF-SCA.

METHODS USED

The Occurrence Report and associated root cause analysis was used as a basis for proceeding into a follow up review. The root cause analysis performed by Tank Farms Administrative Support was reviewed and modified as follows. The root cause was human error. The procedure limit on pull force pressure was knowingly exceeded. The two primary administrative barriers that failed in the event, the JCS change system, and the QC hold point were the primary focus of the investigation. Interviews were conducted with associated personnel to probe the contributing causes for the failure of these barriers. The interviews were conducted jointly by Richard Bloom of TPE and Peter Praetorius of ESQ.

ROOT CAUSE EVALUATION

In the course of the review an attempt was made to confirm the information contained in the event and causal factor analysis prepared in response to the Occurrence Report. There was general agreement with most of the information in the analysis. Considering the limited time allotted to the original occurrence investigation as compared to this follow up, the detection of some differences was expected. One significant clarification is the status of approval for the modification of the pressure limit in the procedure. Contrary to what is implied in the event and causal factor analysis, although change was initiated via verbal communications with the cognizant engineers, the process was not completed. No written change to the original 300 psi pressure limit for pull #1 was initiated and no approval was obtained.

This clarification does not affect the conclusion of the original analysis that the event was caused by personnel error. The focus of this review was to determine the contributing causes to the personnel failure associated with this event, and look for similar events to establish an appropriate and meaningful corrective action.

WORK PERFORMANCE CONDITIONS

Unavoidable conditions that contribute to human error can be anticipated during all window operations. These include work being performed under undesirable physical conditions, excessive time pressure to complete tasks, and overworked staff. These conditions can be expected to adversely affect the performance of skilled personnel and contribute to an increase in human errors. While management can take action to mitigate these conditions, it is not within the resources of Tank Farms or any organization to consistently eliminate these conditions.

PROCEDURAL ISSUES

Procedural Deviations

In order to address the issue of noncompliance with procedures, a judgement had to be made relative to the validity of the actions taken. This judgement was based on the reasonable expectation that a change to the procedure to cover the actions would be approved. In reviewing information it was noted that the deviations represented procedure changes; some that would have been approved and others that would have been disapproved. Technically based procedure changes could be anticipated as being approved, while many changes associated with radiological control would have been rejected and represent deviation from accepted safe practices without sufficient justification. In all cases the change control process was either not initiated or appropriately completed prior to deviating from the process, in spite of the use of QC and HPT Hold Points.

In the instrument tree package, 2W-92-00980/M, two types of change control were utilized, CM 5-5 and JCS based. Some were pen-in-ink changes (CM 5-5) and others were processed using the J-7 form (JCS). The CM 5-5 change control was inappropriately mixed with the JCS change control process. Pen-in-ink modifications were made to previous J-7 changes without processing additional J-7s. Post review indicates that the change control for this package was very weak.

For work packages active in the field it is imperative that the package owner (the PIC) maintains status of the package and clearly understands the status of changes to the package, PRIOR to the continuation of the work. Formality for the processing of changes to the procedure must be required. A single change control system for all changes should be used, no matter what the Impact Level of the change, to allow for maintaining control of package status. It is recommended that the CM 5-5 change control not be utilized once the work plan is incorporated into the JCS package unless additional structure is added to the process. Also, it is imperative that the ability exists to effect a procedure change within a reasonable time period and is a reality to the field crew. Procedures should be reviewed during mockup for potential areas of conflict and needed latitude, and where appropriate, this experience

should be incorporated into the procedure to eliminate the need or simplify the approvals for changes during field work.

A face-to-face meeting of individuals to be involved in processing and approving changes should be made prior to start of work. Expectations, consistent with field needs for turnaround time, should be established. Disapproval authority for changes must be used in a responsible manner and respected by the field.

Hold Point Compliance

Hold Points are used to indicate points where a specified verification is required prior to proceeding. Hold Points can be either HPT Hold Points as specified in CM 4-10 or QC Hold Points as addressed in CM 4-2 and CM 4-8 manuals. Both types of Hold Points represent points where work may not continue or proceed until requirements are met. Although, in concept the two types of Hold Points are very similar, the review has revealed significant differences in the implementation and acceptance of QC and HPT Hold Points. The only commonality noted was a failure to consistently observe the Hold Point requirements.

QC Field Verification/Hold Points

Three options for QC inspection points are briefly discussed in CM 4-8 manual: Hold, witness, or verify. These methods are not clearly defined as "points" within the Quality Assurance Manual, CM-4-2, and are poorly addressed within the Quality Assurance Instructions, CM-4-8. Uniform guidance on the use of these methods needs to be provided to both the package preparers and the field crews.

For the instrument tree removal package, only QC Hold Points were utilized in the procedures reviewed. The work instructions for the various QC Hold Points were not written in a clear and crisp manner nor properly incorporated into the package. Specific problems noted were: Subjective acceptance criteria, such as "verify nuts are tight," a QC Hold Point was assigned to a limit which had to be met continuously within the document over multiple shifts, a QC Hold Point was signed off taking exception to a specified limit, the QC function was used via Hold Points for data collection rather than data verification, and QC Hold Points were placed one or two pages after applicable operating steps.

Interviews with personnel indicated a surprising acceptance of the value of the Quality Control in the field and a good working relationship has developed. This good working relationship indicates the detected problem associated with the lack of respect for QC Hold Points is a result of poor Hold Point application, not a lack of respect for the program.

The problem is not with the individuals in the field but rather with what is being sent to the field. Hold Points should be reviewed for clarity and necessity. The use of alternate measures to QC Hold Points should be considered to achieve the same verification function. Since continual QC

coverage is provided during window activities, the use of surveillance reports to document general procedural compliance could be used. QC witness and QC verification of activities should be indicated rather than specific Hold Points. Witnessing of activities could be documented on Inspection/Surveillance Reports or a continual QC log for the activities, separate from the work package. Only essential separate, independent, specific QC actions which must be completed prior to proceeding should constitute Hold Points. The Hold Point step should be written in a manner such that the QC signature requires no further explanation of meaning. Activities which require the QC technicians to be within the zone should be indicated and addressed utilizing ALARA principles to determine the method of verification used. Substitution of craft or PIC verification or witnessing may be appropriate in certain instances.

HPT Hold Points

Unlike QC Hold Points, HPT Hold Points suffer from a lack of acceptance of the program. This conclusion results from the review of the Operational Safety Assessment (OSA) for radiation protection in West Tank Farms during Window G activities and interviews conducted. In reviewing the Hold Points contained in the instrument tree package, they appear to be clearly written and appropriately placed within the package. Due to unfamiliarity with the radiological conditions, no determination of the need for additional Hold Points was made. In OSA finding F-03 it is suggested that additional Hold Points for the air lance package may have been appropriate. Problems noted with HPT Hold Points include failure to provide supported survey results to support Hold Point sign off, performance of steps out of sequence, and bypassing HPT Hold Points.

Unlike QC inspection points (hold, witness, or verify), HPT interface with the work package is limited to Hold Points per the requirements of CM 4-10. Implementation of the HPT Hold Point requirements, in a situation where the requirement is relatively new and proven value to the field personnel is lacking, represents a different problem to be addressed. While most HP Hold Points were clearly written, they are perceived as an excessive burden placed on the job performance.

The requirements associated with the Hold Points need to be made an integral and natural part of the work activity. This can be accomplished through inclusion of radiological actions in mockup training and providing necessary HPT support. Continual HPT coverage of window activities within the farm should be mandatory. Hold Points requiring HPT supervisor approval need to be supported in an aggressive manner. A system should be in place to decisively resolve conflicts between work activities and CM 4-10 on a real time basis.

WORK ENVIRONMENT CONSIDERATION FOR THE PIC

Work Package Design

The particular work package was arranged in a multi-sectioned folder with two hole top binding. This binding made manipulation of the package content difficult and the use of a three-ring binder was suggested. A separate data sheet was used for sign off for various steps which made maintenance of the status of the package difficult. Use of two PICs was presented as a viable action, one to manage the job and one to manage the package. Procedure changes to the work package via Work Change Notice (J-7) were not clearly linked to the existing package. Changes initiated without J-7 forms were not tracked on the cover of the work package.

Human factor considerations should be made in designing the physical work package. In discussions with the individuals involved there was a general consensus that the paper work is a problem. It should be stressed that there is no one solution for all packages. The completed instrument tree work package including all the reference material, permit forms, general information, change notices, and other miscellaneous material collected in the course of the project was of significant physical size (3 to 4 inches thick). By inspection of the completed package it was obvious that the package was both directing field activity and acting as a file drawer for paper work generated.

The Work Plan, originally 28 pages long, grew to approximately 50 pages of work instructions when change instructions are included and non-essential portions excluded (e.g., approval pages and justification). Physical separation of work plan from the references and documentation (permits, surveys, etc.) collected during the field activity should be considered. Management of the reference and supportive documentation could become assigned separately from the management of the procedure. The risk of separation of this material needs to be weighed against the improvement in the procedure appearance as being manageable. This will enhance the PICs ability to effectively manage both the work package and the work activity simultaneously. Experience has shown that the lack of clear PIC leadership in the field is disastrous.

Communications and Work Distractions

A successful PIC must remain closely involved in the field work activity to monitor progress and provide the communication link with non-field support staff. Distractions from this primary focus increases the probability for failure. Conduct of Operations provides guidance on methods of preventing these detractions via control of access to the work area. Consideration for the affect of activities that are tertiary to the actual field activities needs to be taken. External observers of activities separate from those incorporated into the work instructions via QC or HPT, has the potential of adversely affecting the performance of the field crew. Actions should be taken to ensure that these activities are conducted in a manner where distraction of the field work activities are minimized. Ground rules for

conduct of visitors in and around the SY farm during the window activities should be established. Access to the farm should be controlled, and visitors briefed on proper conduct within the farm prior to entry authorization.

The formality of communication with the PIC from individuals outside also needs to be addressed. The pressure and stress the PIC may be under must be considered in the method used to transfer information to the PIC. Three examples of communication failure were detected in the course of the interviews. The original deviation to pressures over 300 psi can be attributed to indirect and incomplete communications between the engineers and the PIC. The introduction of J-7 # 03 (unapproved) into the work package was the result of a written communication failure. The management direction to the PIC to close the window was communicated in a manner which did not consider the impact of increased stress on procedure compliance.

Actions previously suggested, such as improved access control and change control, as well as communications to and from the field (PIC) would address most of the noted problems. Management must recognize that if the work in the field is to be controlled by the procedure, changes in direction to the field must be communicated via changes to that field procedure.

CONCLUSIONS AND RECOMMENDATIONS

The conclusion reached as a result of the review of Window G activities is that the root cause associated with the event was personnel error. The factors which contributed to this event do not appear to be isolated, but rather systemic to the Tank Farm operation. These contributing causes were a poorly implemented change control process, inappropriate QC Hold Point design, lack of acceptance of the radiological control program as implemented by CM 4-10, and failure to compensate for the working conditions placed on the Person In Charge (PIC). The following is a summary of recommendations contained in this report.

Change Control Formality

A single change control system for all changes should be used, no matter what the Impact Level of the change, to allow for maintaining control of package status. The CM 5-5 change control should not be used once the work plan is incorporated into the JCS package.

Responsive Change Control Process

The change control process needs to be responsive to field needs. Areas of unnecessary constraint detected during mockup training should be eliminated prior to field work. A face to face meeting of individuals to be involved in processing and approving changes should be made prior to start of work. Expectations, consistent with field needs

for turn around time, should be established. A system should be in place to decisively resolve conflicts between work activities and CM 4-10 on a real time basis.

QC Hold Point Use

QC Hold Points should be reviewed for clarity and necessity. The use of alternate measures to QC Hold Points should be considered to achieve the same verification function. Clarification of alternative methods within the Quality Assurance Manual, CM 4-2, may be required.

HPT Hold Point Use

HPT Hold Point and radiological control requirements should be made a part of the mockup training. Necessary resources required to support HPT Hold Point activities need to be readily available.

Package Design

Physical design of the work package needs to be improved. The current work packages are excessive in size and very difficult to manage in the field. Separation of work instructions from the rest of the work documentation should be considered.

Control Area Activities

The SY Tank Farm should be considered a control area during major window activities and guidance contained in DOE Order 5480.19, Chapter III, should be followed. Communications with this control area should be conducted in a formal manner.