D&D (System Closure) Mockup Testing Demonstration—Remediation of Legacy Radioactive Piping and Tank Systems at the Reactor Technology Complex (RTC) (2007) – 8397

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ABSTRACT

This paper presents the results of an integrated mockup demonstration of technologies and equipment designed to remove radioactively contaminated piping systems from underground vaults and pipe trenches at the Idaho National Laboratory. The integrated mockup demonstration included performing a bench scale wax fixative study and field demonstrations of the remotely operated equipment that will be used to remove radioactively contaminated pipe systems. The bench-scale wax fixative study involved defining optimum temperature and moisture conditions for effectively filling pipe sections containing residual wastes with a wax based fixative. The field demonstrations involved dismantling underground vault and trench piping systems, including pipe sections filled with the wax fixative. The purpose of the demonstration was to ensure the selected technologies and equipment would be effective prior to field deployment. The demonstration was conducted as a joint effort by MSE Technology Applications, Inc., and CWI on behalf of the U.S. Department of Energy at the Mike Mansfield Advanced Technology Center in Butte Montana.

INTRODUCTION

The U.S. Department of Energy (DOE) Western Environmental Technology Office supported the Idaho Cleanup Project (ICP) remediation efforts at the Idaho National Laboratory (INL) by performing this study. MSE Technology Applications, Inc. (MSE) conducted the integrated mockup at the MSE facility in Butte, Montana, performing wax fixative studies and mockups of a typical piping vault and pipe trench to allow ICP bargaining unit personnel to acquire hands-on training using the equipment selected for tank system closure efforts at INL [1] and [2].

MSE also performed bench-scale wax fixative investigations to determine the ability of the selected wax fixative to flow through piping, solidify residual contaminated materials within the pipe, and prevent spillage of residual contaminated materials during the pipe cutting and removal phase of the project.

The ICP is completing development of work plans and closure strategies for closure of legacy radioactive piping and tank systems at the Reactor Technology Complex (RTC). These systems present many challenges due to high radiation fields, the presence of difficult-to-contain radionuclides, and physical and spatial limitations. The ICP has selected innovative technologies for radiological contamination control and remote operations. Due to the complexity of the challenges and the selection of several innovative technologies to overcome these challenges, it was apparent that an integrated mockup would be beneficial before field deployment at the RTC.

The integrated mockup was conducted primarily to demonstrate and test technologies for the RTC Voluntary Consent Order (VCO) Action Plan VCO-5.8.d Test Reactor Area (TRA)-630 Catch Tank System (CTS) closure. However, the technologies and techniques demonstrated may be useful at additional facilities within RTC, the INL, and the DOE Complex. A similar approach will be used for the hot waste tank system remediation (TRA-613/713) also located at the RTC.

CWI provided the remote-operated Brokk demolition machine with six tool attachments and arranged for ICP personnel to train on the machine with the vault and trench mockup. The Brokk is a versatile and robust, remotely operated, electrically powered machine designed to work in radioactive environments and demolish and remove contaminated media. Bargaining unit personnel from MSE and ICP worked together to support this field demonstration.

The mockup included two main tests at the MSE facility: 1) a vault mockup that included stainless and carbon steel pipe cutting and removal; and 2) a trench mockup that included cutting and removing buried Duriron and ductile iron piping. Both mockups also included cutting and removing a pipe filled with the WAXFIX stabilizing material.

The WAXFIX study results showed that the product proved successful at permeating and totally encapsulating the 20% moisture content surrogate waste that consisted of 80% bentonite and 20% water by weight. Based on the MSE moisture content tests, project personnel feel that the WAXFIX product will be effective if used on wastes with different residual moisture contents that may be encountered in piping systems during the closure of the TRA-630 Catch Tank System at INL. A section of stainless steel pipe was also used to test a number of leak stop alternatives for wax leaks that may be encountered in a degraded piping system.

Both the vault and the trench mockup demonstration proved successful for ICP, DOE, and MSE. Proper tool selection and tool change procedures were defined as situations requiring these operations were encountered. Methodologies for approaching similar trench and vault situations (including safety concerns) were experienced, and wax filled pipes were successfully cut and removed without spilling the surrogate materials within the pipes.

WAXFIX STUDY

The WAXFIX study used the volume filling stabilizing agent "WAXFIX" developed by Carter Technologies. The wax was heated, poured into the selected piping, and allowed to penetrate the surrogate waste contained within the piping and solidify. Although a proof of concept demonstration and report on the capabilities of WAXFIX in the given application were previously completed by Carter Technologies, further investigation was deemed necessary by the project prior to use in the field to determine the effect of other variables on the penetration and solidification properties of the WAXFIX. These variables are the moisture content of the residual waste, pipe temperature, and pipe integrity. The surrogate waste used in the study consisted of bentonite clay.

Three 1.5-m (5-ft) sections of clear PVC pipes with a diameter of 7.62 cm (3 in.) were used for moisture content testing. Two 2-m (7-ft) sections of Duriron pipe with a 10.16-cm (4-in.) diameter were used for temperature testing and then placed in the trench for the Trench Mockup. One 1.2-m (4-ft) section of stainless steel pipe with a 10.16-cm (4-in.) diameter was used for pipe integrity testing and was placed in the vault for the initial Vault Mockup. A 5.0-cm (2-in.) piece of stainless steel pipe was also filled with wax and included in the vault mockup.

Three moisture content conditions ranging from 10 wt% moisture content to standing water on top of the surrogate waste were tested in three clear PVC pipes. Two pieces of Duriron pipe with 10% moisture in the surrogate waste were used to determine if a difference in pipe temperature would affect the wax when introduced to the pipes. A stainless steel pipe without surrogate waste was used to determine the wax flow and self-sealing characteristics when encountering voids in the pipe system.

Moisture Content Testing

The purpose of the moisture content testing was to determine the effect of residual moisture in the waste matrix on the performance of the wax fixative. This is of interest to the project as it is likely that although efforts will be made to remove all water from the subject piping, some moisture may remain. The three clear PVC pipes were prepared by gluing 90-degree fittings on each end. Three moisture contents were used: 1) a 10% moisture by weight; 2) a 20% moisture by weight; and 3) standing water on top of a 10% moisture surrogate waste by weight. The PVC pipes were heated to approximately 50 ºC [120 degrees Fahrenheit (ºF)] by submerging them in a heated water bath. The pipes were taken out of the water bath, and the wax was poured into the pipes using a pitcher.

The WAXFIX temperature was 60 ºC (140 ºF) at the time it was placed into the clear PVC pipes using a pitcher. The wax was introduced into the pipe containing 10% moisture surrogate, and it flowed evenly over the waste surface but did not appear to permeate the surrogate waste. It appeared that a distinct layer was produced at the interface of the wax and surrogate waste surface.

The following results were observed.

- The pipe containing the 10% moisture surrogate bentonite waste produced a very uniform material that was easily placed into the pipe and leveled producing a uniform top surface.
- The pipe containing the 20% moisture bentonite produced a wasteform that was somewhat clumpy but was still easily leveled in the pipe but produced a more uneven top waste surface.

The 20% moisture content pipe was filled with WAXFIX, and the wax flowed evenly over the top of the surrogate waste surface and appeared to permeate the waste.

The wax was introduced to the standing water pipe last, and again the wax flowed evenly over the top surface of the waste. Since the bentonite had sorbed most of the free liquid on the top surface, a very gummy layer was produced on the top surface of the waste, which generated a very distinct layer at the interface of the surrogate waste and the wax. The wax did not appear to permeate the gummy surface of the surrogate waste, instead the gummy layer seemed to act as a barrier that did not allow the wax to penetrate the high moisture level surrogate waste.

After approximately 25 minutes, the pipe temperatures varied from 50.5 to 52.2 ºC (123 to 126 ºF); the temperatures were not measured again during the testing sequence. The wax shrunk in volume as it cooled in the pipe, and the wax level in both of the 90-degree fitting sections of the pipes dropped approximately 5 to 7.5 cm (2 to 3 in.) after complete wax cool down to room temperature.

The next morning, the clear PVC pipes were cut into five 30.5-cm (12-in.) sections to determine if the wax had permeated the surrogate waste in the pipes. As evidenced during wax introduction, the wax permeated the 20% moisture surrogate waste and completely fixed the wasteform in the pipe. The wax coated the grains of the 10% moisture surrogate but did not encapsulate the waste to a solid form similar to what it did for the 20% moisture sample. However, since it did coat the surrogate waste grains, the bentonite was no longer dusty, demonstrating that the wax should prove to be effective for elimination of airborne contamination because of the wax coating properties. The wax did not permeate into the standing water pipe surrogate waste, instead two distinct layers were formed between the materials with the waste continuing to be very wet but staying within the pipe after it was cut. The bentonite surrogate waste was unconsolidated and fell out of the pipe after cutting. The cutting surface shows the brownish bentonite grains with pieces of the clear PVC pipe along with some wax particles. However, since the WAXFIX coated the individual bentonite clay particles (which were originally gray in color), the test was considered successful because the wax could eliminate airborne contamination in the field.

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The 10% and 20% moisture sample sections have holes in the WAXFIX areas while the standing water pipe sections do not. The holes appear in four out of five sections for the 20% moisture sample sections but only appeared in the two end sections for the 10% moisture sample sections. It appears that the more wax that permeates into the surrogate waste correlates to larger holes in the middle area of the wax sections of the pipe. The wax cooled and sealed itself after wax introduction at the fitting but formed voids in the middle of the wax area as the wax permeated the surrogate waste. During field applications, it may be necessary to introduce half of the wax and allow it to permeate the waste and cool slightly before completely filling the pipes to avoid generating any void spaces in the pipes.

Temperature Testing

The purpose of the temperature testing was to determine the effect of cold piping on wax placement. Previous testing had been performed on piping heated to above the melting temperature of the wax. This test addressed pouring the wax into a cold pipe, to test both the self-sealing properties of the wax in a cold pipe and amount of piping that could be addressed without pre-heating. The two sections of Duriron pipe were prepared by taping bored PVC fittings on the pipe ends using Gorilla tape. Twine was tied around the Gorilla tape close to the fittings at each end of the pipe to prevent wax leakage. One end was capped, and the other end had a 90-degree fitting that was used for wax introduction. The 10% moisture surrogate waste was then placed into the pipes. One of the Duriron pipes was heated to 60 ºC (140 ºF) using fiberglass heat trace while the other piece of pipe was maintained at room temperature. Temperature controllers were used to control the heated pipe temperature and to monitor the pipe temperatures before, during, and after wax introduction. Figure 1 shows the test setup before wax introduction. The Duriron pipe shown at the top of the picture was the heated piece of pipe. The blue 200-L (55-gal) drum contained the WAXFIX that was kept at approximately 60 ºC (140 ºF) using two drum heaters. The temperature was monitored using a temperature probe as shown in Fig. 1 [on top of the 200-L (55-gal) drum]. The ambient temperature of the test facility and the unheated pipe was approximately 29.4 ºC (85 ºF).

Fig. 1. Duriron pipe and WAXFIX test setup.

The WAXFIX was introduced into the unheated piece of Duriron pipe. No leaks were detected coming from the unheated piece of Duriron pipe. Approximately one-half hour later, the unheated pipe temperature was 32.7 ºC (91 ºF) and dropped to 29.4 ºC (85 ºF) 3-1/2 hours later. After 4 hours and 20 minutes, the pipe had cooled to 28.8 ºC (84 ºF) and remained at that ambient air temperature for the remainder of the day.

The temperature of the heated piece of Duriron pipe ranged from 58.8 to 60.5 ºC (138 to 141 ºF) before the wax [at approximately 60 ºC (140 ºF)] was introduced. The pipe began to leak from each of the pipe sections at the taped fittings. Burlap was wrapped around the taped pipe and fitting sections and was tied down with twine. (Twine proved better than rope to fix the burlap in place since it could be tied tighter to the pipes.) The wax continued to leak out of the taped area that was covered with burlap. The heat was maintained between 57 to 60 ºC (135 and 140 ºF) for one-half hour after the wax was placed into the pipe, and the wax continued to leak during that time. The pipe temperature ranged from 39.5 to 50 ºC (103 to 122 ºF) after 1 hour and dropped to a range of 28 to 39 ºC (83 to 100 ºF) after 6 hours. At approximately 6 hours and 25 minutes, additional wax was added to the pipe, and the pipe temperature rose to a range of 35 to 38 ºC (95 to 100 ºF) within 15 minutes. The pipe did not leak at this point, which shows the wax does self-seal and provides a hardened interface for hot wax introduction after initial wax cool down.

The conclusions of the test indicate that in some instances, a cold pipe might be beneficial, as the wax is more likely to self-seal a leak if the pipe has not been previously heated. The wax proved to be very effective at fully penetrating and fixing an entire 2.5-m (8-ft) length of pipe easily even without pre-heating. It is projected that considerably more piping than the 2.5-m (8-ft) length tested could be filled without pre-heating, as the wax carries considerable heat with it as it is introduced to the cold piping. This conclusion was valuable to the project as there are likely instances in which pipe heating will prove to be impractical.

Two pieces of Duriron were placed into the trench for the trench piping Mockup after wax was placed into the pipes. The heated piece of Duriron pipe was cut during the first Trench Mockup, and the unheated section of Duriron was cut during the second Trench Mockup. Figure 2 shows the heated piece of Duriron pipe after the Brokk cut it into two pieces during the first Trench Mockup. Notice that the WAXFIX product has encapsulated the 10% moisture surrogate waste in the pipe instead of coating the bentonite grains as it did in the clear PVC pipe. Also, the wax and the surrogate waste stayed in the pipe after it had been cut.

Fig. 2. (5-11) Cut Duriron pipe.

Pipe Integrity Test

The purpose of the integrity investigation was to determine the absolute flow characteristics of the wax with regard to potential compromised piping systems. The piping systems contained with the vaults at the RTC are 40-50 years old and integrity is suspect. In the event leaks developed, it was desired to determine if leaks in a vault-type situation would self-seal or if repairs would be required and if so, the type of repairs. The expediency of a repair technique is critical, given the elevated radiation fields in the subject vaults. A round hole approximately 2.54 cm (1 in.) in diameter, a tear type of hole approximately 10 cm (4 in.) long, and an uncompleted weld approximately 7.5 cm (3 in.) long were added to a 1.2-m (4-ft) section of 10.16-cm (4-in.) stainless steel pipe with 90-degree fittings on each end. The top of the pipe had a 10.16-cm (4-in.) diameter hole approximately 20 cm (8 in.) from the right end and acted as a checkpoint to monitor wax flow in the pipe.

The incomplete weld was on the backside of the pipe at the welded section on the left end of the pipe. The tear type of hole was located to the right of the incomplete weld (the hole ran diagonally from the top left to the bottom right and continued underneath the pipe). The round hole was covered by black Gorilla tape to help uniformly heat the pipe. The tape was removed after the pipe was brought to temperature and before the wax was introduced. The pipe was heated to 60 ºC (140 ºF) by inserting a heat gun into the end of the pipe.

The pipe was prewrapped with five layers of burlap that were secured to the pipe with twine for the round hole and the tear hole. The incomplete weld had layers of twine wrapped around the void space in the weld and was then covered with burlap and secured to the pipe with more twine. The wax was introduced at the left end of the pipe. However, due to the wax temperature and the characteristic of the wax to flow into solids, the burlap proved to be ineffective at stopping the wax flow out of the pipe.

A large amount of wax flowed out of the tear hole and smaller amounts flowed out of the unwelded section. The twine that was inserted into the void in the weld proved to stop the wax better than the holes that did not have twine inserted. All of the wax introduced into the pipe eventually flowed through the holes. At that time, it was decided to try other materials to stop the wax from flowing out of the holes in the pipe. Later in the day, alternative materials were identified for use. Since the twine and burlap wrap were somewhat effective at stopping the wax leakage from the void in the welded area after the first introduction of wax, the same materials and rope were used on the incomplete weld. Rope was used to insert and wrap around the hole and then twine was used to fill in void spaces between rope layers before covering it with burlap and wrapping with twine to secure it to the pipe. The round hole was covered with Gorilla tape, and the tape was wrapped around the pipe numerous times to secure. The tear hole was wrapped with Parafilm and then secured to the pipe with twine. Parafilm is a waxy type of covering used in laboratory work and melts to the pipe starting at approximately 38 ºC (100 ºF). The pipe was heated to approximately 50 ºC (125 ºF), and the wax was introduced at 60 ºC (140 ºF).

The incomplete weld section of the pipe and the tear hole started leaking a few minutes after the wax was introduced into the pipe. A cold compress was placed around the burlap (covering the incomplete weld area) and covered with sorbent pads and secured with twine. The area stopped leaking after the compress cooled the pipe section. The total length of the tear hole had not been completely covered with the Parafilm. Consequently, wax started to leak from the bottom of the pipe. More Parafilm was wrapped around the tear hole and secured with twine and the leak eventually stopped. The Gorilla tape completely eliminated wax leakage from the round hole after the second introduction of wax into the pipe. The wax was allowed to cool in the pipe, and the pipe was eventually placed in the vault during the first Vault Mockup.

The second set of materials were much more effective at stopping wax leakage from the holes in the stainless steel pipe. It was determined that Gorilla tape should be used on straight pieces of pipe since it forms a good seal if it is not bent to leave open spaces from which the wax can flow. Parafilm should be used on sections of pipe that have fittings or are curved since the Parafilm can be molded into the hole with the pipe then being wrapped with several layers of Parafilm and secured with twine. The melting properties of the Parafilm seem to be compatible for use with WAXFIX at 60 ºC (140 ºF). Each of these techniques is relatively simple and quick to apply, making them perfect candidates for use in the high-radiation-field vaults at RTC.

Summary and Benefits

These results are presented in a final report by MSE [3]. The WAXFIX product proved successful at permeating and totally encapsulating the 20% moisture surrogate waste that consisted of 80% bentonite and 20% water by weight. The WAXFIX permeated the 10% moisture surrogate waste but did not completely encapsulate the waste in the PVC pipe as it did with the 20% surrogate waste; however, in the Duriron pipe, the waste residual was completely permeated. However, WAXFIX did coat the individual bentonite grains and proved to reduce the dust when compared to dry bentonite. WAXFIX did not permeate the standing water surrogate waste, which consisted of 10% moisture bentonite that was covered with approximately 2.54 cm (1 in.) of water. The bentonite continued to sorb the water phase and formed a very gummy layer that acted as a barrier for the WAXFIX, resulting in two distinct layers in the clear PVC pipe. Although the WAXFIX product did not permeate the waste, the test was considered successful since wet waste would not promote airborne contamination. Based on the MSE moisture tests, project personnel feel that the WAXFIX product will be effective if used on different moisture content wastes that may be encountered during the closure of the TRA-630 Catch Tank System at RTC. It was also clear from the moisture testing, that the dryer the waste matrix, the more effective the wax will be.

Two sections of Duriron pipe were used to determine if different pipe temperatures would affect the WAXFIX as it was introduced in the pipes. The only difference discovered during these tests was that the WAXFIX would leak from the connections of the heated pipe during wax introduction but not from the unheated section of pipe. The conclusion to be reached from this observation is that if leakage were to be observed in a vault-type environment (piping surrounded by air), a lower temperature may allow the piping to self-seal. Given the scale of the test, it was inconclusive however, as to how much ‘cold’ piping could be filled. The wax easily filled an eight foot length of cold piping. Much larger sections of piping would need to be filled with the heated WAXFIX product to determine the limit of the product to be introduced to cold piping.

The stainless steel pipe used for pipe integrity testing provided invaluable experience in stopping leaks that may be encountered in a degraded piping system. The first method attempted using rope (twine) and burlap was unsuccessful at stopping the wax from leaking from the pipe. However, Gorilla tape stopped the wax from leaking from a hole in the straight section of the stainless steel pipe. Parafilm worked well to stop leaks and the wax was at the test temperature of 60 ºC (140 ºF). These techniques are simple and effective, making them ideal for use in the highly radioactive environments of the vaults located at the RTC.

MOCKUP DEMONSTRATION

The ICP TRA-630-CTS closure team determined that a mockup utilizing and combining selected technologies would be beneficial to accomplish the following goals:

- identify any additional operational and technological needs;
- ensure the selected technologies are effective both individually and as an overall strategy;

- provide field experience for preparation of regulatory, work control, and health and safety documentation; and
- demonstrate for regulatory agencies the ability to successfully complete the remediation.

PIPE VAULT AND TRENCH MOCKUPS

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MSE and CWI personnel toured the MSE facility in Butte, Montana, and selected two separate areas for conducting the vault and pipe trench mockups. These areas were selected based on their availability, proximity to electrical power required for the selected equipment, and ability to simulate conditions that will be encountered during closure of the CTS. Additionally, miscellaneous steel column concrete support piers in immediate proximity to the pipe vault were identified for demonstration of concrete demolition.

An existing, not in use, concrete structure measuring approximately 4 m (13 ft) wide by 5.5 m (18 ft) deep with 1.5 m (5 ft) high cement walls on three sides and an open front was selected to replicate a typical pipe vault. The cement walls of the concrete vault were extended to 2.13 m (7 ft) high using a wood frame and sheathing. The vault was then covered with a flat wood frame and sheathing roof to simulate the headspace of a typical RTC pipe vault. Pumps and piping systems were installed by MSE personnel in accordance with CWI instructions that were designed and installed to replicate a typical RTC pipe vault as shown in Fig. 3. Following the wax fixative demonstration, one pipe filled with wax fixative was installed in the vault mockup.

An existing, undisturbed and sparsely vegetated field was selected for the pipe trench mockup/demonstration. The required electrical outlet was approximately 30 m (100 ft) from the selected location and approximately 12 m (400 ft) from the pipe vault location.

MSE personnel excavated a 1.5 m (5 ft) wide by 1.2 m (4 ft) deep trench approximately 9 m (30 ft) long and installed cast iron and Duriron pipe as specified by CWI. A section of Duriron pipe filled with wax fixative was also installed. Pipe joints were covered with concrete to simulate conditions that will most likely be encountered at the CTS as shown in Fig. 4.

Fig. 3. Pipe shear moving into the vault for cutting piping.

Fig. 4. Pipe joints covered with concrete in the trench mockup.

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CWI delivered a Brokk 330 remote demolition robot and six attachments to the MSE facility the week of July 9, 2007. The Brokk 330 is a remotely controlled electro/hydraulic tracked robot capable of entering and working in areas not generally habitable to humans. A CWI representative arrived simultaneously to inspect and perform a startup of the equipment and organize the tools at each mockup before the extensive operations planned for the following week.

The Brokk Company offers a wide array of tools. These tools can be attached to and removed from the Brokk hydraulic arm by remote control. The Brokk 330 tools used for this demonstration were:

- cement breaker–used to break through cement walls, floors, ceilings, and other cement structures;
- crusher–used to crush objects such as large pipe, steel vessels, or cement ;
- pipe cutter or shear–used to cut off rebar, bolts, pipe sections, or other structures when a complete cut was required;
- snap cutter–specifically designed by Brokk for CWI to provide a clean cut of brittle pipe, such as Duriron;
- clamshell excavator–typically used to remove pipe sections or other objects from a hole when large quantities of dirt were not wanted;
- bucket excavator–designed for digging holes or removing rubble; and
- band saw–specifically designed by Brokk for CWI to cut pipe.

Mockup Demonstration Schedule and Operations

The pipe vault and pipe trench mockup demonstrations were scheduled for July 16 through July 19, and July 24 through July 26. July 25th was pre-established as a visitors day to allow interested parties the opportunity to witness the demonstration. The schedule was adhered to and all demonstration objectives were accomplished.

Mockup – Week 1

July 16. CWI personnel traveled to the MSE facility and received orientation during the morning. CWI personnel walked the Brokk 330 to the pipe trench and completed exercises designed to practice change out operations for the trench pipe-cutting tool.

July 17. Operations during the morning resumed at the pipe trench and involved breaking cement around the pipe joints with the cement hammer and the crusher. After breaking away cement from the joints, the shear and the snap cutter were used to determine the suitability of each tool for cutting either cast iron or Duriron pipe in the trench. The pipe filled with WAXFIX was successfully cut during this exercise with the fixative remaining in the pipe sections as they were removed as shown in Fig. 2. The Brokk 330 was moved to the pipe vault location in the afternoon and operations involving cement hammering and rebar cutting with the shear attachment were accomplished.

Mockup – Week 2

July 18. Morning operations involved cutting and removing pipe sections from the pipe vault using both the shear and snap cutting tools and placing the cut off sections into 55 gallon barrels. This operation was originally scheduled for a day; however, operations went well and the Brokk 330 was relocated to the pipe trench in the afternoon for additional cement breaking and pipe cutting exercises in the trench.

July 19. Morning operations involved additional tool changing, cement breaking, and pipe cutting operations before moving the Brokk 330 to a secure location for the remainder of the week.

July 19, 20, and 23. MSE personnel repaired the pipe vault for additional pipe vault demonstrations during the following week.

July 24. CWI personnel arrived at the MSE facility and practiced tool-changing exercises during the afternoon at the pipe vault location.

July 25. CWI personnel demonstrated cement breaking and pipe cutting operations at the pipe trench and at the pipe vault for interested visitors during the morning. The afternoon was devoted to finalizing the removal of all pipe system components from the pipe vault.

July 26. CWI personnel used the clamshell excavator and bucket excavator to remove residual cement and piping components from the pipe trench and refill the trench. The Brokk 330 and tools were then prepared for return to INL.

Summary and Benefits

The mockup included two main tests at the MSE facility: 1) a vault mockup that included stainless and carbon steel pipe cutting and removal; and 2) a trench mockup that included cutting and removing buried Duriron and ductile iron piping. Both mockups included cutting and removing a pipe filled with the WAXFIX stabilizing material.

Based on the MSE moisture tests, project personnel concluded that the WAXFIX product would be effective when used on wastes with different moisture contents that may be encountered in piping systems during the closure of the TRA-630 Catch Tank System at INL. A section of stainless steel pipe was also used to test a number of leak stop alternatives for wax leaks that may be encountered in a degraded piping system.

Both the vault and the trench mockup demonstration proved successful for ICP, DOE, and MSE. The ICP operators received valuable hands-on training using the selected equipment and tooling in situations very similar to what they will encounter at INL. Proper tool selection and tool change procedures were defined as situations requiring these operations were encountered. Methodologies for approaching similar trench and vault situations (including safety concerns) were identified and experienced, and wax filled pipes were successfully cut and removed without spilling the surrogate materials within the pipes. All of the tools performed well except the band saw tool. The band saw was specifically designed to cut pipe; however, it was not robust enough and generally the shear was used in its place.

Mockups are essential in gaining actual hands on training before going to the field. Mockups improve efficiency and safety that results in cost effective remediation. The MSE facility provides a valuable resource for demonstration of mockups. The facility has several acres of available space and a highly qualified support staff.

The integrated mockup demonstration was considered a great success by all involved parties. ICP operators received valuable experience using the equipment selected for catch tank system closure before field deployment in a radiological contaminated environment. The selected equipment proved to be applicable to the safe and effective closure of the catch tank systems, and MSE demonstrated the ability to provide facility and services necessary to support closure mockup demonstrations [4].

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