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FUEL RETRIEVAL SUB-PROJECT STUCK FUEL STATION PERFORMANCE TEST DATA REPORT

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Abstract: This document provides the test data report for Stuck Fuel Station Performance Testing in support of the Fuel Retrieval Sub-Project. The stuck fuel station was designed to provide a means of cutting open a canister barrel to release fuel elements that are stuck due to bent or swollen fuel, corrosion products, or the presence of debris. Testing confirmed that the cutting system adequately cuts the barrels provided an alternate blade is used.

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Rev. 0

FUEL RETRIEVAL SUB-PROJECT STUCK FUEL STATION PERFORMANCE TEST DATA REPORT

Spent Nuclear Fuel Project

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October 1999

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-96RL13200

FUEL RETRIEVAL SUB-PROJECT DECAPPING STATION PERFORMANCE TEST DATA REPORT

Spent Nuclear Fuel Project

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Approved by:	D. R. Jackson, FRS Test Engineer	1/27/00 Date

EXECUTIVE SUMMARY

This document provides the test results from the Fuel Retrieval System Stuck Fuel Station Performance Test conducted in the Hanford 400 Area. Tests were performed to establish the operability of the equipment and to refine the operating procedure. Design improvements were made to the saw blade, station base-plate, and canister spreading tool based on the results of these tests.

During the initial tests, the saw did not perform up to design expectations. The design specified blade could not easily cut through the canister barrels without excessive binding. Changing blade rotation direction and orientation on the saw did not improve the cutting performance. An alternate blade was tried and significantly outperformed the design specified blade. This alternate blade successfully cut both the stainless steel and aluminum canister without binding and no damage to the blade.

The station base-plate was modified to ensure that narrow spaced canisters would fit over the alignment foot. When the MK-0/MK-I aluminum canisters were placed on the stuck fuel station, they would not go down over the alignment foot. It was determined that the aluminum canisters in the basin are made to various design revisions, some of which were spaced closer together than the design used for setting the alignment foot width. The alignment foot was made narrower to resolve this problem.

Modifications were recommended for the canister spreading tool after it was discovered that the nose plate (hydraulic ram) could over-extend past the support weldment and could rotate out of alignment, causing it to jam while being retracted. Suggested modifications are to either lengthen the nose plate ram guide so it does not allow rotation or add to the taper of the nose plate ram guide. Modification status is unknown at the time of this publication.

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1.0 INTRODUCTION

This report details the equipment used for the Stuck Fuel Station testing activities, discusses equipment performance, and presents results from the tests. The tests described herein were conducted in accordance with SNF-3814, *Fuel Retrieval Sub-Project Stuck Fuel Station Performance Test Procedure*.

1.1 BACKGROUND

The Fuel Retrieval System (FRS) Sub-Project is providing development testing, factory acceptance testing (FAT), cold validation testing, and construction acceptance testing (CAT) for the FRS equipment. Pre-operational testing, hot process validation and system operations will be performed by the SNF Operations Sub-Project. The primary goal of the FRS test program is to validate the system design prior to deployment of equipment in the basins. This approach will minimize the potential need for system modification once the equipment is installed in a radioactive environment. The FRS test program provides an integrated transition from design to fabrication to installation and on into pre-operational testing.

The stuck fuel station is designed to provide a means of cutting open a canister barrel to release fuel elements that are stuck due to bent or swollen fuel, corrosion products, or the presence of debris. The station provides the ability to cut two vertical slits in the side of the canister barrel at 180° apart. Once a canister barrel is slit, a spreading tool may be used to force the barrel sides apart, causing the stuck fuel elements to break loose or providing increased access for releasing fuel that remains stuck in the canister barrel.

A prototype stuck fuel cutter and a canister spreading tool was provided for testing by the FRS project. A mock-up of the hydraulic system was assembled and used to complete the system. Each system identified above was tested together, as a whole, to demonstrate that requirements specified in the FRS performance specification could be met. Successful performance of these tests provides verification of the final system design, including specific design features for remote operation, and establishes the methods and parameters of operation.

Testing was performed to verify and validate that the FRS stuck fuel station can adequately perform its intended function. Testing was based on the Test Specification for the Fuel Retrieval Sub-Project Stuck Fuel Station, SNF-FRS, SPC.012, Rev. 0. Performance and operation of the canister cutting equipment, canister spreading tool, canister restraint, and design features for remote operation and maintenance were tested.

1.2 OBJECTIVE

To meet the goal of FRS stuck fuel performance testing, which was to verify performance and operation of the canister cutting equipment, canister spreading tool, canister restraint, and design features for remote operation and maintenance, several specific objectives had to be met. These objectives were as follows:

- Verify that cutting of all specified canister types can be performed effectively. Canisters used in testing shall include MK-0 aluminum, MK-I aluminum or stainless steel, and MK-II stainless steel designs.
- Perform the spreading open of canister barrels to verify effectiveness of the spreading tool and its ease of use.
- Verify that the canister restraint is adequate to service the cutting and fuel removal operations.
- Verify that remote lifting and securing configurations for replacement of the cutter blade, cutter motor, and bolted assemblies can be adequately accessed and operated.
- Establish system characteristics and operating parameters for canister cutting operations

2.0 STUCK FUEL STATION SYSTEM

2.1 Canister Slitting Station

The Canister Slitting Station (Figure 1) consists of the station baseplate, cutting tool, canister restraint, and saw placement and feed assembly. The baseplate is constructed of carbon steel plate with lifting attachments. The baseplate is equipped with threaded studs and alignment pins for locating and securing other stuck fuel station components. Additional threaded studs are provided in the baseplate for storage of retaining nuts during equipment maintenance activities. The stuck fuel station baseplate mounts to the support table (DW-367) with threaded fasteners and alignment pins.

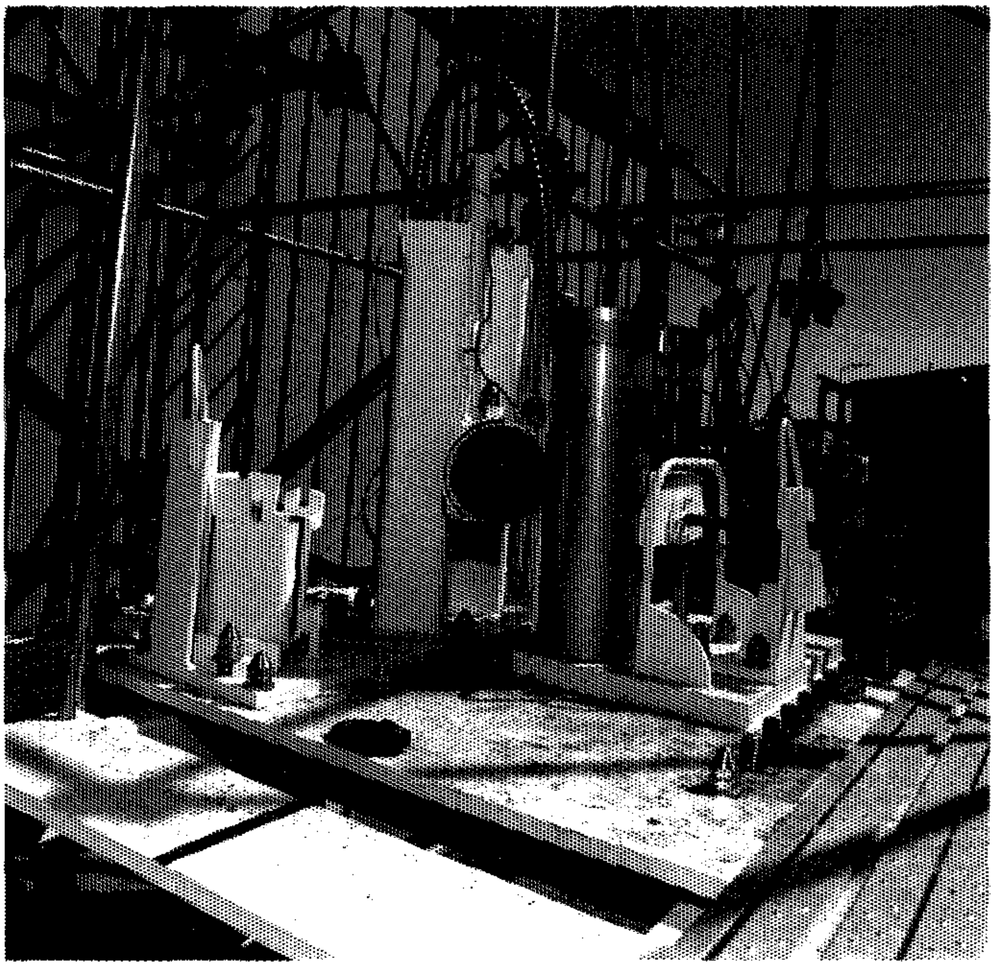

Figure 1. Stuck Fuel Station

The canister barrel cutting tool is comprised of a hydraulic motor with a cutter blade directly mounted to the motor shaft. The original design cutter, at the time of these tests, is a NIAGARA (CAT. # MC8022, EDP # 80846) 8" diameter, 1/8" wide metal slitting saw blade constructed of high-speed steel. The hydraulic motor is capable of 2,927 in-lb of torque and 65 rpm at maximum design hydraulic supply conditions of 2,000 psi and 3gpm flow. The motor has a brake capable of 5,000 in-lb of holding torque to permit installation and removal of the blade-retaining nut. Vertical guide tubes provide alignment and horizontal restraint of the saw and slide assembly during cutting operations. The vertical guide tubes are constructed of 6" x 6" x ½" square carbon steel tubing with a vertical slot for protrusion of the saw motor and blade.

Canisters are restrained during canister barrel cutting and when attempting to pry loose stuck fuel elements. A mechanical screw jack is used to force the canisters against a rigid stop and hold them in position during cutting and prying operations. The screw jack is operated with a long-reach tool from the operating deck level. The tool is identified in DW-378 and shall be used for test purposes.

The saw placement and feed assembly consists of a lifting jack and slide assembly used to position the cutting saw into each of the guide tubes and provide vertical feed during cutting. Saw placement and feed is performed by hand at the operation deck level. Horizontal positioning of the saw is accomplished with a slide and trolley arrangement that is hand positioned to the desired location and then locked in place with a retaining pin. Vertical motion of the saw is provided by a screw jack driven by a hand-wheel. Ratio for vertical motion is 5.4 turns/in. of vertical travel.

2.2 Canister Spreading Tool

The canister spreading tool, seen in Figure 2, is illustrated in drawing DW-376 and consists of a hydraulic cylinder mounted on the end of a long pole with associated tubing and fittings for actuation. The top of the pole has a lifting bail and opposing handles for tool placement and handling. In operation, the tool is manually placed on top of a canister barrel which has been cut. The tool is positioned opposed to location of the canister cuts. The cylinder interfaces with top of the canister barrel and when activated, spreads the barrel sides apart. Controls for the spreading tool cylinder are provided at the operator control panel. After spreading of the canister barrel, the tool hydraulic cylinder is retracted and the tool is removed from the canister barrel.

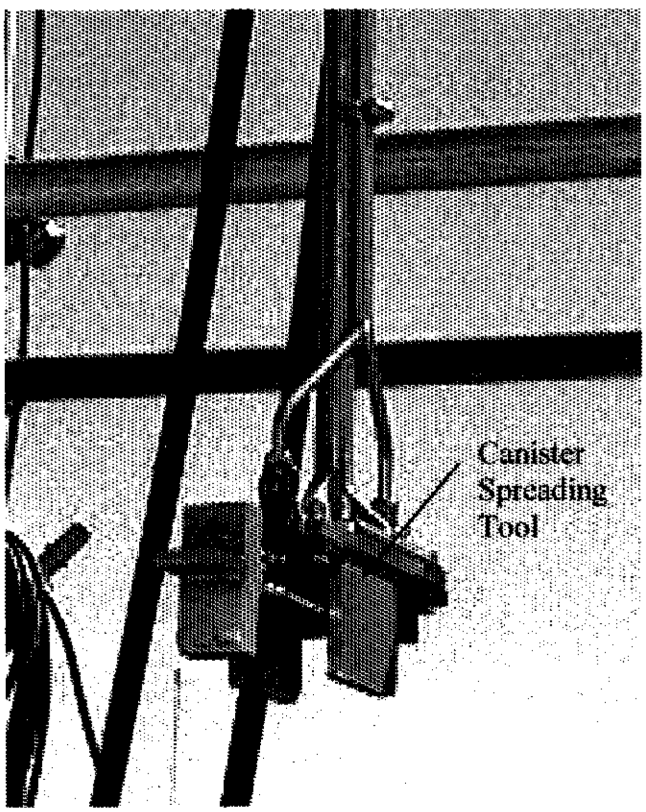

Figure 2. Canister Spreading Tool

2.3 Test Mock-up

The stuck fuel station performance test was conducted outdoors in the 400 area. Conducting the test out of water gave the test performers easy access to the equipment, enabling them to make adjustments and equipment changes more quickly and easily, and to readily evaluate saw cutting blade performance. A scaffold was erected to mock-up the K-Basin pool depth and grating. The station baseplate with mounted equipment was placed on the support table underneath the scaffold and the lifting carriage was mounted on the grating mock-up, which was pre-set at the proper height. The test operator stood on the scaffold mock grating and turned the hand wheel on the lifting carriage to lower and raise the saw, cutting the canister barrels. Cooling water was applied directly to the saw blade.

There were also disadvantages of testing the stuck fuel station dry, specifically as related to meeting test specification requirements. A summary of these disadvantages is presented below.

- There was no water damping to evaluate vibration, chatter, or unusual performance during cutting operations
- Visual and equipment handling dynamics of being in the water could not be evaluated
- Canister behavior after spreading could not be adequately evaluated
- Cooling water vs large water heat sink may not yield same blade and saw temperatures, potentially effecting blade wear and saw performance
- Remote installation, removal and maintenance operations could not be adequately evaluated since these operations will be more difficult to perform under several feet of water vs dry

3.0 TEST RESULTS

This section discusses the test results for the stuck fuel station tests.

3.1 Canister Restraint Tests

The canister restraint testing tested the ability of the jack clamp to hold the canister tight enough to allow cutting of the canister without damaging the cutting blade. Both MK-I and MK-II canisters were tested fully loaded with full weight mock fuel. In each case, the canister restraint jack nut was tightened 6 turns after the jack was snug against the canister. This held the canisters very tightly in place in all cases. No observable damage to the canisters and a very slight deflection of the cans was seen. During the canister cutting tests, the restraint jack tightened in the above manner held the canisters securely in place. Completed data sheets are found in Appendix A of this data report.

3.2 Canister Cutting Tests

The purpose of the canister cutting tests was to test the effectiveness of the cutting action at various feed rates and blade rotational rates. The testing was also to verify that the canisters could be cut without excessive blade wear or damage. Cutting tests were performed on aluminum (MK-0), and stainless (MK-II) canisters. Completed data sheets are found in Appendix A of this test report.

A total of five cutting tests, totaling 18 barrel cuts, were performed using the stuck fuel station set up in a dry condition in the 400 area. Three tests were performed using stainless steel canisters and two tests were performed using aluminum canisters. Up to four cuts were made per test. Table B.1 (Appendix B) summarizes the data obtained during each test.

3.2.1 Test 1

The first test was performed using a stainless steel (MK-II) canister loaded with 14 dummy fuel elements. The dummy fuel element adjacent to the cutting blade was painted green to make it easier to see any damage that might occur from the cutting blade. The canister was placed into the stuck fuel station and tightened down using the canister restraint jack. The first cut was made using a new NIAGARA (Cat. # MC8022, EDP #80836) blade (design specified blade). Figure 3 shows a typical test set-up.

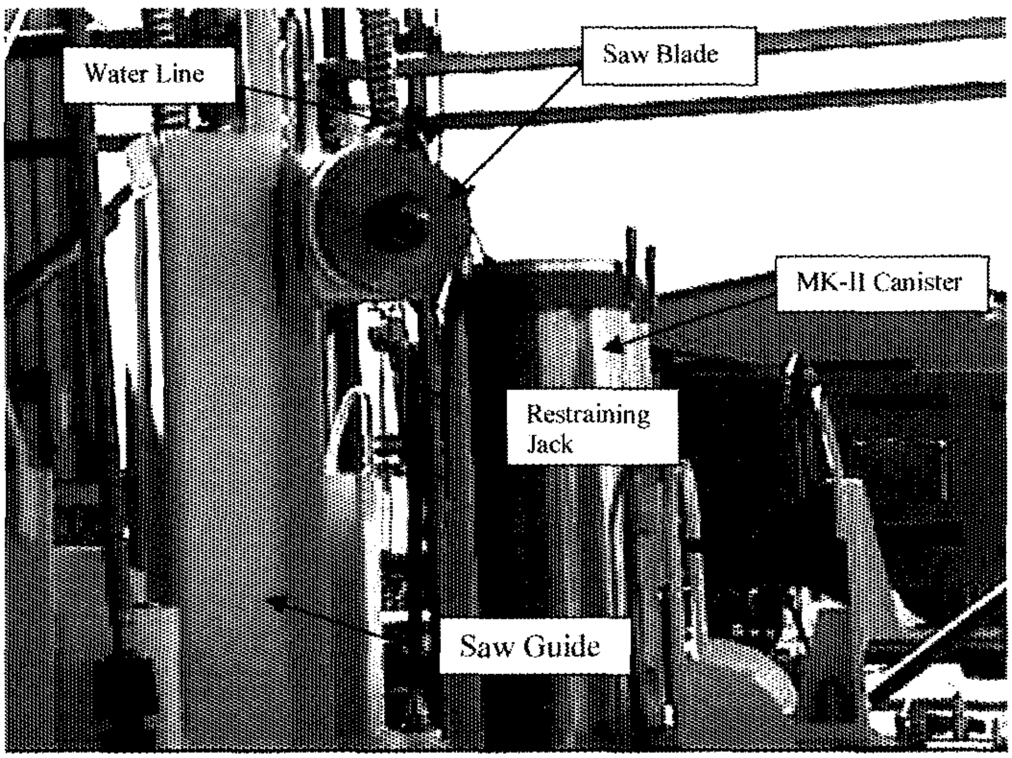

Figure 3. Typical Test Set-up

During the first cut, the blade jammed and stopped when the hydraulic flow was set at 1.5 gpm (flow meter calibration data is found in Appendix C). The torque on the nut holding the blade to the saw was inadequate and the nut loosened when the blade jammed. The nut had to be re-tightened beyond what could be achieved with the remote tool. The flow was re-set at the maximum design flow of 3 gpm and the blade jammed and stopped once again. The hydraulic flow was again re-set, this time at 3.25 gpm in an effort to increase the blade torque, and the cut was made. The saw jammed and stopped several times during the cut and had to be backed off and restarted. Total time for the first cut, including re-setting hydraulic flow, was 32 minutes.

For the second cut, the flow was set at 3.25 gpm. The second cut behaved much like the first. It was extremely difficult to start the cut, with a lot of binding as the blade contacted the top lip of the can. Once the saw blade was several inches past the can collar, the cutting went more smoothly. Total time for the second cut was 55 minutes, with ~ 10 minutes needed to adjust pressure.

The saw blade was replaced with a new blade (design specified) and the final two cuts for test 1 were made. The hydraulic pressure was increased at the cabinet to ~2800 psig in an effort to increase the flow and pressure induced torque. The no-load flow increased to ~ 3.3 gpm @ 700-900psig. Cut 3 behaved much the same as the first two cuts, with total cut time at 22 minutes. For the forth cut, the blade rotation was reversed from the original clockwise direction to a counter-clockwise direction to see if the cutting performance could be improved. Although the cut started more easily, overall cutting performance was not improved, taking 26 minutes to make the cut. The one advantage from reversing the rotation direction was to eliminate the potential for the blade nut to loosen.

Once all four cuts were made, the canister spreading tool was used to spread the cans. The spreader did not engage the barrel lip well, and popped out during operation. The spreader was lined up with the lid brackets and performed much better. The spreader was able to open the cans up to over 8.5 inches. Figure 4 shows typical canister barrels after spreading. See Table B.2 for diameter after spreading data.

Figure 4. Typical Spread Canister Barrels

Finally, the dummy fuel was removed and inspected for damage due to the cutter blade (Figure 5). There was slight surface damage to the dummy fuel, with an ~1/16" deep cut several inches long.

Figure 5. Typical Fuel Damage Cause by Cutter Blade

3.2.2 Test 2

The second test was also performed using a stainless steel (MK-II) canister loaded with 13 full weight and one outer (painted green) dummy fuel elements. The canister was placed into the stuck fuel station and tightened down using the canister restraint jack. The design specified blade was again used for this test. Blade wear was noted as medium, with some side wear on the teeth. About one out of every five teeth showed some signs of damage. Figure 6 shows typical blade wear.

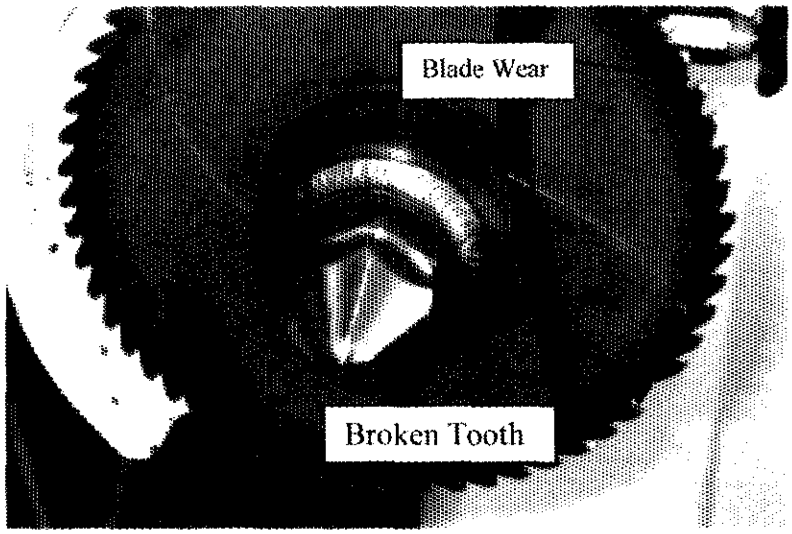

Figure 6. Typical Blade Wear - Specified Blade

The saw blade rotation was reversed from clockwise to counter-clockwise and the blade was in the reversed orientation from the original setting (tooth pitch toward the direction of rotation). The hydraulic flow was set at 3.3 gpm, and the cut was made. The cut started easily. While cutting through the expansion chamber, the saw again experienced periodic jamming, which was relieved after the saw was backed up. Total time for the first cut was 37 minutes.

For the second cut (first cut second barrel), the flow was set at 3.25 gpm. The direction of rotation was changed back to the clockwise direction. The saw pushed the can out and did not cut. The cut was stopped and the rotation was set back to counter-clockwise. A thin skin 8" to 10" long was left during the downward portion of the cut. This skin was cut while raising the saw back up. Total cutting time was 49 minutes. The cutting time was increased over previous cuts because the saw had to finish cutting the 8" to 10" of thin skin on the way up and experienced the same difficulties with cutting as on the way down the can.

The third cut for test 2 (second cut second barrel) was made with the hydraulic pressure to the blade between 700-900 psi and a flow of 3.3 gpm. No changes were made to blade rotation or configuration. The cut behaved similarly to the previous cut. The cut went completely through the can side with the exception of ~ 1.5" just at the can band location. Total cutting time was 28 minutes.

The forth cut for test 2 (second cut first barrel) was made making no adjustments to previous settings. Again, cutting was slow with the saw hanging up several times during the cut. Hydraulic pressure was 1600-1900 psig with a flow of 3.65 gpm while cutting through the band. Once through the band, the hydraulic pressure dropped to 1300-1500 psig with a flow of 3.5 gpm. Total cutting time was 27 minutes. Examination of the saw blade after making this cut revealed that one tooth had broken completely off of the blade.

Once all four cuts were made, the canister spreading tool was used to spread the cans. The spreader was lined up with the lid brackets and actuated. The spreader was able to open the cans up to 8.3 and 8.4 inches. The spreader was difficult to handle without the use of a crane hoist. After spreading a can, the ram hung up going back to the "home" position. See Table B.2 for diameter after spreading data.

The dummy fuel was removed and inspected for damage due to the cutter blade. Superficial surface damage to the dummy fuel was noted, with an ~1/32" deep cut.

3.2.3 Test 3

The third test was performed using an aluminum (MK-I) canister loaded with the same contingent of dummy fuel elements. The canister was placed into the stuck fuel station and tightened down using the canister restraint jack. The hydraulic system was set at a no load flow of 3.5 gpm @ 800 to 900 psig. A new, design specified blade was put on the saw and the first cut was made. Blade rotation was in the final configuration, counter-clockwise with the blade rakes pointing in the counter-clockwise direction.

The first cut went very fast, with the saw traversing down and back up in five minutes (as fast as the operator could turn the crank). No problems were encountered during the cutting activity and no tooth damage was noted as a result of cutting.

For the second cut (first cut second barrel) no changes were made to the test configuration. The second cut behaved much like the first. No problems were encountered while the operator made the cut in 4.5 minutes.

The third and forth cuts (second cut second barrel and second cut first barrel, respectively) behaved like the first two cuts, with each cut taking only three minutes to perform.

Inspection of the dummy fuel showed no damage after each cut. There was no visible wear to the saw blade after test 3 was completed.

Once all four cuts were made, the canister spreading tool was used to spread the cans. Because the tool was being handled by hand, it was difficult to line it up inside the barrel. Tool alignment should be easier during actual operations because the monorail hoist will be used to suspend the tool. The spreader was able to open the right barrel to over 9.6 inches. The tool actually over-spread the barrel before spring-back, opening up the potential for the fuel to fall out. Again, after spreading a can, the ram hung up going back to the "home" position. See Table B.2 for diameter after spreading data.

3.2.4 Test 4

The forth test was performed using a stainless steel (MK-II) canister loaded with the same dummy fuel elements. The canister was placed into the stuck fuel station and tightened down using the canister restraint jack. The hydraulic system was set at a no-load flow of 3.25 gpm at 750 psig. An alternate blade, MSC # 03148095 (Figure 7), was used to see if cutting performance could be improved for the stainless steel canisters. Cutter blade information is given in Appendix D. No other changes were made from the previous test configuration.

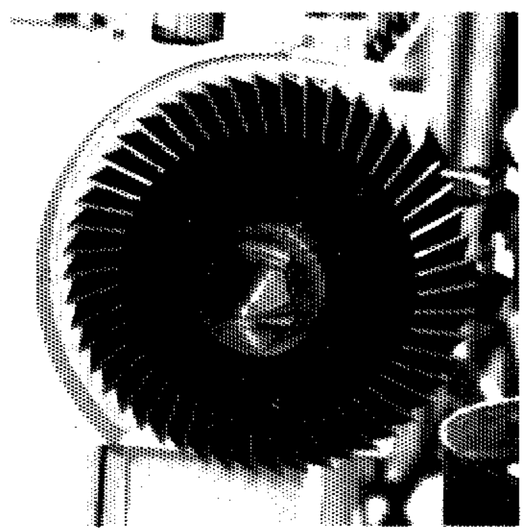

Figure 7. Alternate Saw Blade - MSC # 03148095

The first cut went very fast, with the saw traversing down and back up in six minutes (as fast as the operator could turn the crank). No problems were encountered during the cutting activity and no tooth damage was noted as a result of cutting.

For the second cut (first cut second barrel) no changes were made to the test configuration. The second cut behaved much like the first. No problems were encountered while the operator made the cut in 4.5 minutes.

The third cut (second cut second barrel) behaved like the first two cuts. No problems were encountered while the operator made the cut in 5 minutes.

Once the first three cuts were made, the canister spreading tool was used to spread the cans. One barrel had only one cut to see if the spreading tool could adequately spread it under this condition. The spreader was able to open the single cut barrel to ~8.3 inches. Again, after spreading a can, the ram hung up going back to the "home" position. See Table B.2 for diameter after spreading data.

The forth cut (second cut first barrel), was made after spreading the cans. Test 5 was also performed prior to making this forth cut for test 4. The hydraulic cabinet pressure was set back to dead head at 2000 psig and the hydraulic flow was set at 3.0 gpm @ 500-600 psig with no load. No problems were encountered during cutting. Total cutting time was 8.5 minutes.

The dummy fuel was removed and inspected for damage due to the cutter blade. Superficial surface damage to the dummy fuel was noted, with an ~1/32" deep cut about 2" down the fuel column.

3.2.5 Test 5

The fifth test was performed using an aluminum (MK-I) canister loaded with the same dummy fuel elements. The same Alternate Blade was used for this test (see Figure 8). The canister was placed into the stuck fuel station and tightened down using the canister restraint jack. The hydraulic system was set at a no load flow of 3.25 gpm @ 750 psig (hydraulic cabinet pressure still at ~2800 psig). Only one cut per barrel was made for this test.

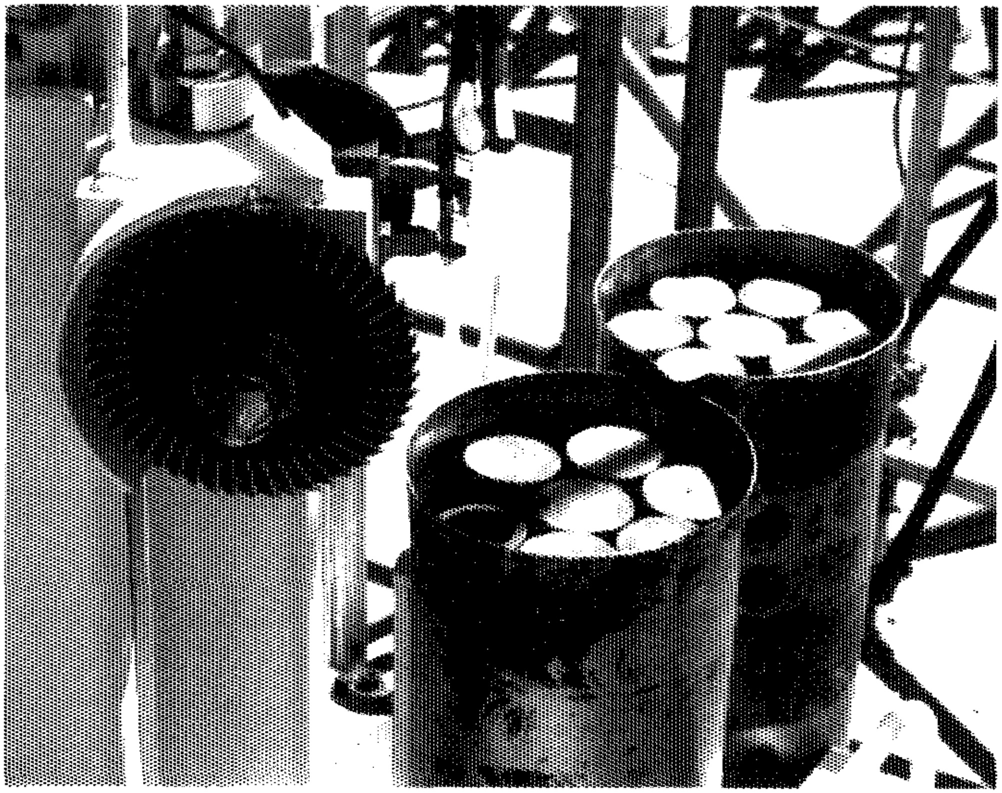

Figure 8. Alternate Blade Cutting Aluminum Canister

The first cut went very fast, with the saw traversing down and back up in 4.5 minutes (as fast as the operator could comfortably turn the crank). No problems were encountered during the cutting activity and no tooth damage was noted as a result of cutting.

For the second cut (first cut second barrel) no changes were made to the test configuration. The second cut behaved much like the first. No problems were encountered while the operator made the cut in 2.5 minutes.

Inspection of the dummy fuel showed no damage after each cut. There was no visible wear to the saw blade after test 5 was completed.

Once each barrel was cut once, the canister spreading tool was used to spread the cans. The spreader was able to open the barrels as much as 8.5 inches. With just the one cut per barrel, the tool did not over-spread the barrel before spring-back, eliminating the potential for the fuel to fall out. The ram did not hang up going back to the "home" position. See Table B.2 for diameter after spreading data.

3.3 Cutting Tool Wear and Condition

Cutting performance and blade wear were evaluated during the testing activities. Data sheets for cutting tool wear and condition are found in Appendix C of this procedure.

Blade #1, NIAGARA Cat # MC8022, EDP # 80846, was used for a total of two cuts on stainless steel canisters. Figure 9 shows a photograph of the blade after cutting operations. A total of 45 out of 58 teeth sustained damage ranging from minor chips to total tooth loss.

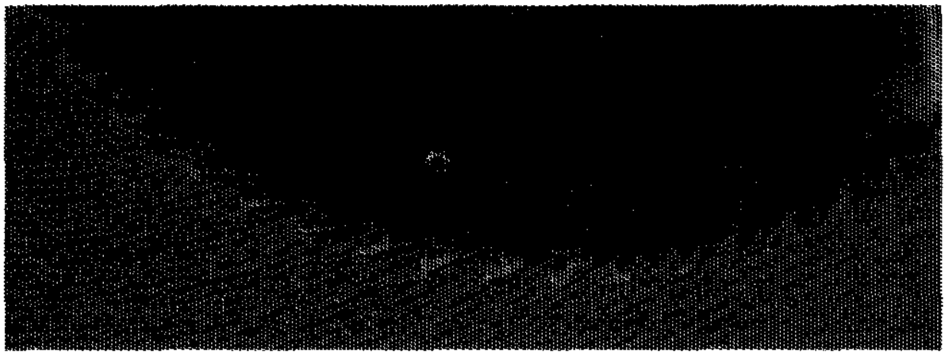

Figure 9. Blade #1, NIAGARA CAT # MC8022, EDP # 80846

Blade #2, NIAGARA Cat # MC8022, EDP # 80846, was used for a total of six cuts on stainless steel canisters. Figure 10 shows a photograph of the blade after cutting operations. Sever tooth damage was observed with one tooth broken completely off. All teeth suffered rounding on each side with major chipping on most teeth.

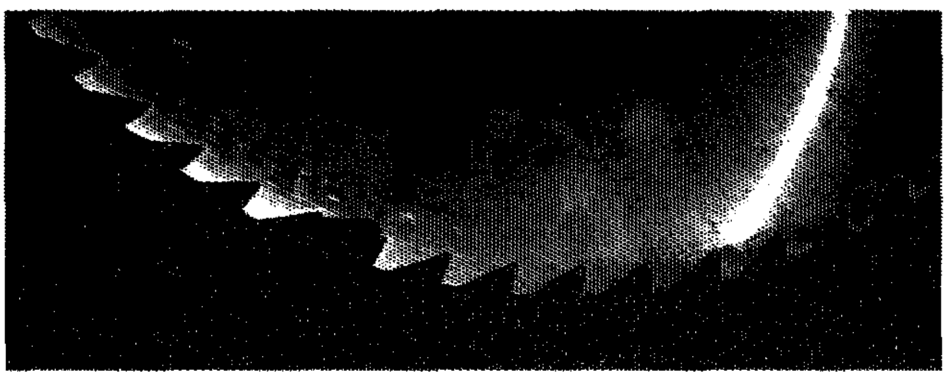

Figure 10. Blade #2, NIAGARA CAT # MC8022, EDP # 80846

Blade #3, NIAGARA Cat # MC8022, EDP # 80846, was used for a total of four cuts on aluminum canisters. Figure 11 shows a photograph of the blade after cutting operations. There was no visible wear or tooth damage resulting from cutting the aluminum canisters.

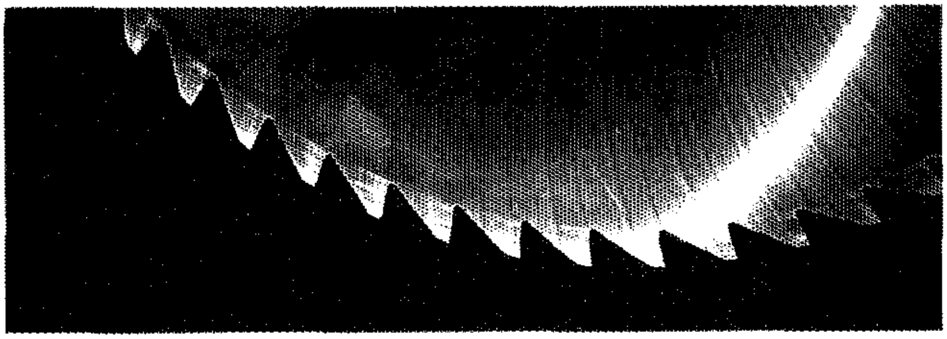

Figure 11. Blade #3, NIAGARA CAT # MC8022, EDP # 80846

The Alternate Blade, MSC # 03148095, was used to make four cuts on stainless steel canisters and two cuts on aluminum canisters. Figure 12 shows a photograph of the blade after cutting operations. There was no visible tooth damage or chipped teeth. Tooth wear was negligible.

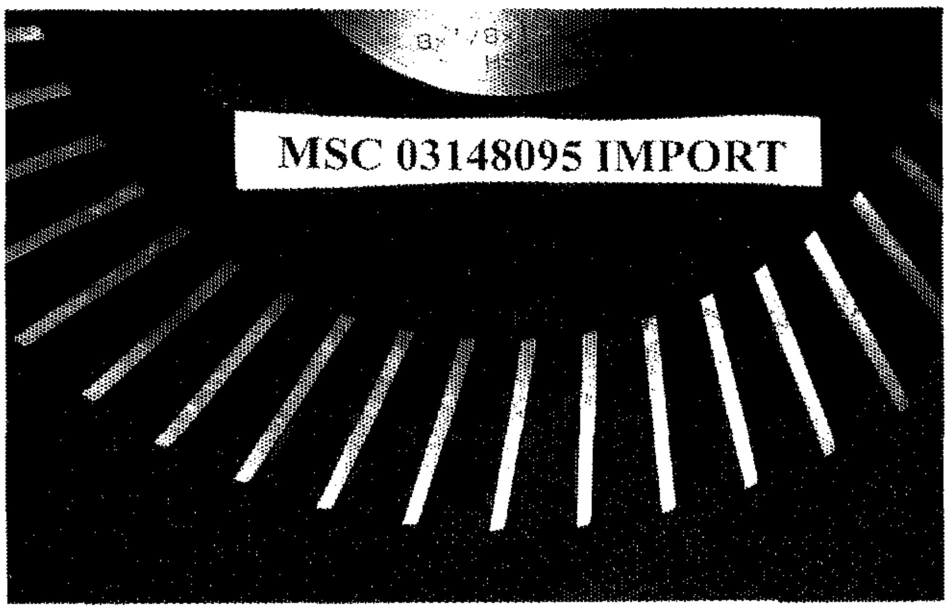

Figure 12. Alternate Blade, MSC # 03148095

3.4 Remote Features Tests

The purpose of the remote features testing was to verify that the equipment can be installed and maintained in the basin. These remote feature testing operations were not verified due to schedule limitations, but were, instead, evaluated by K-Basin operators to determine if the operation could be performed in the basin.

Remote operations reviewed with operator personnel included removing and replacing the saw guide tubes, removing and replacing the baseplate assembly, removing and replacing the canister restraint jack, and disconnecting and reconnecting the hydraulic hoses. In each case, operator personnel were confident that the operation could be performed.

The canister restraint jack remote handling operation was performed, except the jack was not lifted from the station baseplate and reset. The operator placed the nut removal tool on each nut and was able to loosen and tighten them all except the nut closest to the jack (upper right hand corner looking out from grating). This nut was determined not to be necessary and a design change replaced it with a guide pin.

3.5 Blade and Motor Change Out

The blade and motor change out testing was performed to show that the cutting blade and hydraulic saw motor could be removed and replaced from the grating level. Again, due to schedule limitations, the operations were only partially performed. For the blade change-out, the K-Basin operator went through the nut removal and replacement sequence using the flexible long handled tool. The operator was confident that the remainder of the operation, which was to remove the old blade, discard, and replace the old blade with a new blade, could be performed. The nut removal and re-tightening part of the operation was performed twice. After the second performance, the nut torque was checked and found to be 85 ft-lbs. The saw was subsequently used for cutting operations with no backing off of the nut.

For the saw motor maintenance operation, all nuts could be accessed with the tool and turned. The K-Basin operator was confident that the motor could be removed and replaced remotely.

4.0 SUMMARY AND CONCLUSIONS

4.1 Testing

Stuck Fuel Station performance testing provided valuable input to the final system design, as well as establishing that equipment operability was acceptable. Testing was also used to refine the designer's operating procedure. Testing confirmed that the cutting system adequately cuts the canister barrels provided the original design blade is discarded and replaced with an alternate blade, as discussed in Section 4.4. Testing showed that the canister spreading tool adequately spreads the canister barrels after cutting. While spreading the MK-II type canister, the tool needs to be lined up with the lid locking tabs to give it sufficient surface to push against. This is because the fuel is nearly at the top of the canister barrel and does not allow the spreading tool to recess far enough into the barrel to adequately spread it without popping out.

4.1.1 Canister Restraint Tests

A total of five canister restraint tests were performed using the canister restraint jack and both aluminum and stainless steel canisters. These tests verified that the canister restraint jack adequately holds the fuel canisters in place for canister barrel cutting.

The canister restraint jack was tightened 6 turns after the jack was snug against the canister. Testing showed that this was adequate in holding the canisters in place for this activity and in the subsequent canister cutting tests. Examination of the canister barrels after testing showed no observable damage. This is important since over-tightening can smash the canister barrel. Only a slight deflection of the canister barrels was observed during the tightening operation.

4.1.2 Canister Cutting Tests

Canister cutting tests were performed on both aluminum and stainless canisters. Testing showed that the original design specified saw blade was inadequate to cut the stainless steel canisters in a productive fashion, sustaining substantial tooth damage, but could cut the aluminum canisters adequately. An alternate blade was found that significantly outperformed the original blade for stainless steel canister cutting. The alternate blade cut both the stainless steel and aluminum canister barrels with the same ease and sustained no visible wear or damage.

During the course of canister cutting, several system parameters were changed while attempting to improve the performance of the cutter. These changes included increasing the system source hydraulic pressure and flow to increase saw cutting torque. These increases enabled the original saw blade to cut the stainless steel canister, albeit with poor performance. Changes to the blade orientation and rotation direction were also made in an attempt to improve performance. Turning the blade around from its original configuration and reversing the direction to counter-clockwise improved the overall performance of the original blade and worked quite well for the alternate blade.

The final aluminum and stainless steel canister cuts verified that the alternate cutter blade significantly outperformed the original cutter blade. The hydraulic pressure and flow were reduced back to the original 2000 psig and 3 gpm to demonstrate that the alternate blade could perform at design conditions. The alternate cutter blade performed well under these conditions, cutting that canister barrel with no hesitation or stoppage of the blade.

4.1.3 Cutting Tool Wear and Condition Evaluation

The original specified cutter blade did not hold up well while cutting the stainless steel canisters. After making only a few cuts, this type blade sustained damage ranging from minor chips to major chipping and total tooth lose. This blade type did, however, perform satisfactorily while cutting aluminum canisters. No wear or tooth damage was observed while cutting an aluminum canister.

The alternate cutter blade performed significantly better than the original blade while cutting both stainless steel and aluminum canisters. There was no visible tooth damage or chipped teeth. Tooth wear was considered negligible. It is recommended that this blade type be used during actual operations.

4.1.4 Remote Features Tests

The remote features tests were not performed as planned due to schedule limitations. K-Basin operators evaluated the remote activities to decide if they could be performed in the basin and were confident the operations could be performed. During this evaluation, it was determined that the canister restraint jack hold down nut closest to the jack (upper right hand corner looking out from the grating) could not be reached. The bolt was replaced with a guide pin to eliminate the need to remotely remove this nut.

4.1.5 Blade and Motor Change Out Evaluation

Testing activities were performed to ensure that the cutting blade and hydraulic saw motor could be removed and replaced from the grating level. Results showed that the cutting blade was easily removed remotely and replaced, re-tightening with enough torque that the cutter blade would not back off during operation. The saw motor maintenance operation was not performed. K-Basin operators assessed the operation and were confident that the entire operation could be performed.

4.2 Open Issues

Several items were found during testing activities requiring equipment modification. These items are listed below:

- Put a stop on the base plate below the saw for the North cut - Status unknown
- Taper the foot between the canister barrels to accept narrower spaced canisters - Complete
- Remove stud on jack support as described in Section 3.4 and replace with a guide pin - Complete
- Weld the shim between the saw and the saw support to the saw support - Complete
- Lock tight the studs - Complete
- Cut off the canister jack crash bar or bend it back - Bar was cut off
- Reverse labels on the hydraulic hoses to depict the reversal of the saw blade rotation - Complete
- Finalize the saw hydraulic hose attachment to the saw lifting rod - Complete

It is also suggested that the recommended blade, NIAGARA, CAT # MT8022, be tested in a dry configuration to verify it does, indeed, adequately cut the canisters.

4.3 Facility Operation Recommendations

Add a power feed to the saw advance lead screw for raising the saw motor after making a cut. A power feed will reduce the time to retract the saw and reduce operator fatigue.

4.4 Final Configuration

The following is a summary of the final configuration that is recommended for stuck fuel station operation as a result of data collected during testing activities.

Blade rotation:Counter-Clockwise
Blade Direction: Toward direction of rotation
(Tooth pitch)
Hydraulic Pressure: 2000 psig
Hydraulic Flow Rate: 3 gpm
Blade Type: The NIAGARA, Cat. # MT8022, EDP # 08890, blade is very similar to the MSC 03148095 blade used in the testing and is the one recommended. The MSC blade order could not be duplicated. If an import MSC blade like the one used is purchased, it is not guaranteed to be the exact blade, although it should perform similarly. Several blades were ordered to the MSC part No. and a slightly different blade was received each time. The MSC blade was taken to a local vendor and the NIAGARA MT8022 blade was the closest match. It has essentially the same rake angle and material, but has two less teeth. All other blade attributes are the same. This blade could be tested in the dry configuration, if deemed necessary.
Canister Restraint Setting: snug against canister plus 6 turns

5.0 REFERENCES

SNF-FRS-SPC-012, Rev. 0, *Test Specification for the Fuel Retrieval Subproject Stuck Fuel Station*, C. Keller, BNFL, Inc., 1998.

SNF-3814, *Fuel Retrieval Sub-Project Stuck Fuel Station Performance Test Procedure*, J. R. Thielges and P. V. Meeuwsen, Numatec Hanford Corporation, Richland, WA, 1999.

APPENDIX A

TEST DATA SHEETS

Date: 4/23/99

CANISTER RESTRAINT TEST

MK-II STAINLESS STEEL CANISTER

Test 4 Alternate blade #1

1. Place fourteen (14) dummy fuel elements into MK-II stainless steel canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: Held in place very tightly. Six turns after snug.

   ~~Jack Torque: ________ ft-lb.~~

4. ~~Measure maximum canister deflection. Record canister damage (if any).~~

   JRJ 4/23/99 DR 4-26-99

   ~~Original diameter: ________ inches Ending diameter: ________ inches~~

   Describe damage (if any): No observable damage. Slight deflection.

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date: 4/23/99

CANISTER RESTRAINT TEST

MK-II STAINLESS STEEL CANISTER

Test 4 Alternate blade #1

1. Place fourteen (14) dummy fuel elements into MK-II stainless steel canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: Held in place very tightly. Six turns after snug.

   ~~Jack Torque: ________ ft-lb.~~

4. ~~Measure maximum canister deflection. Record canister damage (if any).~~
   JRJ 4/23/99 ② DJL 4-26-99
   ~~Original diameter: ________ inches Ending diameter: ________ inches~~

   Describe damage (if any): No observable damage. Slight deflection.

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date:

CANISTER RESTRAINT TEST

MK-II STAINLESS STEEL CANISTER

2nd Cut 1st Test 4/21/99

1. Place fourteen (14) dummy fuel elements into MK-II stainless steel canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: 6 revolutions on jack nut after snug. used flex drive tool. Canister held very tightly

   ~~Jack Torque: ________ ft-lb.~~ 4/21/99 [initials] ② [initials] 4-26-99

4. ~~Measure maximum canister deflection.~~ Record canister damage (if any).

   [initials] 4/21/99 ① [initials] 4-26-99

   ~~Original diameter: ________ inches~~ ~~Ending diameter: ________ inches~~

   Describe damage (if any): No observable damage. Slight deflection.

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date:

CANISTER RESTRAINT TEST

MK-II STAINLESS STEEL CANISTER

Test # 1 4/21/99

1. Place fourteen (14) dummy fuel elements into MK-II stainless steel canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: Turned 6 revolutions on jack nut. Canister held very tightly

   Jack Torque: 10 ft-lb.

4. ~~Measure maximum canister deflection.~~ Record canister damage (if any).
   (2) RF 4-26-99 JRJ 4/21/99 (2) RF 4/21/99
   ~~Original diameter: ________ inches~~ ~~Ending diameter: ________ inches~~

   Describe damage (if any): No observable damage. Very slight deflection

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date: 4/23/99

Test 5

CANISTER RESTRAINT TEST

MK-0 ALUMINUM CANISTER

1. Place fourteen (14) dummy fuel elements into MK-0 Aluminum Canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: Very tight. 6 turns after ~~snug. Al canister~~ 3/8" from bottoming out until fuel loaded. Then bottomed out

   ~~Jack Torque: __________ ft-lb.~~ JCJ 4-23-99 (1) DAF 4-26-99

4. ~~Measure maximum canister deflection. Record canister damage (if any).~~

   (1) DAF 4-26-99 JC Jhilger 4-23-99

   ~~Original diameter: __________ inches Ending diameter: __________ inches~~

   Describe damage (if any): No damage

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date:

CANISTER RESTRAINT TEST

MK-0 ALUMINUM CANISTER

Test 3 1st Al test 4/23/99

1. Place fourteen (14) dummy fuel elements into MK-0 Aluminum Canister.

2. Place loaded canister into stuck fuel station.

3. Tighten canister restraint jack against the canister using a torque wrench on the long handled tool. Start with sufficient torque to adequately restrain the canister while using a moderate amount of force to try and move it.

   Describe how tightly canister is held: Rotated in ~8 turns after jack snug. Extremely tight. No deflection.

   ~~Jack Torque: ________ ft-lb.~~ GRJ 4-23-99 DRY 4-26-99

4. ~~Measure maximum canister deflection. Record canister damage (if any).~~ DRY 4-26-99 GRJ 4/23/99

   ~~Original diameter: ________ inches Ending diameter: ________ inches~~

   Describe damage (if any): Canister held extremely tight. No defection. No problems during cutting

5. Repeat steps 3 and 4 if, during canister cutting, the canister is found to be inadequately held. Increase torque 5 ft-lbs. at a time until the canister is adequately held during cutting operations.

6. Note problems encountered (if any): NA

Date: 4/23/99

CANISTER CUTTING TEST

Test 5

MK-0 CANISTER

① AJ 4-26-99
Alternate Blade 1 JR Thielges 4/23/99

1. ~~Prior to cutting, measure, in at least four equally spaced places, the outside diameter of cutting blade to the nearest one-thousandth of an inch.~~ Photograph cutter blade, including a backdrop of the measuring device. Use digital color camera.

   ~~Record: __________ inches~~

2. Load fourteen (14) dummy fuel elements into MK-0 canister. Note any existing damage to dummy fuel:

   Superficial damage only.

3. Place canister into stuck fuel station. Tighten canister restraint against canister side.

4. Adjust hydraulic system to a no-load flow of ~~three gallons~~ 3.25 gallons per minute. JRJ 4/23/99 ① AJ 4/26/99

5. ~~Start video camera.~~ JRJ 4/23/99 ① AJ 4/26/99

6. Feed cutting blade into canister at the rate of .9 revolutions per second (.9rev/sec equals ~10 inches per minute feed rate).

   3.25 gpm 750 psi

   Note cut start time: 1:43:30 p.m.

7. Cut length of canister. If cutter binds, jams, fails to cut, or makes unusual noise, stop cutting and contact test director. Comment on unusual vibrations, chatter, loosening, or other problems encountered (if any):

   No cutting problems

   Record cut time: 1:48 Record hydraulic pressure during cutting: 750 psi

8. Observations on cutter rotational speed and feed rate:

   Very fast feed. No jamming up. As fast as tech could crank.

or mobile crane. JR Shields 3/29/99

3. ~~Remove canister from stuck fuel station using hoist mounted on 305 monorail. Note problems (if any).~~ JRJ 4-23/99 DRJ 4-26-99

Removed by hand.

4. Measure maximum inside diameter of each canister barrel (after spring back):

Right barrel: ~~9~~.65 inches Left barrel: 8.4 inches
JRJ 4/23/99

9. Unless cutting performance was unacceptable, cut other side of canister barrel, using the same rate, rotational speed and cutter blade. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

No problems. 800-900 psi 3.4 gpm.

Record cut time: Start: 10:09am Stop: 10:12 am.

10. Cut both sides of uncut barrel. Comment on unusual vibrations, chatter, canister loosening, or other problems, (if any):
1st Cut 3.5 gpm 800-900 ~~rpm~~ psi
2nd Cut 3.4 gpm 800-900 psi

Record cut time: 1st Cut Start 9:16:30am Stop 9:21 2nd Cut Start 9:57a.m Stop 10:00 ~~p~~m.

11. Remove and inspect dummy fuel. Note any damage to fuel: 1st Cut no damage. 2nd Cut no damage - No visible blade wear. 2nd Cut

Canister Spreading Tool

1. Comment on condition of canister prior to spreading: Both sides cut through on both barrels. Good condition.

2. Spread canister using canister spreading tool. Record hydraulic pressure during spreading: 750 psi

Note problems encountered positioning and operating canister spreading tool (if any):

Tool difficult to get lined up inside the barrel lips. Should be easier to use on crane hoist. Tool over spreads the Al barrel to where fuel could dump out. Tool ram caught when going back into "home" position.

CONTROLLED COPY

Date: 4/23/99

CANISTER CUTTING TEST

MK-0 CANISTER

Test 3 1st Al test. Original Blade Design

DAF 4-26-99 GRJ 4/23/99

1. ~~Prior to cutting, measure, in at least four equally spaced places, the outside diameter of cutting blade to the nearest one-thousandth of an inch.~~ Photograph cutter blade, including a backdrop of the measuring device. Use digital color camera.

   ~~Record: ________ inches~~ DAF 4/26/99 GRJ 4/23/99

2. Load fourteen (14) dummy fuel elements into MK-0 canister. Note any existing damage to dummy fuel:

   Green element has noted damage from MK-II tests

3. Place canister into stuck fuel station. Tighten canister restraint against canister side.

4. Adjust hydraulic system to a no-load flow of ~~three-gallons~~ per minute. GRJ 4/23/99 3.5 gpm @ 800 to 900 ~~psig~~ psi DAF 4-26-99

5. ~~Start video camera.~~ GRJ 4/23/99 DAF 4/26/99

6. Feed cutting blade into canister at the rate of .9 revolutions per second (.9rev/sec equals ~10 inches per minute feed rate).

   Note cut start time: 9:02 a.m.

7. Cut length of canister. If cutter binds, jams, fails to cut, or makes unusual noise, stop cutting and contact test director. Comment on unusual vibrations, chatter, loosening, or other problems encountered (if any):

   No problems. No observed tooth damage.

   Record cut time: 9:07 a.m. off Record hydraulic pressure during cutting: 800 to 900 psi

8. Observations on cutter rotational speed and feed rate:

   Cut very fast down & back in 5 minutes. As fast as operator could comfortably cut

4. Measure maximum inside diameter of each canister barrel (after spring back):

Right barrel: ~~8.4~~ 8.3 JRD 4/23/99 inches Left barrel: 8.4 inches

9. Unless cutting performance was unacceptable, cut other side of canister barrel using the same feed rate, rotational speed, and cutter blade. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):
450psi below band
3.0 gpm 500-600 psi Changed coolant pressure to dead head @ 2000psi. No notable blade damage.

Record cut time: Start: 3:10p.m. Stop: 3:18:25pm. Went lower on canister near the bottom.

10. Cut both sides of uncut barrel. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):
1st Cut 3.25gpm 750 psi through reservoir
2nd Cut 3.25gpm 710-900psi

Record cut time: 1st cut reservoir Start 11:04:30a.m. Stop 11:09a.m. 2nd Cut: Start 2:34:30 Stop 2:3[illegible]

11. Remove and inspect dummy fuel. Note any damage to fuel: No additional damage after 1st cut
Superficial to 1/32" deep slit ~ 1/2" down fuel after 2nd Cut

Canister Spreading Tool

1. Comment on condition of canister prior to spreading: ~~Two~~ One canister JRS had 2 good cuts. One barrel only had one cut on purpose to see if it could spread adequately

2. Spread canister using canister spreading tool. Record hydraulic pressure during spreading: 750 psi

Note problems encountered positioning and operating canister slitting tool (if any):
Tool sticks when coming back to start position

3. Remove canister from stuck fuel station using hoist mounted on 305 monorail or mobile crane. Note problems encountered (if any):
Removed by hand.

JR Thielge 3/29/99

Date: 4-23-99

CANISTER CUTTING TEST

Test #4

MK-II CANISTER

Alternate blade 1

1. ~~Prior to all cutting, measure, in at least four equally spaced places, the outside diameter of cutting blade to the nearest thousandth of an inch.~~

   ~~Record: ________ inches~~ JKHildge 4/23/99 DRJ 4/26/99

2. Load fourteen (14) dummy fuel elements into MK-II canister. Note any existing damage to dummy fuel:

   Superficial scratches on green fuel

3. Place canister into stuck fuel station. Tighten canister restraint against canister side.

4. Adjust hydraulic system to a no-load flow of 1.5-gallons per minute. 3.25 gpm 750 psi

5. ~~Start video camera.~~ JRJ 4/23/99 DRJ 4/26/99

6. Feed cutting blade into canister at the rate of .6 revolutions per second (.6 rev/sec equals ~6.6 inches per minute feed rate).

   Note cut start time: 10:53 a.m

7. Cut length of canister. If cutter binds, jams, fails to cut, or makes unusual noise, stop cutting and contact test engineer. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

   No problem. No observable blade damage.

   Record cut time: 10:59 am Record hydraulic pressure during cutting: 750 psi

8. Observations on cutter rotation speed and feed rate:

   Fast speed - as fast as can be turned

4. Measure maximum inside diameter of each canister barrel (after spring back):

Right barrel: 8.3 inches Left barrel: 8.4 inches

9. Unless cutting performance was unacceptable, cut other side of canister barrel using the same feed rate, rotational speed, and cutter blade. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

psi 700/900 5rm
700–900 psi 3.3 gpm Cut through all the way except ~ 1½" just at the band.

Record cut time: Start. 3:16 stop 3:44

10. Cut both sides of uncut barrel. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

1st cut: 2nd barrel reversed direction of rotation. Did not work. Went back to previous cutting rotation. 800 to 1000 psi 3.25 gpm. Cut through after ~ 8-10" Cut that 8 to 10" through on the way back up. 4/23/99

4/23/99 2nd Cut: Through band 1600-1900 psi 3.65 gpm. After band 1300-1500 psi @ 3.5 gpm. Broke tooth on blade

Record cut time: 1st Cut Start 2:12pm Stop 3:01pm. 2nd Cut Start 7:50am Stop: 8:17a.m.

11. Remove and inspect dummy fuel. Note any damage to fuel: Superficial damage up to 1/32" or less.

Cut all the way through except ~ 2" "skin" at the top.

Canister Spreading Tool

1. Comment on condition of canister prior to spreading: One barrel had both cuts all the way through. One barrel had one good cut and one that left a slight skin all the way down (reservoir cut).

2. Spread canister using canister spreading tool. Record hydraulic pressure during spreading: 750 psi

Note problems encountered positioning and operating canister slitting tool (if any): difficult to handle without crane hoist or mobile crane. Ram Hung up going to "home" position.

3. Remove canister from stuck fuel station using hoist mounted on 305 monorail. Note problems encountered (if any):

Removed by hand.

JK Thielges 3/29/99

Date: 4/22/99

CANISTER CUTTING TEST

MK-II CANISTER Test # 2

1. ~~Prior to all cutting, measure, in at least four equally spaced places, the outside diameter of cutting blade to the nearest thousandth of an inch.~~

   ~~Record: ________ inches~~ JR Thielges 4/22/99 DAJ 4-26-97

2. Load fourteen (14) dummy fuel elements into MK-II canister. Note any existing damage to dummy fuel:

   Green painted element clean with one slight nick.

3. Place canister into stuck fuel station. Tighten canister restraint against canister side.

4. Adjust hydraulic system to a no-load flow of ~~1.5~~ 3.3 JRT 4/22/99 DAJ 4-26-97 gallons per minute. Reverse rotation 670 psi 3.3 gpm. 800 to 1000 psi during cutting, up to 1400 psi while going through expansion chamber.

5. Start video camera.

6. Feed cutting blade into canister at the rate of .6 revolutions per second (.6 rev/sec equals ~6.6 inches per minute feed rate). Jack 3 revolutions after snug. Prior to start one out of 5 teeth damage. Medium [illegible] on one side medium wear ??

   Note cut start time: 1:25pm

7. Cut length of canister. If cutter binds, jams, fails to cut, or makes unusual noise, stop cutting and contact test engineer. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

   Saw catches in the expansion chamber. Started easily. Periodic jamming was relieved after saw was backed off.

   Record cut time: 2:02pm Record hydraulic pressure during cutting: 800-1400 psi

8. Observations on cutter rotation speed and feed rate:

   Rotation speed ~72rpm. Feed rate extremely slow.

4. Measure maximum inside diameter of each canister barrel (after spring back):

Right barrel: 8.6 inches Left barrel: 8.8 inches

Date: 4/21/99

CANISTER CUTTING TEST

Test 1

MK-II CANISTER

New blade 1st test 4/21/99 JRS

1. Prior to all cutting, measure, in at least four equally spaced places, the outside diameter of cutting blade to the nearest thousandth of an inch.

   Record: 8.011 inches   1) 8.010   2) 8.010   3) 8.014   4) 8.011

2. Load fourteen (14) dummy fuel elements into MK-II canister. Note any existing damage to dummy fuel:

   Dummy nearest blade wear scratches. Filmed on digital video. Painted dummy green to easily see damage.

3. Place canister into stuck fuel station. Tighten canister restraint against canister side.

4. Adjust hydraulic system to a no-load flow of 1.5-gallons per minute.

5. Start video camera.

6. Feed cutting blade into canister at the rate of .6 revolutions per second (.6 rev/sec equals ~6.6 inches per minute feed rate).

   Note cut start time: 10:58a.m

7. Cut length of canister. If cutter binds, jams, fails to cut, or makes unusual noise, stop cutting and contact test engineer. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any): New Blade (Blade #1)

   The cutter stopped when the flow was adjusted to 1.5 gpm. Readjusted to 3 gpm and encountered same problem. Readjusted to 3.25 gpm (maximum system capacity) and made cut. Saw stopped several times during cut and had to be backed off then restarted. 1300 JRS 4/21/99

   Record cut time: 11:30a.m Record hydraulic pressure during cutting: ~~2000~~ psi

8. Observations on cutter rotation speed and feed rate:

   Need faster feed rate and finer toothed blade. The saw rotation speed needs to increase, i.e. up hydraulic flowrate.

9. Unless cutting performance was unacceptable, cut other side of canister barrel using the same feed rate, rotational speed, and cutter blade. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any):

@ 3.25 gpm behaved like the first cut. Had extreme difficulty starting the cut with alot of binding. Once the saw was past the collar several inches the cutting went more smoothly. The cut needs to be only 2/3 to 3/4 down the barrel.

Record cut time: Start 1:50pm Stop ~ 2:45 p.m. Stop ~ 10 min to adjust pressure

10. Cut both sides of uncut barrel. Comment on unusual vibrations, chatter, canister loosening, or other problems encountered (if any): Start. Saw running ~ 72 rpm

Circuit pressure 680 psi flow 3 3/8 gpm 900 psi supply. New Blade (Blade #2) 2nd cut reversed blade

Record cut time: Start 10:33 a.m. Stop 10:55 2nd Cut Start 11:14 Stop 11:40

11. Remove and inspect dummy fuel. Note any damage to fuel: Slight surface damage to fuel. ~ 1/16" deep cuts several inches long. Video taped.

Canister Spreading Tool

1. Comment on condition of canister prior to spreading: All barrels cut nicely. One can lock cut 8" from bottom. All other cuts are lower. Fuel elements ~ 3/4" down from lip

2. Spread canister using canister spreading tool. Record hydraulic pressure during spreading: 750 - 800 psi pressure increased to 900 psi

Note problems encountered positioning and operating canister slitting tool (if any): Spreader did not engage well and popped out during operation. Spreader was lined up with lid brackets and worked better

3. Remove canister from stuck fuel station using hoist mounted on 305 monorail or mobile crane. Note problems encountered (if any): JK Thielges 3/29/99

Crane not available. Removed by hand.

Date:

REMOTE FEATURE TESTING

Installation

The purpose of the installation testing is to verify component fit up. Replacement of the saw guide tubes, baseplate assembly, canister restraint jack, and in-pool hydraulic fluid manifold will also be tested.

1. ~~Lower table to floor. Install stuck fuel station to table. Tighten nut using long-reach tools. Comment on degree of difficulty and placement of lift points:~~ 4/1/99 JR Hughes 3/29/99

2. Remove saw guide tubes. Bring to grating level. Place nuts on holder studs. Lower saw guide tubes into position and replace nuts using long-reach tool. Comment on degree of difficulty:

   Review with operator Tim Vanreenen. Tim was confident the operation could be performed. Jim Van R

   Record total time: NA Did not perform actual operation.

3. Remove baseplate assembly. Bring to grating level. Place nuts on holder studs. Lower baseplate assembly into position and replace nuts using long-reach tool. Comment on degree of difficulty:

   Review with operator Tim Vanreenen. Tim was confident the operation could be performed. Jim Van R

   Record total time: NA Did not perform operation

4. Remove canister restraint jack. Bring to grating level. Lower jack into position and replace nuts using long-reach tool. Comment on degree of difficulty:

   Review with operator Tim Vanreenen. Tim placed the nut removal tool on each nut and was able to loosen and tighten all except the nut closest to the jack (upper right hand corner). Otherwise, Tim was confident this operation could be performed.

   Record total time: NA

   The nut that could not be removed is not needed and will be eliminated and replaced with a guide pin. Jim Van R

H-15

5. Disconnect hydraulic hoses and remove in-pool hydraulic fluid manifold. Bring to grating level. Place nuts on holder studs. Lower manifold into position and replace nuts using long-reach tool. Reconnect hydraulic hoses. Comment on degree of difficulty:

Review with operator Tim Vanreenen. Tim was confident the manifold could be removed and replaced remotely. Tim Van R[illegible] DR [illegible] 4/1/9[illegible]

~~Repeat installation test four additional times using at least two different personnel.~~ JR Thielges 3/22/99

~~Once removal and replacement activities are deemed acceptable, repeat one time using K Basin operators to perform the work activities.~~ JK 4/26/99 DR 4-26-99

Blade and Motor Change Out

The blade and motor change out testing will verify the cutting blade and hydraulic motor can be removed and replaced from the grating level.

1. Isolate hydraulic supply and return lines from cutter motor.

2. Remove blade, bring to grating level, and reinstall blade using long-reach tools. Comment on difficulties encountered:

3-24-99 Used the tool to tighten nut on blade - 85 ft-lbs. Made additional cuts successfully. Nut did not come loose. Jim Van [illegible]

~~Record total time:~~ JKJ 4/23/99 Only performed blade tightening with tool. DKJ 4/26/99

3. Remove saw motor, bring to grating level, and reinstall motor using long-reach tools. Comment on difficulties encountered:

NA this operation

Record total time: ______

Jf J Thielges
3/29/99
QR [illegible] 4/1/99

Blade and Motor Change Out

The blade and motor change out testing will verify the cutting blade and hydraulic motor can be removed and replaced from the grating level.

1. Isolate hydraulic supply and return lines from cutter motor.

2. Remove blade, bring to grating level, and reinstall blade using long-reach tools. Comment on difficulties encountered:

   Reviewed with operator Tim Vanreenen. Tim was confident the operation could be performed. Went through the bolt removal and blade tightening sequence using flexible long handled tool. Jim Van R

   Record total time: N/A did not perform entire operation remotely.

3. Remove saw motor, bring to grating level, and reinstall motor using long-reach tools. Comment on difficulties encountered:

   Reviewed with operator Tim Vanreenen. Tim was confident the operation could be performed. All the nuts could be accessed with the tool and turned. Jim Van R

   Record total time: N/A did not perform entire operation remotely.

   [signature] 3/29/99

   QR [initials] 4/1/99

APPENDIX B

TABULATED TEST DATA SUMMARIES

TABLE B.1 Canister Cutting Test Data Summary

Test #	Cut #	Canister Type	Blade Type/ Condition	Blade Orientation	Start Time	End Time	Hydraulic Flow Rate, gpm	Hydraulic Pressure, PSIG No Load	Hydraulic Pressure, PSIG During Cutting	Fuel Damage
1	1	SS	Design/New	CW, Teeth lead	10:58	11:30	3.25		1300	Slight Surface damage ~1/16" deep cuts several inches long
	2	SS	Design/Damaged Teeth	CW, Teeth lead	13:50	14:45	3.25		1300	
	3	SS	Design/New	CW, Teeth lead	10:33	10:55	3.3	700-900		
	4	SS	Design/Damaged Teeth	CCW, Teeth Follow	11:14	11:40	3.3	700-900		
2	1	SS	Design/Damaged Teeth	CCW, Teeth lead	13:25	14:02	3.3	670	800-1000	Superficial damage up to 1/32" deep
	2	SS	Design/Damaged Teeth	CCW, Teeth lead	14:12	15:01	3.25	670	800-1000	
	3	SS	Design/Damaged Teeth	CCW, Teeth lead	15:16	15:44	3.3	670	700-900	
	4	SS	Design/Damaged Teeth	CCW, Teeth lead	7:50	8:17	3.65		1600-1900	
3	1	Al	Design/New	CCW, Teeth lead	9:02	9:07	3.5	800-900	800-900	No damage
	2	Al	Design/No damage	CCW, Teeth lead	9:16	9:21	3.5	800-900	800-900	
	3	Al	Design/No damage	CCW, Teeth lead	9:57	10:00	3.4	800-900	800-900	
	4	Al	Design/No damage	CCW, Teeth lead	10:09	10:12	3.4	800-900	800-900	
4	1	SS	Alternate/New	CCW, Teeth lead	10:53	10:59	3.25	750	750	Superficial damage Up to 1/32" deep, 2" long
	2	SS	Alternate/No damage	CCW, Teeth lead	11:04	11:09	3.25		750	
	3	SS	Alternate/No damage	CCW, Teeth lead	14:34	14:39	32.5		710-900	
	4	SS	Alternate/No damage	CCW, Teeth lead	15:10	15:18	3.0		500-600	
5	1	Al	Alternate/No damage	CCW, Teeth lead	1:43	1:48	3.25	750	750	No damage
	2	Al	Alternate/No damage	CCW, Teeth lead	13:51	13:53	3.25		700	

Table B.2

Canister Barrel Spreading Data Summary

Test #	Canister Type	Maximum I. D. After Spreading, Inches Right Barrel	Left Barrel
1	MK II S.S.	8.6	8.8
2	MK II S.S.	8.3	8.4
3	Aluminum	9.65	8.4
4	MK II S.S.	8.3	8.4
5	Aluminum	8.5	8.6

APPENDIX C

CALIBRATION RECORDS

	Component				Stuck Fuel Station (Records in Appendix E)			
Item No.	Component Tag #	Component Description	Units	Leak Tightness	NIST/ HSL	305 CAL/ QC VERIFY	Manufacturer	QC Signature
		CUTTER STATION INSTRUMENTATION						
1	S/N SL688	~~Micrometer~~ Caliper JRJ 4-15-99	Inch	NA	X			[signature] 4/29/99
2	6304-1	Hydraulic Flow meter	gpm	MLSD		X		[signature] 4/29/99
~~3~~		~~Hydraulic Pressure~~	~~psi~~	~~MLSD~~				

JR Thielges 4/15/99
[signature] 4/21/99

HANFORD STANDARDS LABORATORY CALIBRATION REPORT

CUSTODIAN/ADDRESS: CASTO ML, L6-38
STANDARDS CODE NUMBER: 679-15-03-002
NEW: ✓ | MODIFY
REFERENCE NUMBER: 415805
ORGANIZATION CODE: W08E00
WORK ORDER:

INSTRUMENT: COMBINATION CALIPER STARRETT 122 0-36 INCH
SERIAL NUMBER: SL688
PROPERTY NUMBER: N/A
RECALL STATUS (1 ACTIVE, 2 NONRECALL, 3 SUSPENDED, 4 DELETED, 5 PM, 6 NONDATA MNTE): 1
RECALL CYCLE: 360
TOLERANCE HISTORY:
ROOM: N/A
BUILDING: 306E
SERVICE DEPARTMENT: 6
DATE RECEIVED: 980429
TOLERANCE (AS FOUND; 1 IN, 2 OUT, 3 NA, 4 FAILED): 1

SENDER: TERESA 6-5013
COMMENTS:
RUSH? YES | CO ID: J | SD: WE

INSTRUMENT SPECIFICATIONS:

NO CHARGE:
TRAINING HOURS ______
ACTUAL CAL HRS 1.0
OTHER HOURS .5
ENG/ADMIN HOURS ______

Standard(s) used in calibration traceable to National Institute of Standards and Technology or nationally recognized standards.
4:1 RATIO? [✓] YES [ ] NO

Standard	EXPIRATION DATE		EXPIRATION DATE
002-50-02-001	6-9-98		
002-41-05-001	6-13-99		
002-79-06-002	7-10-98		

BILLED:
STD CAL HOURS 1.3
REPAIR HOURS ______
MATERIALS ______
TOTAL CHARGE = ($198 x SUM OF HOURS) + MATERIALS

REMARKS: DS IN SLIC
Cleaned - De Burred & Lubricated, Applied S/N

DATE CALIBRATED: 5-5-98
DATE DUE: 5-5-99

PROCEDURE NUMBER: WHC-6-CALIPER REV.3
AMBIENT TEMPERATURE = 19.7°C

TEST POINTS	AS FOUND I.D.	AS FOUND O.D.	FINAL I.D.	FINAL O.D.	TOLERANCE
1.000"	W/I .001"	W/I .001"	SAME	SAME	+/- .001"
2.000"	" "	" "	"	"	"
4.000"	" "	" "	"	"	"
6.000"	" "	" "	"	"	"
8.000"	" "	" "	"	"	"
10.000"	" "	" "	"	"	"
12.000"	" "	" "	"	"	"
24.000"	W/I .002"	" .002"	"	"	+/- .002"
36.000"	W/I .003"	" .003"	"	"	+/- .003"
48.000"					+/- .004"
60.000"					

THE ABOVE TEST POINTS ARE CONVERTED TO METRIC EQUIPMENT, FOR METRIC CALIPERS. (CONVERSION: 1"=25.4mm).

APPROVED BY: 5/6/98 W. H. Ulbricht, Jr.
CALIBRATED BY: 41

Project Hanford Management Contractor for the United States Department of Energy
DynCorp Tri-Cities Services, Inc
P.O. Box 1400
Richland, WA 99352

PAGE 1 OF 1

RUSH

Thielges, James R (Jim)

From:	Diehl, John I
Sent:	Wednesday, April 21, 1999 3:16 PM
To:	Thielges, James R (Jim); Meeuwsen, Paul V; Fleming, Leon R Sr
Cc:	Davis, Glen M; Davis, Paul E; Henderson, John M (Mark)
Subject:	RE: FRS 305 TESTS CALIBRATIONS

Jim & Paul;
My understanding of this is: The contract went to FDNW who has the responsibility to design and fabricate in accordance with their program. Therefore I would make sure that the procurement and testing complies with their program and the requirements HNF-3253 and related ECN's.

-----Original Message-----

From:	Thielges, James R (Jim)
Sent:	Tuesday, April 20, 1999 9:36 AM
To:	Diehl, John I
Cc:	Meeuwsen, Paul V; Thielges, James R (Jim)
Subject:	FRS 305 TESTS CALIBRATIONS
Importance:	High

John,

We are planning to field calibrate the water and hydraulic flow meters for the decapper and stuck fuel station testing activities in 305 and 400 area. The flow meters were purchased with calibration certs but they were not acceptable because the certs were not traceable to the individual flow meters. We have prepared a field calibration procedure that measures the volume of liquid over a given time, using a calibrated instrument to measure the volume. With your concurrence, we will field calibrate the instruments and have Quality Control verify the calibrations. QC from the 1100 area is available to support us in this effort. If you have any question, please call me on 376-9029 or Paul Meeuwsen on 376-5718.

Thanks,

Jim

Jim Thielges
376-9029

K-BASIN FUEL RETRIEVAL DECAPPER AND CANISTER SLITTER FIELD CALIBRATION

OMEGA FL-6304 FLOW METER #6304-1

Cog Engineer PAUL MEEUWSEN Date APRIL 21/1999

Quality Assurance [signature] Date 4/22/99

INTRODUCTION

The Omega FP-6304 flow meter will be used to measure the Houghto-safe fluid flow into the canister slitter motor. The purpose of this procedure is to verify that the flow meter purchased from Omega is within the expected accuracy range. The range of this instrument is ½ to 4 gallons.

1. Adjust flow to one gallon per minute.
2. Fill empty one gallon container for one minute.
3. Record actual volume .37/.37 gallons.
4. Perform calculation to find percent error.

   (found volume/expected volume)x100 Record value 63%

   If volume found is not within 5% of expected volume, perform specific gravity correction calculation. The formula for this calculation is found in appendix A. Rerun one gallon per minute flow test.

5. Adjust flow to two gallons per minute.
6. Fill empty ~~one~~ two gallon container tank for ~~1/2~~ one minute.
7. Record actual volume 1.3/1.3 gallon(s).
8. Perform calculation to find percent error.

   (found volume /expected volume)x100 Record value 35%

9. Adjust flow to ~~4~~ 3 gallons per minute.
10. Fill empty container for ~~25~~ 30 seconds. 2nd test 1 min
11. Record actual volume 1.37/2.75 gallons.
12. Perform calculation to find percent error.

   (found volume/expected volume) x 100 Record value 8.3%

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company

Certificate of Conformance

for

FLUOR DANIELS

P O BOX 1000

RICHLAND WA 99352

Cust. P.O. #: 0002715 **OMEGA W.O. #** 901923749

CAL-1

OMEGA Engineering, Inc. certifies that the items comprising the above order have been manufactured in accordance with all applicable instructions and specifications as published in the OMEGA COMPLETE PRESSURE, STRAIN AND FORCE MEASUREMENT HANDBOOK AND ENCYCLOPEDIA®.

Certified by: Stephen Cardone **Date:** 02-15-99
Quality Assurance Inspector

Omega Engineering, Inc., One Omega Drive, Box 4047, Stamford, CT 06907
Telephone: (203) 359-1660 · FAX: (203) 359-7811
Internet Address: http://www.omega.com E-Mail: info@omega.com

750-88-01-006 417074

- CERTIFICATE OF CALIBRATION -

NORTHWEST CALIBRATION SYSTEMS, INC.

3119

~ NCS is ISO-9002 Registered ~

NCCB 6097, ANSI-RAB 10025

1000197644
Certification Number

Id #	750-88-01-006		
Company	DYNCORP C/O FLUOR DANIEL HANFORD	P O #	MKB-SDX-A61176
Item Type	TORQUE WRENCH (CW), 80 FT-LB	Serial #	A120582
Size/range	80 FT-LB	Manufact	PROTO
Model #	6008-4	Cal Date	07/31/1998
Ambient Temp	74.0 Rel Humidity 55.0 Tech: WJB	Cal Due	07/31/1999
Department	UNASSIGNED	Procedure	105AA
Location	UASSIGNED		

Calibration Technician Wm Brown Date 7/31/98

ACCURACY
+/-4% CW

CONDITION
RECEIVED IN TOLERANCE, NO ADJUSTMENT REQUIRED

ADJUST NOTES
N/A

REPAIR NOTES
N/A

CALIBRATION STANDARD		Cal Due Date
100663	TORQUE/FORCE/TENSION CALIBRATION TESTER	07/08/1999

NIST Reference
(100663)505500

------ ATTRIBUTES ------

NAME	NOMINAL	BEFORE ADJUST	ACTUAL
16 FT-LBS (CW 4%)	16.00	15.60	15.60
32 FT-LBS (CW 4%)	32.00	30.80	30.80
48 FT-LBS (CW 4%)	48.00	46.60	46.60
64 FT-LBS (CW 4%)	64.00	64.40	64.40
80 FT-LBS (CW 4%)	80.00	81.20	81.20

Northwest Calibration Systems certifies this instrument has been calibrated using standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. NCS's calibration system complies with the requirements of ISO-9002, ISO/IEC Guide 25, ANSI/NCSL Z540-1 and MIL STD 45662A.

----- End of Report -----

8/18/98 W.H. Gilbert Jr.

WHC STD LAB 58 8/19/98 WHG

WHC STD LAB 58

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Printed: 08/03/1998 Page:

APPENDIX D

ALTERNATE CUTTER BLADE INFORMATION

ALTERNATE CUTTER BLADE INFORMATION

The recommended cutter blade for use in cutting the K-Basin stuck fuel canisters is the following:

Manufacturer: Niagara
Blade type: Straight Side Tooth Saw
EDP Number: 08890
Catalog Number: MT8022
Cutter Diameter: 8"
Face Width: 1/8"
Arbor Hole: 1-1/4"
Number of Teeth: 48

DISTRIBUTION SHEET

To	From	Page 1 of 1
P. A. Young X3-88	J. R. Thielges	Date 12/17/99
Project Title/Work Order		EDT No. 613076
SNF-5116 FRS Stuck Fuel Station Performance Test Data Report		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
J. A. Dent	X3-65	X			
J. I. Diehl	X3-80	X			
S. D. Godfrey	X3-88	X			
J. M. Henderson	X3-88	X			
D. R. Jackson	K5-22	X			
M. J. Langevin	X3-76	X			
J. D. Mathews	X3-65	X			
P. V. Meeuwsen (2)	L6-13	X			
R. G. Pedigo	S1-51	X			
M. J. Schliebe	L6-13	X			
G. E. Stegen	H3-26	X			
J. R. Thielges (2)	L6-38	X			
T. J. Harper	H8-68				X
T. C. Vanreenen	X3-65	X			
B. D. Groth	X3-88	X			
Central Files	B1-07	X			
DOE/RL Reading Room	H2-53	X			