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KBC-26294
Revision 0

Technology Demonstration Underwater Hydrolasing Phase 0, I, II Technical Report

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Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

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KBC-26294
Revision 0
EDC #: HNF-EDC-05-26295

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Document Type: TR Program/Project: KBC

G. B. Chronister
Fluor Hanford, Inc.

Date Published
June 2005

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Total Pages: 27

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EDC (ENGINEERING DOCUMENT CHANGE) FORM

Document Identification

1. Change Title:
Technology Demonstration Underwater Hydrolasing Phase 0, I, II Technical Report

Key Words:
Underwater, Hydrolasing, Demonstration, 105 KE

2. Project No./Work Package No.:
K Basins Closure Project (KBCP)

3. Review Designators:
N/A ☒ D ☐ P ☐ E ☐ N ☐ R ☐ I ☐ F ☐ Q ☐
Additional Reviewers:
___ ☐ ___ ☐ ___ ☐ ___ ☐ ___ ☐ ___ ☐

8. Release: Release CACN _____

JUN 8 2005
DATE: HANFORD RELEASE ID:
STA: #19 (15)

4. Area	5. Building	6. Facility	7. System No.
100K	Basins 105 KE	K Basins Closure Project	— (JKB 6/8/05)

9. USQ Required? ☐ USQ ☒ CX ☐ NA No.: GCX-5, PRO-062, Rev. 11 W. Walker

10. Distribution - Name	MSIN	Distribution - Name	MSIN
RL Maurer	X3-85	RT Winward	X3-79
DL John	X3-85	AM Umek	X3-71
R Yanochko	X3-85		
RM Suyama	X3-85		
JL Westscott	T4-05		
GS Hunacek	X3-79		
DJ Watson	X3-79		

11. Change Description (description and reason for requested change):
Initial issue of technology report demonstrating underwater hydrolasing. This report covers Phase 0, I, and II hydrolasing demonstration.

Approvals

12. Change Originator	TA/DA	Engineering Management/TA Manager
GB Chronister 5/26/05	GB Chronister 5/26/05	RM Suyama 5/31/05
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date
Title 100K Deactivation Manager	Title N/A (JKB 6/8/05)	Title N/A (6/8/05
T. Umek 5/31/05		
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date

13. Document Index

Action	Number	Title	Rev (being issued)	Change Page(s)	Config Baseline
~~DR~~ N (JKB 6/8/05)	KBC-26294	Technology Demstration Underwater Hydrolasing Phase 0, I, II Technical Report	0	— (JKB 6/8/05)	☐

14. Potentially Affected Documents Not Modified By This EDC:

Document Type	Document Number/Revision	Document Owner (Organization)	Technical Authority Notified	Date Notified
N/A (JKB 6/8/05)				

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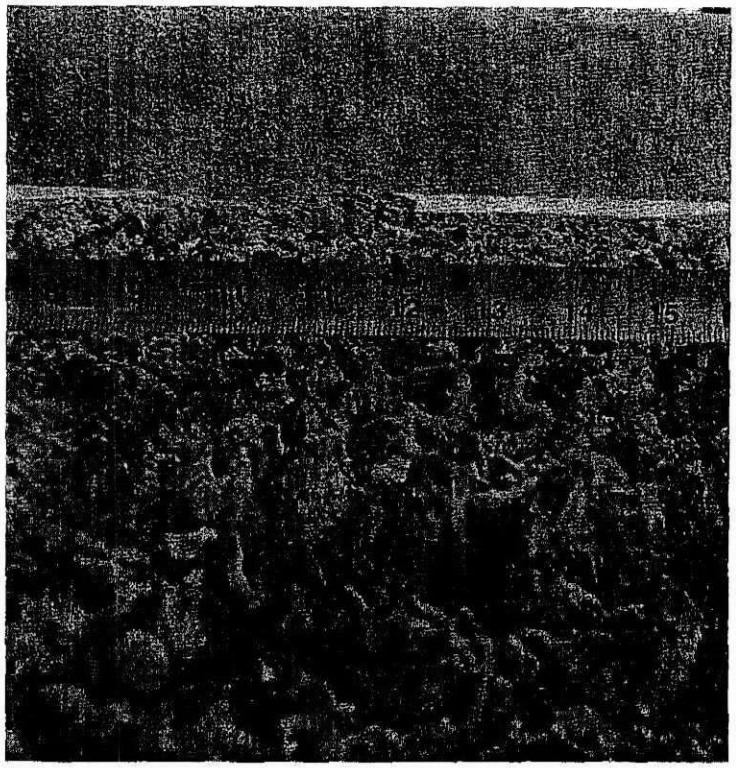

Fluor Hanford Contract No. 20807

Prepared by:

S.A. Robotics

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Loveland, CO 80537

Executive Summary

From September 10 through December 17th, 2003, S.A.Robotics executed Phases 0, I, and II of the Technology Demonstration - Underwater Hydrolasing. Phase 0 was performed at the S.A.Robotics facility in Loveland, Colorado, while Phases I and II were performed at the Hanford K-Basin East Site. The purpose of the demonstrations was to show 1) underwater hydrolasing is a feasible method of removing contaminated concrete underwater to a required depth, 2) the hydrolasing head could be controlled during operation, 3) the depth of contamination in the concrete structure could be accurately measured, and 4) a characterization of the waste stream during hyrdolasing activities could be recorded. Video monitoring was also used during all demonstrations.

All phases of the demonstration were completed and deemed a success by both the observers and the demonstration team. Single and multiple passes were made using variable cutting rates, different stand-off distances were tested, and stationary cuts were executed. Hot and cold hyrdolasing was performed with radiological and depth scans of the affected surfaces. Specially designed equipment was installed and operated within the contaminated environment of 100-K East Basin. Separate results are documented below by phase.

The Phase II radiological demonstration was performed to determine the feasibility of underwater hydrolasing technology for decontamination of the DOE spent fuel basins at Hanford 100-K area. This project demonstration was conducted at 105 KE Basin with the expectation that, once proven, this technology can be implemented at Hanford and other DOE sites.

Background

Data collected from 105-KE in 1981 showed that contamination levels were at 10 microcuries per square centimeter. Current measurements showed this figure to average between 1000 and 1500 microcuries per square centimeter. Having the radiological exposure increase in excess or two orders of magnitude requires dose reduction prior to

dewatering due to the significant radiation field (it is expected to be somewhere between 19 and 50 rem at the basin edge unshielded).

The original baseline, while it considered decontamination through scabbling of the surfaces, was considered to be done in a dry atmosphere following dewatering. The recent radiological profiling now requires the decontamination method be performed underwater, or some other method of shielding will be required if underwater decontamination efforts prove unsuccessful.

The end point criteria for transfer of the basins to the River Corridor contractor are:

- exposure to the public of less than 25 mrem/yr at the 100 K Area river shoreline
- and for worker protection less than 5 mrem/hr at the facility boundary.

Proposed Actions

The use of the underwater hydrolasing technology would allow the SNF Project to maintain an accelerated schedule for clean-out of the basins and transition to D & D, with an associated cost savings. The technology would enhance worker safety and lower exposures by performing the work underwater, thereby reducing worker radiation exposure from both the shine emanating from the contaminated basin walls (estimated at 19 - 50R/hr. unshielded) and the potential for airborne exposure due to above water scabbling of the concrete.

The Goals for the demonstration were ability of the equipment to meet

- production rates of minimum 150 sq. ft/hr removal of 1/8" of surface
  - – achieved 150 sq. ft/hr plus single pass of ½" – four fold increase in production speed
- Residual dose of ~2mr/hr or less
  - – achieved ~2 mr/hr
- Ability to capture solids removed
  - All spoils captured underwater
- Adequate controls
  - All processing and recovery of contaminated waste performed underwater with no radiological or environmental issues
- Re-migration study to determine time to eleveated cesium levels
  - Remigration study is underway as of the writing of this report no remigration is evident

The demonstration was planned to minimize interference with any current fuel and sludge handling operations. The work was broken down into phases;

- Proof of Concept at contractors location in Loveland, CO
- Cold demonstration performed in the KE183 sedimentation basin,
- Hot Demonstration in 105KE Basin Fuel Pool West bay on the cantilevered wall
  - Testing on the underwater waste recovery,
  - deployment and production capability and
  - obtain samples of the materials removed form the wall for characterization.

The following items were the technology project goals:

- Demonstrate the hydrolasing on underwater surfaces (walls, floors, and corners/crevices)
- Demonstrate underwater waste recovery from the hydrolasing
- Provide an understanding of the depth of radiological contamination into the concrete surfaces of the basin walls and floor, which will allow for proper planning of decontamination operations in the basins.

This project demonstration was supported by contamination measurements of the walls and floors both before and after to validate the effectiveness of the technology demonstration goals.

The surface area of each that this technology will be demonstrated on in each phase will be nominally 800-1,000 square feet. Diameter and width should be sufficient to place an underwater waste recovery system. The estimated cost to perform the project demonstrations was roughly $800K. These costs cover the following items:

- Project Management
- Facility modifications
- Establishment of Statement of Work
- Contract with contractor
- Mobilization
- Deployment/demonstration
- Demobilization
- Waste recovery/disposition
- Facility Operations and Radiological support
- Final report

The use of subcontracts secured technologies needed to successfully execute this technology project. The subcontracts are broken down into four key elements as follows:

- **Underwater Hydrolasing** – This subcontract tested and demonstrated the effectiveness of underwater hydrolasing while simultaneously determining the extent of penetration of radionuclides into the concrete. Additionally, this demonstration yielded the production rates based on depth of surface removal.

- **Underwater Waste Recovery** – The waste stream coming off of the hydrolasing was a high dose residue/concrete. This subcontract was issued to demonstrate the technology in terms of underwater waste segregation/capture to prevent dispersion of waste streams in the basins, underwater handling of the waste container, and removal of the equipment and containers from the basins. This recovery operation met ALARA goals and assured the turbidity in the water did not increase during hydrolase operations.

- **Water Treatment** – The water generated by hydrolasing/waste recovery operations will be saturated in soluble and suspended fine particulate radionuclides. Water clean-up is essential to protect equipment and aid in ALARA for handling/sampling. The water clean-up train will be designed to lessen potential increases in turbidity of the basin/discharge chute water.

- **Remote Control (Robotic) Arm** - This subcontract provided the deployment mechanism for the underwater hydrolasing shroud, as well as the mechanism for handling the waste containers from the underwater waste recovery system. The use of a robotic arm provided positive controls for deployment of the hydrolasing shroud (resolves concerns with possible detachment) and was adapted to accommodate a variety of cameras so that the arm and hydrolasing can be operated regardless of turbidity issues.

Benefits:

The proposed Demonstration Project provided data on the extent/depth of contaminant penetration into the basin walls/floors, which allows for effective planning of the actual work to be performed in the basins.

This Technology Project demonstration allows for data to support the application of underwater or above water shielded waste recovery of the waste stream from the hydrolasing process.

This demonstration does have application at other DOE sites for consideration in contaminate removal and surface decontamination in basins, tanks, and pits at other DOE sites. Currently, discussions have commences with key personnel in Idaho and West Valley concerning the technology deployment.

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Technical discussion of results:

- The cold demonstrations showed satisfactory control and rate of removal with the hydrolasing blast head.
- Radiological demonstration
  - confirmed satisfactory control and rate of removal with hydrolasing head and shroud assembly;
  - showed radiological reduction from 3,8 REM/hr. to <100mrem/ hr.
  - Cesium remigration – the study was initiated on 12/17/2003 and will be concluded by 3/01/04. Indication to date show minor levels of recontamination/migration and will be evaluated in a separate report.

Next Steps

Full scale operations contracts have been released for fabrication and deployment of the necessary equipment and tools to make the current project baseline successful. The scheduled deployment to support production activities is June of 2003, a full year ahead of previously planned activities.

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PHASE 0

Description

Phase 0 of the Technology Demonstration – Underwater Hydrolasing was a cold demonstration of the vendor's ability to perform basic operations needed for submerged concrete removal. The demonstration was performed at SARobotic's facility in Loveland, Colorado. Controlled operation of the Hydrolasing Head, feasibility of underwater hydrolasing, and successful removal of debris generated by this process were all reviewed.

Participants

The following participants were present for the demonstration.

Glen Chronister – Fluor-Hanford
Bob Suyama – Fluor-Hanford
Jim Mathews - Fluor-Hanford
Rich Creed – E^2 Consulting Engineers
Dick McGinn – D3 Technical Services
David Will - D3 Technical Services
Dan Johnson – S.A.Robotics
Rob Owen – S.A.Robotics
Matt Cole – S.A.Robotics
David Morely – S.A.Robotics
Bob Morris – Alpha Group and Associates, LLC
Pat Canonica – AK Services, Inc.
Dennis Brunsell – DTGS

Test Plan

To support the project, Fluor-Hanford created a check sheet for the attendant team members to use during the demonstration to evaluate specific criteria relative to the

Statement of Work and parameters of special interest which are to be used to help answer nuclear safety and industrial safety issues.

The following are items from the statement of work to be assessed in the Phase 0 demonstration:

- X axis control ability
- 1/8 inch surface removal (X4)
- 1/2 inch surface removal
- Production rates associated with 1/8 inch surface removal
- Production rates associated with 1/2 inch surface removal

The following items were assessed relative to industrial /nuclear safety

- Surface removal for stationary X deployment @ 2 inches
- Surface removal for stationary X deployment @ 1 inch
- Surface removal for stationary X deployment @ Contact
- Turbidity changes in the water for all aspects of the demonstration relative to particulate loss at the contact point on the hydrolasing head
- Large particulate capture/loss relative to the contact point on the hydrolasing head
- Water line proximity tests to determine adequate control depth to eliminate splash/spray

Test Set Up

The S.A.Robotics remote and gantry were attached to the fabrication shop bridge crane (5 ton capacity). Originally, S.A.Robotics had proposed using a mobile A-frame to suspend the arm, but it became apparent that the thrust from the high pressure jets would require a more stable platform. Additionally, the bridge crane provided a third axis of controlled, powered movement. The remote arm provided a vertical stroke distance of 4', and the gantry provided movement perpendicular to the test surface of 3.5'. The hydrolasing

head was equipped with a 2 inch suction line off of the inner shroud and a 1-1/2 inch suction line off of the outer (secondary) shroud. The inner shroud suction line was attached to a 180 gallon/minute (maximum) trash pump. The trash pump was routed to a strainer/filter bank which was used to simulate the DTGS filter skid. The outer shroud was routed to an 80 gallon/minute (maximum) pump, which was dumped without filtering.

A concrete tank (1000 gallons) was filled to approximately the 4' level, and the concrete slab test panel was immersed and held in place vertically. The concrete slab was comprised of 5,000 psi (minimum) concrete with wire mesh and approximately ½" aggregate. See Figure 1 below for the general arm and test tank arrangement.

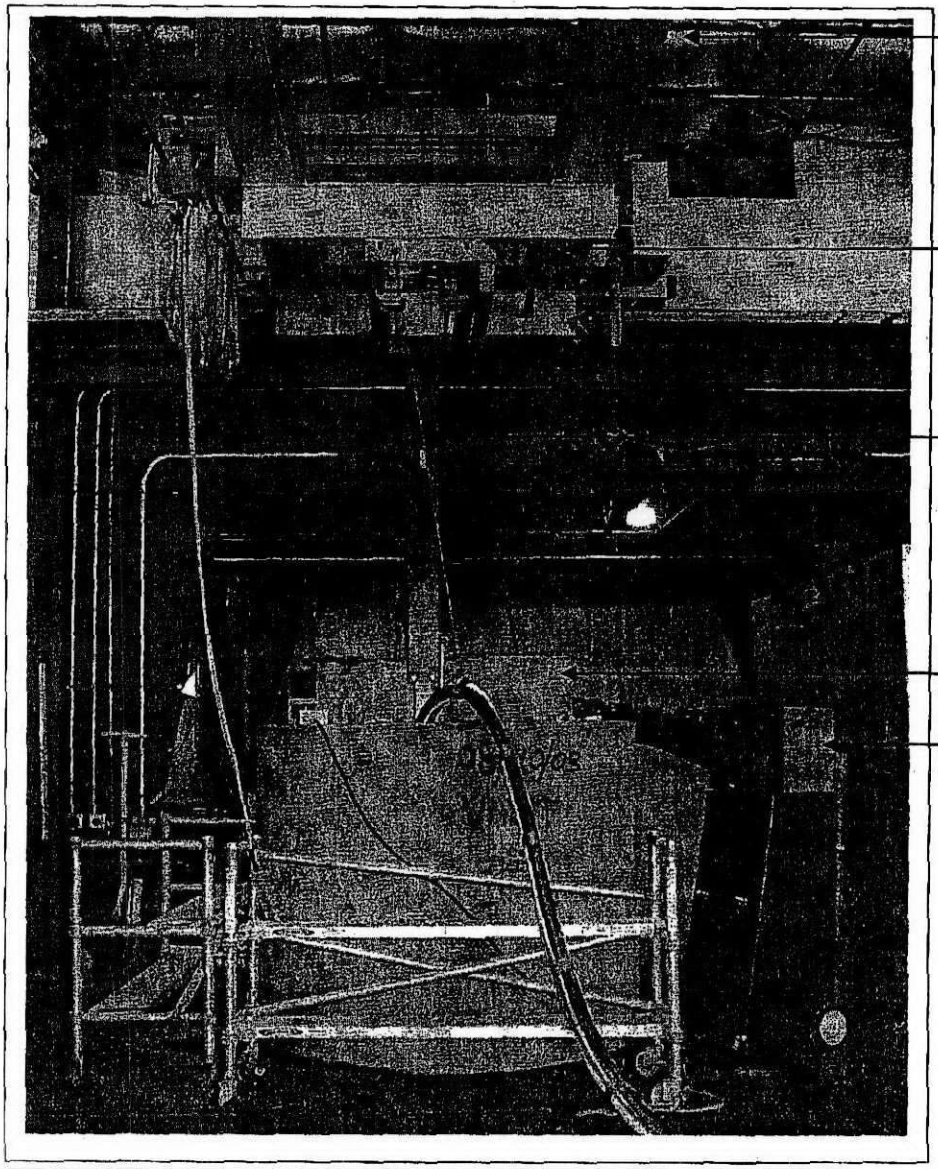

Figure 1 - Arm and Test Tank Arrangement

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The hydrolasing head was a modified Aquadyne Mini-Scrubber®, which had a secondary shroud added and the wheel removed. The Mini-Scrubber® is marketed as a coating blast head. The rotary bar of the blast head had six nozzles. See Figure 2 below for details of the blast head set-up. Dual bristle rings were added to aid in capturing the debris. Stand-offs provided assurance that the head would not be pulled to the wall by the vacuum created by the pumps. The rotor on the blast head was air driven, and a snorkel was added to eliminate bubbling off of the motor exhaust.

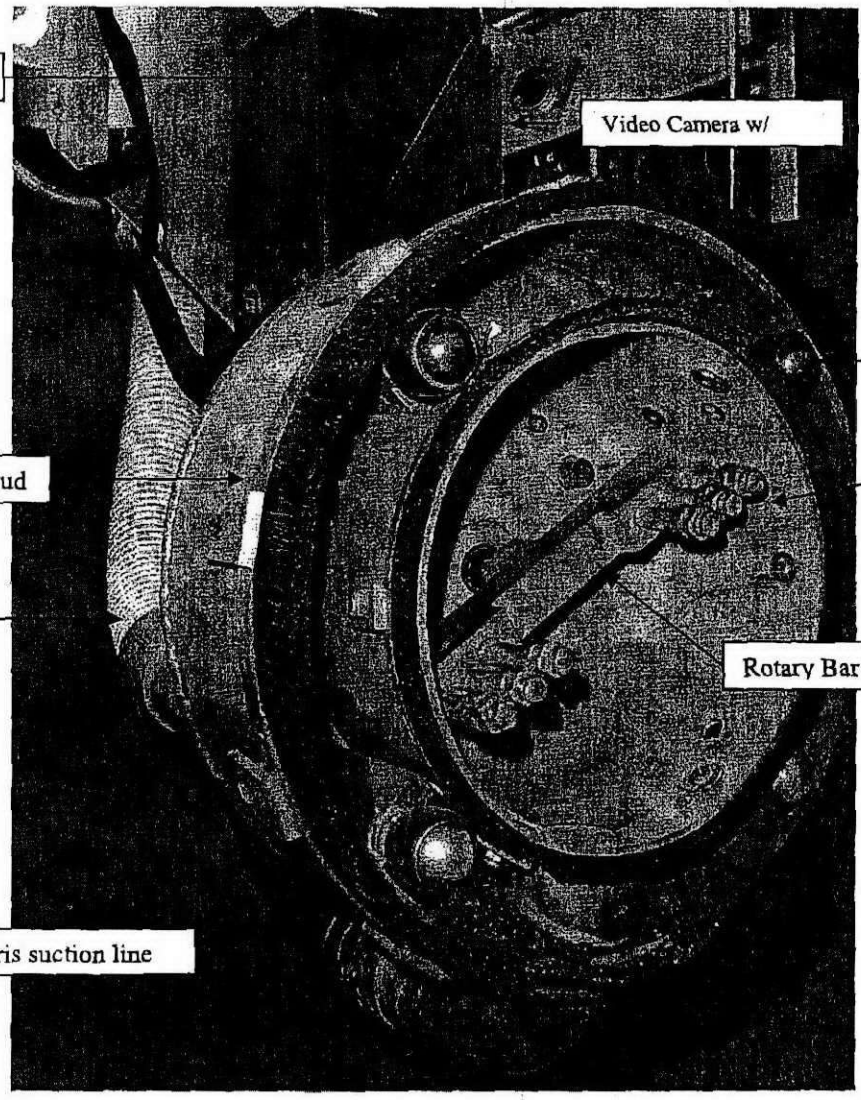

Figure 2

The AK Services diesel-powered high pressure pump was located outside of the fabrication shop. The control panel and high pressure lines were connected to the pump unit, and the hoses (air and water) were routed to the blast head. The pump unit is shown below in Figure 3.

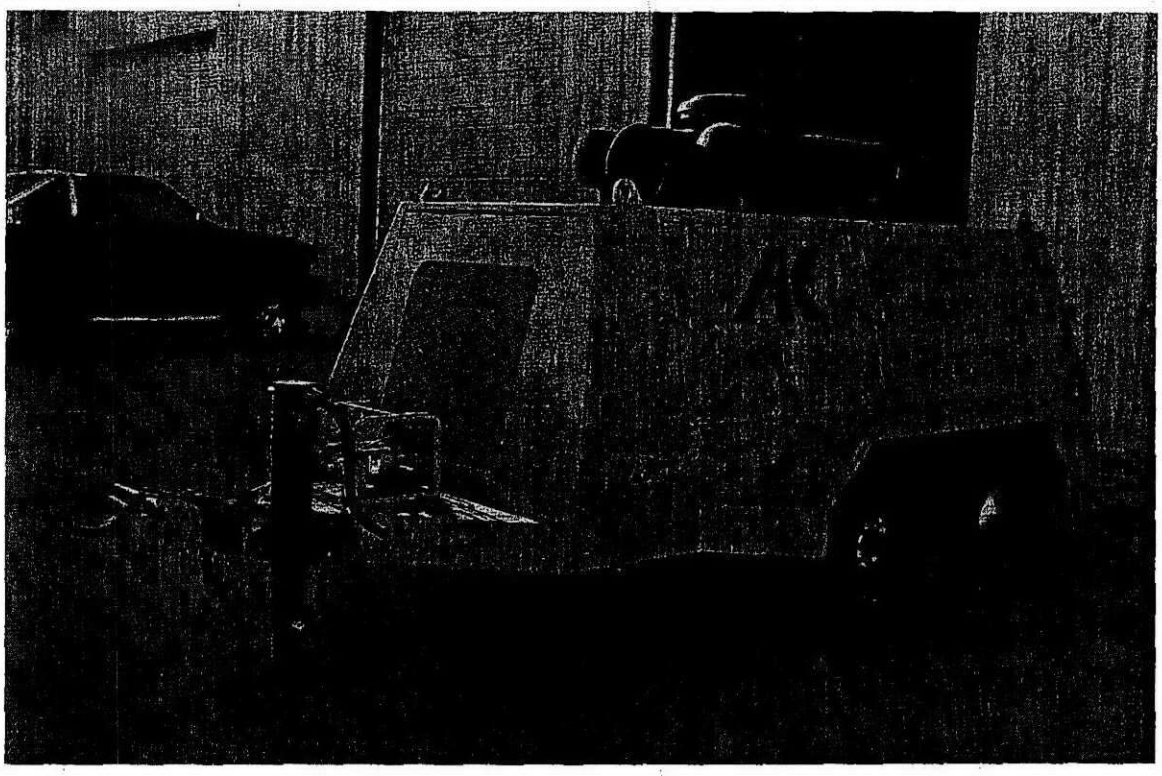

Figure 3

Underwater video cameras were attached to either side of the blast head, and a video monitor was placed adjacent to the test tank for viewing from both the scaffolding surrounding the tank and from the shop floor. Reference Figure 2 for the video camera placement. Test pressure was set at 34,000 psi.

Test Results

Figure 4 is a photograph of the test panel. The speeds and depths of cut, durations and stand-off distances are noted below.

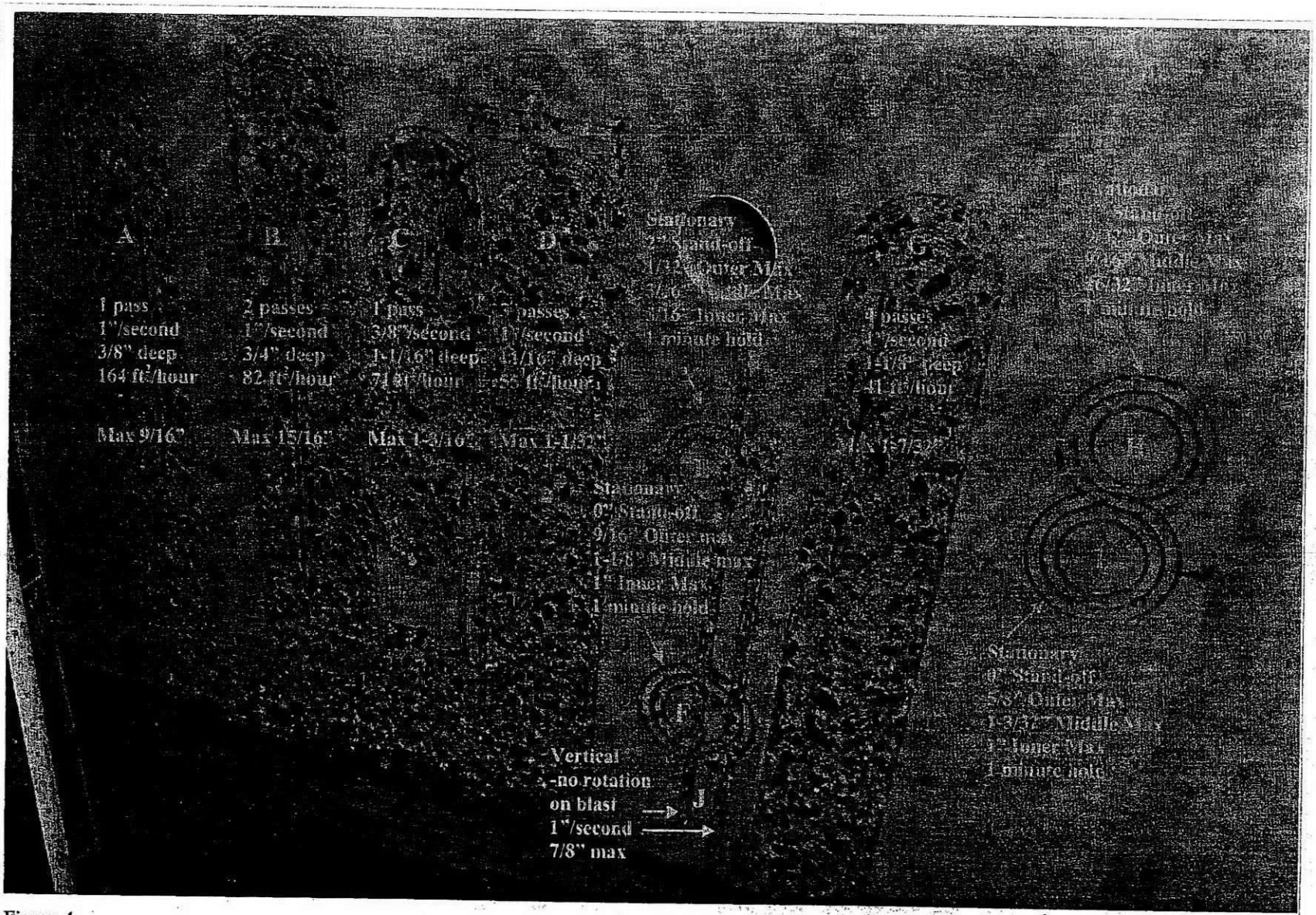

Figure 4

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Conclusions

- At 34,000 psi, the hydrolasing blast head achieved the minimum required 150 sq.ft/hour and 1/8" depth of cut (Test Run A., achieved 164 sq.ft/hr with a 3/8" deep cut). Higher pressure will only increase the rate of cutting.
- Turbidity was minimal with the test pump and filter skid, as was observed and video taped. Samples of the debris were provided to the Fluor-Hanford personnel following the demonstration.
- Control of the blast head was maintained. At no time was the blast head pushed away from the test slab due to the thrust exerted by the blast jets, nor did it affix to the test slab due to suction created by the filter pump.
- The video camera arrangement showed the results of the cutting process. Note that one of the off-the-shelf cameras was defective and was returned to the manufacturer. The remaining camera provided excellent clarity and illumination. The cameras had built-in lighting which eliminated the need for separate lighting.
- The underwater radiation detector will be mounted near the hydrolasing head and will be inside a shielded collimator to reduce interference from the surrounding radiation environment (per Alpha Group).
- The anticipated unshielded exposure rate to the equipment ranges from 50 mR per hour to 50 R per hour (input from Fluor-Hanford).
- A sample filter stand will be added to the Underwater Waste Recovery Unit to allow collection of particulates during hydrolasing. The incoming waste stream will be diverted to a sample station containing 4 separate filter elements. Each filter element, once used, will be detachable for analysis.

Problems Noted and Solutions to be Incorporated into Phase I/II

- As the Mini-Scrubber® is designed to be used primarily for coating removal, a gap of sufficient size to capture and wedge aggregate exists at the end of the rotor bar. In Test Pass J the rotor bar was intentionally not rotated to mimic this problem. As shown in Figure 4, Test Pass J, the result of a jammed piece of aggregate is six straight cuts into the surface. S.A.Robotics will add a hoop to the perimeter of the bar to eliminate this gap while still allowing aggregate to pass by to the vacuum intake.

- Pump pressure was not varied during the testing significantly, so the effects of lower pressure were not tested. Due to the successful achievement of all test parameters at 34,000 psi, it was decided by FH representatives that testing at lower pressures was not warranted. As the removal rates were in excess of the required 150 sq.ft/hour, it is assumed that lowering the pressure would result in lower removal rates, and testing is not deemed critical. The pressure drop in the high pressure lines is reported by AK Services to be approximately 50 psi/50 feet. With the use of a 250 foot hose, the removal rate would nearly identical to those documented in the Phase 0 test.
- Phase 0 was run immediately after the complete system had been assembled. The testing was not practiced by S.A.Robotics prior to the Phase 0 test being run. Prior to the Phase I and II demonstrations, S.A.Robotics and team members will perform dry runs on all testing steps to ensure a smooth demonstration.
- One of the purchased cameras had problems during the testing. All newly purchased items, including the camera system, will be run through a burn in period to ensure no defective components have been installed on the equipment to be used during the demonstrations at Hanford.

PHASE I

Description

Phase I of the Technology Demonstration – Underwater Hydrolasing was a cold demonstration of the specially designed remote arm to be used in 100-K East Basin. The demonstration was performed in the sedimentation basin south of the 100-K reactor facility. All aspects of the operation of the remote arm, control equipment, and underwater waste recovery unit were tested and reviewed. Hydrolasing was performed on the sedimentation basin wall in four sections. Each section was hydrolased with a different number of total passes, the first starting with a single pass and the last with four. The wall was to be scanned for radiological data (should read zero) as well as depth of cut per pass and the data compiled and reviewed. Furthermore, all radiation sensors were tested for accuracy using air as a medium.

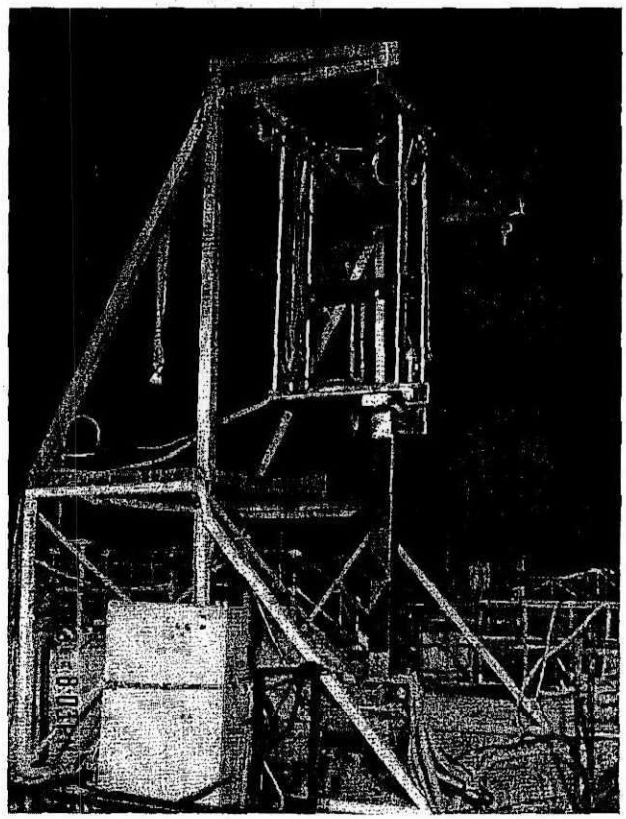

Figure 5

Test Plan

The Phase I test plan was a cold demonstration for conditions that the remote arm and apparatus will see once deployed in the K basin fuel pool. The operations to be tested were:

- Hydrolasing depth of cut per first, second, third, and fourth pass
- Turbidity changes in the water for all aspects of the demonstration relative to particulate loss at the contact point on the hydrolasing head
- Submerged operation of the Underwater Waste Recovery Unit
- Operability of the sample filter stand
- Scan of the cut area to record radiological data as well as depth of cut
- Video surveillance capabilities

Test Set Up

The S.A.Robotics remote arm was suspended from a fabricated frame above the sedimentation pond at K Basin East (Figure 5). The arm was submerged to the same depth as it would be in the actual basin. Lateral travel on the frame was restricted to approximately 12 feet. Vertical travel was restricted to 5 feet using a software limit due to underwater obstructions. The cutting area subsequently was a 12' by 5' area on the side of the sedimentation pond. The Master Control Panel for the remote arm was mounted to the frame to allow for ease of transportation. The Underwater Waste Recovery Unit was submerged in the sedimentation pond next to the pond wall to allow for easy access to the sample filter stand. Entry to the sample filter stand was needed to collect individual filters after hydrolasing. The filters were analyzed to determine if enough particulate was captured to provide an accurate sample of hydrolasing waste. As in Phase 0, the hydrolasing head was equipped with a 2" and a 1 ½" suction line originating from an inner and outer shroud. Both lines terminated at the Underwater Waste Recovery Unit. Suction was provided by two submersible pumps averaging 50 gal/min. Support equipment consisting of the AK Services High Pressure Pump, Generator, DTGS control stand, and the S.A.Robotic's computer/video cart were located along the side of the sedimentation pond.

The hydrolasing head design was altered from the design used in Phase 0. The new design incorporated a solid stainless steel head with six removable jets (Figure 7). The change in the head design was made to alleviate any jamming problems the Phase 0 head had with hydrolasing debris. Bristle rings were once again added to aid in capturing debris. A standoff ring was included to

eliminate possible suction of the head to the wall created by the pumps. Head rotation was accomplished through a high flow hydraulic motor. The Phase 0 design using a pneumatic motor was still applicable but in order to eliminate any possible bubbling a hydraulic variant was favored.

Three underwater video cameras were used to aid in control and evaluation of the hydrolasing apparatus. Two cameras were mounted to opposite sides of the hydrolasing head. The third camera was mounted to an extendable pole to allow for free movement anywhere within the pond. All camera inputs were capable of being recorded. The scanning system incorporated two laser range finders encased in watertight housings. Furthermore, two directionally shielded, underwater GM gamma detector assemblies were positioned above the hydrolasing head approximately 5 inches from the wall. All radiological detectors, both distance sensors, and position feedback from the remote arm terminated at the computer cart. Using an automated data acquisition application running on a laptop, position and meter readings were recorded every second and stored in a text file for later review and analysis.

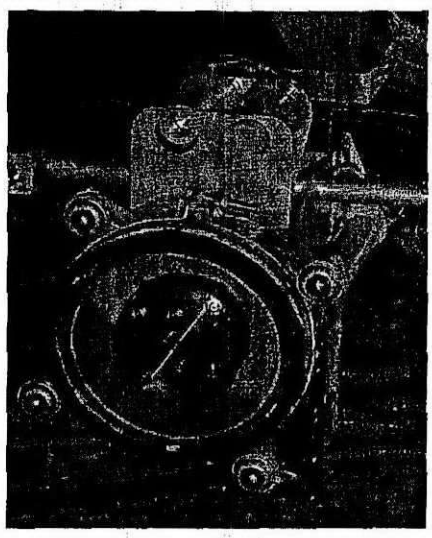

Figure 7

Test Results

The Phase I hydrolasing demonstration was successfully completed on November 12, 2003. All aspects of the hydrolasing system operated correctly except for minimal problems encountered during waste stream sampling.

Conclusions

1. At 34,000 psi, the hydrolasing blast head achieved the minimum required 150 sq.ft/hour and 1/8" depth of cut per pass. A four pass area resulted in an average ½ inch deep cut.
2. Turbidity was minimal with the Underwater Waste Recovery Unit. Only when the hydrolasing head was distanced too far from the wall was any clouding seen.
3. Underwater Waste Recovery Unit primed and operated correctly once submerged.
4. The video camera arrangement showed the results of the cutting process.
5. Radiation detectors and automated data acquisition application ran correctly.

Problems Noted and Solutions to be Incorporated into Phase II

1. The Phase 1 hydrolasing head had eliminated the standoffs used in Phase 0. This was quickly seen as a problem and rectified with a standoff ring added to the head.
2. Underwater Waste Recovery Unit had difficulty priming when above the water. Once submerged, several hoses had to be disconnected to allow air to escape and the pumps to prime. Future model must have valves at all high points upstream of the pumps to allow priming.
3. The sample filter stand proved incapable of accumulating a large sample. A bypass for the strainer will be needed to allow enough particulates to travel to the sample filters.
4. A low level radiation detector will need to be added to the detector apparatus to allow for possible readings below the high level detectors' range.
5. The two fixed cameras allowed for a very two-dimensional view of the cutting surface. One of the cameras will be repositioned to allow greater depth of view.
6. The RS232 communications card in the PLC failed. A new card was acquired and worked correctly but the cause of the failure was not found. Research into the cause may be necessary to insure failure does not occur again.

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PHASE II

Description

Phase II of the Technology Demonstration – Underwater Hydrolasing was a radiological demonstration of the remote arm's hydrolasing capabilities in 105-K East Basin at the Hanford site in Washington State. A 100 square foot area of the west side of the west center divider wall was hydrolased. Radiological surveys of the targeted wall area were taken before and after hydrolasing to allow comparison between radiation levels. Furthermore, three samples of the contaminated material was acquired from the waste stream to allow characterization of the contents.

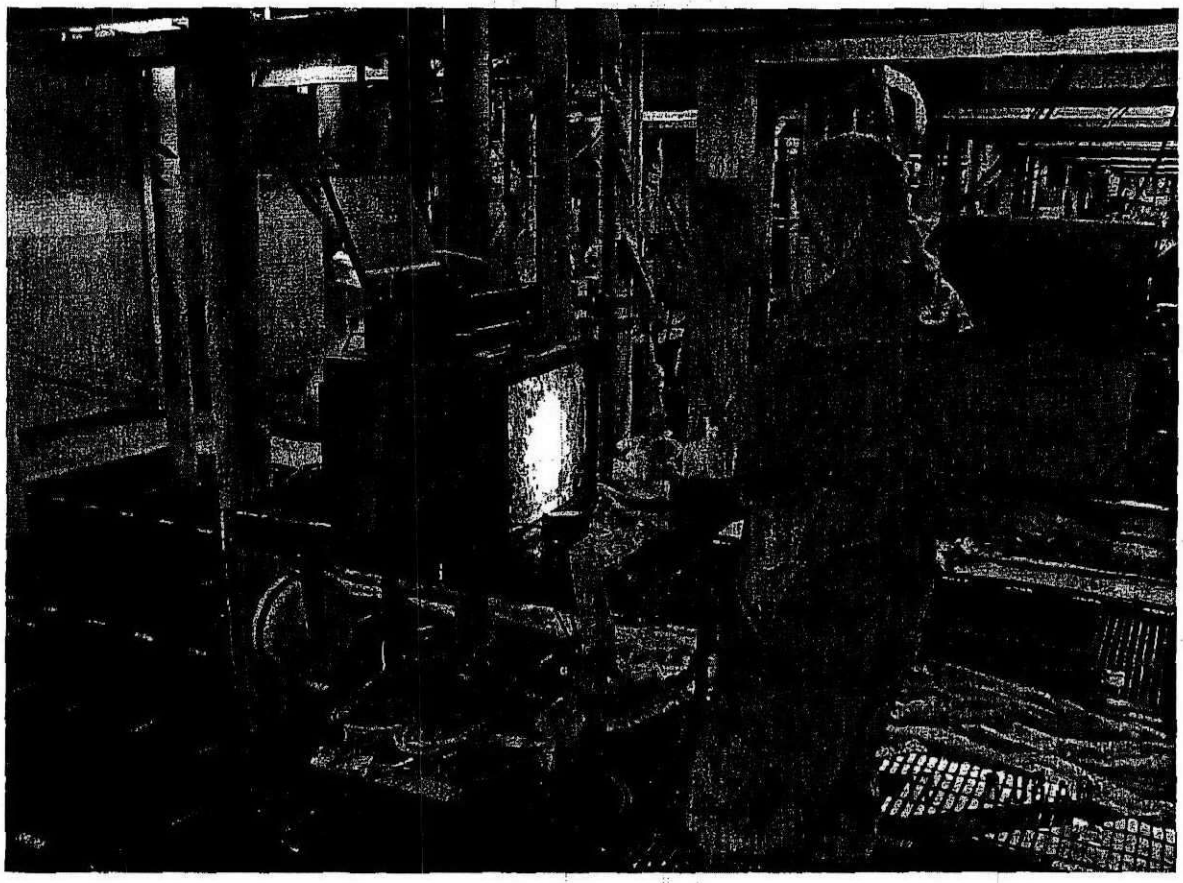

Figure 8

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Test Plan

The Phase II test plan was to hydrolase a section of the 100-K East Basin. The operations to be tested were:

- Hydrolasing depth of cut per first, second, third, and fourth pass (as needed)
- Turbidity changes in the water for all aspects of the demonstration relative to particulate loss at the contact point on the hydrolasing head
- Collection of several samples using the sample filter stand
- Scan of the cut area to record radiological data as well as depth of cut

Test Set Up

The S.A.Robotics remote arm was submerged then suspended from overhead support beams (monorails) in K Basin East. The arm was manually moved into position in front of the west divider wall. The cutting area was approximately a 6' by 17' span. The Master Control Panel for the remote arm was located directly above the wall to be cut. The Underwater Waste Recovery Unit was submerged in the center of the basin in a open section of the grating named "Crystal Lake" (Figure 9). The Underwater Waste Recovery Unit control stand was placed directly beside this opening. The S.A.Robotics computer cart was located directly beside the cut path to allow operator viewing of the cameras. All other equipment (ultra high pressure pump, hydraulic pump and generator) were located outside the building with appropriate lines running through outside access doors to the equipment.

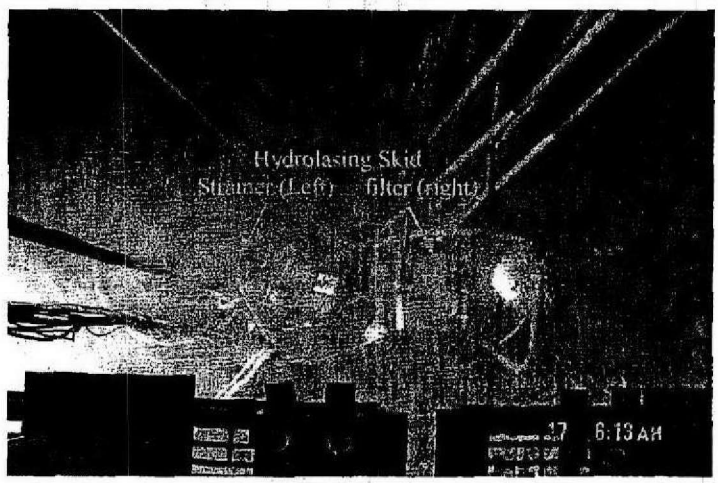

Figure 9

All equipment remained the same as in Phase I except for a few additions. These included:

- One fixed camera was remounted to allow more depth of view.

- A bypass was added to the Underwater Waste Recovery Unit to eliminate the large strainer when taking samples. Valves were added to the high points for priming.
- A collimated low range radiation detector was added to allow for possible readings below the range of the high range detectors.

Test Results

The Phase II hydrolasing demonstration was completed successfully on December 17, 2003. After encountering installation problems due to unforeseen clearance issues, solutions were implemented and the remote hydrolasing arm was positioned in front of the west divider wall. Hydrolasing proceeded without incident once DOE approval was verified.

Conclusions

- At 34,000 psi, the hydrolasing blast head achieved the minimum required 150 sq.ft/hour. However, due to a difference in physical properties (e.g. hardness) between the previously blasted concrete and the basin walls, ½" depth of cut per pass was experienced in Phase II (only one pass was performed).
- No increase in turbidity was observed with the Underwater Waste Recovery Unit and hydrolasing head shrouds.
- Underwater Waste Recovery Unit primed and operated correctly once submerged.
- The video camera arrangement showed the results of the cutting process and allowed easy operation of the hydrolasing head using the monitors instead of direct line of sight.
- Radiation detectors, laser range finders, and the automated data acquisition application ran correctly. Data was correlated and sent for analysis.
- Measurements taken before and after the single pass hydrolasing show the contamination levels lowered from 3.8 Rem/hr to ~29 mRem/hr following removal of ½" of concrete.

Problems Noted and Solutions to be Incorporated into Phase II

- Depth of cut measurements were not usable in a real time manner. Analysis of the data was needed to see the results. Future models may be required to do this while in process.
- The remote arm experienced slipping of the X axis due to lack of traction and unanticipated obstructions. Problems associated with slipping include loss of X axis position and

misalignment of the two upper legs of the remote arm. Production models may need a positive means of obtaining traction on the monorail supports.

- Hose routing and management should to be examined more closely to determine ways to eliminate ground clutter and tripping hazards. Also, cables and hoses prone to breaking need a method of replacement even if submerged.
- The camera system displays a limited view of events occurring near the hydrolasing head. Multiple screens with multiple camera angles or remote camera positioning would be an improvement. Furthermore, the issue of camera replacement in the basin should be addressed.
- Production unit design may address the use of a larger head to reduce time and motion necessary to hydrolase a given wall area.
- Sample filter stand collection system was difficult to use even with the added bypass. A new system capable of collecting large and small particles should be considered.
- The Underwater Waste Recovery Unit should be upgraded to production status. Future design still depends on the analysis of waste stream material taken during the Phase II process.
- A permanent demineralized water source for production hydrolasing should be located, as well as a solution to balancing the volume of water being added to the basin by the hydrolasing process.
- Production hydrolasing arms should be designed with increased ruggedness to survive installation and operation. Handholds and lift points should be clearly identified to prevent handling and installation damage.
- Installation was hampered by the tight tolerances in the carriage assemblies as well as an unforeseen obstruction near the flexible transfer crane. Future models will need to be designed with a better knowledge of the obstructions, tolerances and necessary clearances needed in the basin.

Estimated programmatic benefits

- Costs – The costs for the project are minimal in consideration of the high radiological dose areas being resolved by remote application. Other methods for dose reduction involved extensive shielding underwater, or dewatering in layers to provide access for dry scarification techniques coupled with shielding. Comparing estimates to these other approaches the hydrolasing was safest and least costly in terms of budget and resources needed to apply the technology.

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- Schedule – Underwater hydrolasing has the added advantage of allowing the project to integrate with other basin work activities. Utilizing technologies of shielding such as grout placement over walls and floors, or dry scarification/shielding techniques required all current operations to be concluded and the basin ready for D & D. Underwater hydrolasing can be worked concurrent with fuel and sludge removal, allowing for shorter overall schedules and ultimately a significant savings on infrastructure support.

- Worker Safety – The underwater hydrolasing offered maximum safety to personnel due to the fact that the work was operated remotely, the high dose areas were shielded by water, and the waste capture systems were operated underwater precluding any spray release potentials of radiological particles.

- Other sites with potential interest in work – The demonstrations performed in Phases I and II have generated interest in other organization at the Hanford site, and some interest as well from INEL having similar basin contamination issues. The potential for remote hydrolasing/waste capture that was the focal point of this particular demonstration could easily be modified to work in other high dose environments such as tank farms, or industrial settings such as confined space tanks, etc.

Budget summary

- Technology Assistance (EM-50 funding) received was $397K
- Subcontract to SARobotics $315K
  - Subcontracts for Project Engineering support ~ $80K
  - Total Contracts ~$395K
  - Final numbers are being invoiced
- Fluor Hanford Company Spent Fuel Costs
  - Labor, Materials, Equipment, Nuclear Safety Support - Estimated to be $500K

Points of Contact for the Hydrolasing Demonstration

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