# Compilation of Disposable Solid Waste Cask Evaluations

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

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



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# Compilation of Disposable Solid Waste Cask Evaluations

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#### COMPILATION OF DISPOSABLE SOLID WASTE CASK EVALUATIONS

### **EXECUTIVE SUMMARY**

The Disposable Solid Waste Cask (DSWC) is a shielded cask capable of transporting, storing, and disposing of six non-fuel core components or approximately 27 cubic feet of radioactive solid waste. Five existing DSWCs are candidates for use in storing and disposing of non-fuel core components and radioactive solid waste from the Interim Examination and Maintenance Cell, ultimately shipping them to the 200 West Area disposal site for burial. A series of inspections, studies, analyses, and modifications were performed to ensure that these casks can be used to safely ship solid waste. These inspections, studies, analyses, and modifications are summarized and attached in this report.

Visual inspection of the casks interiors provided information with respect to condition of the casks inner liners. Because water was allowed to enter the casks for varying lengths of time, condition of the cask liner pipe to bottom plate weld was of concern. Based on the visual inspection and a corrosion study, it was concluded that four of the five casks can be used from a corrosion standpoint. Only DSWC S/N-004 would need additional inspection and analysis to determine its usefulness.

The five remaining DSWCs underwent some modification to prepare them for use. The existing cask lifting inserts were found to be corroded and deemed unusable. New lifting anchor bolts were installed to replace the existing anchors. Alternate lift lugs were fabricated for use with the new lifting anchor bolts. The cask tiedown frame was modified to facilitate adjustment of the cask tiedowns.

As a result of the above mentioned inspections, studies, analysis, and modifications, four of the five existing casks can be used to store and transport waste from the Interim Examination and Maintenance Cell to the disposal site for burial. The fifth cask, DSWC S/N-004, would require further inspections before it could be used.

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# 1.0 PURPOSE

The purpose of this report is to document inspections, studies, analyses, and modifications that were performed to address the use of five existing Disposable Solid Waste Casks (DSWC) and overpacks. The inspection reports, studies, analyses, and modification information are attached to this report.

The DSWC is a shielded cask capable of transporting, storing, and disposing of six non-fuel core components or approximately 27 cubic feet of radioactive solid waste. The DSWC packaging system consists of a DSWC cask, lifting and tie-down equipment, impact limiters, and a transporter trailer. The system is designed for onsite transfer and long term storage and disposal of Fast Flux Test Facility (FFTF) non-fuel irradiated core components or solid wastes from the 400 Area to the 200 West Area disposal site.

Five DSWCs are currently stored at the Hanford 400 Area. It is desired to use these casks to store waste removed from the Interim Examination and Maintenance Cell, ultimately shipping them to the 200 West Area disposal site for burial. In order to use these casks, a series of inspections, studies, analyses, and modifications were performed to ensure that the casks can be used to safely ship solid waste. These inspections, studies, analyses, and modifications are summarized below and attached to this document.

# 2.0 CASK STORAGE HISTORY

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Two sets of five DSWCs each were fabricated in two separate campaigns. The first set was received in 1983 and the second set was received in October 1989. Four DSWCs from the first set and one DSWC from the second set were filled with waste and shipped to the 200 Arca for burial.

The remaining five DSWCs have been stored at the 400 Area for a number of years. Review of shipping and storage records showed that the cask liners were exposed to water for varying amounts of time. The oldest remaining DSWC (S/N-004) was fabricated and delivered in 1983 and may have contained water for most of its life since it was originally only protected by a plastic wrap that degraded long ago. The newer DSWCs (S/N-006, S/N-007, S/N-008 and S/N-010) each contained a small amount of water when received from the manufacturer in October 1989, as documented by the receiving records and an associated nonconformance report. This water was drained and the casks were temporarily covered per work package F9-2983/W and placed in outside storage. Although the water may have been removed from these casks within a month of receipt prior to the temporary cover placement, it is conservatively estimated that the water remained in the casks were fabricated, desiccant filled canisters were placed in the bottom of the casks, tethered by a rope, and the casks were sealed in September of 1990.

All five casks were moved to an indoor storage location in October 1997 and remained indoors until October 2004, when they were again placed outside. While being stored indoors, casks S/N-007 and S/N-008 were opened and the desiccant container was removed from S/N-007. During inspection in April 2006, it was discovered that casks S/N-004, S/N-007, and S/N-008 contained water. Casks S/N-006 and S/N-010 both remained dry. The total duration of time each cask may have contained water is conservatively estimated as follows:

Cask #4 - up to 23 years Cask #6 and #10 - up to 11 months (conservative estimate) Casks #7 and #8 - up to 29 months (conservative estimate)

When cleaned in April 2006, cask S/N-004 contained approximately 20 gallons of water; cask S/N-007, approximately five gallons; cask S/N-008, 11 quarts. This amount of water corresponds approximately to the following depth of water:

<u>Cask</u>	Depth (inches)
4	12.01
7	3.0
8	1.65

Water was removed from the casks prior to the cleaning and interior inspection. The casks were resealed after cleaning and interior inspections were completed.

Starting in October 2006, new bolt anchors were installed in all five casks per work package 4A-04-7583/M. During this time, the casks were opened to facilitate the installation activity. Weather covers were placed over the casks and great pains taken to keep water from entering the cask liner. Each cask was open for about one to three weeks, then DRI II desiccant bags were placed inside the casks. See Appendix A for a complete listing of the opening/closing activities that took place during the new anchor bolt installation.

#### 3.0 **CASK INSPECTIONS**

## 3.1 Interior Visual Inspection and Cleaning

The five remaining DSWCs located on the 400 Area storage pad were cleaned and inspected as part of readying the casks for use. The casks were opened and water and debris were removed. Each cask inside liner was cleaned using a soft chimney carbon steel wire brush. Several inches near the bottom of the cask liner where water had stood was cleaned using a power drill with wire brush attachment. Inspection of the bottom region adjacent to the liner-to-bottom weld was remotely performed using pictures and video.

Work package 4F-06-941/W was used to perform inspections of the casks by removing rust and visually evaluating the interface. The interface refers to the site where the liner sits on the bottom plate. Located behind the interface at the outer diameter of the liner is the 5/8-inch filet weld applied to the liner and bottom plate. The weld is covered with concrete making a direct inspection of the weld impossible.

The liner specification is schedule 60 pipe, ASTM A106, A53, or API 5 LBS. Optionally, the liner may be a rolled plate, A36, of equivalent thickness with a full penetration weld. These casks were fabricated using schedule 60 pipe, API Specification 5L, Specification for Line Pipe. The bottom plate is made of  $\emptyset$ 36 inch x 4 inch, carbon steel ASTM A36.

Inspection photographs were obtained using borescope model XL Pro, manufactured by Everest VIT (now owned by General Electric). Note that items will appear larger than normal. The color of the borescope light source is green. These pictures are presented in the small web format size of 448 x 299 without any enhancements.

Visual examination observations and information gathered during inspection of the casks are summarized in Appendix B.

# 3.2 Exterior Visual Inspection

The exterior of each DSWC was inspected for damage. Cask SN-006 has a  $\sim 1/8$ -inch deep, 1-1/4 x 7/8 inch gouge located about 31 inches from the ground level. This was most likely caused by the scaffold used for the interior inspections and cleaning. There are some superficial lines or cracks in the paint located on the sides of each cask. There is no evidence of concrete spauling at or near these lines/cracks.

The A36 shield plugs and the closure plates were examined and no problems were noted. The plugs and closure plates had been stored outside in an open but covered shed. Also, except for mill scale no problems were noted during examination of the DSWC at the weld site for the closure plate. That weld area is protected by the temporary cover.

# 3.3 Rebar Scans

In preparation for drilling holes in the top of the DSWCs to relocate the anchor bolts, scans using a magnetic locating device were performed on two DSWCs to locate the rebar under the top surface of the casks. The scans showed that there was a layer of steel three inches below the surface but for the most part could not discern distinct rebar with any certainty. The scans managed to map only about one quarter to one third of what should be there. A rescan using ground penetrating radar was performed and confirmed the location of rebar scen in the initial scan plus located additional rebar.

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# 3.4 Overpack Inspection

The DSWC transportation overpacks were inspected to verify that the overpacks have remained leak tight against the intrusion of water, which could deteriorate the foam filling in the overpacks. Inspection was limited to the external welds that form the seal for the overpacks. Inspection was performed to determine acceptability of welds. The results of the inspection showed that all welds are acceptable. Most exhibited some light rust and for some, the paint had chipped. After final acceptance of the welds, the overpacks were re-painted. The weld inspection table is included in Appendix C.

The foam manufacturer was contacted concerning potential for deterioration due to exposure to moisture. Their test sample/research confirmed no deterioration of the foam from exposure to moisture, based on their test conditions.

## 4.0 CASK/CASK SUPPORT EQUIPMENT MODIFICATIONS

## 4.1 Cask

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The five remaining DSWCs underwent some modification to prepare them for use. The existing cask lifting inserts were found to be corroded and deemed unusable, Figures 1 and 2. New lifting anchor bolts were designed to replace the existing anchors. An alternate lift lug was designed for use with the new lifting anchor bolts.

The cask modification included replacing the existing lifting attachment by drilling holes in the casks and inserting new lifting anchors with couplers to be used with new lifting lugs. The new lifting anchors with couplers were installed per FFTF work package 4A-04-07583/M. The alternate lift lug weldments are per FFTF work package 4F-06-04307/M. Both the new lift anchors and alternate lift lug weldments were addressed in HNF-FMP-06-30682-R0. Appendix D contains inspection and materials information for the new anchor bolts and couplers installed on the casks. The appendix also includes inspection and materials information for the alternate lift lugs.

Core drilling, installation of new lifting anchors and individual proof testing of the anchors per 4A-04-7583/M, "Modify Lifting Attachments for DSWC," was started on Monday, October 2, 2006 and completed on Wednesday, November 29, 2006. Grouting of abandoned holes, painting of Lift Lug locating stripes and anchor group proof testing was completed in May 2007.

Appendix A contains information gathered during the installation of the new anchor bolts. Extensive training (work package # 4F-06-03335/W) on the core drilling method and anchor bolt installation was conducted prior to the actual work being performed on the DSWCs. A drilling template was fabricated to align the hole location relative to the predicted location of the rebar,

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as determined from the rebar scans. A full scale layout of the rebar locations was prepared, the drilling template was placed on this layout, and the hole placement for each hole grouping was determined. Once the template was set, it was transferred to the DSWC, aligned, and used for the hole drilling activity.

Appendix E presents the updated analysis of the lifting anchor bolts. Drillco Maxi-bolts were used to replace the existing rusted inserts. Three sets of four 1-inch Drillco Maxi-bolts and ASTM A193 Grade B7 bolts (four bolts per set) with 20½-inch embedment (22-inch may be used for additional safety) were installed at 120° apart. The bolt patterns are 7 inches from the outside face of the cask to the outer row of bolts, 8 inches between rows of bolts, and 11 inches between columns of bolts. The bolt location was allowed to vary up to 1.25-inch either way in the hoop direction when the new anchor bolt interfered with the reinforcing steel.

The margin of safety of the existing inserts is 0.82 as calculated in Reference 1, Design Analysis Report (DAR). Based on the same method as used in Reference 1, the margin of safety for the Drillco Maxi-Bolts anchors is 1.36. The new anchor bolts are safer than the existing inserts.

# 4.2 Alternate Lift Lugs

An alternate lift lug was designed (HNF-FMP-06-30682-R0 and -R0A) to be used with the new anchor bolts. Because the anchor bolt placement needed to avoid the rebar in the cask concrete, actual anchor bolt placement could be adjusted, as discussed in Section 4.a. To account for this possible adjustment, an alternate lift lug was designed and built that had slotted bolt holes. The removable lifting lug base plates are  $11\frac{1}{2}$ -inch wide, 14-inch long, and  $2\frac{1}{2}$ -inch thick. The removable alternate lift lugs are attached to the anchors by 1-inch ASTM A193 Grade B7 Studs and ASTM A197 Heavy Hex Nuts. The other parts and weld are the same as the existing lug. Appendix E also includes the analysis of the alternate lift lugs, which shows acceptable margins of safety.

# 4.3 Cask Tiedown Frame

The cask tiedown frame was modified to facilitate adjustment of the cask tiedowns. The endplates of the tiedown frame were modified to allow the tiedown links to swing, permitting workers to make adjustments without getting under a suspended load. The endplate lugs were reduced from 12-inches wide to 8.5-inches wide. This reduction is acceptable from a DAR standpoint (HNF-FMP-06-29173-R0) because the attachment lugs are assumed to be 8.0 inches in the analysis.

# 5.0 CORROSION STUDY

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A contract was placed to evaluate the potential for degradation of the disposable solid waste cask weld joint due to corrosion. Amber Engineering (Bill Brehm) was contracted to assess the condition of the remaining four DSWCs with respect to structural integrity of the steel cavity liner, and to evaluate whether or not there is a practical concern due to water in the steel cavity liner lower weld joint and surrounding parent metal.

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This evaluation concluded that the steel liner of the two casks that contained water for a period of less than one year sustained only light rusting during their storage, and are satisfactory for use as far as the scope of this evaluation is concerned, provided they are stored under conditions that preclude future water entry into the casks. The same is true for the two casks which contained water for up to 29 months. This conclusion was reached based on the fact that the evaluation indicates very little potential for crevice corrosion, stress-assisted corrosion, stress-corrosion cracking, or galvanic corrosion, and that the total amount of corrosion, even using the maximum probable rate based on available information, would not be sufficient to compromise cask integrity. Regarding the one cask (S/N-004) that probably had water in it for over 20 years, there may have been sufficient corrosion over the 20+ years to thin the region near the bottom weldment to such a degree that cask integrity is no longer guaranteed, *but it is by no means certain that such an amount of corrosion has actually occurred*.

The complete study is provided in Appendix F. An analysis of water and solids collected from casks S/N-004 and S/N-008 was discussed in the Corrosion Evaluation and is attached in Appendix G. Water from these two casks was analyzed because S/N-004 had the most water for the longest time and S/N-008 had the least water for the least time, thus bounding all of the casks.

# 6.0 SUMMARY AND RECOMMENDATIONS

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The condition and configuration of the five DSWCs currently stored on the 400 Arca Interim Storage Area (ISA) was addressed herein. Based on the information presented and summarized in Tables 1 and 2 below, DSWCs S/N-006, S/N-007, S/N-008, and S/N-010 are acceptable for receiving and storing waste. The condition of DSWC S/N-004, relative to corrosion of the inner liner weld, needs to be examined further if it is to be deemed acceptable for receiving and storing waste.

The corrosion of the weldment in cask S/N-004, even though it is not expected to be more than the corrosion of the steel liner, may be too great to maintain the integrity of the welded joint in the design basis accident when the maximum corrosion rate is considered. If cask S/N-004 is needed, additional inspection of the weld and bottom of the liner, perhaps using ultrasonics, should be performed.

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DSWC	Liner Inspection	Corrosion Evaluation	Weld Inspection
S/N-004	This cask had approximately 20 gallons of water and was not covered. Bird feathers, sand, and RTV debris were found in this cask. The neoprene gasket at the shield plug set down ledge was in poor condition and removed. Some rust spots were noted in the floor and wall. No cracks or pitting were noted at the weld interface.	Needs further evaluation of liner and weld.	N/A
S/N-006	This cask contained no water when opened in April 2006. The exposed portion of the caulking had small cracks and shrinkage the caulking between the water proof cover and cask was very pliable. The water proof cover had to be pried off. The bottom side of the cover, which faces the inside of the cask, had no rust. The desiccant canisters were in excellent condition as shown in Figure 3 with the humidity indicator showing no pink, indicating low moisture content in the cask interior environment during storage. The neoprene gasket on the shield plug set down ledge was in good condition but had exceeded its shelf life. The gasket was replaced during anchor bolt installation.	Acceptable	N/A
	Some rust spots were noted in the floor and wall. No cracks or pitting were noted at the weld interface.		
S/N-007	This cask had approximately five gallons of water when opened in April 2006. The metal cover had been disturbed and caulking was not providing an impermeable seal. Rust was noted on both sides of the water proof cover. The neoprene gasket on the shield plug set down ledge was in good condition but had exceeded its shelf life. The gasket was replaced during anchor bolt installation.	Acceptable	N/A
	Some rust spots were noted in the floor and wall. No cracks or pitting were noted at the weld interface.		

# Table 1. Summary of DSWC Evaluations/Inspections

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DSWC	Liner Inspection	Corrosion	Weld
	· · ·	Evaluation	Inspection
S/N-008	This cask had approximately 11 quarts of water when opened in April 2006. The water proof cover was off center and cracks were noted in the caulking. Rust was noted on both sides of the water proof cover. This cask had two desiccant canisters which were both lying in water at the bottom of the cask. The humidity indicator and the attached paper labeling were in poor condition. The closure plate weld surface wasn't completely smooth due to mill scale. There was some rust in the mill scale. The neoprene gasket on the shield plug set down ledge was in good condition but had exceeded its shelf life. The gasket was replaced during anchor bolt installation.	Acceptable	N/A
	Some rust spots were noted in the floor and wall. No cracks or pitting were observed at the weld interface.		
S/N-010	This cask contained no water when opened in April 2006. The exposed caulking had minor cracks and minor shrinkage. The caulking between the water proof cover and cask was pliable and intact. The water proof cover had to be pried off. When the cover was removed air movement was heard but it couldn't be determined if air leaked into or out of the cask. Desiccant canisters were in excellent condition and thus, had remained functional. There was some rust in the mill scale at the plate and pipe interface. The bottom of the cover has rust. The cask bore had some rust dust. There is a white residue at the top which is not water or alcohol soluble but it will scrape off.	Acceptable	N/A
	Some rust spots were noted in the floor and wall. No cracks or pitting were observed at the plate and pipe interface. The neoprene gasket was replaced during anchor bolt installation.		
Impact Limiters	N/A	N/A	Acceptable

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	Modification	Status
Anchor Bolt	New Anchor Bolts Installed	Anchor bolts were installed on all DSWCs.
Tie Down Lugs	End Plate Lugs	Complete
Alternate Lift Lugs	New Lift Lugs Fabricated	Complete

# Table 2. Summary of Modifications

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Figure 1. Typical Corroded Cask Lifting Insert Showing Broken and Missing Threads



Figure 2. Typical Corroded Cask Lifting Insert Showing Broken and Missing Threads



Figure 3. Dessicant Canisters Removed from DSWC S/N-006.

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# 7.0 LIST OF APPENDICES

Appendix A, Lifting Anchor Bolt Installation Information

Appendix B, Inspection & Cleaning Summary

Appendix C, Overpack Weld Inspection Information

Appendix D, Lifting Anchor Bolt and Coupler Information

Appendix E, Updated Analysis of Lifting Anchor Bolts and Lift Lugs

Appendix F, Corrosion Study

Appendix G, WSCF Analyses

# 8.0 **REFERENCES**

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EDT 118712, Design Analysis Report (DAR) FFTF Disposable Solid Waste Cask (DSWC) D-1, Revision 3, dated January 1982, Westinghouse Hanford Company.

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# APPENDIX A LIFTING ANCHOR BOLT INSTALLATION INFORMATION

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# **OPENING/CLOSING ACTIVITIES PERFORMED UNDER WORK PACKAGE** 4A-04-7583/M:

# DSWC S/N-004

OPENED 10-3-06, DESICCANT CANISTERS SEALED IN BAGS.

CLOSED 10-25-06. DESICCANT CANISTER BAGS REMOVED. TWO NEW CONTAINER DRI II DESICCANT BAGS INSTALLED UNDER TEMPORARY COVER.

SHIELDING PLUG NEOPRENE GASKET WAS NOT REPLACED.

### DSWC S/N-008

OPENED 10-17-06. DESICCANT CANISTERS SEALED IN BAGS.

CLOSED 10-25-06. DESICCANT CANISTER BAGS REMOVED. TWO NEW CONTAINER DRI II DESICCANT BAGS INSTALLED UNDER TEMPORARY COVER.

SHIELDING PLUG NEOPRENE GASKET REPLACED 10-25-06.

## DSWC\_S/N-010

OPENED 10-27-06. DESICCANT CANISTERS SEALED IN BAGS.

CLOSED 11-8-06. DESICCANT CANISTER BAGS REMOVED. TWO NEW CONTAINER DRI II DESICCANT BAGS INSTALLED UNDER TEMPORARY COVER.

SHIELDING PLUG NEOPRENE GASKET REPLACED 11-8-06.

#### DSWC S/N-007

OPENED 11-1-06. NO DESICCANT CANISTERS IN CASK – ONLY DESICCANT BAGS WHICH WERE DISPOSED OF.

CLOSED 11-14-06. FOUR NEW CONTAINER DRI II DESICCANT BAGS INSTALLED IN MAIN CHAMBER. TWO NEW CONTAINER DRI II DESICCANT BAGS INSTALLED UNDER TEMPORARY COVER.

SHIELDING PLUG NEOPRENE GASKET REPLACED 11-14-06.

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# DSWC S/N-006

OPENED 11-21-06. DESICCANT CANISTERS SEALED IN BAGS. NO DESICCANT BAGS FOUND UNDER TEMPORARY COVER.

CLOSED 11-28-06. DESICCANT CANISTER BAGS REMOVED. TWO NEW CONTAINER DRI II DESICCANT BAGS INSTALLED UNDER TEMPORARY COVER.

SHIELDING PLUG NEOPRENE GASKET REPLACED 11-28-06,

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# **DSWC ANCHOR INSTALLATION INFORMATION**

	DSWC S/N-004						
HOLE	GROUP A						
IIOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	YES	EXPLORATORY	~ ¼" DIA. ~ ¼" DEEP TOP L.S.	SHORT (Assumed)	NO		
2	NO				NO		
3	YES	EXPLORATORY & FINAL	~1/16" R.S.	LONG	NO		
4	NO				NO		
HOLE	ROUP B	·	· · · · · ·				
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	YES	FINAL	~1/16" R.S.	SHORT (Assumed)	NO		
2	YES	EXPLORATORY	~1/16" R.S.	LONG (Assumed)	NO		
3	NO			• <b></b>	NO		
4	NO				NO		
HOLE G	ROUP C						
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	NO				NO		
2	NO				YES	~¾ BAR THICKNESS	
3	NØ			<b>-</b>	NO		
4	NO				NO		

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	DSWC S/N-006							
HOLE (	GROUP A							
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	YES	FINAL	~3/16" R.S.	SHORT (Assumed)	YES	~¼ BAR THICKNESS		
2	YES	EXPLORATORY	<1/16* TOP R.S.	LONG (Assumed)	YES	FULL BAR THICKNESS		
3	NO				NO			
4	NO	<b>.</b>			NO			
HOLE O	ROUP B	I <u></u>				<u> </u>		
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED	AMOUNT MATERIAL		
		DRILLING	REMOVED	SHOKI	(YES/NO)	REMOVED		
1	NO				YES	~ ¼ BAR THICKNESS		
2	NO				NO			
3	NO				YES	~ ¼ BAR THICKNESS		
4	NO				YES	~ ¼ BAR THICKNESS		
HOLE G	ROUP C	······			<u> </u>			
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	NO				NO			
2	YES	FINAL	<1/16" R.S.	LONG (Assumed)	NO			
3	NO				NÖ			
4	NO		••		NO			

	DSWC 5/N-007							
HOLE C	GROUP A							
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	NO				YES	~ ½ BAR THICKNESS		
2	YES	EXPLORATORY	<1/16" R.S.	LONG	YES	FULL BAR THICKNESS		
3	YES	EXPLORATORY	<1/16" R.S.	LONG	NO			
4	YES	FINAL	~3/16" L.S.	LONG	NO			
HOLE (	ROUP B		·			·		
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	NO				NO			
2	YES	EXPLORATORY	<1/16" TOP	SHORT (Assumed)	NO			
3	NO				NO			
4	YES	FINAL	<1/16" R.S.	LONG	NO			
HOLE G	ROUP C							
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAI. REMOVED		
1	YES	EXPLORATORY	<1/16" TOP L.S.	LONG (Assumed)	YES	¾ BAR THICKNESS		
2	NO				NO			
3	NO				NO			
4	NO		<b></b>		NO			

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·	DSWC S/N-008							
HOLE (	ROUP A	·						
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	YES	EXPLORATORY	~1/16" R.S.	LONG	NO			
2	NO				NÖ			
3	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NO			
4	YES	EXPLORATORY	~¼" TOP L.S.	LONG	NO			
HOLE C	ROUP B							
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	YES	EXPLORATORY	<1/16" TOP <b>R.S</b> .	SHORT (Assumed)	YES	¼ BAR THICKNESS		
2	YES	EXPLORATORY	~1/16" R.S.	UNK.	NO			
3	NO				NO			
4	NO				NO			
HOLE G	ROUP C							
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED		
1	YES	FINAL	<1/16" R.S.	LONG (Assumed)	YES	¾ BAR THICKNESS		
2	YES	EXPLORATORY	~ ¼" TOP R.S.	SHORT (Assumed)	YES	¾ BAR THICKNESS		
3	NO				NO			
4	NO				NO			

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	DSWC S/N-010						
HOLE C	GROUP A						
HOLE NO,	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	NO		<b></b>		YES	FULL BAR THICKNESS	
2	YES	EXPLORATORY	~3/16" TOP L.S.	SHORT (Assumed)	YES	FULL BAR THICKNESS	
3	NO				NO		
4	NO				NO		
HOLE	ROUP B	·	·		·		
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	IIOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	NO				YES	¾ BAR THICKNESS	
2	YES	EXPLORATORY	<1/16" TOP R.S.	SHORT (Assumed)	YES	¾ BAR THICKNESS	
3	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NO		
4	YES	EXPLORATORY	<1/16" TOP L.S.	LONG	NO		
HOLE G	ROUPC						
HOLE NO.	RADIAL REBAR ENCOUNTERED (YES/NO)	EXPLORATORY OR FINAL DRILLING	AMOUNT MATERIAL REMOVED	LONG OR SHORT	HOOP REBAR ENCOUNTERED (YES/NO)	AMOUNT MATERIAL REMOVED	
1	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NO		
2	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NØ		
3	YES	FINAL	~1/8" <b>R.S</b> .	LONG	NO		
4	YES	EXPLORATORY	NONE	LONG	NO		

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#### **TABLE NOTES FROM ANCHOR INSTALLATION:**

Exploratory drilling drill bit sizes ranged from  $\frac{1}{4}$ " up to  $\frac{1}{4}$ ". Normally very little material was removed from rebar that was encountered during the exploratory drilling. Typically the rebar was just nicked with less than  $\frac{1}{16}$ " material removed. Notations of  $\frac{1}{16}$ " material removal indicate the rebar was just nicked.

Final core drill bit diameter was 1.69". Any rebar that was encountered during the final core drilling had material removed from the side of the rebar in the shape of an arc that corresponds to the radius of the core drill bit. The fraction entered in the Amount Material Removed block for the radial rebar indicates the approximate distance from the theoretical edge of the rebar and the deepest part of the arc. These are distance estimates are based on rough measurements taken in the field.

R.S. = Right Side L.S. = Left Side

Left and Right sides of rebar are as viewed by a person standing at the center of the DSWC and looking towards the outside edge.

Hole Groups were assigned letter designations of A, B and C in a clockwise direction, with A being the first Hole Group located clockwise from the cask nameplate.

Any radial rebar encountered in holes 3 or 4 was considered to be LONG. If radial rebar encountered in holes 1 or 2 appeared to line up with rebar encountered in holes 3 or 4 it was also considered to be LONG.

Radial rebar encountered in holes 1 or 2 that has been given the SHORT (Assumed) notation has been given that notation based on relative location to either the presence or absence of radial rebar in holes 3 or 4 and/or ground penetrating radar scan results.

The Amount of Material Removed from hoop rebar is expressed as fractions of the total rebar thickness ( $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$  or Full Bar Thickness). These are only estimates base on field notes and sketches.

Radial rebar is #6 rebar (¾" diameter). Hoop rebar is #4 rebar (½" diameter).

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# DSWC LIFTING ANCHOR INSTALLATION

Performed per 4A-04-7583/M during October and November of 2006

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# DSWC S/N-006 on ISA Pad



# DSWCs S/N-007 & S/N-010 with scaffolding & weather enclosure.



# DSWCs S/N-007 & S/N-010 with scaffolding & weather enclosure.



Determining ideal hole locations using Adjustable Template laid over rebar scan tracings.



Prior to drilling. Temporary cover still installed. New anchor hole group letters have been assigned.



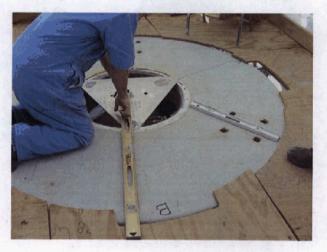
Temporary steel cover has been removed. Cask ID was used to locate Adjustable Template and Hole Pattern Angle Locating Template.



Hole Pattern Angle Locating Template placed in cask ID.



Hole Pattern Angle Locating Template was used to verify new hole pattern centerlines.



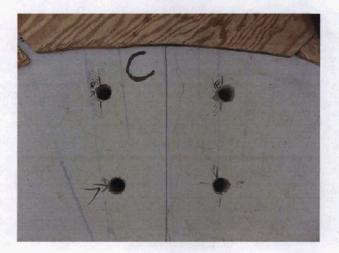
Adjustable Template used to mark start points for exploratory drilling.



Exploratory drilling, dry with Hilti concrete drill bits.



Exploratory drilling complete. Note indication of encounters with rebar at holes C-1 & C-2.



Adjusting Drillco Drilling Machine to level core drill bit prior to beginning core drilling.



Starting core drilling using Adjustable Template with Core Drill Guide Bushing installed.



Continuation of core drilling without aid of Adjustable Template. Note rubber dam to channel water to side of cask.



Continuation of core drilling without aid of Adjustable Template.



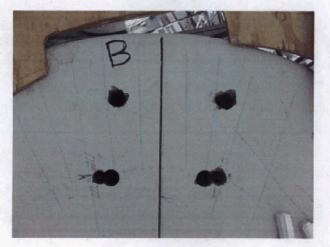
Drillco Undercut Tool installed on Drillco Drilling Machine.

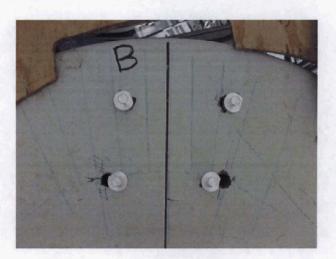


Undercutting hole with Drillco Undercut Tool.



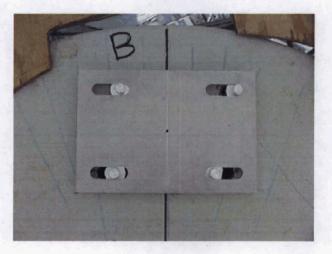
Completed core drilled holes at hole group B. Note relocated holes at locations B-2, B-3 & B-4.





Gauge pins inserted in completed anchor holes.

Lift Lug template set over gauge pins to verify proper location of anchor holes.



Drillco Flush Mount Anchors.



Drillco Flush Mount Anchor with some of the setting tooling (black items) attached.



## Drillco Flush Mount Anchor inserted in hydraulic setting tooling.



Drillco Flush Mount Anchor in hydraulic setting tooling being inserted in hole.



### Setting Drillco Flush Mount Anchor using hydraulic setting tooling.



Drillco Flush Mount Anchor installed in hole prior to installing Coupler (aka Coupler Nut).



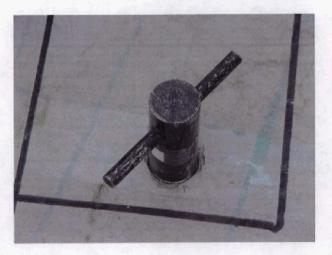
### Drillco Flush Mount Anchor Coupler (aka Coupler Nut).



Installing Coupler.



Installing Coupler using installation tool.



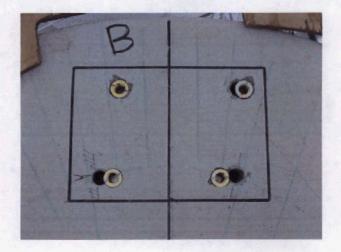
Coupler after installation, flush with cask surface.



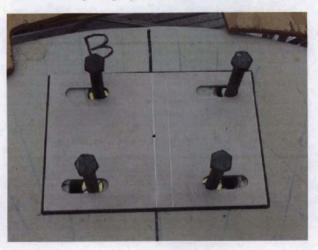
# Individual anchor proof testing using hydraulic unit.



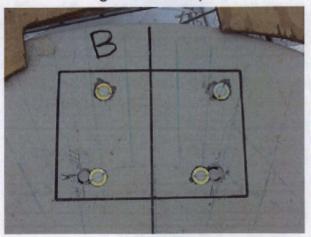
Hole Group B with Drillco Flush Mount Anchors completely installed and individually proof tested.



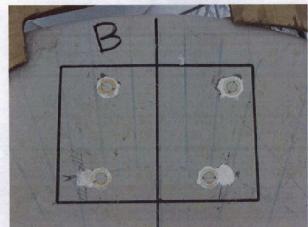
Using Lift Lug Template to mark position of location striping (to be painted on later).



Thread Protectors installed in Couplers. Backer rod material inserted in exploratory holes (to be grouted later).



Gaps between Couplers and holes sealed with RTV. Exploratory holes temporarily sealed with RTV (to be grouted later).



#### APPENDIX B. INSPECTION AND CLEANING REPORT SUMMARY

4F-06-941/W Clean and Inspection Findings Mike Rodriguez - August 8, 2006

#### Introduction, Summary and History

The five remaining DSWCs located on the 400 Area storage pad were cleaned and inspected as part of readying the casks for use. The casks were opened, water and debris was removed. The cask inside liner was cleaned using a soft chimney wire brush. Several inches of the bottom cask liner was cleaned using a power drill with wire brush attachment. Inspection of the bottom region adjacent to the liner to bottom weld joint was remotely performed using pictures and video.

The history for DSWC #4 is not comparable with the history of the other casks; therefore it's not likely to be used without further evaluation. DSWC #4 is the oldest and with 20 gallons of water this was the dirtiest of the casks. DSWC #'s 6, 7, 8, 10 will be used to bury irradiated waste. DSWC #7 had 5 gallons and #8 had 11 quarts of water. DSWC #'s 6 and 10 contained no water.

In 1983, DSWC #4 was fabricated and stored outside. The shield plug was in the cask and a plywood disk was placed over the hole.

In 1989, DSWC #'s 6, 7, 8, and 10 were fabricated and stored outside prior to shipping. Upon arrival at FFTF, all four casks had water in them. During manufacture the steel liner was hydraulically tested and water in the casks was from that test.

In September 1990 per work package F9-02983/W the water was removed, desiccant was installed, and #'s 6, 7, 8, and 10 were sealed with a weather proof carbon steel cover. Work package F9-02983/W (4F-89-02983/W) leads us to believe the DSWC #4 shield plug was removed at this time. Work package F9-02983/W doesn't clearly state what was done to prepare #4 prior for outside storage. Inquiries have led us to believe plastic sheeting was used to cover the cask. It's unclear why a weather proof carbon steel cover wasn't installed on #4 as per F9-02983/W.

In October 1997, all five DSWCs were moved indoors into the Maintenance and Storage Facility (MASF) per work package 4F-97-1976/M. It's assumed #4 was still without a weather proof cover.

In March 2004 per work package 4A-04-1039/W the weather proof cover was removed from two casks for demonstrating the transfer of a Core Component Pot (CCP) into a cask. The shield plugs had previously been removed in 1990. With a high degree of confidence it's certain that #'s 8 and 7 were opened. When #7 was examined per this package the desiccant canisters were missing. Recently, desiccant canisters were located at MASF and we believe they belonged to #7. The excellent condition of these desiccant canisters is a strong indicator that there was no

water in #7 when it was sealed in 1990 and then opened in 2004. We believe that is also the case with #8 but it's not certain. Another strong indicator that #7 and #8 were the two casks opened in MASF in 2004 is that water was found in these casks when they were opened in April 2006.

On October 28, 2004 all five DSWCs were removed from MASF and placed outside per work package 4A-04-6586/W. Four casks had metal covers. DSWC #4 had a wooden cover but it's not clear if plastic sheeting was in place.

On April 5, 2006 #4 didn't have its wooden cover in place and 20 gallons of water was found in the cask. On April 6, 2006 #7 was uncovered and 5 gals of water was found in the cask. On April 25, 2006 #8 was uncovered and 11 quarts of water was found in the cask. The weather proof covers on casks #'s 8 and 7 had not been properly sealed in March 2004. Therefore water may have resided in these casks from October of 2004 into the spring of 2006. It's uncertain how long water might have resided in DSWC #4 since it isn't clear when, if ever, it was scaled with a weather proof cover.

After removing rust from the casks per 4F-06-941/W weather proof covers were installed and sealed for all casks, including DSWC #4. While waiting for material and scaffolding and due to a prolonged spring some rain water was removed from the cask prior to sealing them on the following dates:

5/22/2006	#7
5/24/2006	<b>#6 and #10</b>
6/22/2006	#8 and #4

Work package 4F-06-941/W was used to inspect the casks by removing rust and visually evaluating the cask liner to bottom plate interface. The interface refers to the site where the liner sits on the bottom plate. Located at the outer surface of the cask liner is the 5/8" filet weld applied to the liner and bottom plate. The weld is covered with concrete making a direct inspection of the weld impossible.

The liner specification is schedule 60 pipe, ASTM A106, A53, or API 5 LBS. Optionally, as is the case in all five casks, the liner may be a rolled plate, A36, of equivalent thickness with a full penetration weld. The bottom plate is made of  $\emptyset$ 36 inch x 4 inch, carbon steel ASTM A36.

Digital pictures were obtained using borescope model XL Pro, manufactured by Everest VIT (now owned by General Electric). Note that items will appear larger than normal. The color of the borescope light source is green. These pictures are presented in the small web format size of 448 x 299 without any enhancements.

#### DSWC #4

History: DSWC #4 was fabricated in 1983, shipped to the 400 Area and stored outside. The shield plug was in the cask and a plywood disk was placed over the hole. Plastic sheeting was draped over the cask and down the side. The plastic covering was replaced at least once prior to moving the cask indoors and the cask probably had water in it by that time. After October 1997 it was moved indoors to MASF. In October of 2004 the cask was moved outdoors.

Summary: Cask #4 should not be used without further evaluation. This cask was the dirtiest and oldest of the five casks. Also, documentation of this cask is incomplete. The liner seam weld is in the south west quadrant of the cask. While facing the cask nameplate the seam weld is about 50 degrees to the right. A medium grade carbon steel wire wheel was used for cleaning the interface. A liquid sample for analysis was not obtained, but wet debris was submitted for analysis. In the mpeg the interface can be difficult to observe. There are rust spots on the interface. Both of these items could be resolved by cleaning with a wire rope wheel (not available at the time) rather than with the medium grade wire wheel used. The remainder of the cask is in satisfactory condition.

Initial observations: This cask had approximately 20 gallons of water and was not covered. This cask had a wooden cover which presumably had blown off leaving this cask open to the environment. Bird feathers, sand, and RTV debris were found in this cask. The neoprene gasket at the shield plug setdown ledge was in poor condition and removed.

The following pictures were rotated to orient the interface horizontal showing the bottom plate below and the liner above the interface.

• East interface has some rust. Approximately ½ inch of the interface isn't distinct. No cracks or pitting were noted in the interface. The interface is difficult to distinguish.



• North interface has some rust spots. Some debris was noted (wooden splinter, and white RTV particles). There wasn't any rust scale but there is significant rust. See #6 east video for comparison. No cracks or pitting were noted at the interface.

• South interface has some rust spots on the south-southeast wall and floor. In this picture the bright reflection is off the exposed bottom plate. The medium grade wire wheel didn't completely remove the oxide layer. No cracks or pitting were noted in the interface.





• West interface is distinct. Some rust spots. No cracks or pitting. In this picture the interface and the liner seam weld can be seen.

#### DSWC #7

History: DSWC 7 was fabricated in 1989 and shipped to the 400 Area where it was stored outside. On arrival the cask had water in it. Work package F9-02983/W (4F-89-02983/W) drained the water, installed desiccant, and installed a water proof cover. In October 1997 the cask was moved into MASF. In the fall of 2004 the cask was moved outdoors to the 400 Area ISA.

Summary: this cask is satisfactory; the liner seam weld is in the southwest, as stated in the video. While facing the cask nameplate the seam weld is about 50 degrees to your right.

Initial observations: This cask had approximately 5 gallons of water when opened in April 2006. The metal cover had been disturbed and caulking was not providing an impermeable seal. Rust was noted on both sides of the water proof cover. The neoprene gasket on the shield plug setdown ledge is in good condition but has exceeded its shelf life. Inspection of the interface occurred after cleaning with a medium grade wire wheel. At a later time and prior to caulking the water proof cover onto the cask a final touch up of the interface using a wire rope wheel was performed. A follow up video inspection was not performed, but confidence is high that the interface is cleaner than it appears in the inspection videos.



• East interface is a bit uneven, some rust near the interface, no cracks or pitting.



• North interface is satisfactory, no cracks or pitting

• South interface has no cracks or pitting



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- West interface has no cracks or pitting.

Some rust on the bottom plate.



#### <u>DSWC #8</u>

History: DSWC 8 was fabricated in 1989 and shipped to the 400 Area where it was stored outside. On arrival the cask had water in it. Work package was written F9-02983/W (4F-89-02983/W) to drain the water, install desiccant, and install a water proof cover. In October 1997 the cask was moved into MASF. In the fall of 2004 the cask was moved outdoors to the 400 Area ISA.

Summary: this cask is satisfactory. The liner seam weld is in the north side. While facing the nameplate the seam weld is about 165 degrees to the right.

Initial observations: This cask had approximately 11 quarts of water when opened in April 2006. The water proof cover was off center and cracks were noted in the caulking. Rust was noted on both sides of the water proof cover. This cask had two desiccant canisters<sup>1</sup> which were both lying in water at the bottom of the cask. The humidity indicator and the attached paper labeling are in poor condition. The closure plate weld surface isn't completely smooth due to mill scale<sup>2</sup>. There was some rust in the mill scale. The neoprene gasket on the shield plug setdown ledge is in good condition but has exceeded its shelf life. A wire rope wheel was used for cleaning the interface.

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 <sup>&</sup>lt;sup>1</sup> <u>Drierite Compartment No.3 Desicator</u>, anhydrous calcium sulfate, manufactured by W.A. Hammond DrieRite Co., Xenia OH, phone 937.376.2927
 <sup>2</sup> Reference John Rush, weld engineer, identified the rough surface as mill scale will be removed prior to welding

<sup>&</sup>lt;sup>4</sup> Reference John Rush, weld engineer, identified the rough surface as mill scale will be removed prior to welding the cover plate.



• East - a small part of the interface is uneven, no cracks or pitting

• North interface has no cracks or pitting, the liner seam weld can be seen





• South interface has no cracks or pitting, light rust towards west, RTV debris

• West interface has no cracks or pitting



#### DSWC #6

History: DSWC 6 was fabricated in 1989 and shipped to the 400 Area where it was stored outside. On arrival the cask had water in it. Work package was written F9-02983/W (4F-89-02983/W) to drain the water, install desiccant, and install a water proof cover. In October 1997 the cask was moved into MASF. In the fall of 2004 the cask was moved outdoors to the 400 Area ISA.

Summary: The interface is satisfactory. The liner seam weld is in the southwest. While facing the nameplate the seam weld is about 45 degrees to the right.

Initial observations: This cask contained no water when opened in April 2006. The caulking had small cracks and shrinkage. The caulking between the water proof cover and cask was very pliable. The water proof cover had to be pried off. The bottom side of the cover, which faces the inside of the cask, had no rust. The desiccant canisters are in excellent condition with the humidity indicator showing no pink. These desiccant canisters will be reused. The neoprene gasket on the shield plug setdown ledge is in good condition but has exceeded its shelf life. A wire rope wheel was used for cleaning the interface.

• East interface has some light rust but no cracks or pitting, some rust on wall.



• North interface has no rust, cracks or pitting.



• South interface has no cracks or pitting, some light rust, loose debris, some unevenness due to the seam weld.





• West interface has no cracks or pitting, liner seam weld in the southwest, light rust

#### **DSWC** 10

History: DSWC 10 was fabricated in 1989 and shipped to the 400 Area where it was stored outside. On arrival the cask had water in it. Work package was written F9-02983/W (4F-89-02983/W) to drain the water, install desiccant, and install a water proof cover. In October 1997 the cask was moved into MASF. In the fall of 2004 the cask was moved outdoors to the 400 Area ISA.

Summary: This cask is satisfactory. The liner seam weld is southwest and near the cask nameplate.

Initial observations: This cask contained no water when opened in April 2006. The exposed caulking had minor cracks and minor shrinkage. The caulking between the water proof cover and cask was pliable and intact. The water proof cover had to be pried off. When the cover was removed air movement was heard but it couldn't be determined if air leaked into or out of the cask. Desiccant canisters were in excellent condition. There was some rust in the mill scale of the weld surface. The bottom of the cover has rust. The cask bore had some rust dust. There is a white residue at the top which is not water or alcohol soluble but it will scrape off.

· East interface has no pitting or cracks, light rust





• North interface has no pitting or cracks, light rust, RTV debris.

• South interface has no pitting or cracks, light rust, some rust on the wall but not in the interface.



• West interface has no cracks or pitting, liner seam weld in the southwest hampered cleaning the interface.



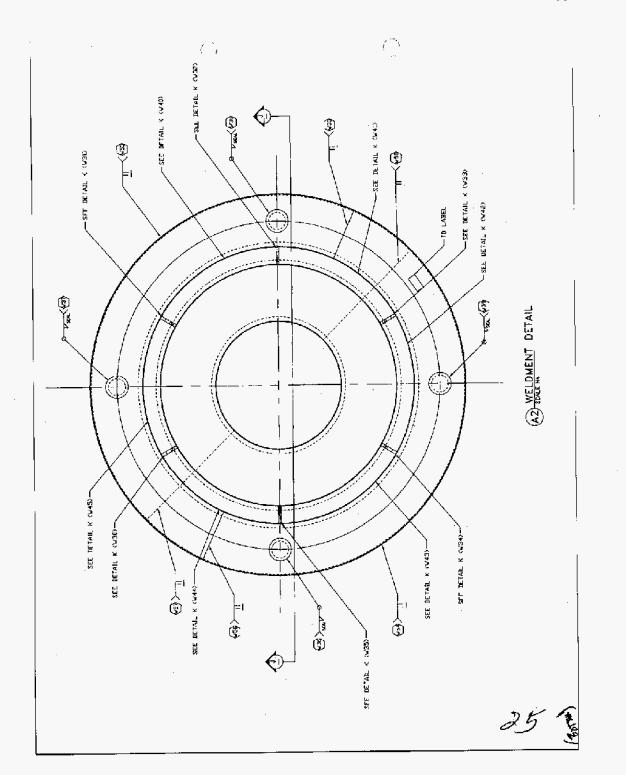
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#### APPENDIX C. OVERPACK WELD INSPECTION INFORMATION

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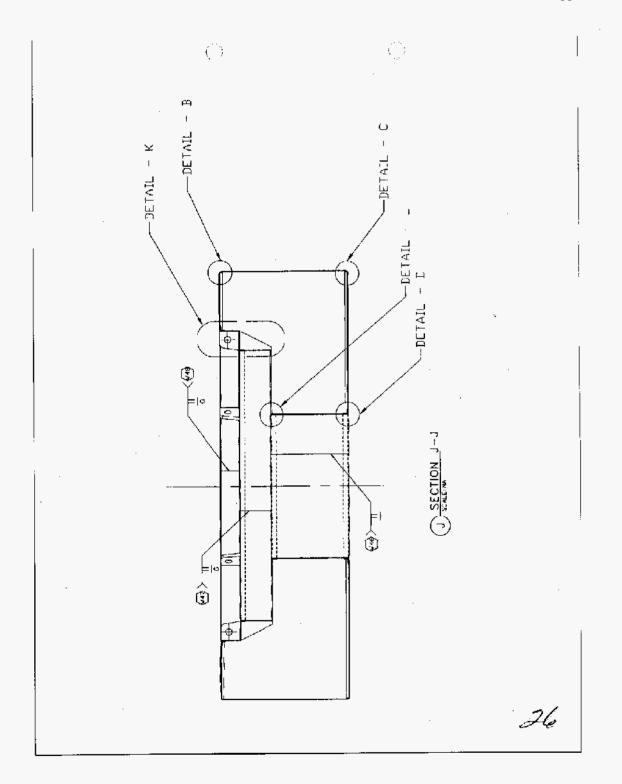
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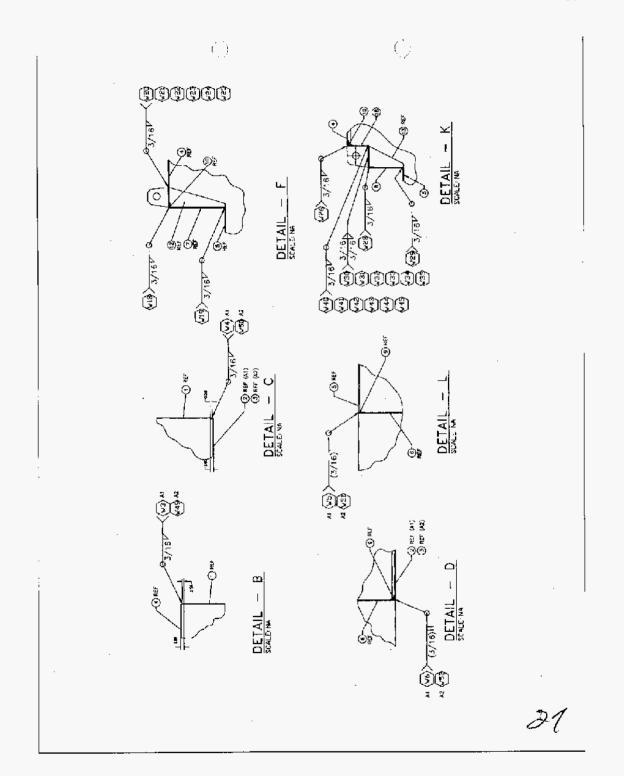
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Same Apple Street Str



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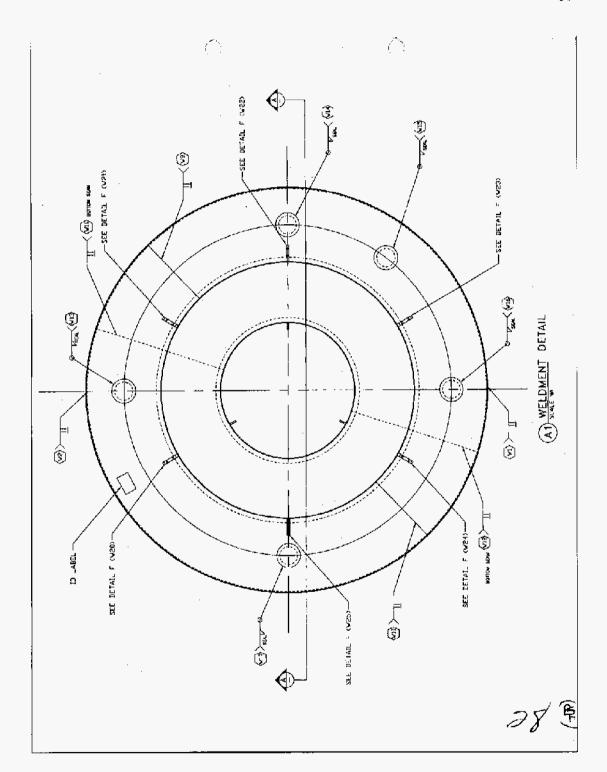
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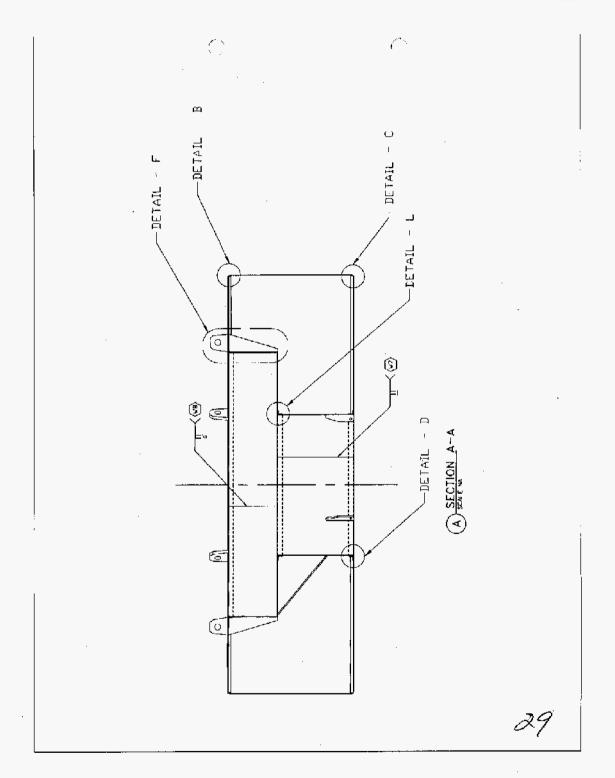
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WELD	DSWC OVERPACK WELD BY	007	ENGINEERING	DATE
NUMBER WI	Light rust, used is sol-	pate EC	ACCEPTANCE	
	is action.	6/23/06	(SP)	6 /2/06
W2	0		N	
W Z	Light rust, weld is	BBC	Mar	600/06
		6/23/06		and the
W3	Light rust, chipped print	BBC	000	11
	wild is solidadedy	5/06/06	hier	62566
W4	Light cust, abigued augat	BBC		11
	which is caterianting	5/26/06	REF	6,87,66
W5	Light rust, chipped paint	86C	IV g	
	weld is say it hickney	5/26/06	AID	62306
W6	Light cust, chipped paint	BBC	u y	
	used is satisfied on	5/26/06	MA -	6/23/06
w7	Light just, wold to		$\Lambda \lambda \not\ge$	
••• •	Solistandom	BEC -	AB	chelor
		6/23/06	AY 44	0/0700
W8	Light rust weld is	86c	an	of G
]		6/23/06	AXX	6290
W9	Weld is satisfactory	86C	00	11
ļ		6/23/06	ASSA -	6/03/08
W10	Lightrust, weld is	DBC /	10 m	11
1	Satistactory	6/23/04	fYCI -	60306
wii i	Light rust, weld is	sec.		
Ĺ	Softistactory		1977	6 2800
W12	light rust und is	6/23/06 BBC	all	17
	adrietar toring.	6/23/06	NR .	6/206
W13	Light rust, weld is	BBC	<u> </u>	
	Light rust weld is satisfactory.		AC	60mm
¥14		6 27/06	VIC A	P140
	Light rust would is	SSC	an	dela
í	2	6/23/06	MX	ante
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weld Number	DSWC OVERPACK WELD IN OBSERVED CONDITION/PREP REQUIRED	OCI	ENGINEERING	DATE
W15	Light rust, weld is satisfactory.	- BBC - 6/23/06	A C	425,65
W16	Light rust, weld is Socialistactory.	BOC. 6/23/06	RM)	6/2015
W17	Light rust weld is	- 56C 6/23/06	AQ	shafes
W18	Light rust, weld is Sous-factory,	- BBC 6/23/02	AV Q	6/22/25
W19	Light rust weld is Satisfactory.	- BBC 6/23/06	http://	6/23/06
W20	light rust, useld is selfistering.	- BBC 6/23/06	NO.	6/23/06
W21	Light rust, weld is	- 6/23/26	100	6/2/05
W22	Light rust weld is Satisfactory	80C 6/23/04	an An	chakes
W23.	Light rust, weld it	86e 6/23/06	WY BO	cherter .
W24	Light rust, weld is Satisfactory.	- 68C 6/23/01	RET	663/2
W25	Light clest, weld is	- 6/23/06	and the second	40.405
W26	light rust. Chipped paint	- BBC - 5/24/06	AD	6/29/26
W27	NA	NA	NA G	NA
W28	Light sust, chipped paint wald is satisfactory	- 5/26/06	1007	thefas

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وجهوري والارد والعملات بالانتي والإردانية والإستناب والمستاب والاردانية المترا

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WELD NUMBER	DSWC OVERPACK WELD IN OBSERVED CONDITION/PREP REQUIRED	DATE	ENGINEERING ACCEPTANCE	DATE
W29	Light sust adjoard paint weld is satisfactory	- BBC. Striloc	ROZ	6/09/06
W30	Light sust dhipped paint	- 8BC 5/24/04	AND	6100/06
W31	Light cust, chipped paint weld is satisfactory	BBC	NOT	6/29/06
W32	Light rust, chipped print	<u>SZ6/06</u> - BBC	Avar	6/23/06
W33	Light cust chipped paint	5/26/06 - BBC	diaz	(Jzeles
W34	Light cust, chipped perat-	<u>5/24/04</u> - BCC	Alty	dates.
W35	1. Schot aust, chipped paint well is setisfectory.	-BBC	NA	Charles.
W36	Light sust chipped point	5/26/06 BBC	an -	1 hours
W37	Lisht rust, chipped paint wind I satistacture	<u>576/00</u> BBC	NY	bizde6
W38	Light rust, chipped print	5/26/0C	NY	111
W39	Light rust, Chipped print	57666	NG	SET 66
w40	wild is satisfactory	5726/00	ŇĢ	6/2-766
w41	Light rust , Chipped paint	Skipe Skipe	\$7	6/25/26
w42	wild is satisfasting	5/26/06	AS	6 25/06
W42	weld is satisfication	66C 5/86/06	R.	ekoko
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FFTF-31477 Revision 0 Appendix C

WELD	DSWC OVERPACK WELD IN OBSERVED CONDITION/PREP REQUIRED	SPRETTION	ENGINEERING	
NUMBER		DATE	ACCEPTANCE	
W43	Light rust, chipped paint	- 88C - 5/26/06	1007	6/25/06
W44	Light rost, Chipped print weld is satisfactory	- BSC - 5/26/06	60	4206
W45	Lisert rust, chipped fraint	୍ଟଟ୍	ACT.	chab6
W46	Light net weld is	- <u>5176/04</u>	AM	Charles 1
W47	Light sust weld is	<u>6103/04</u> BUC		el de
W48	light rust weld is	6/23/01 1300	INCY	5 Paper
W49	Licht sust weld is	6/23/02	NG	6/27/06
W50	Light rust. Weld is	6/23/06	NQ	spage
	satisfactory.	- 60C - 6123/06 - 68C	NO	épzyné
₩51	Light rust, weld is solistectory.	_88C b Z3 06	ACI	6/25/2
W52	Light Tust, Weld is Solistactory.	-BBC -6/23/06	NO	4/206
W53	Light out, thepped paint	BBC	ava	6/2/06
₩54	Light cust, wold is	- <u>5126106</u> - <u>B</u> BC		hales
W55	Light rust, chipped paint	6/23/06 BBC	NY	Chales.
W56	Light rust, chipped august	- 5/26/06 - 8BC,	NY)	e kapas
	weld is southering.	5/26/06	NØ	epspe

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4F-06-1155, WCN-01 May 25, 2006

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	DSWC OVERPACK WELD INS	PECTION		
WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC/ DATE	ENGINEERING	DA'TE
W57	weld is satisfication	BBC. Skilos	NA	épset
W58	Linut quist, with is Solitorized	6/23/05	NG	sported

7.0 <u>RETEST</u> No Retest Required.

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# APPENDIX D. LIFTING ANCHOR BOLT, COUPLER AND ALTERNATE LIFT LUG INFORMATION

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A-6700-119.1 (10/99)

#### ANCHOR BOLT AND COUPLER INFORMATION Rowook DAN NCRICH-FAMOS-Sheet 1 of 4 20. Remarks 0000 12. Inspected By (Print name, signature, and apply stamp) 7. Purchase Order or Contract Order No. 29480 44899 ł 1.5 8. Release No. (for bianket orders) How A. P. Boy 18. In-Process 18. Cond. Acc 3 InspectionReceiver No. Ņ 11. Quantity 45 10. Item No. Inspection Status QUALITY ASSURANCE INSPECTION PLAN 3 ы 17. Rei 3. Quality Level 4. Safety Class 6. Drawing/Spec. No./Revision 16. Hki Tag Supplier Name: NOVA Item Description: DRILLCO Flush Mount Anchor and Flush Mount Cutator Item; 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000) 15. Acc Catalog, Item: 633740: Anchor, 1<sup>n</sup>; Flush Mount with 22" EMB (FMB-1000-20,75-19,375) a di Q Sample size (number of items to be inspected in a kot), shall be determined by using Table I and Table III-A of the latest edition of ANSI/ASQC21.4 as follows: Select the sample size from Table III.A using the Sample Size Code Letter obtained from Table I and the AQL number specified by the QAIP. Date <u>6129/86</u> The minimum sample size utilizing Level II, AQL 4.0, Table III-A shall be 8 or 100%, if the lot size is less than 8. NOTE: If any samples are found nonconforming the entire lot shall be plared on HOLD pending engineering evaluation and NCR disposition. based on the lot size of material received and the General inspection Level indicated by the QAIP Date 6 [29] Select the Sample Size Code Letter from Table L Date Signature not required if submitted as PassPort attachment 14. Inspection Characteristics Prepared/Approved by (Print and Sign Name)\*: SAMPLE SIZE DETERMINATION Rev. 1 (69/06) NCB-06-FEAVS-00056 Ś (Level I, II, or III). D.C. Johnston Coupler M.E. Riste J.W. Rich 13. Char. No.

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DA05240516

Sheet 2 of 4	Purchases Order or Contract Order No. 25480 Release No. (for blanket orders)	-		20, Remarks							•								
	7. Purchase On 8. Release No.				┥—		· · · · · · · · · · · ·										-		
N PLAN	~ 8			Inspection Status	1	<u> </u>	- <u>-</u>			 					. •	:			
NSPECTIC	<ol> <li>Quality Level</li> <li>Safety Class</li> </ol>				P				· .					-					
JRANCE II	amt Coupler B (FMB-	F7 (MBCP-						C							•		•	,	
QUALITY ASSURANCE INSPECTION PLAN	<ol> <li>Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler Catalog Item: 633740: Anchor, 1<sup>n</sup>; Flush Mount with 22<sup>n</sup> EMB (FMB- 1000-20.75 ~ 19.375)</li> </ol>	<u>Catalos Mar</u> is 633741: Coupler, 1° Flush Mount, ASTM A 193 GR B-7 (MBCP, 1000)	(69/06) NCR-06-FHAVS-00036	14. Inspection Characteristics	NOTE: This revision of the QAIP is a result of an NCR (NCR-06-FHAVS-00086) written by AVS	documenting problems noted daring receiving inspection of items received from NOVA Machine. This	revised QAIP will provide guidance to AVS for re- inspection as a result of disposition of the NCR. If any of the holow steps were completed in the original QAIP and were found to be acceptable, mark the step as	Verify compliance with Quality Assurance Clauses monified on Durchies Chart	NOTE: See inspection fram 2 note for clarification on CMTR's.			· · · · · · · · · · · · · · · · · · ·	•		-			 · ·	
· .	tem Description: DR1 Catalog Item: 633740 1000-20.75 - 19.375	Catalog Itary: 6337 1000)	Rev. 1 (6/9/06) NCR-0		NOTE: 1 (NCR-06	document inspection	revised Q inspection of the belo and were	1) Verify co	NOTE: See			• .							

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QUALITY ASSURANCE INSPECTION PLAN	IRANCE II	NSPECTIO	N PLAN				- 19 - 19 - 19 - 19 - 19 - 19 - 19 - 19
<ol> <li>Item Description: DRULLCO Fluch Mount Auchor and Fluch Mount Coupler Catalog Item: 633740; Auchor, 1": Fluch Mount with 22" EMB (FMB- 1000-20.75 – 19.375)</li> </ol>	unt Coupler B. (FMB-	<ol> <li>Qualify Level</li> <li>Safety Class</li> </ol>	22 /7 22 /7	7, Purchase	7, Purchase Order or Contract Order No. 29490 8. Robasso No. (for tsenket orders)	Na. 28480	
<u>Catalog Item</u> : 633741: Coupler, 1" Fluxh Mount, ASTM A 193 GR B-7 (MBCP- 1000) •	-7 (MBCP-				·		
			Inspection Status	*		70 Bamarka	
	15. Acc	16. Hid Tag	17. Rej	18. In-Process	19. Cond. Acc		
Test Report The following thems will have CMTR'E Anchor Assembly; (Part No. FMB-1000-20.75- 19.375)	, <b>-</b>		<u> </u>				
<ul> <li>Conteal Nut: ASTM A193 Grade B7</li> <li>Expansion Sleeve. ASTM A513 Type 5</li> <li>Turnaded Stud Bolt. ASTM A513 Type 5</li> <li>Distance Tube: ASTM A513 Type 5</li> <li>Complex (Part No. MBCP-1000)</li> <li>Complian Nut: ASTM A193 Grade B7</li> </ul>	(				<u> </u>		
Perform a review of documentation submitted for the chemical and mechanical properties per the following						• .	
WOTE: The CMJR's were requested for information and are not required for acceptance of the anchor assemblies and couplers. For purposes of this inspection, verify that CMTR's have been received and that the CMTR chemical/Physical results meet the ASTM standards referenced in this OAIP.		·	<u></u>		· · · · · · · · · · · · · · · · · · ·		••••
<ul> <li>ASTM A193 Grade B7</li> <li>Chemical Analysis - per Para 7 &amp; Table 1</li> <li>Mechanical Properties - per Para. 9 &amp; table 2</li> <li>ASTM A513 Type 5</li> <li>Chemical Analysis - Para. 5</li> <li>Mechanical Properties - N/A</li> </ul>		· · · · · · · · · · · · · · · · · · ·					

	Sheet 4 of 4	Ortker No. 294490 ars)			20. Rumarks	Sample Size:	Sample Size:			
		<ol> <li>Purchasse Order or Contract Order No. 29480</li> <li>Release No. (for blanket orders)</li> </ol>		•	18 In-Durness 11 Cond Sco					
-	QUALITY ASSURANCE INSPECTION PLAN	3. Quality Level 2.			Inspection Status 16 Hid Tao 1 17 Rei 18				· · · · · · · · · · · · · · · · · · ·	
	JRANCE IN	ler	9-7 (ABCP-		15. Acc 1			Ð	((ter)))) 	
	GUALITY ASSL	<ol> <li>Item Description: DRILLCO Flush Mount Archor and Flush Mount Coupler <u>Catalog Item</u>: 633740: Auchor, 1<sup>n</sup>; Flush Mount with 22<sup>n</sup> EMB (FMB- 1000-20:75 – 19:375)</li> </ol>	<u>Catalog lien</u> : 633741: Couplet, 1" Flush Mount, ASTIM A 193 GR B-7 (MBCP- 1000)	(\$900) NCR-06-FHAVS-00088	14. Inspection Characteristics	<u>detentification</u> <u>Sample per Level II. AOI. 4 0. Tahla III. A</u> Verify Anchors and Couplers are identified with pert number on the items or on the packaging for the anchors.	Visual Inspection Sample per Level II. AOI. 4.0. Table III.A Verify Anchors and Couplers are free from damage.	Attach an A&RH Tag to each Box or lot of items per instructions included in the attached "FFTF General Procurement" instruction.	Forward a copy of the Completed QAIP's to: FFTF QA N2-11	•
		Item De Catalo 1000-2	Contalog 1000)	<u>Rev. 1 (6</u>		(f	Ŧ	ŝ	6	

N PLAN	QUALITY ASSURANCE INSPECTION PLAN       Riem Description: DRULLCO Fhat Morat Astron with Zr Endo     2.3.5       Complex     2.3.57       Complex     3.3740: Anchor, Pr. Flush Morat Astron with Zr Endo       1000:30.75 - 19.377)     2.3.5       Catalog Herr. 63740: Couple, P Flush Morat ASTRA 198 GR E-7 (MB- 76.3.7     2.4.5       1000:30.75 - 19.377)     7.3.5       Catalog Herr. 63740: Couple, P Flush Morat, ASTRA 198 GR E-7 (MB- 7.5.5)     2.4.5       1000     Reamadeoproved by (Pfrat and Sign Name):     5. Supplier Name: NOVA       Reamadeoproved by (Pfrat and Sign Name):     Desc 5/72/46     5. Supplier Name: NOVA       Reamadeoproved by (Pfrat and Sign Name):     Desc 5/72/46     5. Supplier Name: NOVA       Reamadeoproved by (Pfrat and Sign Name):     0.4. Subplier Name: NOVA     2.       Catalon     March     Desc 5/72/46     6. Envirogistor, NoVA       Reamond in a contraction of Anticol Bio Endo     Desc 5/72/46     6. Envirogistor, NoVA       Ream     React the sample size Context and Fable Endo     6. Envirogistor, NoVA       Sample Size Definition of ANSI/ASOCZ1.4 as fable Endo     6. Envirogistor, NoVA       Sample Size Context and Bio Endo     Catal LA and Be for Ordel and the fable Endo       Sample Size Context and Bio Endo     Catal Bio Endo       Sample Size Context and Size for Context and fable Endo       Sate table Size Context an
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FFTF-31477 Revision 0 Appendix D

	QUALITY ASSURANCE INSPECTION PLAN	DANCE I	NSPECTION	V PLAN		. <sup>.</sup> .	· .	Sheet 2 of 2	
Catak Det	them Description: DRULLCO Fluxh Mount Anchor and Fluxh Mount Coupler Catalore Rema:	Coupler	3. Quality Level	2	7. Purchas	e Order or Contra	7. Purchase Order of Cantrad Ottler No. 29450		
			4. Safety Class	8	8. Release	Release No. (for blanket orders)	(Siels)		
Cher.				Inspection Status	B			31 Remarks	
ġ	14. Inspection Characteristics	15. Acc	i6. Hbd Tag	17. Rej	18. In-Process	18. Cond. Acc		u. tournales	
ন	Test Report: The following tiems will have CMTR's: Auchor Assembly: (Part No. FMB-1030-20,75-		• • •					:	
	<ul> <li>19.375)</li> <li>Conical Nur: ASTM A193 Grade B7</li> <li>Conical Nur: ASTM A513 Type 5</li> <li>Exemated Stud Bott, ASTM A513 Type 5</li> <li>Distance Tube: ASTM A513 Type 5</li> <li>Conture: (Part No. ABCP-1900)</li> </ul>			······	۰.				
	Coupling Not. ASTM A193 Grade B7			<u></u>					
·	e errorm a review or coornectionance a monthly and the following: chemical and mechanical properties per the following:								
	ASTM A193 Grade B7 • Chemical Analysis – per Para. 7 & Table 1 • Mechanical Properties - per Para. 9 & table 2 ASTM A513 Type 5 • Chemical Analysis Para. 5 • Chemical Properties WA		· · · · · · · · · · · · · · · · · · ·				· · ·		
e	Identification Sample per Level II, AOL 4.0. Table III-A Verity Anchoss and Couplers are identified with part number on the items or on the packaging for the auchors.						Sample Size:		
Ŧ	<u>Visual Inspection</u> <u>Sample per Level II. AOL 4.0, Table III-A</u> Verity Anchors and Couplets are free from damage. <i>sr</i>	O		· ·			Sample Size:	-	
G	Attach an A&RH Tag to each Box or lot of items per injärnedious included in the attached "FFTP Conneral Procummant" instruction.				•.				

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## FFTF-31477 Revision 0 Appendix D

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			18001 Sheldon Road
			Middleburg Heights, OH 44136
		1. Sec. 1. Sec	
	** MACHINE PRODUCTS		216 267 3200
	l 📲 🖉 👘 👘 👘		FAX 216 433 1840
	CERTIFICAT	non	
			. •.
	CERTIFICATE OF COMPLIANCE/CONFORMANCE		
	CERT # 40882 CERT DATE: 19-MAY-08	PO # 00028480 REV. 002.	·
	Fluor Daniel Hantow		···
	Fluor Hanford	8D# 114125	
	Hanford Beservation	LINE # 1	
	2365 Stevens Drive	QTY 65 EA	
	Richland WA 9862 US	LOT # 50078287	
	A DESTRICTION AREAP ALCONOMIC TORA	HEAT # See attached certs	
	· · ·	DRWQ #	
	GL/STOCK:	· · · · · · · · · · · · · · · · · · ·	
	0000633740 2	. · · · ·	
	ITEM D89C: DRILLCO FMB-1000-20.75-19.975 PROPRIETARY MFG. PA	AT NUMBER	•
	Customer specifications: Airs grade b7	· · ·	•
	MATERIAL SPECIFICATIONS: Per Part Number regularments	· ·	
-	HEAT SPECIFICATIONS: Heat instand per the material specification (As applicable).		
	QUALITY SPECIFICATIONS; Meate applicable portions of ANSI/ASME NGA-1 (#8 ED., *8) visually examined and recorded por Noiva Work instruction 8.1 NixeSto, F-788 & F-812; Domestic Manufecture(;;	Add., and ine '94 Edition's 1905FR21 A .3 Nev 5 which meets the requirement	ppRost CO% s of SA/A-614,
	PROGRAM STATEMENT: Nove, Mechine Products Corporation certifies the material, purchase order have base supplied in accordance with, and it asiabilished by the references or specifications cited in this on	ants, components, or services proce perfore meet or exceed the quality n	sseed on this equiraments incodements
•	the applicable portions of Nova Mashine Products. Corporation Rev. 9 dated 9-14-05.	n Quality Assurance Manual (ISD/NPT	) Menual Edition 7
	I estify these results are a true and correct, copy of records on compliance with the requirements of the purchase order and a and the items were maintained mercury and espectos free by	peolications alter, No waiding was be	ahne Producta In Informed by Nova
	Processed per ISO-5001(2000), Certificate #GOC 211 Fasterier products received from Nova are FOA compilant. YOUR SALESPERSON IS: States, Mr. James		
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	CERT # 40882 CERT DATE: 19-MAY-08		Page: 1 of 1
	NOTE: Knowingly and willfully integying or concessing a material fact on the form could consultate a telony purity table under tabera escutus.	a form or making false or DotAlocue or frage	· (1.51)
	and a second s		716110
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DRILLCO DEVICES LTD. 24-32 44<sup>TH</sup> Street Long Island City, NY 11103 718-726-9801 FAX 718-956-3759 CERTIFICATE OF COMPLIANCE To whom it may concern: This is to certify that the materials used in the manufacture of the Drillco Devices Ltd. Maxi-Bolt or Maxi-Bolt component shown below are in compliance with the requirements of the latest ASTM/ASME meterial specification as follows: Maxi-Bolt or Maxi-Bolt component: FMB-1000-20 14-19 3/8 "Flush-Mount Maxi-Bolt" Description ASTM/ASME Specification Part Number 0001 Threaded Cone A/SA 193 B7 🔨 0002 Expansion Sleeve A 513 Type S Threaded Rod A/SA 193 B7 🕤 0003 D004 Distance Tube А 513 Туре 5 🧹 MB8 Maxi-Bolt Spacer A 513 Type 5 / Reference: Ship to: Nova Machine Products Nova Machine Products Purchase Order No: 3036467 18001 Sheldon Road Report Number: NMP 009-1 Middleburg Heights, OH 44130 Lot Number 9232-D Carton Number(a) 1 @ 65 Pieces. Drillco further certifies that the above material was supplied in accordance with Drillco Devices Ltd. Q.A. Manual Rev. 2 dated 07/26/91. REV. J Autholized Signature Date **u**l. Form F13-1A Rev. 2 9/(2/97 714/06 7 XO' 3564 MARS: 8 2006 9:29AM 3

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DRILLCO DEVICES LTD. 24-32,44th Street Long Island City, NY 11103 718-726-9801 FAX 718-956-3759 MATERIAL SUPPLIER REPORT FORM Date June 21, 2006 No. NMP 009-1 Customer: Nova Machine Products Customer P.O. 2053476 Job Name Specification: Location: Middleburg Heights, OH Part Identification: 1" Flush Mount Maxi-Bolt P.O. Item No.1 Catalog Number: FMB-1000-20 %-19 3/8 Quantity: 65 Diameter 1" Length 20 3/4" Embedment 22" CHEMICAL COMPOSITION X Certified Material Test Report X Certificate of Compliance Certificate of Conformance Supplementary Requirements: Yes No X If yes, typs of analysis, tost or examination. Also when verified and by whom, The above-described material has been supplied under Lot Number 9232D, Carton(s) Number (s) 1 @ 65 pieces, and is accordance with Customer Purchase Order requirements. Ø Authorized Signature Farm 13-0 Rev. 3 9/2/97 RO 5563 B' 5 . NV 58' 5008 8: 58VM

04 e-ur-se sallpa p. 2 of 3 401 ROSE AVE 5 8 MASSILLON, DH 44646 רבטטטעוכ 😂 FAX 330-837-7617 Engineered Stock CERTIFURITE OF TESTS FEBRUARY 07, 1997 PAGE: 1 OF 2 \*\*\*\*\*\* PLACKASE ORDER: 3117 PART NUMBER : REPUBLIC CROER: 07-14200-07 821 NEAT . . : 8970345 Fays Charge Address forgasisters PURCHASE ORDER DATE: 06/28/96 AGCOUNT NUMBER . : 21934081 87 621 SCHEDULE . . . : 59479-\*\*\*\*\*\*\*\*\*\*\*\*\*\* 5HIP TO \* ousr. Herocha PAILLOO REVICES LIMITED ORILLOO DEVICES LTO POR COSTILISO PO BOX 6285 LONG ISLAND CITY NY 11186 COLD FINISHED STEEL BARS ALLOY ASTM A 199-95 ORD B7 PLUS SURF BHN NRC 100FR2; AISI-4148 FINE GRAIN COLD DRAWN QUENCH & TEMP BEFORE CO/SRA AFT CD REST SIZE TOL QUAL ASSURANCE DOC ( T MAX LIFT MAG TEST SIZE: ROS 1.6398/1.6430 X 12 FT C MN P S LAOLE CHEMISTRY 0.420 88.87V .011 .031 8.222 6.24 60.15 80.99 8.280 60.024 0.004 - SEMI-FINISH RESULTS------AUSTENITIC GRAIN SIZE AUST GRAIN SZ 7. OHN NT TRTD (LAB) ASTM EIG ASTM A370 FCE 21 SURFACE 269. MIGRADUS 269. FCE 22 SURFACE 269. MIGRADUS 269. NOVA MACHINE QA REVIEW APPROVED 201-6 DATE 24-015 MACAGETCH SRC ASTM 8901 HTL STD 430 PCS I SURFACE I. RANDOM I. CENTER I. TENSILE HT TRTO Austenitize Deg 1602. ASTM A370 TEMPERI CEG F ASTM E8 TEMPER2/SR OIL 1658, TEMP2 TIME Hours TEMPI TIME Kours 6.0 AUST TIME HOURS 3-17 3.2 YIELD(.2%) FSI |[2808:1/ |15889.1/ REDUCTION AREA ELONGATION PERCERT PERCENT 63.5 23.0 64.7 23.0 TEASILE PSI 120000.1 131920.1 PCE at PCE az THE MATERIAL WAS NOT EXPOSED TO MERCURY OR ANY METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURE DURING PROCESSING OR WHILE IN OUR POSSESSION. NO WELDING OR WELD REPAIR WAS PERFORMED ON THIS MATERIAL. I HEREBY CERTIFY THAT THE MATERIAL LISTED HEREIN HAS BEEN INSPECTED AND TESTED IN ACCORDANCE WITH THE METHIDDS PRESCRIBED IN THE GOVERNING SPECIFICATIONS AND BASED LPON THE RESULTS OF SUCH INSPECTION AND TESTING HAS BEEN APPROVED FOR CONFORMANCE TO THE SPECIFICATIONS. 21-22-3 DEVICES LTD. MATERIAL WAS PROCESSED IN ACCORDANCE WITH THE CANTON HOT BOLLED PLAN OUALITY ASSURANCE PROGRAM MANUAL, REV. 4 DATED 5/1/95 AND THE MASSILLON COLD FINISH PLANT QUALITY ASSURANCE PROGRAM MANUAL REV. 0 CATED 81/208/26. QA ACCEPTED KANTI JAIN MANAGER MET & OC A. J. BLONDHEIM CERTIFICATION ANALYST TH W P. Symenike W. Jayl Sink ..... a.g. planstein 7/4/06 4.1 مينية والمراجع

tras EISSILLAT LIE 401 ROSE AVE S E MASSILLON. OK 44646 2-07-17 Sizin, p. 1 . 12-3 REDUDLIC FAX 388-837-7217 Engineered Such \* CERTIFICATE OF TESTS FEBRUARY 07. 1997 PAGE: 2 OF 2 PURCHASE ORDER DATE: 05/28/96 ACCOUNT NUMBER . : 21984001 SCHEDULE . . . : 39479- 

 PURCHASE ORDER: 3117
 PURCHASE ORDER IF

 PART NUMBER
 ACCOUNT NUMBER

 REPUBLIC ORDER: 37-14202-07 821
 SCHEDULE

 HEAT
 1 8979349

 ALL TESTING HAS BEEN PERFORMED USING THE CURRENT REVISION OF THE

 TESTING SPECIFICATIONS.

 MED IN THE U.S.A. FAX BY FAX PC I COPY FILE 2 COPIES 718-956-3759 NOVA MACHINE QA REVIEW APPROVED 401 NG DATE OUST: RO. 4 COC 294 20 s.o.# 5007572871 LOT# ---:\_\_\_\_\_\_ DEVICE'S LTD. COSPTED 2 7 97 PART IN : 1901-0 THEELDED COUR LOT Nº : 1232-7 Carston 14: 1 045-Pieces . Nova Machine Products, inc.-FUNCHASE OF DEN IP : 3034 46T KETOKT HUMBER: HIMPOOPT (45) THE-1000-20 Pe-1414 р н 101 KANTI JÀIN MANAGER MET G A. J. BUCNDHEIM CERTIFICATION ANALYST ä go 74400 a.g. blondhim 4.5

) Ì. 7-2.-90 1:37an 9. 2 of 1 , To: 5 718-956-3759\_ From MASSILLON CER 401 HOSE AVE S E MASSILLON, OH 44846 Republic FAX 330-887-7917 Bagingered Starks JULY 24, 1998 Fige: 1 DF 2 . . PLACHASE ORDER DATI: 01/12/98 ACCOUNT NUMBER : 21934001 SCHEDULS : 19625~ NOVA MACHINE GA REVIEW APPROVED STOLO DATE STOLO ORILLCO DEVICES LTO 1005 SSTR AVE Long IS CT NY 11106 DRILLOG DEVICES LIMITED P O BOX 6285 Long Island City Ny (1146 -COLO FINISHED STEEL BARS ALLOY ASTM A 199-964 GRO 87 PLUS SURF BHN NRC 1807824 AISI-4140 FINE GRAIN COLO DRAWN QUENCH & TEMP BEFORE COASRA AFT CL REST SIZE TOL QUAL ASSURANCE DOC 1 T MAX LIFT MAG TEST SIZE: ROS .9120/.9160 X 12 FT C MN P S SI CU NI CR 10 AL 0.410 96.86 .019 .030 0.240 0.24 00.28 00.97 0.280 00.024 0.014 -- SEMI-FINISH RESULTS AUSTENITIC GRAIN SIZE AUST GRAIN SZ 7. 

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 BXN HT TATO (LAB)
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 PCE 02
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 RO.#

 MAGRGETCH SRC
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 custillun ha RO. # 0079480 B.D. # 114125 MEN # 1 UT 5007578 TENSILE KT TRTO TEMPERI DEG F II 00. ASTM A370 TEMPI TIME TEMP2 TING HOURS HOURS 8.0 S.B REDUCTION AREA ELONGATION PERCENT PERCENT 36.1 IS.SV ASTM E8 Temperz/SA Deg f 1950. YIELD(.2%) PSI 142809: 143909. TENSILE PSI 154400. 164508. PC5 01 : PC5-02 THE MATERIAL WAS NOT EXPOSED TO MERCURY OR ANY METAL ALLOY THAT IL LIQUID AT AMBIENT TEMPERATURE DURING PROCESSING OR WHILE IN OUR POSSESSION. CHEMICAL ANALYSIS CONFORMS TO APPLICABLE SPECS: ASTM E 327 ASTM E 1006 ASTM E 415 ASTM E 1019 ASTM E 1085 ASTM E 172. NO WELDING OR WELD REPAIR WAS PERFORMED ON THIS MATERIAL. I HEREBY CERTIFY THAT THE MATERIAL LISTED HEREIN HAS BEEN INSPECTED AND TESTED IN ACCORDANCE WITH THE METHODS PRESCRIBED IN THE GOVERNING SPECIFICATIONS AND BASED UPON THE RESULTS OF SUCH INSPECTION AND TESTING HAS BEEN AFPROVED FOR CONFORMANCE TO THE SPECIFICATIONS. CERTIFICATE OF TESTS SHALL NOT BE REPRODUCED EXCEPT IN FULL, ALL TESTING HAS SEEN PERFORMED USING THE CURRENT REVISION OF THE TESTING SPECIFICATIONS. F# MEG IN THE U.S.A. ×\*. A. J. SLONDHEIM CERTIFICATION ANALYST KANTI JAIN HANAGER MET & QC -lulob W. Freyh Simb Symanski a.g. plandacin

) Ì 7-24-38 7:37an p. 3 of 3 From EASSILLON CER To: 9 718-956-3759 AGI ADSE AVE S E MASSILLON. OH 44646 Engineered State \* CERTIFICATE OF TESTS FAX 330-837-7017 JULY 24, 1998 PAGE: 2 OF 2 PURCHASE ORDER: 4 60 PART NUMBER : REPUBLIC ORDER: 47-25432-02 821 HEAT , , ; 8972530 PURCHASE ORDER DATE: 01/12/98 ACCOUNT NLMEER . . : 21934001 SCHEDULE . . . . : 39923-CC BY FAX PC 1 COPY 719-956-3759 FAX NOVA MACHINE QA REVIEW APPROVED DATE OF OTO CUST: 480 P.O. # 0007 6.0.#} 25 LOT# -DPILLCO DEVICES LTD. CA ACCEPTED 7/2418 Ξ PART SIX: 1003-DLS THREADED ROD. Lot Her 1232.0 Cardon Sin : Locs-Tieces Mova Machine Products, inc. Porchase Order No: Josavict REPORT NUMBER: HMP001-1 (45)FME-1000-20114-1976 f. 5/10/06 T W. Jaye Sink W, KANTI JAIN MANAGER MET & QC A. J. BLONDHEIM -CERTIFICATION ANALYST ylolos f. Symanski a.g. perstein

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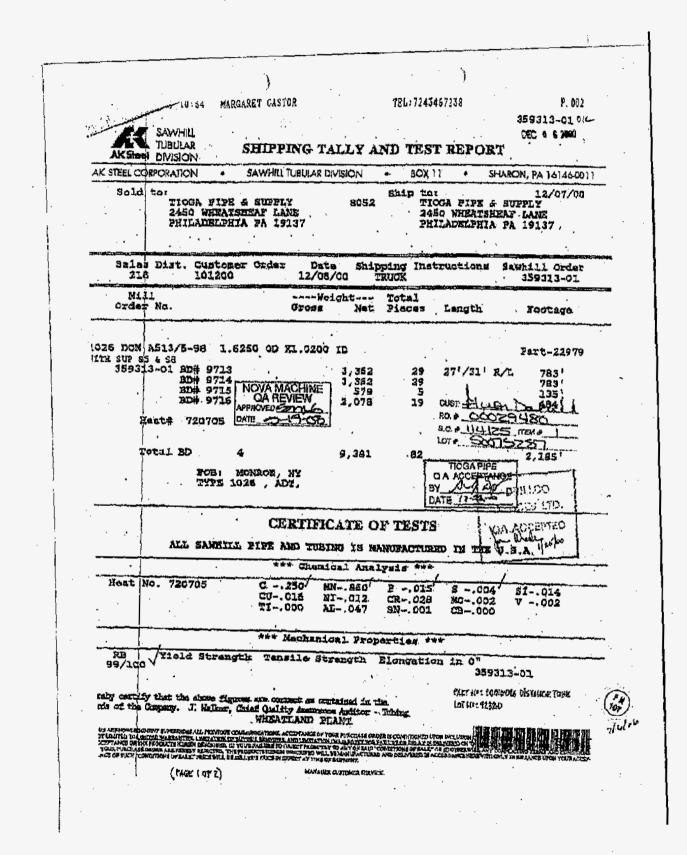
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ì 1 Ge PIPE SUPPLY COMPANY INC. C 2460 WHEATONEAF LANE, F.O. BOX 5887 PHILADELPHIA PA. 19187 C 215 531 6700 WATS NUMBER SON 523 3075 12 TELEX 834850 TWX # 710-070-1800 17 TELEDOPIER 210-001-1845 Certificate of Analyses and Tests January 18, 2001 NOVA MACHINE Drillco Devices LTD QA REVIEW 10-05 35th Avenue . . Long Island City, NY 11106 DATE SIG-02 CUSTOMER P.O.# TIOGA S.O 005225 DRILLCO 111856 CUST: DEVICES LTD. ITEM # 1 P.O. # 9.0. # 114125 MEM # HEAT # 7207.05 LOT#\_\_\_ -500 15281 SIZE: · .1.625" O.D. X 1.020" I.D. SPECIFICATION: ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TURING TYPE 5 . A) Chemical analyses were performed in accordance with ASTM A513-98 and Tioga Fipe Supply Procedure NO. TI-2 REV.1 with results as follow on Pages 2 , 3 & 4 B) A tension test was performed in accordance with ASTM A513-98 and Tiogs Pipe Supply Procedure TI-3 Ray. 1 with results as shown below: TIELD PSI 102,343 V TENSILE PSA ELONGATION, IN 2" 120,341 V 17.5% LONGITUDINAL STRIP LONG . . . . • 2 LAB #'S.C.T. 26381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE FRET UP: 1002-D EXPLASION SLEENE LOT 11-19232-D CANTON Nº: 1049 Places. NOVA MACHINE PRODUCTS, BSZ -THIS IS TO GERTIFY THAT THE MATERIAL FURNISHED ON THE REFERENCED OR-DER CONFORMS TO THE REPORTED ANALYSIS AS FURNISHED TO US SY OUR SUPPLIERS OF BY TESTS AND EXAMINATIONS FEFORMED BY ACCEPTED LABORATORIES. PURCHASE CROEP He SOUCELT REPORT NUMBERS NINT 001-1 (45) FMB-1000-2014-1448 1 All lab DATE ( TAGE 2 07 2)



١ COMPANY INC. I 2450 WHEATSHEAF LANE P.O. BOX 5997 PHILADELPHIA PA. 19157 I 218 631 0700 WATS NUMBER SOD 523 SOTS I TELEX 83-4540 TWX # TIO-670-1660 CT TELSCOPIER 218-535-1845 Certificate of Analyses and Tests January 18, 2001 NOVA MACHINE GA REVIEW Drillco Devices LTD 19-05 35<sup>th</sup> Avenue DATE Long Island City, NY 11106 CUSTOMER P.O.# TIOGA B.O 005225 DRILLCO 111356 DEVICES LTD. ោ នៅ ITEM # 1 <u>64 80</u> RQ. # CEPTED OTEM & 8.0.# HEAT # 720705 525 LOTH SIZE: .1.625" C.D. X 1.020" I.D. SPECIFICATION: ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TUBING TYPE 5 A) Chemical snalyses were performed in accordance with ASTM A513-98 and Tioga Pipe Supply Procedure NO. TI-2 REV. 1 with results as follow on Fages 2 , 3 & 4 B) A tension test was performed in accordance with ASTM A513-98 and Tiogs Fipe Supply Procedure TI-3 Rav. 1 with results as shown below: ÷. TIRLO PSF TENSILE PSC FLONGATION. IN 2" 102,343 120,341 4 17.54 LONGITUDINAL STRIP LONG 1.124 Ż LAB #'S C,T 26381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE FART Nº: 1004-DIS DISTRUCE TUBE. LOT H== 1232-D CARTON Nº . LOLS PIECES . NOVA MACHINE PRODUCTS, INC -THIS IS TO CERTIFY THAT THE MATCHIAL PURNISHED ON THE REPERENCED OR-Der Componys to the reported analysis as purnished to us by our Suppliers of 2y tests and examinations performed by accepted. Laboratornes, PORCHASE OFFER 14: 3036464 REFORT HUMBER: WHP DOG-(65) THB-1000-2014-1946 DATE (PAGE 2 07 2)

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GA SUPPLY COMPANY INC. I 2450 WHEATSHEAF LANE P.O. BOX 4887 PHILADELPHIA PA. 19157 I 215 831 0700 WAT'S NUMBER SOO \$23 3678 (1 TELEX \$3465) TWX # 710-620-1660 () TELECOPIER 215-033-1643 Certificate of Analyses and Tests NOVA MACHINE QA REVIEW APPROVED 2014 January 18, 2001 DATE Drilloo Devices LTD 10-05 35th Avenue Long Island City, MY 11106 CUSTONER P.O.# TIOGA DHILLCO 005225 111356 DEVICES LTD. CUSE (TTEN) 🖊 🔟 00.8 TTEM & 11412 GCEN s.o.#, 528 HEAT # 720705 UOT#L SIZE : · .1.625" O.D. X 1.020" T.D. SPECIFICATION : ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TUBING TYPE 5 . A) Chemical analyses were performed in accordance with ASTM A513-58 and Tiogs Rips Supply Procedure NO. TI-2 REV. 1 with results as follow on Pagas 2 , 3 5 4 B) A tension test was performed in accordance with ASIM ASI3-98 and Tioga Pipe Supply Procedure TI-3 Rev. 1 with results as shown below: TENSILE PST 102,343 V TENSILE PST 120,341 V ELONGATION, IN 2" 17.54 LONGITUDINAL STRIP LONG LAB #/S.C.T Z6381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE PART NAL MOSTOOD T'L MARI-BOLT SPACER. - 10T H\*: 1232-D CARTON Nº: 1045 TIECES. HOVA MACHINE PRODUCTS, INC. Puschase order 14: 3036467 THIS IS TO CENTIFY THAT THE MATERIAL PURNISHED ON THE REFERENCED OR-DER CONFORMS TO THE REPORTED ANALYSIS AS FURNISHED TO US BY DUR SUPPLIERS OR BY TESTS AND EXAMINATIONS PERFORMED BY ACCEPTED LABORATORISS. Ectory Humber Amy Dog-1 (68) The 1000-2014-1918 ſ 1 DATE: (PASE 2.07 2)

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FFTF-31477 Revision 0 Appendix D

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•	CL/9TOCX: 0000833741 2			-		
•	ITEM DESC: DRILLCO MBCP-1000 PROPPL	ETARY MFG, PART NUMBER	I.	-		
	CUSTONER BRECETCATIONS: A183 GRADE 87	· · · · · ·				
·	MATERIAL BRECIFICATIONS: Por Part Number requirements					•
	HEAT SPECIFICATIONS: Heat treated per the material sp	solfication (As applicable).				
•	QUALITY SPECIFICATIONS: Meets applicable portions of ANI visually examined and accepted Nx-2500, F-788 & F-812;; Dome	SI/ASME NGA-1 (33 ED., '83 ) par Nove Work Instruction 8.1 stic Manufactured::	Ado., and the .D Flev.5 whic	'94 Edition): 100FR2 X) meets the requirem	1 Applies100% ants of SA/A-614,	
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Page 103 of 235 of DA05240516

DRILLCO DEVICES LTD. 24-32 44<sup>m</sup> Street Long Island City, NY 11103 718-726-9801 FAX 718-956-3759 CERTIFICATE OF COMPLIANCE To whom it may concern: This is to certify that the materials used in the manufacture of the Drilleo Devices Ltd. Maxi-Bolt or Maxi-Bolt component shown below are in compliance with the requirements of the latest ASTM/ASME material specification as follows: Maxi-Bolt or Maxi-Bolt component: MBCP-1000 "Maxi-Bolt Coupler" Part Number Description ASTM/ASMB Specification MBCP Maxi-Bolt Coupler A/SA 193 B7 References Ship to: Nova Machine Products Nova Machine Products Purchase Order No; 3036467 18001 Sheldon Road Report Number; NMP 009-2 Middleburg Heights, OH 44130 Lot Number 9233-D Carton Number(s) 1 @ 65 Pieces. Drilloo forther certifies that the above material was supplied in accordance with Drilloo Devices Ltd. Q.A. Manual Rev. 2 dated 07/26/91. Rev 4 UL, Autho zed Signature Form P13-1 A Rev. 2 9/12/97 P. 04 2002 17:20 Jun 21 2009 14:23

Ĩ DRILLCO DEVICES LTD. 24-32 44<sup>TE</sup> STREET LONG ISLAND CITY, NY. 11103 TEL: 718-726-9801 FAX: 718-956-3759 MATERIAL SUPPLIER REPORT No NMP 009-2 Date May 18, 2006 Customer P.O. 3036467 Customer Nova Machine Products, Inc. Job Name Location Middleburg Heights, OH 44130 Part Identification 1" Maxi-Bolt Coupler. P.O. Item No. 2 Catalog Number MBCP-1000 Quantity 65 1.625" O.D. Diameter 2 %" Embedment N/A Longth Chemical Composition CUST; RO, # Contified Material Test Report Certificate of Compliance 8.0.# ITSM A LOT Certificate of Conformance Supplementary Requirements: Yes No х If yes, type of analysis, test or examination. Also, when verified and by whom, The above described material has been supplied under Lot Number 9233-D. Carton(s) Number(s) 1.@65 Pieces: and is in accordance with Customer Purchase Order requirements. Pus Authoriz Signature Form F 13-0 Rev. 3 09/02/97

energy areapy p. 6 of 3 1.10 + 1.00, max man ANT ROSE AVE S E MASSILLON, CH 44646 ٣. 🛃 Republic FAX 238-837-7817 Engineered Steels \* CERTIFICATE OF TESTS FEBRUARY 97; 1997 PAGE: 1 OF 2 ţ \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* PURCHASE ORDER DATE: 08/28/98 ACCOUNT NUMBER . : 21934001 SCHEDULE . : 59479-PURCHASE ORDER: 31:7 PART NUMBER : 07-14200-07 821 REPUBLIC ORDER: 07-14200-07 821 NEAT . . : 0570345 Seat Charge Address Samasan RA SHTA TO SAMA NOVA MACHINE QA REVIEW APPHOVED 214 DATE 2-19-102 DATLICO CEVICES LTO 1808 36TH AVE LONG ISLAND CITY NY (1186 ORILLCO DEVICES LIMITED P O ECX 6203 Long Island City Ny 11166 COLD FINISHED STEEL BARS ALLOY ASTM A 193-55 GRD B7 PLUS SURF SHN NRC (200721) AISI-4140 FINE GRAIN COLD DRAWN QUENCH & TEMP BEFORE CO/SRA AFT CO REST SIZE TOL QUAL ASSURANCE DOC 1 T HAX LIFT MAG TEST SIZE: ROS 1.63992/1.6458 X 12 FT C MN P S LACLE CHEMISTRY 9.420 29.87 .911 .931 8.220 8.24 9 NI CR 29.18 28.99 0.420 . BO.87 HO / AL 8.004 - SEMI-FINISH RESULTS-AUSTENITIC GRAIN SIZE AUST GRAIN SZ 7. HINISH SIZE RESULTS SCHEOLRE: 39479 B) ASTM EIØ ASTM A370 RFACE 289. MIDRADIUS 289. RFACE 269. MIDRADIUS 289. cust - Luci Dan BHN HT TRYO (LAB) PCE BI SURFACE PCE BZ SURFACE RO. # 00029480 11412 C. ITEM #> 8.0,# MACROBICH SRC ASTM 2381 MIL STD 430 PCE I SURFACE 1, RANDOM I, CENTER I, LOT ASTM EB ASTM ASTR TEMPERI DEG 7 1120. TENSILE NT TRTD AUSTENITIZE Deg F 1820. TEMPER2/SR OIL. 1050. TEMP2 TIME Hours 3.0 AUST TIME HOURS TEMPI TIME Hours 6.0 YIELO(.2%) PSI REDUCTION AREA ELONGATION PERCERT PERCENT 65.5 2 23.9 E4.7 23.9 TENSILE PSI 112890 120002. PCE 61 PCE 62 THE MATERIAL WAS NOT EXPOSED TO MERCURY OF ANY METAL ALLOY THAT IS LYOUTD AT AMSIENT TEMPERATURE OURING PROCESSING OR WHILE IN OUR POSSESSION. NO WELDING OR WELD REPAIR WAS PERFORMED ON THIS MATERIAL. I HEREBY CERTIFY THAY THE MATERIAL LISTED HEREIN HAS BEEN INSPECTED AND TESTED IN ACCORDANCE WITH THE METHODS PRESCRISED IN THE GOVERNING SPECIFICATIONS AND BASED UPON THE RESULTS OF SUCH INSPECTION AND TESTING HAS BEEN APPROVED FOR CONFORMANCE TO THE SPECIFICATIONS. 01,4200 MATERIAL WAS PROCESSED IN ACCORDANCE WITH THE CANTON NOT ROLLED PLANT DUALITY ASSURANCE PROGRAM MANUAL, REV. 4 DATED S/1/95 AND THE MASSILLON COLD FINISH PLANT QUALITY ASSURANCE PROGRAM MANUAL REV. 2 DATED 01/00/96. DEVICES LTD, QA ACCEPTED A. J. BLONDHEIM CENTIFICATION ANALYST KANTI JAIN MANAGER MET & DC 7/6 g. plan .... لاستدوائه a - 35

. . 2-07-92 J.21pa (p. 3) of 3 ( ETONE BASSILLER CTD 101. 9- 110-200-1100-. HASSTLLON, CH 44646 h **7** -FAX 330-897-7017 CERTIFICATE OF TESTS FEBRUARY 27, 1997 PAGE: 2 OF 2 PLRCHASE CROCK: 3117 PART NUMBER REPUBLIC OROER: 07-14202-07 521 HEAT : 8975345 法国家科学科学会教育 PURCHASE CADER DATE: 08/22/99 ACCOUNT NUMBER . : 21934061 SCHEDULE . . . : 59478-ALL TESTING HAS BEEN PERFORMED USING THE CURRENT REVISION OF THE TESTING SPECIFICATIONS. MED IN THE U.S.A. FAX BY FAX PC I COPY FILE 2 COPIES CC -718-966-3799 NOVA MACHINE QA REVIEW APPROVED 2 DATE 🦽 CUST 80. # \_ 000 8.0. # 114125 MEM # L07# 60 (<u>)</u> 00 DEVICES LTD. CCEPTED A 2 11/97 RANT Nº : MBLP-1000 MASS-BOLT CONFLEX. Lot u=: 9133-d Carton u=: (0.65-fields Nova Machine Products, NC--PURCHASE ORDER SHE : SO3LULLY Report Humber: Rhp 009-1 (65)HBCP-1000 5/10/02 JAIN A. J. BLONDHEIM CERTIFICATION ANALYST 8 DC MANA w. 9 g pla denis 潮潮能 è

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#### ALTERNATE LIFT LUG INFORMATION -



Pasco, WA 99301

#### **CERTIFICATE OF CONFORMANCE**

Contract # \_\_\_\_\_<u>19985</u> Release # \_\_\_\_<u>97</u> Customer \_\_\_<u>Fluor Hanford</u> \_\_\_\_Traveler # \_\_\_<u>P-FH-19985-136</u>

This is to certify that the required acceptance criterion has been met for the following items being delivered:

#### Description of Item(s): ALTERNATE LIFTING DEVICES HNF-FMP-06-30682-R/0A

Materials, Parts. Components, Assemblies of Services furnished under your contract release referenced above, have been manufactured/provided in accordance with all applicable contract requirements, drawings and/or specifications. Any inspection records as required by the purchasing document are included in this package or on file and available for review.

All items furnished under your purchasing document referenced above are genuine (i.e. -- not suspect/counterfeit) and match the quality test reports, markings and/or fitness for use as required by the purchasing document.

QA Signature Kevin Hooper

Page 1 of 1

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PARSONS Pasco Fabrication Facility	Fabrication/Asse	mbly and Insp	action Trav	/eler
TRAVELER F	ACKAGE FINAL	NSPECTION	CHECKL	IST
Traveler No.: P-FH-19985-1	36		· · · · · ·	<u>.</u>
Traveler Description: ALTE	RNATE LIFT LUG WELD	MENTS		
Acti		Acceptable	Rejected	Not Applicable
Traveler Package has been review Superintendent or Project Manager		Tiz In be	· · ·	
All associated NCR's are disposition	ned and closed.			
Impacting issues from an audit/sur	reillance are closed.			•
Product is complete and conforms (including red-line changes) and fa specifications.		12/11/06		
Product is marked/tagged/identified	as required.	De jalalos		
M&TE used during fabrication is wi and service period.	thin calibration specification	At 1/1/06		
Items are protected from damage.		pr12/06		
QA records are adequate and com	plete:		<u>.</u>	
CMTR's		J-12/0 /00		
Weld Record Sheet & VT		Julion 100		
NDE Reports (MT, RT, PT, U	л)	Q112/0/06		
Pressure Test Reports				
Other (list): Liff Test	•	Sp 12/ 1/06		L
Other Characteristics, as needed: List:				-
Comments:				
	QA Revie			
Print Name Sign Jerry Sur July Smith	ith. QA		······································	12/8/06
Print Name Sign	QA Manager R		· · ·	12/12/02
FPM-8-F8, Rev. 4(01-26-05)	Parsons infrastructure & Tec	hnology Group, Inc.		<u>+ 7.5</u> 70K
Traveler Package Number: P-FH-119	65-136		Job Numbe	r: 405303

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FFTF-31477 Revision 0 Appendix D

# SUPPORTING DOCUMENT LOG/QC INSPECTION TEST RECORDS

Page 110 of 235 of DA05240516

FFTF-31477 Revision 0 Appendix D

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PM-8-F7, Rev. 4(01-26-0	5) Parsons	Mirastructure & Te	chnology Group,	Inc,	•

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Alternate Left Lag Wedensets, Side Plates & Lat Plates (Source Impection) 2 Prepared/sporved to (Print and Sign Name): Part (1996) Jim Rich (DA) Date (1996) Mark Riste (QA) Date (1997) Series not required in submitted as PracPoint athornent (1.0 Verify that (3) Alternate Lift Lug Weldments (4) Side Plates and (2) Lift Plates have been fabricested (4) Side Plates and (2) Lift Plates have been fabricested (2) Verify A 36 200 Verify A 577M A572, ** Grade 50 carbon steel • Plate, 1.75" thick, ASTM A572, * Grade 50 carbon steel • Plate, 1.75" thick, ASTM A572, * 6 Tate, 1.75" thick, ASTM A572, * 6 Tate, 1.75" thick, ASTM A572, * 6 Plate, 1.75" thick, ASTM A572, * 8 Plate, 1.75" thick, 1.50-6000° the 8 Plate, 1.50" thick, 1.50"	A Guality Lovel 2 A Sarfacy Class A Suppar Name B Drawing/Spec. No. / Tervision ED Drawing/Spec. No. / Tervision ED Drawing/Spec. No. / Tervision IS, Auc. 15, Hol Teg 15, Auc. 15, Hol Teg 11, Hol Teg 12, 13, -06 12, 13, -06	PHET     Therefore     P. F. H. 19945-136       7. Purthane Order or Contract Order No.     7. Purthane Order or Contract H 19985 / CR#       8. Referen No. (pr. burnet order No.     8. Referen No.       10. Iam No.     8. Referen No.       11. Iam No.     8. Referen No.       12. Impocted By (Pick mannet effect with same field
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### FFTF-31477 Revision 0 Appendix D

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7. Them Description	scription						20-61.21 JAK
(Source	Autornate Law Lung Weddinsons, Side Plates & Lift Plates (Source Inspection)		3. Quality Lovel	ļ	7. Punchase	2. Purchase Order of Contract Order No.	Order No. Dontract# 19985 / DR# 145713
13. Char.			A. Sallery Class		eri i	Release No. (for blanket orders)	16 (se
ź	14. Inspection Characteristice			Inspection Status	3		
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	following Load Testing attachment Assistant	•					* 434445 -
	<ul> <li>(4ea.) Bolt, Heavy Hex. 1-8UNC-2A</li> </ul>					-	Z certs @ 4 weshers a
	x 7" Long, ASTM A325, Type 1	1					Long hear and lot.
	<ul> <li>(4ea.) Nut, Heavy Hex, 1-8UNC-2B.</li> </ul>	E:			-		
	ASTM A194, Grade 7 or Grade 2H)	9					,
	<ul> <li>(8ca.) Washer, Circular, 1", ASTM</li> </ul>	40-\$1-31	-				
	F436, Type 1	Ļ	_	_ <b>.</b> _,			
5.0	Verify that all welds were visually inspected			+			
	(VI) at the final pass, by qualified Weld	æ					
	Inspectors, per the SOW, 3.6.B, 1 <sup>st</sup> bulket.	: <u>B</u>	_			••	8-
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	Weldments have been load tested per the	3					
-	Verify that a builder lask 3.3	90-E1-21					
	and Maonadic Douted Texting Visual	(					
	nerformed and dominional for starts were	E					
		<b>B</b> ).					
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_ <b>*</b> ¢	equipment has been documented within the	æ				<b> </b>	
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				A. Salery Class		πi.	Release No. (for blanket orders)	97	
	n Ng Ng	14. Inspection Characteristics	15. Acc	16. Hid Tan	Inspection Startus	tus 18. In. Erroren	10 Cond Ant	20. Remarks	
AC	0.9	Verify that the following items are documented within the PHFI Documentation Package per the SOW, 3.6.B, 1 <sup>st</sup> bullet. Task 3.3 and Task 3.4.							
$\bigcirc$		<ul> <li>Welder Identification - P.4.=3</li> <li>Weld procedure unlized - Pess-og</li> <li>Weld filler materials -</li> <li>Date of weld performance -</li> </ul>	E	<u> </u>					i
·		<ul> <li>Inspection (VT) results (weld ~ acceptance)</li> </ul>					<u>-</u>		
<u>l</u>		HFI HIFI and and			····		<b>4</b> 7	stay 45	8-05
] 	1.0	Verify that dimensional inspections were performed by qualified inspectors per the SOW, 3.6.B, 2 <sup>nd</sup> builtet. Task 3.3 and Task 3.4.	₩B)						· · ·
	0.21	Verify that the identification verification have been properly documented within the release specific PHFI Documentation Package per the SOW, 3.6.B. 4 <sup>th</sup> bullet. Task 3.3 and Task 3.4.5	æ						
			EB .						
J	4	Verify the PHFI Documentation Package is complete and ready for shipment per the SOW, 3.6.C. Task 3.4.	<b>E</b>						
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Name	Name: Kevin Hooper Date: 10/31/06	<u></u>		ð.	117/06				
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×	CONSOLIDATE POWER SUPPL	<u>Y</u>	3556 Mary Taylor Road Birmingham, Alabama 35235
	CERI	IFICATION	Phone (205) 655-5515 Fax (205) 655-5511
CUSTOMER: PARSONS CO	NSTRUCTORS	DATE :	11/09/2006
	INORTH WHSE #5		
PASCO	WA 99301	SALES ORDER:	6566425 0 900 - 1
ITEM #	QUANTITY UM MATE	RIAL DESCRIPTION	HEAT CODE
1.01	GR.	E 3" THK. ASTM A572 50 4' X 4' # Plate3in	NUCOR HT# 6107182 SN#6107182-07-1 C/C: D10J
2.01	A572	E 1.75° THK. ASTM GR. 50 3' X 3' # PLATE1.75	NUCOR HT# 5104903 SN#6104903-05-1 C/C: D20J
CPS Q.A. PROG BASED UPON RE CERTIFICATION ALL TEST RESU SUBCONTRACTOR PROGRAMMATIC/ OF YOUR REFER CONSOLIDATED SAFETY RELATE QUALIFIED TES ADDITIONALLY, CONSOLIDATED STANDARDS, MA	REMENTS/10CFR50 APPEND RAM 5TH EDITION REVISI VIEW OF THE ATTACHED D AFFIRMS THAT THE CONT LTS AND OPERATIONS PER S ARE IN COMPLIANCE WI REGULATORY REQUIREMENT ENCED PURCHASE ORDER. POWER SUPPLY AS EITHER D IS SUPPORTED BY THE TING THAT WAS CONDUCTE MANUFACTURER MARKINGS POWER SUPPLY TO MAINTA TERIAL SPECIFICATIONS, OF FALSE, FICTITIOUS,	ON 2 DATED 10/6/04 OCUMENTATION/TEST RE ENTS ARE CORRECT AND FORMED BY CONSOLIDAT TH THE MATERIAL SPEC S AS REFLECTED ABOVE MATERIAL THAT WAS N ASME CODE SECTION I ATTACHED TEST REPORT D FOR COMMERCIAL GRA MAY HAVE BEEN SUPPL IN COMPLIANCE WITH T AND CUSTOMER PURCHA	ACCURATE, AND THAT ED POWER SUPPLY OR ITS IFICATION(S), AND THE REQUIREMENTS OT PROCORED BY II AND/OR NON-CODE S WHICH REPRESENTS ALL DE DEDICATION. EMENTED OR REAPPLIED BY HE APPLICABLE CODES, SE ORDER.
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_	A DIVISION OF CONSOLIDATED PI	PF & SUPPLY COMPANY, INC., I	BIRMINGHAM, AL

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	CONSOLIDATED POWER SUPPLY NUCLEAR CERTIFIED PRODUCTS		3556 Mary Taylor Road Birmingham, Alabama 35235 Phone (205) 655-5515 Fax (205) 655-5511
CUSTOMER :		DATE :	11/09/2006
PARSONS CON 3005 R ANSI	NSTRUCTORS IWORTH WHSE #5	CUSTOMER P.O. f	t: 406017 21018
PASCO	WA 99301	SALES ORDER:	6 <b>566425</b> 0 900 - 1
FEDERAL LAW, 1	MAY BE PUNISHED AS A FEI MITLE 10, CHAPTER 47		
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A DIVISION OF CONSOLIDATED PIPE & SUPPLY COMPANY, INC., BIRMINGHAM, AL.

## ACCSCECT Sorvice Contors U.S.A.

ATLANTA PLATE PROCESSING & DISTRIBUTION

November 8, 2006

Consolidated Power Supply 3556 Mary Taylor Road Birmingham, AL 35235

ATTN: Joe Robbins

. .

#### SUBJECT: Certificate of Compliance Customer P.O:# Z6565167

The materials, processes and parts furnished on this shipment were produced in conformance with all applicable specifications and as referenced in or furnished with the above purchase order.

The materials furnished under the above purchase order were produced either from materials furnished by the customer or from materials furnished by the seller for which we have certification and / or physical test reports or other evidence of conformity specifications for your examination.

The material was supplied in accordance with Macsteel Service Centers USA, Atlanta divisions' Quality Assurance Manual dated 9/19/06 as accepted by Consolidated Power Supply.

ITEM	CUTCODE	HEAT#	SLAB#	# PIECES	SZE	GRADE
1	DIN	6107182	<del>ت</del>	1	3" x 48.0" x 48.0" Red	A572 GR60
2	DIN	6107182	07	1 test coupon from same starting plate	3"x 3.0" x 12.0" Red	A572 GR50
3	D21U	6104903	05	1	1.75" x 96.0" x 96.0 "Rect	A572 GR50
4	0201	6104903	<u>05</u>	1 test coupon from same starting plate	1,75'x3.0'x12.0" Rect	A572 GR50

Ronda M. Custis, Quality Manager Macsteel Service Centers USA

ISOBORI PETRETCHED



5D-7-40f8

2005 GRABSLAND PARKWAY - ALPHARETTA, GA 30004 + PHONE: 770-751-1172 - MACSTEELUSA.COM

# FFTF-31477 Revision 0 Appendix D

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FFTF-31477 Revision 0 Appendix D

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Last C	ONSOLI	DATED		CEF	TIFIED M	ATERIAL TEST	REPORT
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	LEAR CERTIFIE				Birm	3556 Mary Tay Ingham, Alabam	
						Phone (205) 6 Fax (205) 6	55-5515
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This certificat	ion affirms that	the contents an	e correct av	n an uate a	: Ind that all	hest nea lits ar	
operations per	onned by Cons	olidated Power a surance Manual	ire în comp	liance with th	e material	specification, a	and
	on Grant va	Sulance Manual	, 501 60100	n, resv. 2, dau		Ĵv .	
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· A DIVIS	ION OF CONSO	UDATED PIPE & :	SUPPLY CO	MPANY, INC. 1	BIRMINGH	M. Al	
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 $\bigcirc$ **CERTIFIED MATERIAL TEST REPORT** Ю 3556 Mary Taylor Road Birmingham, Alabama 35235 Phone (205) 655-5516 NUCLEAR CERTIFIED PRODUCTS Fax (205) 655-5511 **CUSTOMER** CUSTOMER P.O. PARSONS CONSTRUCTORS 405017 21018 CPS PURCHASE ORDER CPS SALES ORDER CPS ITEM NUMBER 265-65167 6566425 N/A MATERIAL SPECIFICATION ASTM A572 GR.50 LINE ITEM LAB NUMBER CUT CODE HEAT OR TRACEABILITY ITEM DESCRIPTION 06-3861 DIO 6107182 5/N-6107182-07-1 3" THK PLATE Ē Mn Ρ <u>S</u> <u>S</u>] ٧ СЬ 0.226 1.43 0.016 0.0003 0.218 0.084 0.016 TENSILE YIELD POINT ELONGATION in 2" BEND 87.5 ksi 56.3 kst N/A 24 % This certification affirms that the contents are correct and accurate, and that all test results and operations performed by Consolidated Power are in compliance with the material specification, and our Quality Assurance Manual, 5th Edition, Rev. 2, dated 10/6/04. In Ist Sionature 9-05 Date Dan Hutchens CPS **CPS Laboratory Technician** Ô٨ A DIVISION OF CONSOLIDATED PIPE & SUPPLY COMPANY, INC., BIRMINGHAM, 50-7 ዮ 801

PAGE 122

Advanced Technical Services NW, Inc. 2718 S. Star Lake Rd. Federal Way, WA. 98003 ECHNICAL SERVICES NW. INC. Phone: 253-529-5186 or 800-287-8046 Fax: 253-529-5261 Page 1 of 2., **Certificate of Verification** Issued To: Certification No: 061023118 Instrument: Testing Machine Columbia Rigging Size - Range: 0 - 200,000 lb.f. P.O.Box 2717 Mig - Model: 6900 802 S. Maitland Pasco, WA. 99302 Serial No: 33118 Plant Location: Columbia Rigging 10/23/06 Date of Test: Attn: Kyle 10/23/07 509-545-4657 Recall Date: Recall Cycle: Annual Technician: Anita Catalinich ATS Asset No: 171 The above identified instrument was verified in accordance with ASTM E-4, Section 7. This verification is in conformance with the requirements of ISO/IEC 17025 and ANSI/Z-540. For verification details, refer to the test data altached. The measurement uncertainty represents an expanded uncertainty expressed at approximately 96% confidence level with a coverage factor of k=2. Machine Range (ib.i.) Loading Range (lb.f.) 0-200,000 10,000 - 200,000 Temperature: 60° F Received: In Tolerance Humidity: Returned: In Tolerance n/a This certificate attests that this instrument has been collibrated under the stated conditions with standards traceable to the National Issibule of This optificate inference interview in the instrument has been contracted on the main standards in tractations were survey and the instrument instantion instantion instantion on the standards and Technology (NIST). The measurement standards used have been calibrated to their manufacturats specified accuracy Juncentainty and companisation for temperature and humidity has been specified accuracy takes the standards used have been calibrated to their manufacturats specified accuracy Juncentainty and companisation for temperature and humidity has been specified accuracy takes to the advanced to their manufacturats of the advanced to their manufacturats of the advanced in this cardinate. Evidence of luceability is on the at our material py location of the standard (s) used and the item calibrated has been maintained. The results documented in this cardinate relate only to the item(s) calibrated or tested. Colibration interval assignment and adjustment are the responsibility of the end user. This cardificate may not be reproduced, except in full, without the written approval of Advanced Technicat Services NW, Inc. Advanced Technical Services NW, Inc. Calden by Anita Catalinich, Quality Assurance Manager 50-5-

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USE	STANDARO				 						
		TEST	<u>11 58</u>		USE		STANDARD	TEST	T.I. ERR		Uncertain
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ſ	198,500	200,000	1,500	0.75		1	199,600	200,000	<b>1,40</b> 0	0.70	

PAGE 2-82

# COLUMBIA RIGGING CORP.

802 S. MAITLAND PASCO WA. 99301 BUS. 509-545-4657 FAX. 509-545-8103

DECEMBER 8, 2006

PARSONS INFRASTRUCTURE 3005 E. AINSWORTH PASCO WA. 99301

LOAD TEST CERTIFICATE

P.O. #406017-21039 CERT #12290

3 ONLY, CUSTOMERS WELDMENTS, MODEL #A7, CUSTOMERS STATED WORKING LOAD LIMIT 54,660 LBS., PROOF LOAD TESTED AS PER CUSTOMER REQUEST TO 68,000 LBS. (125% CUSTOMER RATED CAPACITY), WELDMENT SERIAL NUMBERS ARE #H-4-65153-A7-1 THROUGH #H-4-65153-A7-3.

THIS LETTER IS TO CONFIRM THAT THE ABOVE LISTED CUSTOMERS WELDMENTS WERE PROOF LOAD TESTED TO 125% OF THE CUSTOMER STATED RATED CAPACITY W/O SIGN OF FAILURE FROM TEST. LOAD TEST WAS PERFORMED ON ESCO 280,000 LB LOAD TEST MACHINE, SERIAL NUMBER #33118. NEXT CALIBRATION DATE 10/23/07.

COLUMBIA RIGGING CORP. MAKES NO WARRANTY FOR THE ITEMS LISTED ABOVE OTHER THAN THAT THE LOAD TEST WAS PERFORMED AT CUSTOMERS REQUEST AND IS NOT RESPONSIBLE FOR ANY ACCIDENT OR INJURY WHICH MAY OCCUR FOR USING THE ABOVE MENTIONED PRODUCTS.

JAMES KYLE LEWIS: PRESIDENT

COLUMBIA RIGGING CORP. P.O. BOX 2717 PASCO WA. 99302

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# COLUMBIA RIGGING CORP.

802 S. MAITLAND PASCO WA. 99301 BUS. 509-545-4657 FAX. 509-545-8103

DECEMBER 8, 2006

PARSONS INFRASTRUCTURE 3005 E. AINSWORTH PASCO WA. 99301

#### CERTIFICATE OF CONFORMANCE

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P.O. #406017-21039

3 ONLY, CUSTOMERS WELDMENTS, MODEL #A7, CUSTOMERS STATED WORKING LOAD LIMIT 54,660 LBS., PROOF LOAD TESTED AS PER CUSTOMER REQUEST TO 68,000 LBS. (125% CUSTOMER RATED CAPACITY), WELDMENT SERIAL NUMBERS ARE #H-4-65153-A7-1 THROUGH #H-4-65153-A7-3. CERT #12290

THIS LETTER IS TO CONFIRM THAT THE ABOVE LISTED CUSTOMERS WELDMENTS WERE PROOF LOAD TESTED TO 125% OF THE CUSTOMER STATED RATED CAPACITY W/O SIGN OF FAILURE FROM TEST. LOAD TEST WAS PERFORMED ON ESCO 200,000 LB LOAD TEST MACHINE, SERIAL NUMBER #33118. NEXT CALIBRATION DATE 10/23/07.

THIS LETTER IS TO CONFIRM THAT ALL ITEMS FURNISHED UNDER THIS PURCHASE ORDER/CONTRACT ORDER ARE GENUINE (LE. NOT COUNTERFIET) & MATCH THE QUALITY, TEST REPORTS, MARKINGS AND/OR FITNESS FOR USE REQUIRED BY THE PURCHSE ORDER /CONTRACT ORDER THIS LETTER ALSO ACKNOWLEDGES THAT ANY ITEMS FURNISHED AS PART OF THIS PURCHASE ORDER/CONTRACT ORDER WHICH HAVE PREVIOUSLY BEEN FOUND TO BE SUSPECT/COUNTERFIET BY THE DEPT. OF ENERGY SHALL NOT BE ACCEPTED. THIS LETTER IS TO ALSO CONFIRM THAT THE ABOVE LISTED ITEMS CONFORM IN ALL RESPECTS WITH THE REQUIREMENTS OF THE ABOVE MENTIONED PURCHASE ORDER NUMBER

JAMES KYLE LEWIS: PRESIDENT

COLUMBIA RIGGING CORP. P.O. BOX 2717 PASCO WA. 99302

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**MAGNETIC PARTICLE REPORT** 

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			Job # 406303
Client Parsons Hanfor	d		Date Procedure No. 12/08/06 MT-WTP Rev. 3
Project Alternate Liftin	ng Weldt	nents	Location Port of Pasco, Wa.
Drawing No. See Below	- Br	amination	
Equipment Parker Probe s	n 7319 Pa	rticles	
Cal due date 06/	02/07	<b>r</b>	Red Coil Prods Yoke AC DC
ltem	Accept	Reject	Comments
Weld # 1-1	X		100% Final Welder PH-03
Weld # 1-2	x	·	100% Final Welder PH-03
Weld # 1-3	x		100% Final Welder PH-03
·			
			DOGT LOAD TEST
			POST LOAD TEST
<u> </u>			
	•		
			Drawing - H-4-65153 Sht. 2 Rev. 3
			Traveler # P-FH-19985-136
			No relevant Indications
· · · · · · · · · · · · · · · · · · ·		1.1	Noted at this time.
and applicable codes as noted	i above. 1 Jacan	ected was	in accordance with approved design drawings, specifications
Examined By Randy J.	Watkins		Level II Date 12/08/06

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MAGNETIC PARTICLE REPORT

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					Jo	ob # 406303
Client Parsons	Hanford			Date 12/05/06	Procedure No.	MT-WIP Rev. 3
Project Alternat	te Lifting We	dments		Location Port	of Pasco, Wa	
Drawing No. Se	e Below	Examinatio	n Std.	ASME Sec V	Acceptance Std.	AWS D1.1
	r Probe s/n 7319	Particles	Re			
Calom Item	e date 06/02/07	 ant   Yaiaat	ке і	1   Coil   Pro	Comments	
	Aco	<u> </u>				
Weld # 1	<u>-1 X</u>	<u> </u>	10	0% Final	We	der PH-03
Weld # 1	-2 X	<u> </u>	10	0% Final	We	der PH-03
Weld # 1	-3 X	<u> </u>	10	0% Final	We	der PH-03
			ļ			
·			PR	E LOAD TES	Γ	
· · · · · ·	-					
			Dr	awing – H-4-65	5153 Sht. 2 R	ev. 3
			Tn	weler # P-FH-1	9985-136	
			No	relevant Indica	ations	
			No	ted at this time	•	
To the best of my ki and applicable code	nowledge, work i s as noted above.	$\overline{7}$	1			ngs, specifications
Examined By Ra	ndy J. Watkin	ns		Level	II Date	12/05/06
· · · · · · · · · · · · · · · · · · ·						

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22 Fabrication/Assembly and Inspection Traveler PARSONS Pasco Fabrication Facility LIET TEETING AWEIGHING REPORT Description of liern or device to be tasked (include serial number if applicat PA AT ALTERNATE LIFT LUG WERKENTS Dug. H-4-65153 A7-1 Assy. NOTES: 1. Proof Test to be not more than 125% of rated capacity. The test load shall be accurate to within -5%, +0% of stipulated values. 2. Qualified inspector shall witness all steps below. 3. Note that if the flem or device to be tested is below the scale, the weight of that item or device and any associated rigging shall be considered when applying the test weight. PRIOR TO ANY LIFTING FORCE BEING APPLIED TO ITEM OR DEVICE, THE SUPERINTENDENT SHALL VERIFY LIFT SETUP FOR SAFE CONFIGURATION AND APPROPRIATE RATED CAPACITY OF ALL RIGGING EQUIPMENT USED FOR THIS TEST. Annue Date 12/8/26 Nekcel SUPERINTENDENT Design or Rated Capacity of Item/Device to be tested: 54, 660 L4s. Calculate 125% of Design or Rated Capacity (test load): <u>68,325</u> 120% <u>65,59</u>2 243 RANGE 0-200,000165. 33*11 8* Certified Scale No. \_ Cal. Due date: \_\_\_ / - 23 - - ? Verify all load bearing welds have been visually inspected prior to load test. QNQC TERRY JOHNE TOLLY JOHN Data 12/8/04 Printed Name / Signature If requested, varify NDE of load bearing wolds prior to load test. Include NDE report with work package. TERAY JoHas Terry Jan Data 12/8/06 QA/QC NA Actual test load or weight applied: 68,020,46s. Hold time if required: Date 12-13-06 SUPERINTENDENT LAAN MARCER Verify post-load test visual inspection and NDE of load bearing wetds. Include NDE report with work package. Ensure no deformation, cracks, or other defects as a result of the load test. QAQC TERRY JOHNS Truny John Date 12/8/06 Printophiane i Signature VISUAL For Post Lift Toot Juny Smith 12/13/06 Form FPM-32-F1 (Rev. 0B, 11/08/06) Traveler Package Number: P-FH-1995-135 Job Number, 406303

56-6

Fabrication/Assembly and Inspection Traveler PARSONS Pasco Fabrication Facility LIFT LESTING / WEIGHING REPORT Description of item or device to be tested (include series number 11 applicable): ALTERNATE LIFT LUG LUS (IMENT N/N A? Dusa. H-4-65153 Assu 1. Proof Test to be not more than 125% of rated capacity. The test load shall be accurate to within NOTES: -5%, +0% of stipulated values. 2. Qualified inspector shall witness all steps below. 3. Note that if the item or device to be tested is below the scale, the weight of theil item or device and any associated rigging shall be considered when applying the test weight. PRIOR TO ANY LIFTING FORCE BEING APPLIED TO ITEM OR DEVICE. THE SUPERINTENDENT SHALL VERIFY LIFT SETUP FOR SAFE CONFIGURATION AND APPROPRIATE RATED CAPACITY OF ALL RIGGING EQUIPMENT USED FOR THIS TEST. Date 12/8/26 SUPERINTENDENT LA MERCEL Palmen Design or Rated Capacity of Item/Device to be tested: 54,660  $\pm 6s$ Calculate 125% of Design or Rated Capacity (test load): 68,325 Las 120% 65,572 Las. RANGE @- 200,000 LAS Certified Scale No. 33 118 \_\_\_\_\_ Cal. Due date: <u>/@-23-@7</u>\_ Verify all load bearing welds have been visually inspected prior to load test. QAIQC TERRY JOHNS TELSY John Date 12/8/06 Printed Name / Stignature If requested, verify NDE of load bearing welds prior to load test. Include NDE report with work package. QAIQC TEARY JOHNS TELLY John Date 12/8/06 Actual test load or weight applied: 68,000 4.65 Hold time if required: N/A BOLLY FOR LANN MERCUR Date 12-13-03 SUPERINTENDENT Verify post-load test visual inspection and NDE of load bearing welds. Include NDE report with work package. Ensure no deformation, cracks, or other defects as a result of the load test. QAVOR TERRY JOHN'S TELLY Jakan Date 12/8/06 Printed Atame & Signature Visual For Post Test Jung Sonit 12/13/06 Form FPM-32-F1 (Rev. 0B, 11/08/06) Traveler Package Number: P-FH-19988-136 Job Number: 406303

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PARSONS o Febrication Facility	Fabrication/Assembly and Inspection T	raveler
	LIFT TESTING / WEIGHING REPORT	
Description of item or device to be ALTECNATE L	tested (include serial number if applicable): IFT LUG (28/5 MENT P/1 A7	
Dwg. H-4-6:	5153 A354	4 A7-3
	to be not more than 125% of rated capacity. The test load shall be	
-5%, +0%	of stipulated values.	
2. Qualified	nspector shall witness all steps below.	
3. Note that i	if the item or device to be tested is below the scale, the weight of the	at item or device
and any a	ssociated rigging shall be considered when applying the test weight	•
VERIFY LIFT SETUP FOR RIGGING EQUIPMENT US	ORCE BEING APPLIED TO ITEM OR DEVICE, THE SUPERINTE SAFE CONFIGURATION AND APPROPRIATE RATED CAPACIT ED FOR THIS TEST. MELCER ORTHOUSE Printed Name / Signalitys	Y OF ALL
	f item/Device to be tested: $54,660,26s$	
Calculate 125% of Design o	or Rated Capacity (test load): <u>68,32576</u> :120% <u>65,572</u> 4.65, 2an66 0 - 200,000 1.65	
Certified Scale No. <u>33</u>	(//8Cal. Due data: _/シーユ3-の7	
<i>,</i> +	s have been visually inspected prior to load test.	
QA/QC <u>TERRY</u> Joh Printed/tame/Signa	HAS TERRY John Date 12/8/06	
If requested, verify NDE of I	oad bearing walds prior to load test. Include NDE report with work	package.
QAVQC <u>TEREY John</u> Printed Mame / Signs	NS Terry John Date 12/8/06	
Actual test load or weight a	pplled: <u>68,000, 165</u> Hold time if required: <u>N/A</u>	
	ABUT FOR LACY MECORDate 12-3-	06
	nspection and NDE of load bearing welds. Include NDE report with cks, or other defects as a result of the load test.	work package.
DAVOC TERAY JOA Printed/Name/Stone	His Terry John Date 12/0/06 Hure Post Lift Test Juny Smith 12/13/06	
Visual For ,	Post Lift Test Juny Smit 12/13/06	

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PARSONS Fabrication Facility	Fabrication/Assembly and Inspection Traveler
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LOAD TE Assemble required 1 30682-R0 testing of	STING INSTRUCTIONS: y 1 & 2 Alternate Lift Lug Weldment (P/N A7) shall be load tested as by General Note #18 of Drawing H-4-65153, Sheet 2 (HNF-FMP-06- ) Page 12) and per FH approved, DOE-RL-92-36 (Chapter 11 "Load Below the Hook Lifting Devices" Section 11.9.1.2 Rated Load Test) ant C of SOW).
back (the Center sp Plate) an	) Alternate Lift Lug Weldment (P/NA7) at a time, are bolted back to bolts are to be oriented in the slots to obtain maximum Center-to- bacing (~13.5 inches), with the use of P/N's 19 & 20 (Side Plates & Lift d Heavy Hex Bolts & Nuts 1-8UNC, shall be load tested at 125% of the e Working Load (SWL) of <b>54,660</b> Lbs. (load test value to be 68,325 Lbs. 6 Lbs.)
	Alternate Lift Lug Weldment (P/N A7) will be load tested in the same s above using one Alternate Lift Lug Weldment (P/N A7) a second time.
Ensure th	e test load is evenly distributed during load testing activities.
M&TE_	5/1 33/1 B Date 10-23-07 SEE COPY OF CALIBRATION REPORT CHAT. # 061023/18
	at 68,325 Lbs. +0 / -3,416 Lbs. (125% of rated load). Trister #7 48000 46s.
QC QC Signa	rture Tury John Date 178/04
POST LC	AD TEST MT REQUIRED
· · · · · · · · · · · · · · · · · · ·	WELDS W-1-1thru W-1-3 PER AWS D14.1. SEE WELD DATA FOR INSPECTION POINTS.

Travelar Package Number: #-FH-19985-138

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Job Number: 406303

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FFTF-31477 Revision 0 Appendix D

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A: re 30 te (A Th ba C4 Pi ra +( Th fa	DAD TESTING INSTRUCTIONS: seembly 3 Alternate Lift Lug Weldment (P/N A7) shall be load tested as quired by General Note #18 of Drawing H-4-65153, Sheet 2 (HNF-FMP-06- 1682-R0 Page 12) and per FH approved, DOE-RL-92-36 (Chapter 11 "Load sting of Below the Hook Lifting Devices" Section 11.9.1.2 Rated Load Test) ttachment C of SOW). wo (2ea) Alternate Lift Lug Weldment (P/NA7) at a time, are <b>bolted back to</b> tack (the bolts are to be oriented in the slots to obtain maximum Center-to- enter spacing (~13.5 inches), with the use of P/N's 19 & 20 (Side Plates & Lift ate) and Heavy Hex Bolts & Nuts 1-8UNC, shall be load tested at 126% of the ted Safe Working Load (SWL) of <b>54,660</b> Lbs. (load test value to be 68,325 Lbs. ) / -3,416 Lbs.) ne third Alternate Lift Lug Weldment (P/N A7) will be load tested in the same shion as above using one Alternate Lift Lug Weldment (P/N A7) a second time.
	$aTE = \frac{4\pi 33/18}{5 \epsilon L} Date = \frac{10-23-07}{5 \epsilon L} Date = 10-23-07$
SI	ELET WELDO WELD DATA

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Traveter Package Number: P-FH-19985-138

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	Fabrication/Assembly and Inspection Traveler
60 QC	QC apply acceptance tags to all successfully completed assemblies. The attached acceptance tag denotes the completed assemblies meet the acceptance criteria outlined. QC Signature Date Date Date

Traveler Package Number: P-FH-18985-130

Job Number: 406303

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FFTF-31477 Revision 0 Appendix E

# APPENDIX E. UPDATED ANALYSIS OF LIFTING ANCHOR BOLTS AND LIFT LUGS

HNF-FMP-06-30682-R0

Page 20 of 55

Calculation/Technical Basis Cover Sheet and Revision Summary

Section	1; Identificat	(10)D						
I. Proje	ect Number		on Description Title				3. Päge i	of iii
		Lifting Ancho	or Bolts Design for	Disposal	ble Solid	Waste Cask		
4. Use	of Form					······································	· · ·	
🗹 Cald	alation 🔲	Engineering Analy	sis 🔲 Software	: Installatio	n 🛛	Technical Basis	🗖 Other	
5. Job 7	Filc	· · · · · · · · · · · · · · · · · · ·	6. WBS N	umber	7. Depa	rtment/Organizati	on <sup>(</sup>	
ļ					FFTF			
8. Calci	ulation Numbe	. 9.	Affected Building 1	Numbers	10. Roo			11. Floor
121745	-C-01		0 Area		· ·			
12. Ind	ependent Verif	ication Required?	13. Natural Phone	omena Cat	égory (P(			
	Yes	🗖 No	<b>D</b> 0	<b>1</b>	an a	2 10 2	iii 3	VA ···
Section	2: Preparatio	in, Review, and A	oproval		7.	<b>W</b> itchington (1997)		
14. Rev. No.	15.	16. Designer(s) Date	17. Checker Date	18. Inde Verifier	peadent (s)/Date	19. Design Authority	20. Supersedes Cale, No. or Rev. No.	21. Field Confirmation Required?
0	0 Print Name KC Tu		WI Magruder					T Yes
	Sign	Ac In	WJ91 m	<u> </u>			<u> </u>	
	Date	8/30/06	9/12/06					
	Print Name	<u> </u>		<u>}</u>			· · · · · · · · · · · · · · · · · · ·	☐ Yes
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22. Rev. No.			23 Description	/Reason fo	r Revisio	n		24. Affected Pages
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FFTF-31477 Revision 0 Appendix E

A-6003-084 (08/02)

#### HNF-FMP-06-30682-R0

#### Page <u>22</u> of <u>55</u>

#### Calculation/Technical Basis Sheet

Section 4: Conclusions Drilleo Maxi-Bolts are used to replace the nusted inserts. Three sets of (4) 1" Drilleo ASTM A193 Grade B7 Maxi-Bolts (four bolts per set) with 20%" embeddment (22" may be used for additional safety) are installed at 120 degrees apart. The bolt patterns ere 7 inches from the outside face of the cask to the outer row of bolts, 8 inches between rows of bolts, and 11 inches between columns of bolts. If the location of the new anchor bolt is interference with reinforcing steel, the bolt location may varies 1.25" either way in hoop direction. The removable lifting hig base plates are 11 %" wide, 17" long, and 2 %" thick. The removable lugs are attached to the anchors by 1" ASTM A193 Grade B7 Studs and ASTM A197 Heavy Hex Nuts. The other parts and weld are same as the existing lug.

The margin of safety of the existing inserts is 0.82 as calculated in reference DAR. Based on the same method as used in reference DAR, the margin of safety for the Drilleo Maxi-Bolts enchors is 1.36. The new anchor holts are safer than the existing inserts.

HNF-FMP-06-30682-R0

# Page 2] of <u>SS</u>

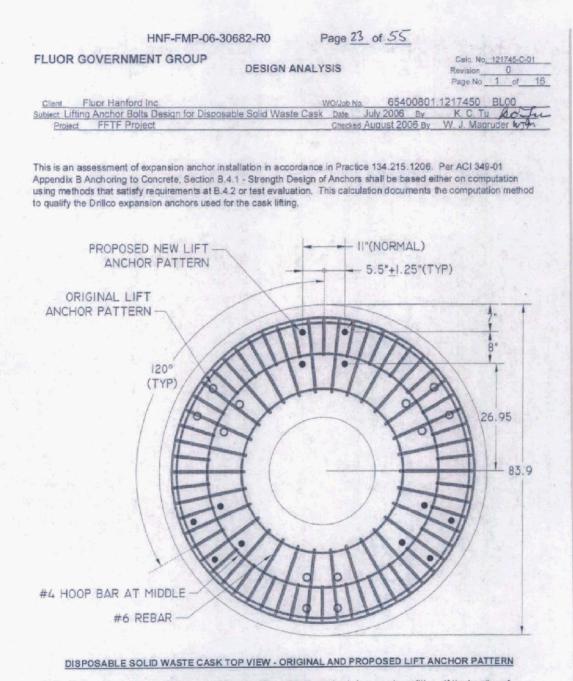
## Calculation/Technical Basis Sheet

Section 1; 10	entification		
<ol> <li>Project Null</li> </ol>	mber	2. Modification Description Title/Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask	3. Page if of it
4. Calculation	Number	1	S. Rev. No.
121745-C-01		and a second second In the second	0
		Method, Assamptions, Technical Basis	Elevente de la constante de la Reconstante de la constante de l
6. Scope and 4 The insens for of anchor boilt	the lifting on th	Disposable Solid Waste Cask are rusted and are not able to be used. The o sens for lifting the cask	bjective is to design a set
<ol> <li>Method</li> <li>Hand calculati</li> </ol>	ons using MathC	AD 13.0. MathCAD is a registered trademark of Mathsoft Engineering and	Education, Inc.
The design		ask is 100,000 pounds without impact limiters.	<u></u>
Section 3: De	sign Inputs/Ref	Pronces	
9. Ref. No.		10. Inputs/References (with Revision and/or Date or Source)	··· ·
ACI-318	"Ruilding Cod	e Requirements for Structurel Concrete (ACI 318-05)", American Concrete	nstitute, 2005.
ACI-349-01	2001.	ments for Nuclear Safety Related Concrete Structures (ACI 349-01)", Amer	
ACI-349-80	1980.	ments for Nuclear Safety Related Concrete Structures (ACI 349-80)", Ather	× ·
AISC	Inc., 1989.	ef Construction - Allowable Stress Design", 9th Edition, American Institute	
ASTM A 193	Designation: A High Tempera	1937A 193M-06a, "Standard Specification for Alloy-Steel and Stahlers Ste hare or High Pressure Service and Other Special Purpose Applications".	el Bolting Materials for
ASME B1.1- 2003		Screw Threads", 2003.	
DAR	D-1, (Released Washington.	Design Analysis Report for Fast Flux Test Facility (FFTF) Dispusable Solic by EDT-118712, July 27, 1990) Revision 3, Westinghouse Hanford Compa	ny, Richland,
1-4-65155	Westinghouse	5135, Sheet 2, Rev. 2, "Steel Liner Weldment Details DSWC", U. S. Depart Hanford Co., 1991.	in the structure in the second se
<u>1-4-65157</u>	Westinghouse	5157, Rev. 3, "Disposable Solid Waste Cosk Concrete Assembly", U. S. De Hanford Co., 1991.	
CBO-4133	February 1992.	iori No. 4135, Drilleo Maxi-Belt Bearing Type, Undercut Anchors, ICBO E	ralitation Service, Inc.,
ractice 34.215.1206	"Design of Exp	unition Anchors", Pluor Federal Services, Publication Date 01 Jan06.	

A-6003-084 (08/02)

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NOTE: The new anchor bolt patterns are 120° apart. The 11" bolt spacing is in normal condition. If the location of the new anchor bolt is interference with #6 rebars, the bolt location may varies 1.25" laterally (in hoop direction). The maximum of two #6 rebars may be cut in each group of the four bolts during the installation of the new anchor bolts. The #4 hoop bar at the middle is allowed to be cut.

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HNF-h	EMP-06-30682-R0 Page <u>29</u> of <u>55</u>	
FLUOR GOVERNMENT GF	DESIGN ANALYSIS	Calc. No <u>121745-C-01</u> Revision 0- Page No <u>2 of 16</u>
Clent Fluor Hanford Inc	WO/Job No. 65400	B01,1217450 BL00
Subject Lifting Anchor Bolts Design	n for Disposable Solid Waste Cask Date July 2006 B	V K.C. TU & Ju
Project FFTF Project	Checked August 2006	By W. J. Magruder hoffin
Disposable Solid Waste Cask		
OD <sub>cask</sub> := (84.5 - 0.6) in	minimum cask outside diameter (Ref. H-4-65157) (	$DD_{cask} = 83.9$ in
ID <sub>cask</sub> := 28-in	cask concrete inside diameter (Liner O.D.) Steel Liner ID = 27.25" (Ref. H-4-65155)	
DesignLoad := 100-k	loaded cask weight (Ref. DAR)	
FactoredLoad = 1.4-DesignLoad	concrete strength design with 1.4 load factor for dead load (the cask weight is calculated and is not a variable)	FactoredLoad = 140 k
f <sub>c</sub> := 4000-psi	concrete strength (Ref. H-4-65157)	
f. := 60000-psi	vield stress of rebar	
Drillco Maxi-Bolt Anchor Bolts		
	isting lifting device and new lifting lugs. I GradeB7 1" Drillco Maxi-Bolt anchor bolts per lug	
A <sub>bolt</sub> := 0.7854-in <sup>2</sup>	bolt nominal area	
$A_n := 0.606 \cdot in^2$	Tensile stress area (Reference: ASME B1.1-2003, T	able 6)
F <sub>v</sub> := 105-ksi	bolt yield stress (ASTM A193)	
Fu := 125-ksi	bolt ultimate stress (ASTM A193)	
$F_t := \min(0.6 \cdot F_v, 0.5 \cdot F_u, 60 \cdot ksi)$	bolt allowable tensile stress (AISC & ICBO-4133)	$F_t = 60 \text{ ksi}$
$T_{allowable} := \min\left(A_{bolt} \cdot F_t, A_s, \frac{F_y}{3}, A_s\right)$	Fe         bolt allowable tension (lesser of 1/3 of yield stress, or 1/5 of ultimate stress (page 3-4 to 3-5 of DAR))	$T_{allowable} = 15.15  k$
$\frac{3 \cdot 4 \cdot T_{allowable}}{DesignLoad} - 1 = 0.82$	the margin of safety > 0 O. K.	
h <sub>ef</sub> := 20.5 in	set the stud embedment - minimum	
d <sub>hole</sub> := 1.69-in	drill hole diameter (Table III of Ref. ICBO-4133)	
sl := 8·in	keep the existing bolt spacing in radial direction as a to be able to use the existing lifing device	shown in H-4-65157

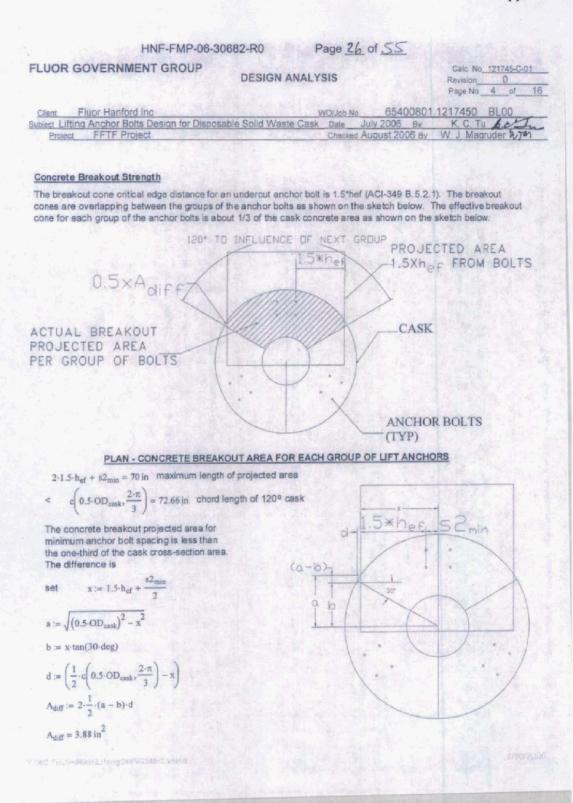
s2 := 11·in

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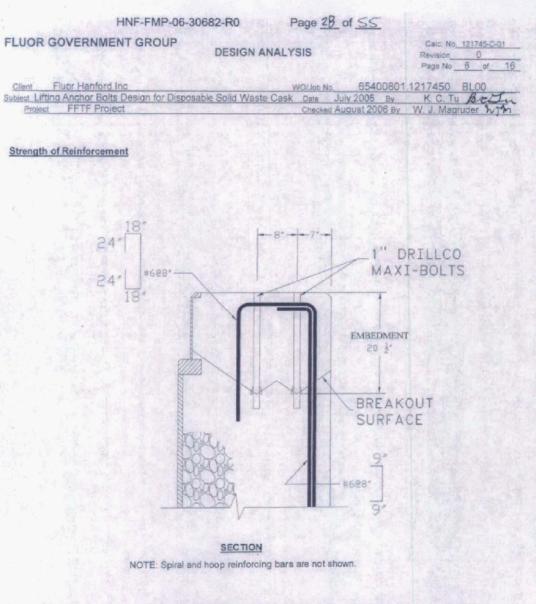
requested best bolt spacing in circumferential direction to avoid cutting rebars

JOR GOVERNMENT GROU	P DESIGN ANALYSIS	Galc         No
ent Fluor Hanford Inc	WO/Job No. 65	400801.1217450 BL00
et Lifting Anchor Bolts Design for D	Disposable Solid Waste Cask Date July 200	
Project FFTF Project	Checked August 2	2006 By W. J. Magruder WTh
eck the clear distance between the c	frilled bolt hole and the #6 rebars	
$=\sqrt{(0.5 \cdot OD_{cask} - 7 \cdot in)^2 + (0.5 \cdot s2)^2}$	outer anchor bolt radius	r <sub>o</sub> = 35.38 in
Note: Use 0.5-s2 approximate aven location.	age, since $\pm 1.25$ " tolerence given in hole	
$=\sqrt{(0.5 \cdot OD_{cask} - 7 \cdot in - s1)^2 + (0.5 \cdot s2)^2}$	) <sup>2</sup> inner anchor bolt radius	r <sub>i</sub> = 27.51 in
$(a, \theta) := 2 \cdot R \cdot \sin(0.5 \cdot \theta)$	chord length formula	
$=\frac{2 \cdot \pi}{2 \cdot 30}$	angle between #6 rebars (60 total, H-4-65157)	$\theta = 6 \deg$
$= \operatorname{asin}\left(\frac{0.5 \cdot s2}{r_0}\right)$	angle from the center line of bolt pattern to the outer anchor bolt	$\alpha_0 = 8.94 \text{ deg}$
$= \operatorname{asin}\left(\frac{0.5 \cdot s2}{r_i}\right)$	angle from the center line of bolt pattern to the inner anchor bolt	$\alpha_i = 11.53 \text{ deg}$
$(\alpha_{o} - \theta) - \frac{6}{2 \cdot 8} \cdot \ln - \frac{d_{hole}}{2} = 0.6 \ln \theta_{o}$ $(\alpha_{o} - \theta) - \frac{6}{2 \cdot 8} \cdot \ln - \frac{d_{hole}}{2} = 0.67 \ln \theta_{o}$	Placing center of bolt pattern at the loc clear distances between outer anchor bars at both sides. The bolt location is the two adjacent bars for the bolts spa	bolt drilled hole and #6 s almost at the mid-point of
$(\alpha_1 - \theta) - \frac{6}{2 \cdot 8} \cdot \ln - \frac{d_{hole}}{2} = 1.44 \text{ in}$ $(3 \cdot \theta - \alpha_i) - \frac{6}{2 \cdot 8} \cdot \ln - \frac{d_{hole}}{2} = 1.88 \text{ in}$	clear distance between #6 and inner anchor bolt drilled hole	
$a := d_{hole} + \frac{6}{8} \cdot in$	range of the anchor bolt locations in order to avoid cutting #6 rebars (slot hole size in the lifting plate) use a full rebar diameter	$d_{slot} = 2.44$ in
$d_{slot} \coloneqq 2.5 \cdot in$		
en $s2_{max} := s2 + d_{slot}$	maximum and minimum possible	s2 <sub>max</sub> = 13.5 in
$s2_{min} := s2 - d_{slot}$	bolt spacings	s2 <sub>min</sub> = 8.5 in

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HNF-FMP-06-30682-R0 FLUOR GOVERNMENT GROUP DESIG	Page 27 of <u>SS</u> Calc. No. 121745-C-01           GN ANALYSIS         Revision         0           Page No         5 of         -
Client Fluor Hanford Inc Subject Lifting Anchor Bolts Design for Disposable Solid V	WO(Jab No. 65400801 1217450 BL00 Naste Cask Date July 2006 By K. C. Tu Rost
Project FFTF Project	Checked August 2006 By W. J. Magruder 503%
$A_{N} := \frac{1}{3} \cdot \frac{1}{4} \cdot \pi \cdot \left( OD_{cask}^{2} - ID_{cask}^{2} \right) - 4 \cdot \frac{1}{4} \cdot d_{hole}^{2} - A_{duff}$	projected concrete failure area $A_N = 1630.87 \text{ in}^2$
$A_{No} := 9 \cdot h_{ef}^{2}$ $A_{No} = 3782.25 \text{ in}^{2}$	projected concrete failure area of a single anchor with an edge distance equal to or greater than 1.5hef
$N_{cbg} = \frac{A_N}{A_{No}} \cdot \Psi_1 \cdot \Psi_2 \cdot \Psi_3 \cdot N_b$	normal concrete breakout strength of a group of anchors in tension (formula B-4b of ACI 349-01)
k <sub>c</sub> := 17	for post-installed anchors (B.5.2.2 of ACI 349-01)
$N_b := k_c \sqrt{\frac{f_c}{psi}} \left(\frac{h_{ef}}{in}\right)^{1.5} \cdot lbf \qquad N_b = 99795.21  lbf$	basic concrete breakout strength of a single anchor (formula B-6a of ACI 349-01)
Ψ1:=1	no eccentricity in tension (formula B-7 of ACI 349-01)
$c_{0} \coloneqq 0.5 \cdot OD_{cask} - \sqrt{\left(0.5 \cdot OD_{cask} - 7 \cdot in\right)^{2} + \left(0.5 \cdot s2_{max}\right)^{2}}$	edge distance from outside face $c_0 = 6.35$ in
$c_{i} := \sqrt{\left(0.5 \cdot OD_{cask} - 7 \cdot in - s1\right)^{2} + \left(0.5 \cdot s2_{min}\right)^{2}} - 0.5 \cdot ID_{cask}$	edge distance from inside face $c_i = 13.28$ in
$c_{\min} := \min(c_0, c_i)$	minimum edge distance
$c_{min} = 6.35 \text{ in} \le 1.5 \cdot h_{ef} = 30.75 \text{ in}$	
$\Psi_2 := 0.7 + 0.3 \cdot \frac{c_{\min}}{1.5 \cdot h_{of}}$ $\Psi_2 = 0.76$	modification factor for edge effect (formula B-8b of ACI 349-01)
Ψ <sub>3</sub> := 1.0	for no cracking in concrete and post-installed anchors (B.5.2.6 of ACI 349-01)
$N_{cbg} := \frac{A_N}{A_{Na}} \cdot \Psi_1 \cdot \Psi_2 \cdot \Psi_3 \cdot N_b$	breakout strength for four anchor bolts $N_{cbg} = 32789.13  lb$
φ <sub>conc</sub> ≔ 0.75	strength reduction factor for anchor governed by concrete breakout (B.4.4 of ACI 349-01)
φ <sub>conc</sub> ·N <sub>cbg</sub> = 24592 lbf	concrete breakout design strength for a group of 4 bolts
NewConcreteBreakoutStrength := $3 \cdot \phi_{conc} \cdot N_{cbg}$	NewConcreteBreakoutStrength = 73775.53 lbf
NewConcreteBreakoutStrength FactoredLoad - 1 = -0.47	margin of safety < 0 if consider the breakout concrete only
	utilize the reinforced steel to hold the concrete



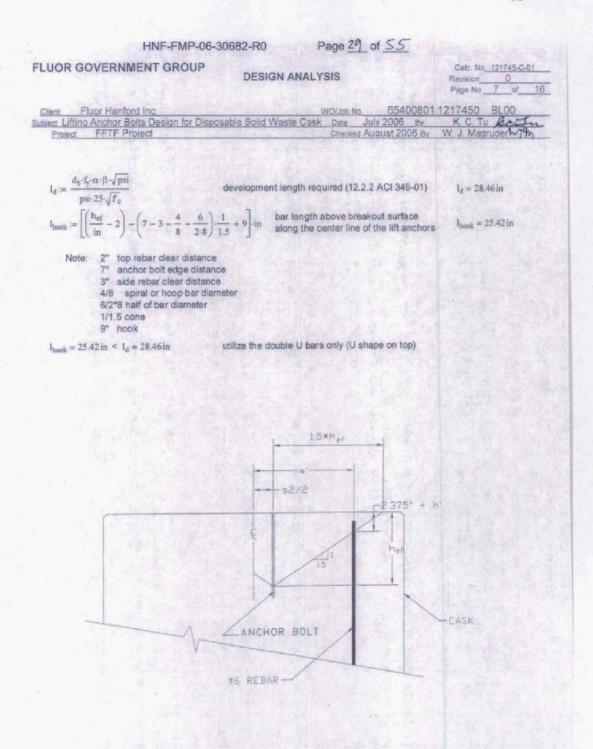
A cross-section is shown above. Consider the #6@4" (2 sets of #6@8) at outside face to hold the breakout cone. The #6@8" with 24" vertical at inner area are not considered.

#6	4.000	1	in the	m	-	tor	1
#0	LICH-	-141	а		0	101	

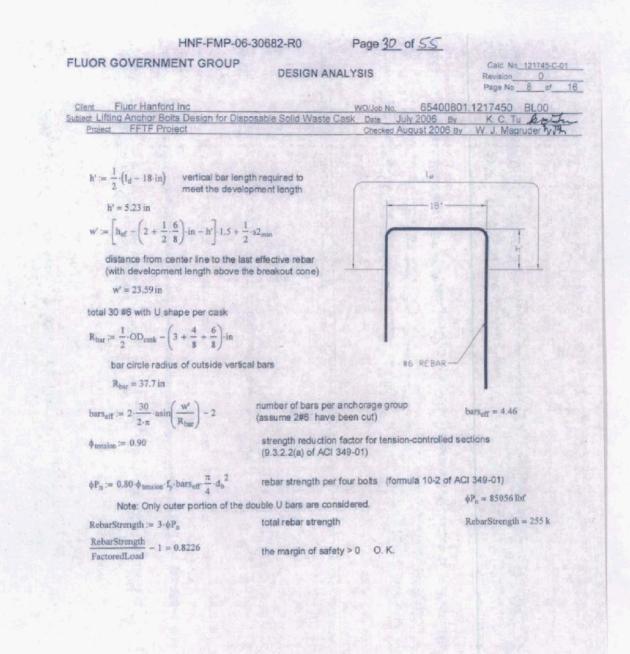
12.2.4 of ACI 349-01

 $\alpha := 1$  $\beta := 1$ 

 $d_b := \frac{3}{4} - in$ 



YAKO TurtimRichtLiftingEWTC349r2.amod



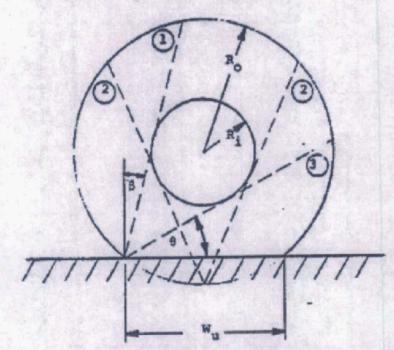
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HNF-FMP-06-30682-	R0 Page 31 of 59	S The second second
FLUOR GOVERNMENT GROUP	ESIGN ANALYSIS	Calc. No <u>. 121745-C-01</u> Revision <u>D</u> Page No <u>9</u> of <u>16</u>
Client Fluor Hanford Inc	WO/Job No. 65	400801.1217450 BL00
Subject Lifting Anchor Bolts Design for Disposable So	olid Waste Cask Date July 2006	B BY K.C. TU BELL
Protect FFTF Project	Checked August 2	006 Ry W I Magnider WTh

#### Check Shear Capacity of Reduced Reinforcing

Three hypothetical failure planes at impact are studied in DAR as shown below (page 4-50 of DAR). The rebars are the holding force for the shear fraction planes. There is a potential of cutting rebars from the installation of the new anchor bolts. The plane 1 is the most critical plane and is investigated here.



The shear allowables incorporate following three types of reinforcing steel as stated in Section 4.2.2.2 of DAR.

 $A_{spiral} := \frac{2}{2 \cdot in} \cdot \pi \cdot \left(\frac{4}{2 \cdot 8} \cdot in\right)^2$ 

 $A_{studs} \coloneqq \frac{14 \cdot \pi \cdot \left(0.5 \cdot 0.75 \cdot in\right)^2}{L_{cask}}$ 

 $A_{hoop} \coloneqq \frac{2 \cdot (7-1)}{L_{cask}} \cdot \left[ \pi \cdot \left( \frac{4}{2 \cdot 8} \cdot in \right)^2 \right]$ 

 $L_{cask} := 171.5 \cdot in$ 

Cross-section area of #4 spiral at 2" through the plane twice

cask length

Cross-section area of studs per inch length of cask (14) 3/4" studs in line (Ref. page 4-31 of DAR)

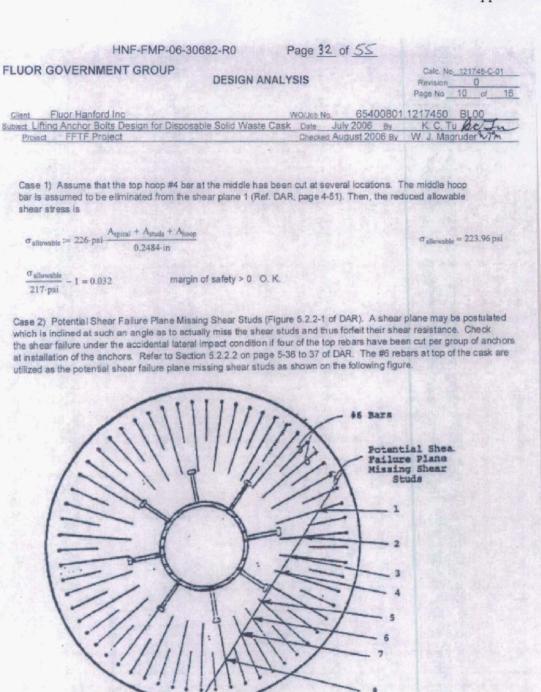
Cross-section area of #4 hoop rebars in the plane per inch length of cask (1 cut & 6 twice)

 $A_{spiral} = 0.1963 \frac{in^2}{in}$ 

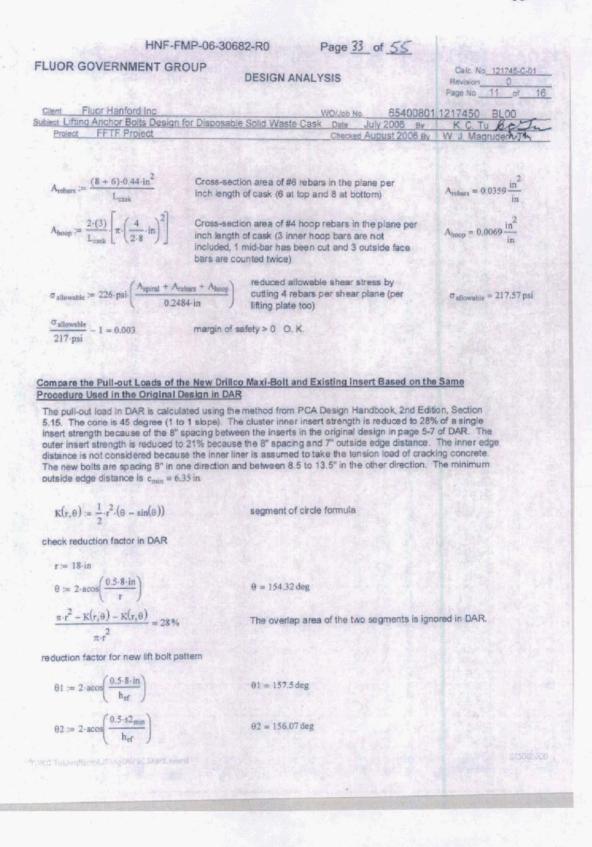
 $A_{studs} = 0.0361 \frac{in^2}{in}$ 

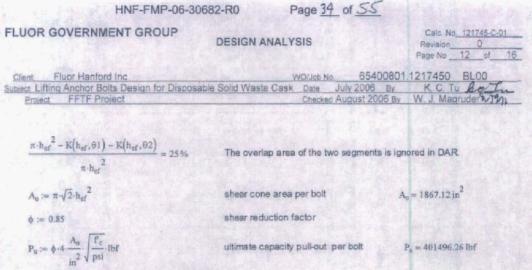
 $A_{hoop} = 0.0137 \frac{\ln^2}{\ln^2}$ 

8/30/2006



FINURE 5.2.2-1





use the same reduction load factor for overlapping as DAR

$$P_{cap} := \frac{2 \cdot P_u \cdot 28\% + 2 \cdot P_u \cdot 219}{5}$$
$$\frac{P_{cap}}{5} - 1 = 1.36$$

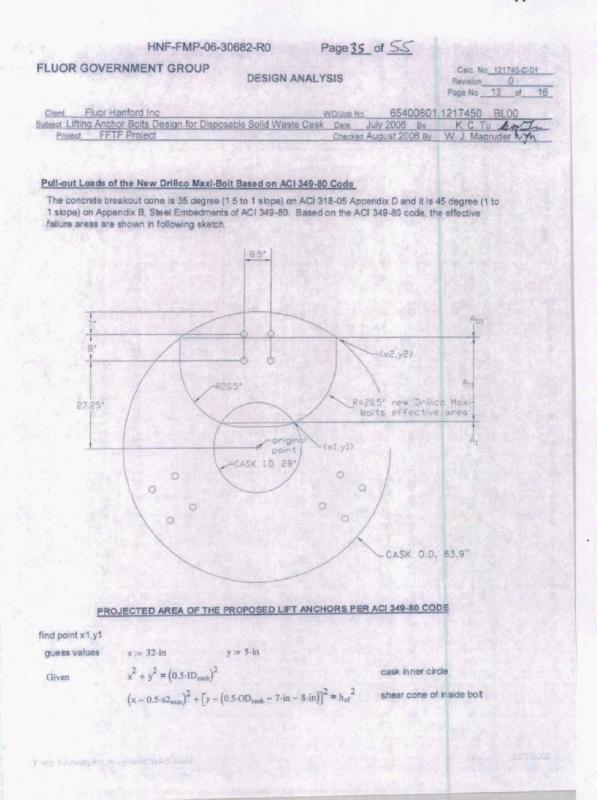
33333-lbf

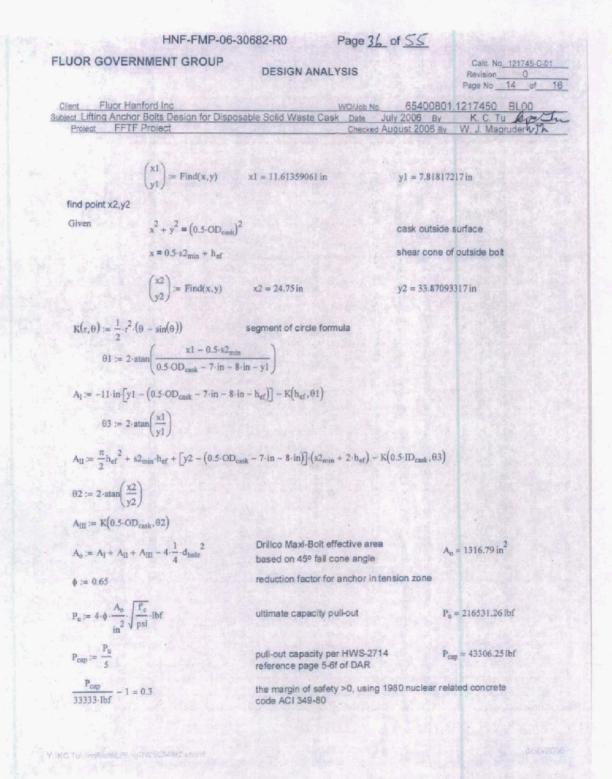
pull-out capacity reference page 5-7 of DAR

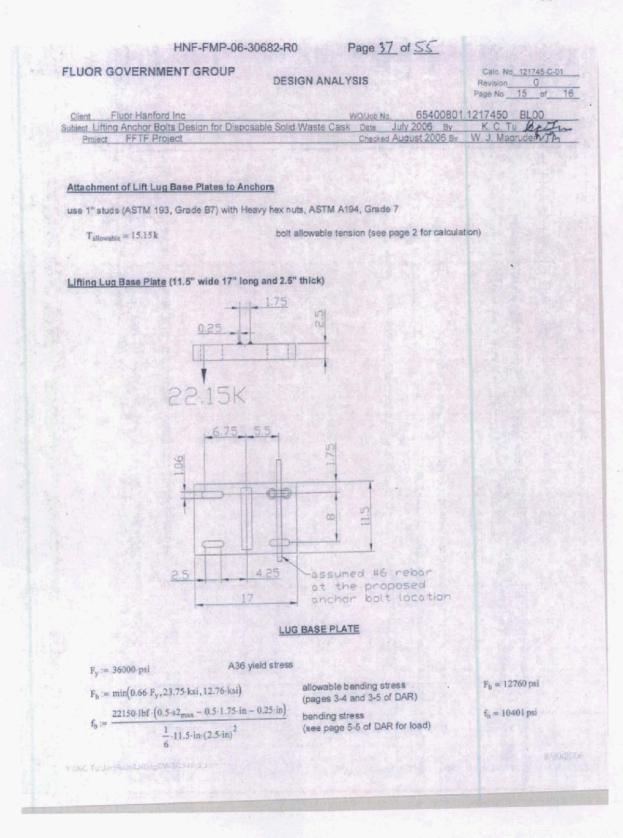
the margin of safety

 $P_{cap} = 78693.27 \, lbf$ 

> 0.62, the margin of safety of existing inserts. Proposed lift anchors are more conservative than the existing inserts.







HNF-FN	AP-06-30682-R0 Page <u>38</u> of <u>55</u>	
FLUOR GOVERNMENT GRO	DUP DESIGN ANALYSIS	Calc No <u>121745-C-01</u> Revision 0 Page No <u>16</u> of 16
Client Fluor Hanford Inc	WO/Job No. 65400801	1217450 BL00
Subject Lifting Anchor Balts Design for Project FFTF Project	or Disposable Solid Waste Cask Date July 2006 By Checked August 2006 By	K.C. Tu Both W.J. Magruder WJM
f <sub>b</sub> = 10401 psi < F <sub>b</sub> = 12760 psi	о.к.	
$\frac{F_b}{f_b} - 1 = 0.23$	margin of safety > 0 O. K.	
check prying action (reference p.	4-90 of AISC)	k = 1000-lbf
B := Tallowable	allowable tension per bolt	
b := 0.5 (s1 - 1.75 in) - 0.25 in	distance from bolt to weld (1/2)	b = 2.88 in
d := 1.00 in	bolt diameter	
b' := b - 0.5·d		
a := 1.5·in	edge distance 1.25 inches minimum edge distance use 1.5 conservative (ref. TABLE J3.5 of AISC)	
p := 0.5-11.5-in	length of flange tributary to each bolt	p = 5.75 in
$t_c := \sqrt{\frac{8 \cdot B \cdot b'}{p \cdot F_{y'} in^2}}$	plate thickness required to develop B with no prying action 2.5" in thick is O. K.	t <sub>c</sub> = 1.18
$s2_{max} + 2 \cdot a = 16.5$ in	length of plate	

# Check a Single Bolt in Extreme Condition

assume X bolt of X load at maximum distance and Y bolt of Y load at minimum distance from the center of the lift plate

y:= 11·k guess values x := 11·k  $x + y = 22.15 \cdot k$ Given x-0.5-s2<sub>max</sub> = y-0.5-s2<sub>min</sub>  $\begin{pmatrix} X \\ Y \end{pmatrix}$  := Find(x,y) X = 8.56 k Y = 13.59k

$$\frac{15.15 \cdot k}{1} = 1 = 0.11$$

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the margin of safety > 0 O. K.

(see page 2 for anchor boit allowable)

	HNP-FMP-06-3	0682 -R 08		
FMP (FA	CILITY MODIFICA	TION PACKAG	E) FORM	Page 1 of 19
Design Package Identification				
. Mod Time: DSWC Replacement Anchors and N	ow lift Lung	8. Ralesso:	Release	CACN 121745
www.wepideemene michoro and m	ew pitt <b>Ad</b> åp	MAY 2	2 2001	
<b>Key Words</b> : DSWC, FFTF, Waste Cask		MAX 2	* / }	
·			- ) MARTOLU (	1 (D:
. Project No.Werk Package No.: /YTF/4F-05-4307/M and 4A-04-75	0 3 /M	STA	15 RELEASE	
Review Designators:		-    '	Solo Solo	(20)
		8		
Additional Reviewers: TP 🔀 🖬 🚺		Modification	Work Complete and Field	Verified
	IP Author		/	1.
100 4717 41C JW 1	Rich	Design Authority P	rint/Signatum/Date	
. USQ Required? USQ 🔀 CX [	] HA . No.: <u>CX-12</u>	Blemunt	5/15/07	
0. Environmental-Activity Screening Fami Cal	npleled? 🔄 YES 🛛 🔀	NO	· · · ·	
If Yee, is the Environmental-Activity Form A		MO	•	
1. Distibution - Name CA Chastain		stibution - Name E Swensch		A3-02
W Rich	N2-02 [5]	U Zaman	•	N2-57
W Hiller E Riste	N2-11 W	R Rodriguez J Magruder	· · · ·	N2-60
D T H n n A Y 2. Change Description (description and reason	-  7-60		<u> </u>	
based on the historical proceed prepared by the DSWC designer side of the cask be lifted ~1" would result in an approximate will be performing the load te using a mobile crane could ree about its axis. As discussed exceeds that required based on Thus the load test criteria ne	Nuclear Packaging off the ground us load of 54,650 p set, there is a co- sult in loss of co- in Block 23, the section 5.1.1 of	, Inc. Proceed sing a single ounds. After ndern that li ntrol of the load test meth the DSWC Dest	dure LOT-3 requi group of 4 Lift discussion with fting of the DSW load if the cask and described by	red that one Anchors which crafts that C as described were to roll LOT-03
Calculation 121745-C-02, Revis EMP-06-30682-R0. The calculat been included, pages 40, 41 an included with this revision of The calculations are unchanged	ion inadvertently d 42. Calculatio the FMP with the	included three n 121745-C-02.	e pages that sh Revision 0, is	ould not have to be
Approvala A 1 A	· · ·		· .	· · ·
3. FMP Author	Deelgn Authority	A	Engineering Menageme	ent d
W Rich Junt 5/15/07	SA Chastain	Kitain sh5/07	st miller	- ¥16/07
me/Signature/Deta	Print/Signature/Date		Print/Signature/Date	
file <u>Transportation Safety</u> fur attacked konnis L. <u>McCall E Meil 5/2/107</u> MiniSignakueDale	Mis Quality Assur- ME Riste MARC PrintSkanature/Date	5/15/07	Nuclear Saf	Marine T
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4. Document Index	·· <del>····</del> ···		· · · · · · · · · · · · · · · · · · ·	Page Rohme

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Page 2 01 19

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	FMP	FACILI	TY MO	DIF	CATI	ON PACKAGE) FOR	RM (continued)	17	1 Jule
I	121745-C-02		<u> </u>	<u> </u>		<u> </u>	.	4 - 6	
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16. F	elated FMPs/Changes:		-			16. Incorporated FMPs/8	EDC9/ECN3/DCNs:		
7. L	ead Engineering Discipline:					18. Attacted Engineering	Disciplines:		
lue.	l Handling			_					<del></del>
	ification Bases								
	ingineering Request or Proj					•		CACN _	121745
	ise the load test								
Rep	lace calculation	121745-C	-02 wi	th a	່ກວ⊎⊣	copy of that calcu	lation having the	a erron	6003
pag	es renoved.					·			_
20. C	hange Status of Engineering	Documents t	a be Modil	fleci :		······			Work
í	Document Number	shiPg	Rev	e e s		Outstanding ECN	(s), DCN(s), FMP(s)		Complete
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	It List to Document Control for			] YES	·	NO			
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F T I a a 1 d h L 5 m t c b l	Unclions, Regularizations, au Unclions: The anchore must be relight of 100,000 lequinaments: he requirements for a order to avoid 11 loads imposed pplied to the max 00,000 pounds (Se efined as the des ardware. All her oad. In fact, th 4,660 pounds to a ethods specified he new Alternate onsidered a bound e noted that the lifting hardware. f 4 new Lift Anch	or lifti stringen on the r ign Safe dware wa llow its in the h Lift Anc ing fact new Alte Thus th	le of : per Second ng of t requession ected 3.1 of Worki o desi ternat tuse f istori hors ( cred 1 reate e mini	the firence load the gned gned cal cal cal cal cal biff	DSWC ments portion 1. The DAR) Load ( i to m ift Lu load to Load f Load 14 Load 14 Anch	I of the DAR. are documented in that existed at th of the lifting ha e maximum expected . The factored lo SWL) for the reusa set or exceed this g Weldment was des esting of the anch Test Procedure LOI on 121745-C-01 inc 0,000 pounds as a ors are not part 0 ed load test requi	the DSWC DAR, Se the time the DSWC radware had a fac l load was determ ad of 44,400 pou ble portion of t igned and tested or bolt group us -3. Although th sluded in HNF-FMP design requireme of the reusable p red to proof loa	ction 5 was des tor of ined to nds was he lift Safe W for SW ing the e analy -06-306 nt, it	.1.1. igned, 1.33 be then ing orking L of sis of second should of the
c	esign Criteria: Levise the Design								
I	ach Lifting Lug a wad of 44.3 kips wift Anchors were	per the also to	be de:	Desi sign	gn Ana ed foi	a Safe working L	oad of 44.3 kips.	.15A), Ci	16 I.EM
1	the proof test met of 125% of their :	thod to ) Safe World	be use king L	d fo oad.	r the The	Alternate Lift Lu proof load test o	gs shall be stati f the new Lift Ar	e load schor g:	test roup

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Page 157 of 235 of DA05240516

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FFTF-31477 Revision 0 Appendix E

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				Page	3 of 1.
	FMP (FAC	ILITY MODIFICATION	PACKAGE) FORM (c	ontinued)	· · · · · · · · · · · · · · · · · · ·
54,660 p	ounds (which wou	25% of the maximum exp ald result from liftin Yorking Load of the ne	ng one side of the D	SWC ~1" off the	
24. Post-Installatio	on Acceptance Test Criteri	a:			
		Anchor to 17,000 pound mined by Calculation 1			lividual
Proof test pounds max		oup with a static test	t loàd of 41,670 pou	nds minimum and	54,660
Additional Des	y: X Peer Roview atton Record Form (A-600) Ign Verification Documents	<b>Formal Dealign Raview</b> 5-845) required per HINF-PRO-8336 alion Propared? YES <del>2</del>	☐ Alternata Calculationa ? ☐ YES 곳 NO ⊴NO	Qualification Tas	ting
	ation Checklist Questions			(Thua	
	-	rementa, and design criteria appropr reptions, functions, requirements, a	· · · · · · · · · · · · · · · · · · ·		
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		operability been adequately address			
		nts identified and appropriately char			
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FFTF-31477 Revision 0 Appendix E

	HNF-FMP-	<u>06 - 30682</u> R- <u>0B</u>	Page/	l¶l
	FMP			
Calculation Title Lifting An	chor Bolts Des	ign for DSWC		
Calculation No. 121745-C-02	Rev.	0		
🕢 New 🔿 Supercedes Ca	culation No. / Rev.	. No	/ <u></u>	
Calculation Description				
This documents the Proof	<b>Test Values</b> fo	or Drilleo Maxi-Bolts	and Lifting Lugs.	
Use of Form				
Calculation Enginee	oring Analysis	Software Installation	Technical Basis	Other
Performance Category as defined				
0 1 02	⊖3	<u> </u>		
Originator W.J. Magruder		to J Mage	•	5/15/07 Date
	Print		Signature	Date
Checked By: J.W. Rich		purfle		5115100
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PE Stamp (if required)				
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HNF-FMP-06-306	82-ROB Page _	5 of <u>17</u>	
FLUOR GOVERNMENT GROUP	DESIGN ANALYSIS		Calc. No <u>, 121745-C-02</u> Revision0 Page Noof13_
Client Fluor Hanford Inc	WO/Job N	65400801.12	217450 BL00
Subject Lifting Anchor Bolts Design for Disposable	s Solid Waste Cask Dete	Sept 2006 By	W.J. Magruder
Project FFTF Project	C	hecked Sept 2006 By	J.W. Rich

This Calculation documents the proof test values for the Drilloo Maxi-Bolts, calculates a load testing device.

## Reference:

- 1. Calculation Number 121745-C1, Rev. 0
- 2. Work Package 4A-04-7683/M
- 3. Procedure for Proof Testing Lifting Inserts D.S.W.C., Procedure No. LOT-03, Revision 1, January 18, 1982 Nuclear Pasking Inc.
- DAR NuPao, 1982, "Design Analysis Report for Fast Flux Text Facility (FFTF) Disposable Solid Waste Cask (DSWC)", D-1, Released by EDT-118712, July 27, 1890) Revision 3, Westinghouse Hanford Company, Richland, WA.
- 5. AISC Steel Construction Manual, Minth Edition.
- Ricker, David T., 1991, "Design and Construction of Lifting Beams," Journal of American Institute of Steel Construction (AISC), Fourth Quarter, 1991, PP 149-158.

## Determine Proof Load for each individual anchor

From Ref. 1, page 2 the following information was used

k := 1000 lbf	
$A_{boit} \coloneqq 0.7854 \cdot \ln^2$	bolt nominal area
$A_s := 0.606 \cdot in^2$	Tensile stress area (Reference: ASME B1.1-2003, Table 6)
Fy := 105-ksi	bolt yield stress (ASTM A193)
F <sub>u</sub> := 125-ksi	bolt ultimate stress (ASTM A193)
$\mathbf{F}_{t} := 0.6 \cdot \mathbf{F}_{y}$	boit allowable tensile stress (page 3-4 of DAR)
$T_{\text{allowable}} := \min \left( A_{\text{boil}} \cdot F_{t}, \frac{A_{s}}{3} \cdot F_{y} \right)$	$\frac{A_{0}}{5} \cdot F_{0} $ T <sub>allovable</sub> = 15.15 k

The allowable tensile was determined from the minimum of three values.

Allowable Tensile strength based on nominal area and $\mathbf{F}_{t}$	$\mathbf{T}_{allow,aom} \coloneqq \mathbf{A}_{boil} \cdot \mathbf{F}_{t}$	$T_{abow.nom} = 49.48$ k
Allowable Tensile strength based on 1/3 Yield Stress	$T_{\text{allow,yield}} := \frac{A_{\text{b}}}{3} \cdot F_{\text{y}}$	T <sub>allow.yield</sub> = 21.21 k

Allowable Tensile strength based on 1/5 Ultimate Siress

 $T_{allow areas} \coloneqq \frac{A_s}{5} \cdot F_a \qquad \quad T_{allow areas} = 15.15 k$ 

From Ref. 1, page 16 maximum load on a single bolt y := 13.59 k

Determine Proof Test Load Pn

Proof<sub>load</sub> := y-1.25 Proof<sub>load</sub> = 16.99 k

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HNF-FMP-06-30	682-ROB Page	<u>6 of 17</u>	
FLUOR GOVERNMENT GROUP	DESIGN ANALYSIS	Cale. N Revision Page No	
Giant Fluor Hanford Inc	WOUdeb	No. 65400801.1217450	8100
Subled Lifting Anchor Bolts Design for Disposal	ole Solid Waste Cask Date		Magruder
Protect FFTF Project		Checked Sept 2006 By J.W.	.Rich

Use Proof Test Load of 17.0 kips

Security instant from the memory of the region operation provides a security of the security of t

Note: Proof Test Load of 17.0 kips is > than Tensile Strength based on 1/5 Ultimate but Less than Tensile Strength based on 1/3 Yield. This is Acceptable for a Proof Load Test. OK

## Determine Proof Load for each group of 4 anchors

Reference 3 directs that each group of four anchors and lug be tested by lifting Cask approximately 1" as shown on the following sketch.

UF Determine the lift force 737.  $LF := \frac{95000 \cdot lbf \cdot 42 \cdot in}{1000}$ 317 42° 73-in LF = 54.66k Check average Load per anchor DSWC EMPTY WEICHT = 95,000 LPS  $L_{anchor.avg} \approx \frac{LF}{4}$ Lascheravg = 13,66 k 🖨 CG Check the maximum force due to minimum spacing per Ref. 1 From page 15 of Ref. 1 Load per 2 bolts = 22.15 k 1 A •  $\mathbf{L}_{\text{enchor}} \coloneqq \frac{\mathbf{22.15} \cdot \mathbf{k}}{2}$  $L_{anchor} \approx 11.07\,k$ Max Load = y = 13.59 k Load<sub>mult</sub> :=  $\frac{y}{L_{motor}}$  $Load_{mult} = 1.23$ This load is less than Proof Load of 17.0 k for  $L_{anchor.avg}$ ·Load<sub>mult</sub> = 16.77 k each individual anchor and is adequate to test anchor group.

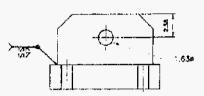
HNF-FMP-06-30682-	ROB Page <u>7</u>	of <u>17</u>	
FLUOR GOVERNMENT GROUP	ESIGN ANALYSIS		Calc. No <u>. 121745-C-02</u> Mision D
		•	ige No <u>3 of 13</u>
Clana Fluor Hanford Inc	WO/Job No.	65400801.1217	
Sublect Lifting Anchor Bolts Design for Disposable Se Protect FFTF Project	Child VVasie Casik Date St Check	pt 2006 By	N J. Magruder J.W. Rich
Determine Test Losd on lifting lug			
Lifting lugs are required to be load teste	ed per the Hanford Holsting e	nd Rigging Manuel.	
Nominal load is 100 klps / 3 = 33.3 kips	when lifting a loaded cask		
The Load per lug of 44.3 kips was used	in the DAR.		
The load that occurs when Proof Loadin described and calculated on the previou		i4.6 <b>6 k.as</b>	
Conclusion: Load Test Lift Lugs to 1251	% of load used when load tee	ting eachor groups.	
$Lug_{TL} := LF(1.25)$ $Lug_{TL} = 68.33$	zk Use 68,600 lbf te	et load	
Calculate the Safa Working Load SW	L := <u>68500-157</u> SW1	. = 54800 lbf	
<u>Check bending stress on lifting lup at p</u> From Ref. 1 page 15	proof load Load <sub>zbolt</sub> := 6850	0-lbf Load <sub>2bel1</sub> =	34250 lbf
s2 <sub>max</sub> := 13.5-in			
Fy.A572 := 50000-psi AS1	FM A572 Grade 50 yield stree	16	
$F_{b} := 0.60 \cdot F_{Y,AS72}$	use AISC allowable for to	ad test	F <sub>b</sub> = 30000 psi
$f_{b} := \frac{\text{Load}_{2boit} \cdot (0.5 \cdot s2_{max} - 0.5 \cdot 1.75 \cdot in)}{\frac{1}{2} \cdot 11.5 \cdot in \cdot (2.5 \cdot in)^{2}}$	<u>- 0.25-in)</u>		
$\frac{-11.5 \cdot iz \cdot (2.5 \cdot in)}{6} = 16083 \text{ psi} < F_b = 30000 \text{ psi} \qquad O.$			
$\frac{F_b}{f_b} - 1 = 0.87$	margin of safe	ly>0 Ο.Κ.	

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# HNF-FMP-06-30682-R0B Page Ø of 19 FLUOR GOVERNMENT GROUP DESIGN ANALYSIS Calc No. 121745-C-02 Revision 0 DESIGN ANALYSIS Page No 4 of Client Fluor Hanford Inc W0/Job No. 65400801.1217450 BL00 Subject Lifting Anctor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder Project Checked Sept 2006 By J.W. Rich

Check Capacity of weid at proof load of 68.500 lbs



Check stress on 1/2" fillet weld at a load of 68,500 lbs

 $L_{weid} := 2.11.5 \cdot in + 2.1.75 \cdot in$ 

L<sub>weid</sub> = 26.5 in

Area<sub>weld</sub> := 0.707-0.50 · in L<sub>weld</sub> Area<sub>weld</sub> =  $9.37 \text{ in}^2$ 

Stresswold := 68500-1bf Arca<sub>veld</sub>

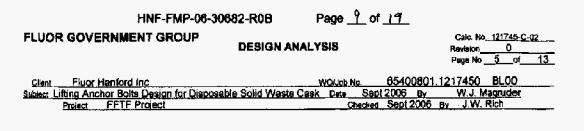
Stress<sub>weld</sub> = 7312 psi

Maximum tension stress from DAR page 3-3, Table 3.2.1-1 is 21500 psi for AISC allowables for test load

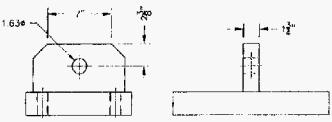
Stress<sub>DAR</sub> := 21600-psi

 $\frac{Stress_{DAR}}{Stress_{netid}} = 1 = 1.95$  Margin of safety > 0 O.K. Note: conservative, groove weld was not included.

152



Determine Capacity of Weldment at Proof Load of 68,500 lbs Based on Failure Modes per Ref. 6



Use ASTM A572, Grade 50

Fx.4372 = 50-ksi

F<sub>U.A372</sub> ≔ 65-ksi

Proof Load PL::= 68500-lbf Web Thickness wt<sub>A2</sub> := 1.75-is

Dia Hole d<sub>A7</sub> := 1.63-in

Reference 2 identifies 5 potential failure modes. Each will be investigated as follows:

Failure Mode 1:

This failure mode involves tension failure on both sides of the hole. Therefore, the ultimate tensile load is given by:

Distance a is the distance from the edge of the hole to the lug. Determine the value of a

 $a_1 := \frac{10 \cdot in}{2} - \frac{d_{A7}}{2}$  or  $a_1 = 4.19 \cdot in$ 

Ref. 6, page 151 also recommends some other values for "a"

a = or exceed the larger of 1/2 hole dia or twice the plate thickness

 $\mathbf{a}_2 := \frac{1}{2} \cdot \mathbf{d}_{A7}$   $\mathbf{a}_2 = 0.81$  in  $\mathbf{a}_3 := 2 \cdot \mathbf{w} \mathbf{t}_{A7}$   $\mathbf{a}_3 = 3.5$  in

Or "a" should not exceed 4 times plate thickness

 $a_4 := 4 \cdot w t_{A7}$   $a_4 = 7 in$ 

and the Distantion of Manifester and State and a state of the

Use the actual distance from edge hole to edge kig  $a_{A7} = a_1$   $a_{A7} = 4.19$  in

 $P_{u,A7} := 2 \cdot a_{A7} \cdot w_{A7} F_{U,A572}$  or  $P_{u,A7} = 952.09 \text{ kip}$ 

Since failure is based upon the ultimate strength of the material, it is common to use a factor of safety of 5 based on ultimate strength (Ref. 2, page 151).

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FFTF-31477 **Revision** 0 Appendix E

HNF-FMP-08-306	82-R0B Page	e <u>10</u> of <u>19</u>	
FLUOR GOVERNMENT GROUP	DESIGN ANALYSIS	5	Calc. No <u>. 121745-C-02</u> Revision <u>O</u> Page No <u>5</u> of <u>13</u>
Clent Fluor Hanford Inc Subject Lifting Anchor Bolts Design for Disposab Project FFTF Project		Ucb No. 65400801. ste Sept 2006 By Checked Sept 2006	1217450 BL00 W.J. Maaruder By J.W. Rich

 $\mathbf{P_{5bil.1.A7}} \coloneqq \frac{\mathbf{P_{uA7}}}{5}$ 

Poul 1.47 = 190.42 kip > PL = 68.5 kip OK ог

### Failure Mode 2:

This failure mode involves bearing failure at the pin/lifting lug interface. Often the pin diameter is much less than the hole diameter. It is conservatively assumed a pin diameter 1/4" less than the hole diameter. Use a bearing stress allowable of 0.9 F<sub>y</sub> (as recommended by Ref. 6) the maximum allowed pin load is given by:

$\mathbf{d}_{pin,A7}\coloneqq \mathbf{d}_{A7} - 0.25 \cdot in$	or	d <sub>pin.A7</sub> = 1.38 in
$P_{\textbf{fin} \textbf{J},\textbf{A7}} \coloneqq 0.9 \cdot F_{\textbf{Y},\textbf{A372}} \cdot \textbf{wt}_{\textbf{A7}} \cdot d_{pin,\textbf{A7}}$	ar OK	P <sub>fail2.A7</sub> = 108.67 kip > PL = 68.5 kip

Failure Mode 3:

This failure mode involves shear failure as the pin tries to push out a block of steel through the edge of the lug plate. The shear area is twice the cross-sectional area beyond the hole for the pin. Therefore, the allowable load based on allowable shear of 0.4 F<sub>y</sub> (as recommended by Ref. 5 and 6) the maximum allowed pin load is given by:

$$P_{\text{fiel},3,A7} := 2 \cdot \left\{ 0.4 \cdot F_{Y,A572} \right\} \cdot \left\{ 2.375 \cdot \text{in} - \frac{d_{A7}}{2} \right\} \cdot \text{wi}_{A7} \quad \text{or} \quad P_{\text{fiel},3,A7} = 109.2 \text{ k/p} > \text{PL} = 68.5 \text{ k/p}$$

### Failure Mode 4:

This failure mode involves tansile failure along the edge of the lug as the pin bends the steel between the pin and the edge of the log plate toward the edge (See Figure 108 of Ref. 6). Assuming a block of steel 0.8 d in length and e in depth (as recommended by Ref. 6), with an allowable bending stress of 1/3 F<sub>w</sub> the allowable load is given by:

$$P_{fbil.4,A7} := 1.67 \cdot \frac{F_{Y,A572}}{3} \cdot \left(2.375 \cdot in - \frac{d_{A7}}{2}\right)^2 \cdot \frac{w_{A7}}{d_{A7}} \qquad \text{or} \qquad P_{fbil.4,A7} = 72.72 \text{ ktp} > PL = 68.5 \text{ ktp} \text{ OK}$$

#### Failure Mode 5:

This failure mode involves the out-of-plane buckling failure of the lug. Per Ref. 6, this failure is prevented by ensuring a minimum lug thickness of 0.5 inches and 0.25 times the hole diameter.

Lug thickness is 1.75 inches which is greater then 0.5 inches and also greater than 0..25 times the hole diemeter.

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FLUOR GOVERNMENT GROUP	DESIGN ANALYSIS	Gelo. No <u>121745-C-02</u> Revision <u>0</u> Page No <u>7</u> of <u>13</u>
Client Fluor Hanford Inc		801.1217450 BL00
Subject Lifting Anchor Bolts Design for Disposab	le Solid Waste Cask Dels Sept 2006	By W.J. Magruder
Project FFTE Project	Checked Sept 2	006 вv J.W.Rich

## Design a below the hock litting device to Proof Load Weldment to \$8,500 lbs and jest load snotor group to 54,640 lbs.

Medmum Proof Load Test is 63,500 ibs when proof loading weldment. The waldment has a 1.63" diameter hole for attaching the lifting fodure. This cannot be changed. Rigging for load testing will require a minimum SWL of 35 tons (70,000 lbs).

From Crosby catolog 35 ton shackles require a 2.25° diameter hole. This will require a device to transfer the load.

1. Determine if a bolt and plate system will transfer the load.

P:≒ 68.5-kip	Maximum load during load test
d := 1.63	Diameter of Hole
Try 1.50" diameter	A325 Bolt

From Ref. 5, page 4-4, Table 1-C. For A325 bolt 1 1/8" to 1 1/2" diameter

 $F_{Y,A325}:=\$1{\cdot}kai$ 

From Ref. 5, page 4-5, Table 1-D, allowable shear is 30.0 ksi for Double Shear

Since this a "Selow the Hook Lifting Device" use maximum of 1/3 yield

$$F_{V,A325} := \frac{1}{3} \cdot F_{V,A325}$$
  $F_{V,A325} = 27$  ksi

Design lifting device so bolt will be in double shear and threads are excluded from shear path

Try 1.5" diameter A325 bolts

The second se

$$F_{V,allow} := \frac{\pi}{4} \cdot (1.5 \cdot in)^2 \cdot 2 \cdot (F_{V,A325})$$
  $F_{V,allow} = 95.4 \text{ kip}$   $\geq P = 68.5 \text{ kip OK}$ 

Use 1 1/2" diameter ASTM A325 bolts with threads excluded from shear plane

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FLUOR GOVERNMENT GROUP	DESIGN ANAL	YSIS	5/2 #	Calc: No <u>, 121745-C-02</u> Revision <u>0</u> Page No <u>8 or 13</u>
Client Fluor Hanford Inc		WO/Job No	65400801.1	217450 BL00
Subject Lifting Anchor Bolts Design for Disposable	a Solid Weste Cas		2006 By	W.J. Magruder
Project FFTF Project	· ·	Checked	Sept 2006 #	ay J.W. Rich

2. Determine Side Plate Size

Ues ASTM A36 meterial, allowable stress is 1/3 yield

 $F_{V,A36} := 36$ -ksi  $F_{U,A36} := 58$ -ksi

Try 4" wide by 1.75" thick side plates and check tenalle stress on gross area.

$$\begin{split} w_{SP} &:= 4 \cdot in & t_{SP} := 1.75 \cdot in \\ f_{LSP} &:= \frac{FL}{\frac{Z}{W_{SP} \cdot f_{SP}}} & f_{LSP} = 4.89 \, km < \frac{1}{3} \cdot F_{V,A36} = 12.0 \, km \, OK \end{split}$$

#### Evaluation Based on Failure Modes Per Reference 6

Use ASTM A36 Steel

Proof Load PL = 68.5 kip

d<sub>pin</sub> > 1.5·in Reference 2 identifies 5 potential failure modes. Each will be investigated as follows:

Failure Note 1:

This failure mode involves tension failure on both sides of the hole. Therefore, the ultimate tensite load is given by:

Dia Pin (Bolt)

Distance a is the distance from the edge of the hole to the lug. Determine the value of a

$$a_{1a} := \frac{w_{SP}}{2} - \frac{d_{SP}}{2}$$
 or  $a_{1a} = 1.22 \text{ in}$ 

Ref. 6, page 151 also recommends some other values for "a"

a = or exceed the larger of 1/2 hole dia or twice the plate thickness.

$$a_{24} := \frac{1}{2} \cdot d_{SP}$$
  $a_{24} = 0.78$  in  
 $a_{34} := 2 \cdot t_{SP}$   $a_{34} = 3.5$  in

Or "a" should not exceed 4 times plate thickness

a4a := 4-tgp a4a = 7 in

Use the actual distance from edge hole to edge lug  $-\mathbf{a}_{SP} := \mathbf{a}_{Ia}$ 

 $a_{SP} = 1.22 in$ 

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FLUOR GOVERNMENT GROUP	DESIGN ANALYSIS	5/22	Calc. No <u>121745-C-02</u> Revision <u>0</u> Page No <u>9</u> of <u>13</u>
Client_ Fluor Hanford Inc	WONIca		1217450 BL00
Subject Lifting Anchor Bolts Design for Disposable	Solid Weste Cask Date	Sept 2006	W.J. Magruder
Project FFTF Project		Checked Sept 2006	By J.W. Rich

Pusp := 2-agp-tap FUAST2

P<sub>u.SP</sub> = 277.55 kip

Since failure is based upon the ultimate strength of the material, it is common to use a factor of safety of 5 based on ultimate strength (Ref. 2, page 151).

or.

$\mathbf{P}_{\text{field, 1.SP}} \coloneqq \frac{\mathbf{P}_{u,SP}}{1}$	or	P <sub>fail I.SP</sub> = 55.51 kip	> <u>PL</u> = 34,25 kip OK
---	----	------------------------------------	----------------------------

#### Failure Mode 2:

This failure mode involves bearing failure at the pin/lifting lug interface. Often the pin diameter is much less than the hole diameter. It is conservatively assumed a pin diameter 1/4" less than the hole diameter. Use a bearing stress allowable of 0.9  $F_{\gamma}$  (as recommended by Ref. 6) the maximum allowed pin load is given by:

$$d_{pm,SP} := d_{pin} \sim 0.25 \cdot in$$
 or  $d_{pin,SP} = 1.25 \cdot in$   
 $P_{finil,2,SP} := 0.9 \cdot F_{V,A36} \cdot t_{SP} \cdot d_{pin,SP}$  or  $P_{finil,2,SP} = 70.87 \cdot kip > \frac{PL}{2} = 34.25 \cdot kip$  QK

Fallure Mode 3:

This failure mode involves shear failure as the pin tries to push out a block of steel through the edge of the lug plate. The shear area is twice the cross-sectional area beyond the hole for the pin. Therefore, the allowable load based on allowable shear of 0.4 Fy (as recommended by Ref. 5 and 6) the maximum ellowed pin load is given by:

$$P_{\text{fbil}3.SP} := 2 \cdot \left( 0.4 \cdot F_{\text{Y},\text{A36}} \right) \cdot \left( 2.0 \cdot \text{in} - \frac{d_{\text{SP}}}{2} \right) \cdot t_{\text{SP}} \qquad \text{or} \qquad P_{\text{fbil}3.SP} = 61.49 \, \text{kip} > \frac{\text{PL}}{2} = 34.25 \, \text{kip} \, \text{OK}$$

Failure Mode 4:

This failure mode involves tensile failure along the edge of the lug as the pin bends the steel between the pin and the edge of the lug plate lowerd the edge (See Figure 108 of Ref. 6). Assuming a block of steel 0.8 d in length and e in depth (as recommended by Ref. 6), with an allowable bending stress of 1/3 Fy. the allowable load is given by:

$$P_{fail.4.SP} := 1.67 \cdot \frac{F_{Y,A36}}{3} \left( 2.0 \cdot \ln - \frac{d_{SP}}{2} \right)^2 \cdot \frac{l_{SP}}{d_{pin}} \qquad \text{or} \qquad P_{fail.4.SP} = 34.8 \text{ kip} > \frac{PL}{2} = 34.25 \text{ kip OK}$$

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Client Fluor Hanford Inc Subject Lifting Anchor Bolts Design for Discosal Protect FFTF Project	ble Solid Waste Ci		1.1217450 BL00 W.J. Magruder Bry J.W. Rich

## Fallure Mode 5:

This failurs mode involves the out-of-plane buckling failurs of the lug. Par Ref. 8, this failure is prevented by ensuring a minimum lug thickness of 0.5 inches and 0.25 times the hole diameter.

Lug thickness is 1.75 inches, which is greater then 0.5 inches and also greater than 0..25 times the hole diameter.

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FLUOR GOVERNMENT GROUP DESIGN ANALY	'SIS	Calo. No <u>. 121745-C-02</u> Revision <u>0</u> Page No <u>11</u> ot 13
Client Fluor Henford Inc Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask		1.1217450 BL00 W.J. Maguder
Project FFTF Project	Checked Sept 2006	By J.W. Rich

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3. Determine Lifting plate size. Use a 35 Ton Shackle which has a 2.25" diameter pln

Use ASTM A38 material, allowable stress is 1/3 yield

 $F_{Y,A36} = 36$  ksi  $F_{U,A36} = 58$  ksi

Try 8" wide by 1.75" thick Lifting Plate and check tenalle stress on gross area

 $w_{LP} := 8 \cdot in$   $t_{LP} := 1.75 \cdot in$ 

$$f_{LLP} := \frac{PL}{w_{FP} \cdot h_{PP}}$$
  $f_{LLP} = 4.89 \text{ km}^2 < \frac{1}{3} \cdot F_{Y,A36} = 12.0 \text{ km} \text{ OK}$ 

### Evaluation Based on Failure Modes Per Reference 6

Use ASTM A36 Steel

Proof Load PL = 68.5 kip

Oia Hole	d <sub>LP</sub> :⇔ 2.37-in	Dia Pin	
	-	$\mathbf{d}_{pin,LP} \coloneqq 2.25 \cdot in$	

Reference 2 identifies 5 potential failure modes. Each will be investigated as follows:

#### Failure Mode 1:

This failure mode involves tension failure on both sides of the hole. Therefore, the ultimate tensile load is given by:

Distance a is the distance from the edge of the hole to the lug. Determine the value of a

$$a_{1b} := \frac{w_{LF}}{2} - \frac{d_{LF}}{2}$$
 or  $a_{1b} = 2.81$  in

Ref. 6, page 151 also recommends some other values for "a"

a = or exceed the larger of 1/2 hole die or twice the plate thickness

$$a_{2b} := \frac{1}{2} \cdot d_{LP}$$
  $a_{2b} = 1.19$  in  
 $a_{3b} := 2 \cdot t_{LP}$   $a_{3b} = 3.5$  in

Or "s" should not exceed 4 times plate thickness

±46 = 4.tLp ±46 = 7 in

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Cliens Fluor Hanford Inc Subject Lifting Anchor Bolts Design for Disposable Solid Waste Car	WO/Job No 65400801 sk Date Sept 2008 By	W.J. Magruder
Project FFTF Project	Checked Sept 2005	By J.W. Rich

Use the actual distance from edge hole to edge lug  $a_{LP} \coloneqq a_{1b}$   $a_{LP} \equiv 2.81$  in

 $P_{u,l,P} := 2 \cdot s_{l,P} \cdot t_{l,P} \cdot F_{U,A372} \qquad \text{or} \qquad P_{u,l,P} = 640.41 \text{ kip}$ 

Since failure is based upon the ultimate strength of the material, it is common to use a factor of safety of 5 based on ultimate strength (Ref. 2, page 151).

$$P_{ful,1,LP} = \frac{P_{u,LP}}{5}$$
 or  $P_{ful,1,LP} = 128.08 \, kip > PL = 68.5 \, kip \, OK$ 

## Failure Mode 2:

This failure mode involves bearing failure at the pin/lifting lug interface. Often the pin diameter is much less than the hole diameter. It is conservatively assumed a pin diameter 1/4" less than the hole diameter. Use a bearing stress allowable of 0.9  $F_y$  (as recommended by Ref. 8) the maximum allowed pin load is given by:

$d_{pin,LP} = 0.25 \text{ in}$	or	d <sub>pin,f,P</sub> = 2 in
Pikil212 := 0.9 FY.A36' CLP'dpin.1P	or	$P_{hil2,LP} = 113.4 \text{ kip} > PL = 68.5 \text{ kip}$ OK

#### Failure Mode 3:

This failurs made involves shear failurs as the pin tries to push out a block of steel through the edge of the kig plate. The shear area is twice the cross-sectional area beyond the hole for the pin. Therefore, the allowable load based on allowable shear of 0.4 F<sub>y</sub> (as recommended by Ref. 5 and 8) the maximum allowed on load is given by:

$$P_{\text{final},3,LP} = 2 \cdot (0.4 \cdot F_{Y,A36}) \cdot \left( 3.0 \cdot \text{in} - \frac{d_{LP}}{2} \right) \cdot t_{LP} \qquad \text{or} \qquad P_{\text{final},3,LF} = 91.43 \text{ kip} > PL = 68.5 \text{ kip} \text{ OK}$$

Failure Mode 4:

an in the second sec

This failure mode involves tensile failure along the edge of the lug as the pin bends the steel between the pin and the edge of the lug plate toward the edge (See Figure 108 of Ref. 6). Assuming a block of steel 0.8 d in length and e in depth (as recommended by Ref. 6), with an ellowable bending stress of 1/3  $F_y$ , the allowable load is given by:

$$P_{\text{fbil},4\text{ LP}} \coloneqq 1.67 \cdot \frac{F_{\text{Y},\text{A36}}}{3} \cdot \left(3.0 \cdot \text{in} - \frac{d_{\text{LP}}}{2}\right)^2 \cdot \frac{t_{\text{LP}}}{d_{\text{pin}}} \qquad \text{ or } \qquad P_{\text{fbil},4\text{ LP}} = 77.02 \,\text{kip} \geq \text{PL} = 68.5 \,\text{kip} \,\text{ OK}$$

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Client Fluor Hanford Inc	WG/Job No.	65400801.1217450 BL00
Subject Lifting Anchor Boits Design for Dispose	ble Solid Waste Cask Date Sep	t 2006 By W.J. Magruder
Protect FFTF Project	Checked	Sept 2006 By J.W. Rich

## Failure Mode 5:

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This failure mode involves the out-of-plane buckling failure of the lug. Per Ref. 6, this failure is prevented by ensuring a minimum lug thickness of 0.6 inches and 0.26 times the hole diameter.

Lug thickness is 1.75 inches which is greater than 0.5 inches and also greater than 0..25 times the hole diameter.

HNF-FMP-06-30682 ROB Tage 18 +- 19 Page 1 of 2

 Chastain, Steve A

 From:
 Mocal, Dennis L

 Sent:
 Monday, May 21, 2007 10:36 AM

 To:
 Levinskas, David; Rich, James W (Jim); Chastain, Steve A; Hiller, Stephen W (Steve); Swenson, Douglas

 Subject:
 RE: HNF-FMP-06-30682-R0B

 Importance:
 High

Mr. Rich...

I have reviewed the subject FMP (HNF-FMP-06-30682-R0B) and associated procedural page changes, calculations and sketches on behalf of TSO. I have no additional comments and by this e-mail give you TSO (Transportation Safety) approval on this FMP.

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**Osumis McCall**, TRANS/TR-91 Fluor Transportation Safety Operations Transportation Engineering (509) 376-1651, dennis\_1\_mccall@rt.gov

From: Levinskas, David Sent: Thursday, Nay 17, 2007 12:04 PM To: Mccall, Dennis L Subject: FW: HNF-FMP-06-30682-R08

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Dave Levinskas Transportation Safety Operations FII Waste Services 372-3855

A 10 A 10 A

From: Swenson, Douglas Sent: Tuesday, May 15, 2007 3:07 PM To: Levinskas, David Subject: FW: HNF-FMP-06-30682-R08

From: Rich, James W (Jim) Sent: Tuesday, May 15, 2007 9:57 AM To: Swenson, Douglas; Chastain, Steve A; Hiller, Stephen W (Steve); Zaman, Shakir U

5/21/2007

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Subject: HNF-FMP-06-30682-R0B

The attached file is a revision to HNF-FMP-06-30682-R0 to allow a reduction in the static load required to test the new Atternate Lift Anchors. This change is consistent with the DSWC DAR. We plan to perform these load tests within the next several weeks, so your review and response is appreciated. In addition, calculation 121745-C-02 is being re-issued. The original calculation included in HNF-FMP-06-30682-R0 contained 3 errant pages which were not part of the calculation. The calculation is unchanged.

Thanks - Jim Rich

5/21/2007

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# APPENDIX F. CORROSION STUDY

# **DISPOSABLE SOLID WASTE CASK LINER**

# **CORROSION EVALUATION**

W. F. Brehm, Ph. D., P. E. Amber Engineering May 2007

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# ACKNOWLEDGEMENTS

The author acknowledges Jim Rich, Jim Thielges, Mike Rodriguez, Dan Johnston, Thurman Cooper, and John Trechter of Fluor Hanford, Inc. for helpful discussions.

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Table 3.	Values Found in Solids Extracted from Casks 4 and 8	182

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## **1.0 INTRODUCTION**

This report evaluates potential corrosion damage to inner steel liners of five disposable solid waste casks (DSWC) resulting from ingress of water into the cask. This evaluation of the DSWCs was performed per the Hanford Site Fast Flux Test Facility (FFTF) per Fluor Hanford, Inc. Contract #29267, "Evaluate Potential for Degradation of Disposable Solid Waste Cask Weld Joint Due to Corrosion." Specifically, the contract specifies that the analysis:

- 1. Evaluate the use of five existing DSWCs with respect to integrity of their steel cavity liners.
- 2. Evaluate whether or not there is a practical corrosion concern resulting from water in the steel cavity liner lower weld joint and surrounding parent metal.

## 1.1 PROBLEM STATEMENT

Five DSWCs, casks 4, 6, 7, 8, and 10, were fabricated and shipped to the Hanford Site in the 1980s. Water, in varying amounts, entered all five casks and remained there for varying periods of time before being drained. There are three concerns regarding corrosion damage to the five casks:

- Is there corrosion of the weld such that the weld is weakened to a degree that the cask would no longer be able to withstand the design basis accident of being dropped while in transit or being placed in storage?
- Will corrosion products deposit in the crevice and create stress in the weld region sufficient to cause cracking or other degradation?
- Is there enhanced corrosion in the crevice adjacent to the weld to weaken the structure?

## 1.2 SUMMARY

The evaluation of the five DSWCs included the following:

- Examination of photographs and video files of the interiors of the casks, including pictures taken both before and after cleaning the rust from the cask steel liners.
- Review of data from chemical analysis of water and solids from two of the casks.

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- Review of pertinent literature and data, and subsequent evaluation of the potential for general corrosion, stress-assisted corrosion, crevice corrosion, and galvanic corrosion of the cask liner and weldment. This included a meeting with FFTF Fuel Handling Engineering Personnel.
- Draw conclusions from the information available.

This evaluation found that although the steel liners of casks 6, 7, 8, and 10 contained water for up to 29 months they sustained only light rusting during storage and are satisfactory for use. This is based on the fact that there is very little potential for crevice corrosion, stress-assisted corrosion, stress-corrosion cracking, or galvanic corrosion and that the bounding rate of corrosion is 19.5 mils/yr at 104°F based on available information.

Cask 4 probably had water in it for over 20 years. There may have been sufficient corrosion to thin the region near the bottom weldment to such a degree that cask integrity is no longer guaranteed, but it is by no means certain that such an amount of corrosion has actually occurred.

If use of cask 4 is desired, an ultrasonic examination of the thickness of the steel liner should be performed to verify that the corrosion loss is not large enough to compromise cask integrity. Visual inspection performed remotely using a borescope that provided pictures and video of the cask liners plus the evaluation showed that no preferential corrosion in the region of the bottom weldment exists.

# 2.0 CASK DESCRIPTION

A DSWC is a shielded cask capable of transporting, storing, and disposing of six non-fuel core components or approximately 27 ft<sup>3</sup> of radioactive solid waste (Thielges 2006).<sup>3</sup> The cask consists of an outer cylindrical concrete shell approximately 84 in. in diameter and 172 in. high. The inner liner, which contains the payload, is a steel pipe approximately 24 in. in outer diameter and 147 in. high. A 12–in.-thick steel plate (actually three 4-in. plates welded together) is at the bottom of the cask. This plate provides shielding and is integral with the containment boundary; it is welded to the bottom end of the 24-in. schedule 60 pipe. A shield plug, a set of three 4-in. plates welded together to form a cylindrical plug approximately 26 in. in diameter and 12 in. thick, fits at the top end of the inner liner. There is a neoprene seal between the inner liner top

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<sup>&</sup>lt;sup>3</sup> The English system of units will be used for discussion of cask dimensions and corrosion rates in this report because essentially all of the dimensions, weights, and measurements associated with the DSWC are in English units.

flange and the shield plug. A closure plate, approximately 29.75 in. diameter and 1 in. thick, is located above the shield plug. The plate will be welded to the top structure of the inner liner assembly after the cask is filled.

A DSWC is assembled by making the inner liner, attaching studs to its outer diameter to affect bonding to the concrete shell, then placing concrete around the outside of the inner liner to attain the final dimensions.

The inner liner cylinder is constructed of standard low-carbon structural steel in compliance with the American Petroleum Institute (API) specification API 5 LBS for pipe. The end plates are made from material that complies with the appropriate American Society for Testing and Materials (ASTM) specification ASTM A36 for plate. The steel for both cylinder and end plates typically contains 0.20% carbon and up to about 1.2% manganese with small, controlled amounts of aluminum, copper, silicon, and molybdenum. Undesirable impurities (e.g., phosphorus and sulfur) are typically in the 0.02 to 0.03% range. Material test reports containing chemical and physical properties for the steel were within the specifications of API 5 LBS and ASTM A36.

Further details of the cask construction are available on Drawings H-4-65155 and H-4-65157.

The weldments on the inner cask liners are made by standard flux-cored arc welding (FCAW) technique using E71-T-1 electrodes. No post-weld heat treatment was specified. The weld documentation indicates that the welds all passed visual inspection.

The only weld of interest in this evaluation is weld W-3 on Sheet 2 of Drawing H-4-65155. Weld W-3 is where the containment lower closure plate is welded to the liner pipe. The liner pipe is approximately 1-in. thick. The callout for the weld is for a 5/8-in. fillet weld on the outside of the liner cylinder. This weld design has a potential to result in a crevice on the inside of the liner, at the bottom (see Figure 1). However, detailed video and photographic examination of the lower inside liner area showed no discernable crevices where the lower plate and liner cylinder meet.

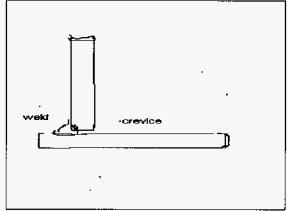


Figure 1. Schematic of Crevice (Exaggerated) and Weldment.

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## 2.1 CERTIFICATIONS AND SPECIFICATIONS

Material test reports and welding records show that the material was within specification, and that the welding techniques were appropriate for the welds to be performed. Visual inspections of the weldments specified (Benegas 1989) were completed and the weldments were found to be satisfactory.

## 2.2 HISTORY

Shipping and storage records show that the cask liners were exposed to water for varying amounts of time. Section 5.5 of *Specification for Disposable Solid Waste Cask System No. 41, Equipment No. M-058* (Benegas 1989) states that:

The Supplier shall provide a means of protecting the internal area of the cask for outside storage for a period of ten years. The method of protection shall be part of the shipping plan.

It appears that this protection was either not supplied properly or that the protection scheme was compromised after the casks arrived at the Hanford Site. The oldest DSWC, cask 4, was fabricated and delivered in 1983 and may have contained water for most of its life; it was originally protected by a plastic wrap that had degraded long ago.

According to receiving records and an associated nonconformance report, newer casks 6, 7, 8, and 10, each contained a small amount of water when received from the manufacturer in October 1989. This water was drained and the casks were temporarily covered and placed in outside storage. Permanent covers for casks 6, 7, 8, and 10 were subsequently fabricated. In September 1990, the four casks were sealed and desiccant-filled canisters were placed inside each cask.

For this evaluation, it was conservatively estimated that the water remained in the newer casks until they were permanently covered in September 1990 because there is no conclusive documentation to confirm that the temporary covers remained in place and remained leak-tight between October 1989 and September 1990.

All five DSWCs (casks 4, 6, 7, 8, and 10) were moved to an inside storage location in October 1997 and remained indoors until October 2004 when they were again placed outside. While inside, casks 7 and 8 were opened and the desiccant canister was removed from cask 7.

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In an April 2006 inspection, casks 4, 7, and 8 contained water. The total duration that each cask may have contained water is estimated as follows:

- Cask 4 up to 23 years
- Cask 6 and 10 up to 11 months
- Casks 7 and 8 up to 29 months.

These are believed to be conservative, maximum time estimates. Table 1 shows the amounts of water in casks 4, 7, and 8 at the April 2006 inspection.

Cask	Volume	Depth (in.)
4	~ 20 gal.	12
7	~5 gal.	3
8	11 qt.	1.7

Tab	le 1	. April	2006	Cask	Water	Measurements.

## 3.0 EVALUATION

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The evaluated corrosion situation was that of low-carbon steel in water containing oxygen (from the air). Possible complicating corrosion factors were:

- Presence of mud and debris inside the casks and the water
- Presence of a potential crevice at the bottom of the cask
- Possible presence of harmful species such as chloride and nitrate in the water

# 3.1 LOW-CARBON STEEL CORROSION

Corrosion of steel in aqueous environments has been thoroughly studied and reported. Because the steels contain only minor amounts of elements other than iron, the corrosion equation for reaction of the steel in water containing dissolved oxygen or in moist air can be written as follows (Van Vlack 1959).

$$4 \text{ Fe} + 3 \text{ O}_2 + 6 \text{ H}_2 \text{O} \Longrightarrow 4 \text{ Fe}(\text{OH})_3$$

Fe(OH)<sub>3</sub>, ferric hydroxide, is the familiar orange-brown rust. It is a flaky, only weakly adherent compound, and does not afford protection to the unreacted steel beneath it. Very little water is required to produce rusting. Rusting proceeds to a greater extent in water than in moist air. However, steel will not rust in absolutely dry air, nor will it rust in pure water containing no dissolved oxygen (both extremely rare conditions).

The above equation does not tell a complete story. It is possible to separate the corrosion process into its component parts (Van Vlack 1959; Masterson and Slowinski 1977). Corrosion is an electrochemical process with separate anode and cathode half-reactions occurring in water containing dissolved oxygen gas as follows:

Anodic half-reaction (oxidation):

$$Fe => Fe^{++} + 2 e^{-}$$

Iron enters solution, producing ferrous ion plus two electrons. Cathodic half-reaction (reduction)

$$\frac{1}{2}O_2 + H_2O + 2e^- => 2OH^-$$

Dissolved oxygen reacts with water and the two electrons donated by the iron to produce two hydroxide ions. Combining these two reactions:

$$Fe + \frac{1}{2}O_2 + H_2O => 2 Fe(OH)_2$$

The  $Fe(OH)_2$  is ferrous hydroxide, insoluble in water. However, the ferrous hydroxide is further oxidized and reacts with water according to

 $2 \text{ Fe}(OH)_2 + \frac{1}{2}O_2 + H_2O => 2 \text{ Fe}(OH)_3$ , ferric hydroxide, or rust. If the corroding system later dries out, the ferric hydroxide can break down to produce ferric oxide according to

$$2 \text{ Fe}(OH)_3 => \text{Fe}_2O_3 + 3 \text{ H}_2O_3$$

This drying reaction would not occur except in extremely dry conditions.

Because the corrosion reaction takes place in solution, with electron movement creating a "corrosion current," any dissolved ionic species that increase the conductivity of the water will accelerate the corrosion. This fact explains why corrosion is more rapid in seawater, containing dissolved ions, than in fresh water, and why metal objects corrode more quickly in air near the ocean. In addition, dissolved ionic species (e.g., chloride and nitrate) can contribute to locally acidic conditions and accelerated corrosion rates.

The corrosion of low-carbon steel in water is usually essentially uniform corrosion, with tendencies toward pitting, particularly if the water contains dissolved salts. A corrosion rate of 2 mils/yr at 72°F and 4 mils/yr at 104°F is reported in *ASM Metals Handbook*, "Corrosion Characteristics of Carbon and Alloy Steels (ASM 1998). ASM (1998) states that these corrosion rates were for aerated water in range of 5 to 9 pH (mildly basic to mildly acidic) and "normalized" to oxygen contents of 1 mL oxygen per 1 L of water.

According to ASM (1998): "To estimate corrosion rates at other concentrations, multiply values derived from this graph by the oxygen concentration in mL/liter." However, the saturation concentration of oxygen from dissolved air in water is 6.51 mL oxygen per 1 L of water at 68°F and 4.88 mL/L at 104°F (Perry and Green 1997). Attachment F-A provides calculation details. (Note that gas solubility in water decreases with increasing temperature at these temperatures.) Performing the calculations per ASM (1998), the corrosion rate of the steel is approximately 13 mils/yr at 68°F and 19.5 mils/yr at 104°F.

An original paper referenced in ASM (1998) reports corrosion rates of pickled (probably referring to an acid treatment to remove mill scale) carbon steel in freshwater "tropical waters" in Gatun Lake in the Panama Canal Zone (Southwell and Alexander 1970). The water temperature was 82°F. The reported corrosion rate was 7.7 mils/yr after 1 year, decreasing to an average (total corrosion divided by total time) of 1.7 mils/yr after 16 years. These rates are significantly lower than the ones quoted in the preceding paragraph, assuming that the Gatun Lake waters were saturated with oxygen. Corrosion rates for machined carbon steel and steel with adherent mill scale were similar.

Addition of chlorides or nitrates to the water increases the risk of both pitting and, for nitrates, stress-corrosion cracking. Even without the presence of chloride ions, the presence of a rough surface or impurities or foreign objects on the surface can increase the risk of pitting in carbon steel. The low-carbon steels are not susceptible to "sensitization," precipitation of carbide phases at grain boundaries that renders the austenitic stainless steels susceptible to intergranular attack; nor is the low-carbon steel susceptible to chloride-induced stress corrosion cracking. However, under certain conditions and at elevated temperatures (well over 100°F), carbon steels are susceptible to stress-corrosion cracking in nitrate solutions. In an ideal situation, carbon steels would not be subject to crevice corrosion because of the lack of a passive layer on the corroding surface, but the fact that corrosion rates in water show a tendency to decrease with time and the fact that pitting has been reported under certain conditions (ASM 1998) makes the possibility of crevice corrosion real, but not very likely, as addressed in Sections 3.1.1 and 3.1.2.

The Southwell and Alexander data set reports pit depth of 72 mils after 16 years as the "average of 20 deepest pits," for pickled carbon steel, with machined steel and steel with mill scale showing similar pit depths. However, pitting was not observed in any of the visual examinations of these casks.

As shown in Figures 2 and 3, the corrosion action produced a rough surface with uneven amounts of rusting, because of the nonprotective nature of the rust formed. The rust appeared to be heavier in areas where liquid water was present.

Figure 2 shows the inside of cask 4 before the corrosion products were cleaned out, and Figure 3 shows the inside of cask 4 after cleaning. Note the rough surface and also the lack of any preferential or accelerated corrosion around the region where the liner joins the bottom plate. Also note that the joint of liner and bottom plate is extremely tight; any crevice is extremely narrow.

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Figure 2. Interior of Cask 4 before Cleaning.



Figure 3. Interior of Cask 4 after Cleaning.

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Figure 4 shows the inside of cask 7 after cleaning. Note the difference in appearance between cask 4 and cask 7 surfaces, and the faintness of the crevice in the image.

Figure 4. Interior of Cask 7 after Cleaning.



Figure 5 shows the inside of cask 6, which did not contain any water when opened. The light rusting will not compromise the integrity of the cask.

Figure 5. Interior of Cask 6 as Opened.

Cask 10 did not contain any water when opened. There was some rust on the mill scale of the weld surface (assumed to be the seam weld of the liner), and the cask interior contained some rust dust.

Figure 6 shows cask 10 after cleaning. Note the very faint line where the crevice would be, and also the similarity to the inside of cask 7 (Figure 4).



Figure 6. Interior of Cask 10 after Cleaning.

Visual examinations of the vertical seam weldments in casks 4 and 7 were made from the photographs of the interior of the casks taken before the casks were cleaned. There was no accelerated corrosion observed at the welds; adding to the body of information that supports the conclusion that there was no accelerated corrosion at the bottom weldment.

### 3.1.1 Crevice Corrosion

The text in this section draws heavily from "Crevice Corrosion" (Kelly 2003). Crevice corrosion can occur when a wetted metallic surface is in close proximity to another surface. In this case, the two surfaces are the bottom of the liner cylinder and the bottom closure plate at weld W-3. Concentrations of dissolved ions in the liquid electrolyte (water in this case), if different inside and outside the crevice, can lead to electrochemical potential differences and accelerated corrosion (or retarded corrosion) inside the crevice.

Metals and alloys that depend on a passive layer on the surface to provide corrosion protection (e.g., austenitic stainless steels and aluminum alloys) are particularly susceptible to crevice corrosion. For example, crevices in stainless steel components exposed to chloride solutions are particularly troublesome in this regard.

Thus, for crevice corrosion to be significant, most of the exposed surface outside the crevice must be "passivated," or rendered more inert to the corroding medium than the material inside the crevice. The crevice under these conditions is anodic to the region outside the crevice and thus more likely to show preferential or accelerated corrosion. Carbon steel does not readily passivate in water, so the tendency of the crevice around W-3 to be anodic to the regions outside the crevice and to show preferential or accelerated corrosion is greatly reduced. This fact is especially true if anions such as chloride and nitrates, which can accumulate in the crevices, are absent.

In the case of the five DSWCs, there was little or no corrosion products deposited in the anodic region because the rust would be deposited in the cathodic areas. This, together with the fact that the ferric hydroxide rust is a relatively weak material incapable of producing any stress in the steel even if it were present, shows that concern about accelerated corrosion of the steel walls of the crevice, or cracking of the weld because of stress produced by deposited corrosion products, is not warranted.

### 3.1.2 Factors Affecting Weldment Corrosion

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The text in this section draws heavily from "Corrosion of Carbon Steel Weldments" (Bond 2003). The weldment itself and the area adjacent to it (the heat-affected zone [HAZ]) are metallurgically different from the unheated base metal. The weldment itself, and any base metal melted during the welding process, is essentially a cast structure with a different microstructure from the unaffected base metal.

Increased corrosion has been reported in weldments where the steel had hardened (transformed to martensite) upon cooling. However, this steel with its low alloy content and low-carbon content does not show tendency to harden after welding. Except in high-conductivity waters (caused by presence of chlorides or other anionic species), HAZ corrosion is relatively rare. Also, the lower sulfur content of modern steels and filler metals has reduced the tendency for weldment/HAZ attack.

Galvanic corrosion of weldments has been reported under conditions when the composition of the base metal and weldment are different. The example quoted is where the base metal steel had increased copper, nickel, and chromium contents relative to the weld metal. Under these conditions, the base metal was noble (cathodic) to the weldment, resulting in accelerated weldment corrosion. The situation is aggravated by the fact that the weldment (anode) is much smaller in area than the cathode (base metal), conditions which result in accelerated corrosion of the weldment. In the DSWC situation, however, the reverse is true. The weld filler metal contains more nickel and chromium (and manganese) than the base metal, so it would be expected to be cathodic to the base metal and HAZ. The DSWC materials of construction, history and environment mitigate any tendency for preferential weld metal attack, particularly if harmful anionic species (e.g., chloride) are not found in the water.

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### 3.2 CASKS 4 AND 8 MATERIALS ANALYSIS

Material from casks 4 and 8 was submitted to the Fluor Hanford, Inc. Waste Sampling and Characterization Facility chemical laboratory. A discrete liquid phase was not available from cask 4, so analysis was done on a small amount of water extracted from the sample, plus the solids. Discrete liquid samples were obtained from cask 8. Data from the analysis are shown in Table 2.

Property	Cask 4	Cask 8
pH	7.8	7.14
Conductivity, µS (microsiemens or micromhos/cm)	802	2170
Chloride, ppm	17.9	8.13
Nitrate, ppm	<1	<0.4
Sulfate	90	1330

Table 2. Values of liquids obtained from Casks 4 and 8

Samples extracted from the solids of casks 4 and 8 by inductively coupled plasma (ICP) analysis were analyzed. The values from those samples are shown in Table 3.

Element	Cask 4 (ppm)	Cask 8 (ppm)
Aluminum	869	7,480
Bismuth	55	<2
Calcium	6,430	38,300
Chromium	61	152
Copper	85	158
Iron	404,000	146,000
Magnesium	543	3,820
Manganese	2,070	1,380
Nickel	121	122
Phosphorus	594	278
Silicon	23	283
Sulfur	<1	<1

Table 3. Values Found in Solids Extracted from Casks 4 and 8.

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The water from both casks was near-neutral with regard to acidity or basicity, and contained minimal amounts of chloride or nitrate. The electrical conductivity of both samples is somewhat above that of normal tap water, because of the dissolved ionic species (calcium and sulfate) present. The conductivity of normal tap water is 200 to 300  $\mu$ S/cm. Information obtained form the Internet (Lake Access 2006) states that conductivity of water from Lake Superior, a relatively pristine lake, is 97  $\mu$ S/cm, and that of water from Lake Mead in Arizona/Nevada, is 850  $\mu$ S/cm.

### 3.3 CASK LINER AND BOTTOM WELDMENT APPLICATIONS

The potential for crevice corrosion or selective corrosion of the weldment is unlikely because chemical analyses show lack of chloride or nitrate, the rust formed is largely nonprotective, and the chemical composition of the starting materials make the potential for crevice corrosion or selective corrosion of the weldment unlikely. For cask 8, the presence of calcium and sulfate in the water is attributed to a desiccant-filled canister, which was placed inside the cask in 2004 and found partially submerged in the water when opened in 2006.

The high calcium in cask 4 may have been the result of interaction with concrete that entered the cask during fabrication. The increased conductivity of the water found in casks 4 and 8, together with the potential for corrosion rates as high as 19.5 mils/yr at elevated temperature (limited to the beginning of the corrosion process), make the potential for excessive corrosion damage to the weldment real although much less extensive in cask 8 due to relatively short exposure time.

Taking cask 4 as an example, by using the corrosion rate of 13 mils/yr at 68°F and assuming the corrosion occurred for 23 years, the result is a total corrosion loss of 299 mils or 0.299 in. The corrosion loss after 23 years at 104°F calculates to 0.45 in. for this cask. The estimated corrosion corresponding to 68°F is a more realistic average corrosion rate in the Hanford Site climate with its hot summers and cold winters.

Before drawing the conclusion that cask 4 has sustained unacceptable corrosion loss, the estimated corrosion rate of 13 mils/yr is based on the assumption that the water was constantly maintained saturated with oxygen which needs to be verified. That rate would be true if the water were agitated or aerated; however, the opposite was actually the case. The water was stagnant and not exposed to air circulation. There is a well-known effect in bodies of water where various mechanisms (e.g., presence of algac, stagnation, lack of sunlight at depths) can cause severe oxygen depletion and fish kill in natural waters (Western Pond 2006). Attachment F-B shows that the amount of oxygen at saturation in the 12 in. of water in cask 4 could not sustain the 13 mils/yr corrosion rate for more than a few months, let alone 23 years. However, even if there were no more air admitted to the cask (by leakage in from the top), there is sufficient oxygen in the air above the water to sustain the corrosion rate, *if it can be dissolved into the water and diffuse to the crevice at bottom of the cask at a rate sufficient to maintain the corrosion rate.* 

The rate of oxygen diffusion from the surface of the water in cask 4 to the bottom can be estimated by assuming the water at the air interface is maintained at saturation and assuming that diffusion is the only mechanism of transport through the water. The analysis given in Chapter 1, equation 1-21 of *Diffusion in Solids* (Shewmon 1963) is used, with a diffusion coefficient of oxygen in water of  $2.5 \times 10^{-5}$  cm<sup>2</sup>/sec. (Perry and Green 1997, page 2-232). This model predicts that over 1 year would be required to achieve 50% saturation of the water at the bottom of the cask, and over 100 years to achieve 95% saturation. This calculation ignores consumption of oxygen by the corrosion reaction on the sides and bottom of the cask.

The calculation from the preceding paragraph significantly underestimates the amount of oxygen absorption into the water because the cask was exposed to both day-to-night and summer-towinter temperature fluctuations. Temperature gradients and hence thermal convection cycles would be produced in the 12 in. of water in the cask; these cycles would carry oxygen-laden water to the lower part of the cask and oxygen-poor water to the regions near the air interface where it could obtain more oxygen. While it is likely that corrosion of the crevice region continued at some lower rate and would have decreased with time, the rate is certainly much less than predicted using water saturated with oxygen. (It is noted that most of the data for the corrosion of carbon steel in water show a decrease in corrosion *rate* with time.)

Determinations of wall thickness in regions below the water depth (12 in.) at numerous locations should be made to obtain definitive data on the amount of corrosion loss before cask 4 is used. Inspection of the lower walls should provide sufficient data to make a judgment regarding the integrity of the bottom weldment. Visual inspection of the vertical seam welds confirmed the analysis that accelerated corrosion of the bottom weldment relative to the cask walls was not likely.

Regarding the potential accessibility of water, into the back of the crevice where the corrosion of the weld would occur, all evidence suggests very tight crevices with resulting limited access of the corroding medium (water).

The maximum wall thickness loss of casks 6, 7, 8, and 10, based on corrosion at saturation oxygen conditions and long term average temperature of about 68°F is 2.4 yr  $\times$  13 mils/yr or 31.2 mils (about 1/32 of 1 in.). This amount of corrosion loss at the bottom weldment should not be detrimental.

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### 4.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this evaluation finds the following responses to the contract statements:

• Has the structural integrity of the steel cavity liner been compromised because of the corrosion?

No. The anticipated corrosion will not degrade the structural integrity of the cavity liner, because of its substantial starting thickness and comparatively limited corrosion rate.

• Is there a practical concern that there is an issue due to water in the steel cavity liner lower weld joint and surrounding parent metal?

No for casks 6, 7, 8, and 10, but possibly for cask 4.

Casks 6, 7, 8, and 10 should not have sustained damaging corrosion to the weldment during the relatively short periods they contained water. While the maximum probable corrosion rate of 13 mils/yr is based on a temperature considered to be consistent with the average temperature at the Hanford Site, it is recommended that 19.5 mils/yr be used as a bounding rate for corrosion for analysis to determine the structural capacity of the weldment for these casks as it is based on higher temperature than experienced by these casks and assumed the water is maintained saturated with oxygen.

The corrosion of the weldment in cask 4 may be too great to assure the integrity of the welded joint in the design basis accident when the maximum corrosion rate is considered. This conclusion is by no means certain because (1) the maximum corrosion rate used to draw this conclusion may not have been maintained for the approximately 23 years water was in the cask, and (2) the crevice may have been so tight that significant amounts of water could not reach the weld at the back of the crevice.

The following actions are recommended for cask 4:

- Perform a series of ultrasonic thickness measurements of the cask wall near the bottom. Because the data and analysis suggest the corrosion of the weldment is not greater than that of the wall, the analysis could show that the corrosion loss was not as great as the equations predict.
- Consider sealing the crevice from the inside by use of a fillet weld at the crevice. Acknowledge that the cost of the repair may outweigh the benefit of being able to use cask 4.

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- Van Vlack, L. H., 1959, *Elements of Materials Science*, Chapter 13, Addison-Wesley Publishing Company, Reading, Massachusetts.
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### ATTACHMENT F-A CALCULATION OF OXYGEN SOLUBILITY IN WATER SATURATED WITH AIR

Solubility of a gas in water is defined according to

 $\mathbf{P} = \mathbf{H}\mathbf{x}$ 

where

P = partial pressure of solute, oxygen in this case, in the gas phase, atmospheres

x = mole fraction in gas phase, units of moles solute/mole of solution

H = Henry's law constant

Therefore, x = P/H.

Since air is 21% oxygen, P = 0.21.

H for oxygen in water = 5.35 E4 ("five point three five times ten to the fourth power") at 104°F; units of H are (atmospheres of solute pressure in the gas phase per unit concentration of solute in the liquid phase).

Therefore, x = 0.21/5.35 E4 = 3.92 E-6 moles solute/mol solution.

One mole of oxygen = 22,400 cc or mL, assuming the perfect gas law.

 $22400 \times 3.92 \text{ E-6} = 8.79 \text{ E-2 mL oxygen/mole of water.}$ 

One mole of water is 18 grams; 1 Liter of water is 1000 grams, therefore

(8.79 E-2 mL/mole \* 1000 grams/Liter)/18 grams/mole = 4.88 mL oxygen/Liter of water.

The corresponding value of x at  $68^{\circ}$ F is 6.51.

**ուս ընդեր մի, ուրցեր, վեկ, վան կն**ական է են ու են ննդել է ենքու է։ Մարդություն

### SOURCE

Perry, R. H., and D.W. Green, 1997, *Perry's Chemical Engineer's Handbook*, 7<sup>th</sup> Edition, p 2-4, 2-125, and 2-127, McGraw Hill Publishing, New York, New York.

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### ATTACHMENT F-B OXYGEN SATURATION CALCULATIONS

Calculating water levels and amount of oxygen required to maintain saturation in cask #4. Assume temperature of 68F, inside diameter of 22.13 inches. Saturation concentration of oxygen is 6.51 mL oxygen per liter of water. Amount of water found in cask #4 = 20 gallons, in cask 7, 5 gal, in cask 8, 11 quarts (2.75 gal.). Gallons per inch calculated at right = 884.7 cubic inches /inch of height

cask	gal	.in3	3	height, in	
	4	20	4620	12.01125	diameter
	7	5	1155	3.002813	22.13
	8	2.75	635.25	1.651547	

Now calculate the amount of oxygen required to maintain saturation while corrosion proceeds at 13 mils (0.013") per year. Basis, one inch height and one year corrosion. Calculate the volume in cubic centimeters. Density of Fe(OH)3 = 3.4 to 3.9 (use 3.4) g/cc and formula weight 106.87 grams/mole (Green 1997)

 Diameter
 height
 corrosion
 Vol, in3
 Vol, cm3
 mass, g
 moles

 22.13
 1
 0.013
 0.903807
 14.81068
 50.35632
 0.471192

It requires 3 moles of oxygen to make 4 moles of Fe(OH)3, from the formula 4 Fe + 6 H2O + 3 O2 = 4 Fe(OH)3, so  $0.471192 \ ^{\circ}0.75 = 0.3534$  moles of oxygen required for 1 year corrosion on one inch of cask height. Now use the volume of one inch of water to see how much oxygen is present in the water at saturation.

vol/in, in3 vol, L Vol O2 (sat), mL 384.6394 6.303085 41.03308

The amount of oxygen required (mL) is the number of moles required for one year times 22,400 cc (mL)/mol

Mol req mL/mol mL reqd 0.3534 22400 7916.16

This is far in excess of what is contained in the water. But can the oxygen in the water be replenished from the air column above it, even with the top of the cask closed. Is there enough oxygen in the air above the water to saturate it? Calculate for cask #4, where the water height is 12.01 inches. Vol oxygen is the height of the air in the cask, for cask #4 = (172-12.01) x the area of the cylinder.

height diameter vol, in3 vol, cm3 vol O2 vol O2 req yrs avail 159.99 22.13 61538.45 1008431 211770.4 7916.16 26.75166

The number of years supply oxygen in the cask is the volume of oxygen present divided by the requirement for one year. Discussion of how air could leak in, and depletion of oxygen in the water due to stagnation and poor mixing is discussed in the main body of the report.

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Docum	ent Re	viewed	
FFTF- Dispo	31477 sable	Apper Solid	ndix F d Waste Cask Liner Corrosion Evaluation
0.0000	of Dou	lower	
Scope Revic			diry of the corrosion rate derived and the conclusions drawn.
Yes	No	NA	
	0	ō•	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
o	ō	ō	Problem completely defined.
ō	ō	۲	Accident scenarios developed in a clear and logical manner.
Θ	ō	0	Necessary assumptions explicitly stated and supported.
Ō	Ó	۲	Computer codes and data files documented.
Θ	Ο	о	Data used in calculations explicitly stated in document.
Ο	ō	Ō	Data checked for consistency with original source information as applicable.
۲	0	О	Mathematical derivation checked including dimensional consistency of results.
•	0	0	Models appropriate and used within range of validity or use outside range of established validity justified.
۲	0	0	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
0	0	۲	Software input correct and consistent with document reviewed.
0	0	◉	Software output consistent with input and with results reported in document reviewed.
٥	0	0	Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
0	0	۲	Salety margins consistent with good engineering practices.
۲	0	0	Conclusions consistent with analytical results and applicable limits.
•	0	0	Results and conclusions address all points required in the problem statement.
0	0	۲	Format consistent with appropriate NRC Regulatory Guide or other standards.
0	0	۰ ی	Review calculations, comments, and/or notes are attached.
•	0	0	Document approved.
	· · ·	୧୦୯୫୦୦୦ rinted N	13 m Achem 5/09/07 ame and Signatures Date

"Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

A-6002-359 (02/98)

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## APPENDIX G. WASTE SAMPLING AND CHARACTERIZATION FACILITY ANALYSES

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## WSCF ANALYTICAL RESULTS REPORT

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Fast Flux Test Facility

Richland, WA

Attention: ME EBY/JIM RICH

Does Not contain Official Use Only Could

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Inchies John Trechter Sam her Bandsteler 3 24 June Cliem Services: John Analytical:

All results are reported on an "as received" basis unless wherwise noted in the comment section.

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Report#: 20060349 Report Date: 4-may-2006 Report W005/ver. 1.2 Fast Flux Test Facility

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Attention:	ion:	ME EBY/IIM RICH	CH							Group #:	p#: 20060349
					WSCF						
Sample # Cli	Client ID	CAS#	Test Performed	Matrix	Method	ã	Result	Ē	눰	MDL	Analyze Sample Receive
Inorganic											
W08000848 DSWC#4	JC#A EBY/RICH	CONDUCT	Conductivity	soup	LA-519-403		208	uS/Cm	1.00	0.48	05/01/06 04/18/09 04/19/06
WORDOODB4B DSWC#4	IC#4 EBY/RUCH	£	pH Soil and Waste Measulement	SOLD	LA-212-411		C <b>B</b> 'L	Ŧ	1.00	0:010	05/01/06 04/16/08 04/19/08
W08000848 DSWC#4	ICM4 EBY/RICH	16964-48-8	Fluoritie (F) by KC	50LD	LA-533-410	⇒	× 2.00	0/Dn	30.00	02	04/25/06 04/15/06 04/19/06
WOODODB4B DSWCr4	ICITA EBY/MICH	16887-00-6	CNoride (C) by IC	SOLID	LA 533 410		17.8	бубл	50.00	<b>C</b> 1	04/25/06 04/18/08 04/19/06
W06000848 DSWCF4	ICM EBY/RICH	N02-N	Nimite (N) by IC	SOLID	LA 533-410	5	< 0.490	0/On	30.00	0.43	04/25/05 04/18/08 04/18/08
WD60C00848 DSWC#4	ICM4 EBY/RICH	\$~£9-86872	Bromide (8r) by IC	SOLD	LA-533-410	⊐	< 4.85	ōjōn	50.00	4.6	04/25/06 04/18/06 04/19/06
W08000848 DSWC#4	/CP4 EBY/AUCH	N/BON	Nitrate IN: by IC	SOLD	LA 533-410	5	< 0.300	b/Dn	50.00	080	04/25/06 04/16/06 04/19/06
W08000848 DSWCr4	ICITA EBY/RICH	P04-P	Phosphate (P) by (C	soup	012-553-410	∍	< 3.90	Bythn	50.00	3.9	Q4/25/06 Q4/18/08 Q4/19/08
WD6000848 DSWC#4	ICR4 EBY/RICH	14806 75-8	Sulfate (BO4) by IC	<b>BOLID</b>	LA-533-410		6 <b>.6B</b>	8/Bn	50.00	<b>6.5</b>	04/25/06 04/16/06 04/19/06
W08000848 DSWC#4	AC#4 EBY/RICH	7429-90-5	Aluminum ty ICP	2011Ds	LA-505-411		869	<b>N</b> yBri	8,72e+002	24	05/03/06 04/18/06 04/19/08
W05000848 DSWCr4	KCP4 EBY/RICH	7440-36-0	Antimany by ICP	SOLD	LA-505-411	5	A 18,3	8/6n	6.72e+002	19	05/03/06 04/18/06 04/19/06
W00000648 DSWC#4	ICAN EBYRICH	7440-36-2	Austimic by ICP	SOLID	LA-505-411	Þ	< 13.2	0y0n	8.72e+002	6	05/03/05 04/18/05 04/19/08
W06000848 DSWCF4	ICIM EBYRICH	7440.38-3	Barium by ICP	anos	LA-505-411		9.74	5/Bn	6.72€ + 002	0.87	05/03/08 04/18/08 04/18/05
W05000048 DSWC#4	ICAN EBY/RICH	7440-41-7	Beryllyum by ICP	SOLID	LA-505-411	∍	< 0.872	byon	B.72e+002	0.87	05/03/06 04/18/06 04/19/06
WD6000848 D5WC#4	ICITA EBY/RICH	7440 43-9	Cadmium by ICP	2011DS	LA-505-411	5	< 0.872	0j0n	8.72e+002	0.67	05/03/06 04/18/06 04/19/06
W05000048 DSWC#4	IC#4 EBY/RICH	7440-70-2	Calcium by ICP	SOLID SOLID	LA-505-411		B.43e + 03	0/0n	B.726+002	14	05/03/06 04/18/08 04/18/05
WDBD000848 DSWC#4	ICFA EBY/RICH	7440-48 4	Cobalt by ICP	SOLD	LA-505-411		13.5	B/On	8.726+002	0.1	05/03/06 04/18/06 04/19/06
WOBCCOCE48 DSWC#4	IC#4 EBY/RICH	7440-47-3	Chromium by ICP	SOLID	LA-505-411		<b>6</b> 1.5	Br⊖n	8,72a+002	7.8	05/03/08 04/18/08 04/18/08
WD9000848 DSWC#4	ICA EBYANCH	7440-50-8	Copper by ICP	SOLID	LA-505-411	0	8 <b>.</b> .6	ð/ðn	8.72++002	2.9	05/03/06 04/18/06 04/18/06
WOODOODE46 DSWC#4	IC#4 EBYRICH	9-68-62+4	Iron by ICP	SOLID	LA-505-411		4.04e + 05	0,80	8.72e+003	1.84 + 02	05/03/08 04/18/06 04/18/06
WDBC000848 DSWC#4	ICAL EBY/RICH	1439-96-4	Megnesium by ICP	SOUD	LA-505-411		543	5,0n	8.72e+C02	1	05/03/06 04/13/06 04/18/06
WORDOODB4B DSWC#4	ICAM ERVIRICH	7439-96-5	Menganees by ICP	SOLD	LA-505-411		2.07e+03	0y0n	8.72e+C02	0.87	02/03/04 04/18/02 04/13/08
WDBDDDDB48 DSWC#4	ICAN EBYARICH	7440-02-0	Nickel by (CP	SOLID	LA-505-411		121	ելըս	8.72e+002	1.2	05/03/06 04/18/06 04/18/06
W0000094S DSWCr4	ICINA EBY/AUCH	7440-09-7	Potatshium by 4CP	SOLD	LA-505-411	5	₿ ¥	0/0n	8.726+002	1.06+02	05/03/06 04/18/05 04/19/06
W00000848 DSWC#4	ICA4 EBY/RICH	7440-22-4	Silver by ICP	SOLD	LA-505-411	5	< 1.67	DyBo	8.726+002	9.	05/03/06 04/18/06 04/19/06
WOGOODBAB DSWCF4	ICIM EBYARICH	7440-23-5	Sodium by ICP	SOLID	LA-505-411	2	v 13	Bjân	B.72e+C02	1.76+02	05/03/06 04/18/05 04/19/06
	Pression Press										
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+ - Indicates more than six qualifier symbols

DF = Ditution Factur • Indicates results that have NOT been vehiclased; Report WOOS/ver. 1.2 Fast Flar Test Facility

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At	Attention:		ME EBY/JIM RICH	ΗC							Group #:		20060349
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WOSODOB46 DSWC 44	DSWC #4	EBY/AICH	1-26-62-1	Lend to ICP	SOLID	LA-505-411		34.3	0/Dn	g	2	05/03/08 04/18/06 04/18/06	6 D4/18/06
WD8000848 DSWC#4	DSWC#4	EBY //OCH	7782-49-2	Selenium by ICP	ennos	LA-505-411	3	< 15.7	0,0n	9.72e+002	ŝ	05/03/05 04/18/06 04/19/06	6 04/19/06
W060000848	DSWC/4	EBV/RICH	7440-28-0	Thallium by ICP	cinos	LA-505-411	Ň	< 17.4	0,0n	8.72e+002	17	05/03/06 04/18/06 04/19/06	04/19/06
M00000040		EBY/IICH	7440-32-6	Titterium by ICP		LA-505-411		216	8/6n	8.728+002	1.2	00/31/16 04/18/06	6 04/15/06
W080000848		EBY/NCH	7440-02-2	Vanodium by ICP	SOLID	LA-505-411		9.11	0,0n	8.72++002	2.6	05/03/06 04/18/06 04/18/08	6 04/18/06
1M060000E4E	DSWCM	EBY/RICH	7440-68-8	Zinc by ICP	anos	LA-505-411	×	151	0/0n	B.726+002	2.6	05/03/06 04/18/06	6 04/18/06
W08000648		EBY/RICH	7440-21-3	Sticon by ICP	anos	LA-505-411	Š	23.7	a/ôn	8,72+002	16	05/03/08 04/13/06	6 04/18/06
W080000846	DSWC#4	EBY/NICH	7436-93-2	Lithum by JCP	SOLID	LA-505-411	ň	< 0.872	Ø,07	8.726+002	0.87	05/03/06 04/18/06 04/18/06	0/81/90 D
W06000084B		<b>EBY/NICH</b>	7440-42-8	Boron by ICP	soup -	LA-505-411		182	6/8n	8.726+002	8	05/03/06 04/18/06	6 04/19/06
W00000648		EBY/NCH	7723-14-0	Miasphores by KP	souo	LA-505-411		5 <b>9</b> 4	0,8n	8.72s+002	42	00/6/17/0 04/19/00	0 04/19/00
W060000E48	DSWC#4	EBV/IIICH	7704-34-9	Sultur by ICP	SOLID	LA-505-411		42	6,6n	0 0	0.0	05/03/06 04/18/06	6 04/19/06
VV060000848		ELTAICH	SCANDIUM	Scandium by ICP	SOLID	LA-505-411		КA	6,6n	8	0.0	05/03/06 04/18/06	0 04/18/06
WD60000848	DSWCM	EBY AICH	7440-24-6	Stiontium by ICP	ŝõuo	LA-506-411		8.18	0,0n	8.736+002	11	05/03/06 04/18/06	0.04/19/06
W06000648		<b>EBY/RICH</b>	7440-65-5	Yttrium by ICP	SOLIDS	LA-505-411		NA NA	0/0n	8	0.0	05/03/06 04/18/06	80/61/10 8
W08000648	DSWC##	EBYAICH	7440-67-7	Zirearium by ICP	SOLIDS	LA-505-411		13.4	0,0n	B.728+002	1. <del>0</del>	05/03/06 04/18/08	8 04/18/06
W08000848		EBY/RICH	7439-58-7	Molybdenum, ICP	SOLID	LA-506-411	J	17.3	6y6n	8.72s+002	3°.5	05/03/06 04/18/06	9 04/19/06
W080000848	DSWC/4	EBY/RICH	7440-31-5	Tin	SOLID	LA-505-411	∍	< 14.0	0,0n	8.72b+002	4	05/03/06 04/16/0	04/16/00 04/19/06
W080200948		FEVAICH	13494-80-8	Tellunium by ICP	sour	LA-S05-411		NA	ß,On	1.00	0.0	05/03/08 04/18/08	d 04/19/06
W00000848	DSWC#4	EBY/RICH	7553-56-2	lodine by ICP	ROLID	LA-505-411		¥,	iljan	8	0.0	OEIO3/OB DA/1B/C	D4/18/06 04/18/D6
W08000848	DSWCF4	EBY/RICH	7440-33-7	Tungsten, ICP	SOLID	LA-505-411		<b>M</b>	€,6n	8.	0:0	05/03/06 04/18/06	6 04/19/06
W060000348	DSWCM	<b>ERV/NICH</b>	7440-57-5	Gold by ICP	sour	LA-505-411		NA	0y0n	8	0.0	06/03/06 04/18/06	6 04/19/06
W08000648	OSWC#4	<b>FBY/RICH</b>	9-19-60112	Mercury by ICP	SOLID	LA-505-411		NA	6j0n	1.00	0.0	06/03/06 04/18/	04/18/06 04/19/06
W05000848	DSWC#4	EBY/RICH	7440-63-9	Bismuch by ICP	CITOS	LA-606-411		54.9	6, Bn	8.72e+002	19	05/03/06 04/18/C	04/18/06 04/18/06
W060000848	DSWCM	EBY/RICH	1-19-0440	Uranium by ICP	CI IOS	LA-505-411		¥	8/Bn	90.'L	0.0	05/03/06 04/16/06 04/19/06	6 04/19/06

U - Analyzed for but not detected above limiting criteria C - The Analyte was found in the Associated Bank. X - Other flags and notes described in the comments/neurative. MDM. = Minimum Detection Limit RQ=Result Qualifier

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DF = Dijuzion Factor • - indicates multi that ave NOT boen valdeted; • - indicates more litan six qualifies symbols Report WOOS/ver. 1.2 Fast Flux Test Facility

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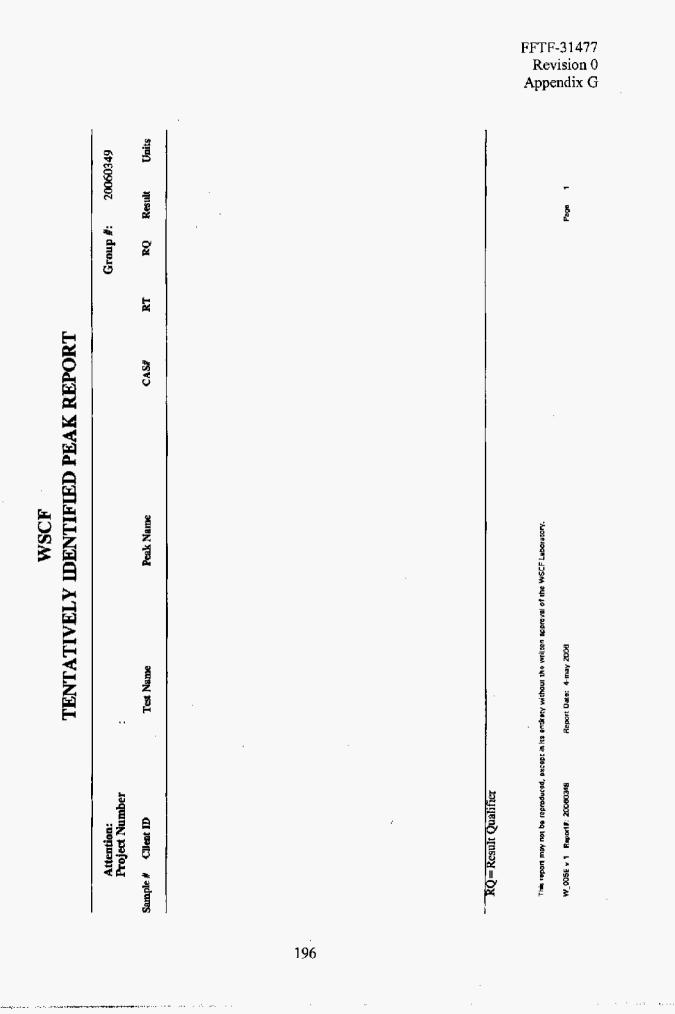
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REPORT	Group #:	Continent	IC-Ardon - Phosphare, Iow recovery on matrix apress probably due to marcin interference, from presence of chlaride. Samyle result <mdl; fleg<="" no="" th=""><th>ICP-AES: "High preparation bisant results for the following envents: catioum, copper, initial, silican, thalieum, and mobybelienum; "C" flage if applicable.</th><th>High andmony, selentum, shuc, and tow shicon and fithiam LCS recoveries: "X' flags if applicable. The following elements have semple results beyond effective</th><th>spike range (späre tosutts markad "NA"); akuninum, ereenis; beekum, censium, cabets, dreamiaer, capper, ikon, magnesium, mengeness, eiskel, pocasskum, sodkum, leed, ereenism, zins;</th><th>vangdium, ailteon, boron, phospharus, stronttum, ziteonlum, muhbdanum, and bismush. Low thostiam sjäte roczuwios: "K" flag.</th><th></th><th>TESTDATA - Test Data Entry</th><th></th><th></th><th></th></mdl;>	ICP-AES: "High preparation bisant results for the following envents: catioum, copper, initial, silican, thalieum, and mobybelienum; "C" flage if applicable.	High andmony, selentum, shuc, and tow shicon and fithiam LCS recoveries: "X' flags if applicable. The following elements have semple results beyond effective	spike range (späre tosutts markad "NA"); akuninum, ereenis; beekum, censium, cabets, dreamiaer, capper, ikon, magnesium, mengeness, eiskel, pocasskum, sodkum, leed, ereenism, zins;	vangdium, ailteon, boron, phospharus, stronttum, ziteonlum, muhbdanum, and bismush. Low thostiam sjäte roczuwios: "K" flag.		TESTDATA - Test Data Entry			
WSCF ANALYTICAL COMMENT REPORT		Test							VALTEST - Test Validation LOGTEST - Login for Tests	en suproval of the WSCF Laboratory.	E.	
AN	ME EBY/JIM RICH	Lab Area	VALGROUP						VALGROUP - Group Validation LOGSAMP - Login for Sample	This report may not be regroduced, ancept in its envirety without the written approval of the WSCFL aboratory.	3445 August Date: 4-may 2008	
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The results provi	METHOD REFERENCES REPORT	
me regulatory of industry method method here doe	The results provided in this report were generated using the following WSCF Laboratory procedures. For your convenience, this table provides a listing of the regulatory or industry methods that are referenced by each of these WSCF procedures. Please note that the most recent version of the regulatory or industry method is listed here even though the WSCF procedure and relative rotation of the method. Also, a reference to a regulatory or industry method here does not necessarily indicate a verbair implementation of that method.	
LA-212-411	Determination of Soil pH Measurement EPA SW-846 9045C SOIL AND WASTE pH	
LA-505-411	LA-505-411: ELEMENTAL ANALYSIS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPE EPA SW-846 6010B INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY	
LA-519-401	LA-519-401: SPECIFIC CONDUCTANCE ASTM D1125 Standard Test Methods for Electrical Conductivity and Resistivity of Water EPA SW-846 9050A SPECIFIC CONDUCTANCE EPA-600/4-79-020 120.1 CONDUCTANCE	
LA-533-410	LA-533-410: ANION ANALYSIS BY ION CHROMATOGRAPHY EPa-600/R-94-111 300.0 DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY	
Note: A complete list \\ap006\tespdoc: links to full-tes Report Date: 4-nev-2006 Report #. 20060349 Report w_006M/1	of WSCF analytical procedures and referenced regulatory or industry methods is available online at NWSCFISample MgmvlProcedureMethodCrossReference.pdf. This document includes on-line at versions of the procedures and methods, where available.	FFTF-3147 Revision Appendix

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SAF Number: NA Sample Date: 04/18/06 Receive Date:04/19/06	RQ		C		Þ	Э	с	Þ							-										D		c.
SAF N Sample Receiv	Upper Limit		20.000	20.02	20.000	20.000	20.00	20.000	20.000	125,000	125.000	125.000	125,000	125.000	125,000	125.000	125.000	125,000	125.000	125.000	125.000	125.000	125.000		300.000	300,000	300.000
	Lower Limit		0.000	0.000	0.000	0.000	0.000	0.000	0.000	75.000	75.000	75.000	75.000	75,000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000		0.00	0.000	0.000
	Analysis Date		04/25/08	04/25/06	04/25/06	04/25/06	04/25/06	04/25/06	04/25/06	04/25/06	04/25/06	04/25/06	04/26/00	04/25/06	04/25/06	04/25/06	04/25/06	04/25/00	04/25/05	04/25/00	04/25/08	04/25/08	04/25/06		04/25/06	04/25/06	04/25/08
	Units		OdH	<b>CPR</b>	RPD	0 de la	<b>UPD</b>	RPD	цРD	¥ Recuv	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov		mg/L	1/6ա	1/ <b>Du</b> r
	QC Yield		a ju	11.634	<b>e</b> /U	e/u	n/a	n/a	7.495	33,500	83.673	009'68	93,373	94.D91	56.133	99-000	92.000	67 <b>9</b> ,62	BB.200	·63.556	95.227	82.474	115.000		n/a	e/u	e/u
	QC Found		<.4.65e0	1.59e + 01	< 2.0000	<4.906-1	< 9.00e-1	< 3.9060	9.69e + 01	1.87e+00	9.18e-01	4.498-01	4.65e-01	4,14e-01	5.406-01	1.98e+00	1.844 + 00	9.67e-01	4.31e-01	4.46a-01	4,194-01	6.01e-01	2.30 <del>c</del> + 00		< 9.30 <del>4</del> -2	< 9.30a-2	< 3.40 <del>a</del> -2
atography	CAS#	) WITH SAMPLE	24859-67-9	16887-00-6	16834-48-8	N-ZON	NEON	P04.P	14808-79-8	24959-67-9	16887-00-5	1 <del>8984 -4</del> 8-8	N-20N	N-EQN	904 P	14606-79-3	24859-67-9	16887-00-6	16984-48-3	NO2-N	NO3-N	P04-P	14808-79-8		24853-67-9	24858-87-9	16887-00-6
SDG Number: 20060349 Matrix: SOLID Test: Anions by Ion Chromatography	Analyte	Lab ID: W06000848 BATCH OC ASSOCIATED WITH SAMPLE	Bromide (Br) by KC	Chioride (CR by IC	Fluceide (F) by IC	Nitrite (N) by IC	NUTTRE IN) by IC	Phosphate (P) by IC	Buffate (SO4) by IC	Bromide (Br) by IC	Chloride (CI) by IC	Fluoridia (F) by IC	Nitrile (N by IC	Nitrate (N) by IC	Phosphate (P) by IC	Sulfate [S04] by IC	Bromide (Br) by IC	Chioride (C) by IC	Fluorida (F) by (C	Nitrite (NJ by IC	Nitrate IN) by IC	Phosphale (P) by IC	Sulfate (SO4) by IC	H OC	Bromide (Br) by IC	Bromide (Bi) by IC	Chloride (CR by IC
SDG N Matrix: Test: A	Type Type	Lab ID: BATCH	4DO	900	PUP	ano	٩U	qUD	qUp	NS	\$N	NS	SN	ŝ	NS	NS	NSD	NSD	NSD	<b>OSN</b>	NSD	NSD	NSD	BATCH OC	BLANK	BLANK	<b>BLANK</b>

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SAF Number: NA Sample Date: Receive Date: ğ Ξ ∍ ⊐ ...... 5 ∍ 300,000 300,000 300,000 300,000 300,000 300,000 300,000 300,000 300,000 120.000 120.000 120.000 120.000 120.000 120.000 Upper Limit 80.000 80.000 80.000 Lower Limit Analysis Date 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/25/06 04/22/06 04/25/06 04/25/00 04/25/08 04/25/06 % Recov % Recov # Recov % Recov % Recov % Recov % Recov Units ղթո μĝ Ч<sup>р</sup> 1/bu ۲**b**u γĝų ž ž Ч<sup>р</sup>ш Ē J∕Bw QC Vield 91.500 103.061 97,088 94,894 91,948 93,250 95.000 QC Found 3.669 + 02 2.02++02 9.50e+01 8.369+01 1.779+02 < 3.40e-2 < 9.80e-3 < 1.80e-2 <7.90e-2 < 7.80a-2 <1.30a-1 <1.306-1 < 9.609-3 8.67++01 3.73+02 < 4.00e-2 < 4.00e-2 < 1.80e-2 24969-67-9 16887-00-8 16964-49-6 14808-79-8 14808-78-8 CAS# 16984-48-8 14608-79-8 6984-48-8 N02-N N-EON NO2-N NO2-N NO3-N NO3-N POA-P POA-P PO4-P fest: Anions by Ion Chromatography SDG Number: 20060349 Phosphate (P) by IC Phosphate (P) by IC Phosphate (P) by IC Sulfate (SO4) by IC Sultate (SO4) by K Sulfate (SO4) by IC Bromde (Br) by IC Chloride (C) by IC Fluoride (F) by IC Chloride (Cl) by IC Huorida (F) by IC Nitrate (N) by IC Fluorida (F) by IC Nitrate (N) by KC NITTERS [N] by IC Nitrite (N) by (C Minim (N) by IC Notice (N) by IC Analyte Matrix: SOLID BLANK BLANK 8 🕺 BLANK BLANK BLANK BLANK BLANK BLANK BLANK BLANK ទ្ធ S) S) ŝ ŝ S 51

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<b>OC REPORT</b>
<b>30RATORY (</b>
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WSCF ANAL

SAF Number: NA Sample Date: 04/18/06 Receive Date:04/19/06	RQ	
SAF Num Sample D Receive L	Upper Limit	3.000
	Lover Limit	000
	Analysis Lower Date Limit	05,101,605
	Units	P.
	QC Yield	0.525
	QC Found QC Vield Units	7,790
ment	CAS #	H SAMPLE
SDG Number: 20060349 Matrix: SOLID Test: pH Soil and Waste Measurer	Analyte	Lab ID: W06000848 BATCH QC ASSOCIATED WITH SAMPLE DUP PI Soil and Wasse Measurement PI
SDG Nur Matrix: S Test: pH (	QC Type Analyte	Lab ID: BATCH C our

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SDG Num Matrix: S( Test: Cork	SDG Number: 20060349 Matrix: SOLID Test: Conductivity							SAF Number: NA Sample Date: 04/18/06 Receive Date:04/19/06	NA 4/18/06 4/19/06
QC Type	Analyte	CAS #	OC Found OC Yield Units	QC Yield	Units	Analysis Lower Date Linút	Lower Limit	Upper Limit B	RQ
Lah ID: BATCH 0	Lab ID: W06000848 BATCH OC ASSOCIATED WIT	WITH SAMPLE							
ing ing	Conductivity	CONDUCT	776.	3.296	RPD	02/01/08	0.000	20.000	
BATCH QC LCS Conduc	QC Conductivity	CONDUCT	2.181	101.308	<b>B</b> irec	06/01/06	80.000	110.000	

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							KECCIVE Date:U4/17/00	04/13/140
Anelvte	CAS#	OC Found	OC Yield	Units	Analysis Date	Limit	Upper Lladt	RQ
Sirpntium by ICP	7440-24-6	ž	18	% Rucor	05/03/06	200.05	130,000	
Tilanium by ICP	7440-32-6	¥N N	÷	h Racov	90/00/50	75.000	125.000	
Thailfrum by ICP	7440-28-0	132	C 1-1 - 1-1-3	3. RINCOV	05/03/06	75.000	125.000	
Vanadium by ICP	7440-52-2	¥Z	nfa	N Rucov	06/03/06	75.000	125.000	
Zite by ICP	7440-86-6	NA	e/u	W RECOV	06/03/08	75.000	125.000	
Ziconium by ICP	2-28-0714	NA	nta	9. Recov	05/03/06	75.000	125.000	
Silver by ICP	7440-22-4	193	84.748	* Recov	05/03/06	75,000	125.000	
Auminum by ICP	7429-90-5	NA	ej u	N Recov	05/03/00	75.000	125.000	
Arcenic by ICP	7440-38-2	NA	D14	% Recov	05/03/06	75,000	125.000	
Boron by ICP	7440-42-8	NA.	nta	% RECOV	05/03/06	75.000	125.000	•
Berium by ICP	2-62-0712	NA	nta	% Recov	05/03/06	75.000	125.000	
Servitiven by ICP	7 14-0792	106	319-EO(	% Recov	05/03/08	75.000	125.000	
Birmuth by KCP	7440-69-9	NA NA	nła	% Recov	90/E0/90	75.000	125.000	
Calcium by ICP	7440-70-2	NA A	e)u	K Recor	05/03/08	75.000	125.000	
Cadmium by (CP	6-E1-0772	1.86	90 732	% Recor	05/03/06	75,000	125,000	
Cebah by KCP	7440-48-4	NA	nta	N Hecov	05/03/08	75,000	125.000	
Chromium by ICP	7440-47-3	¥N N	8/U	% Recov	06/D3/06	75,000	125.000	
Cepper by ICP	7440-50-8	NA	e) u	% Recov	06/03/08	75.000	125.000	
from by ICP	7438-89-6	NA	6/U	16 Recov	05/03/06	75.000	125.000	
Potaccium by ICP	7440-09-7	٧V	ntă	% RINGOV	90/E0/90	73.000	125.000	
Lithrum by ICP	7439-93-2	68.3	86.146	K Recov	05/03/06	75.000	125.000	
Magnasium by ICP	1-36-60×L	¥٩ N	8/u	Record	05/03/06	75.000	125.000	
Manganese by ICP	7439-86-5	Ŵ	B18	% Recov	05/03/06	75,000	125.000	
Matybdanum, ICP	7439-98-7	NP	ttia	A RECOV	05/03/06	75,000	1 Z5.000	
Spéium by ICP	7440-23-5	NA	\$/u	W Record	06/03/08	75.000	000'571	
Nickel by ICP	7440-02-0	ĄN	e;u	A RECOV	05/03/06	75.000	125.000	
Photohorus ky ICP	7723-14-0	A M	e)a	16 Recov	02/03/06	75.000	125.000	
Land by ICP	7439-92-1	NA	eju	K Recov	05/03/06	75.000	125,000	
Antimony by ICP	2440-36-0	194	94.634	W Record	05/03/06	75,000	125.000	
Selenium by ICP	7782-49-2	219	106.829	N Recov	05/03/08	75.000	125.000	

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	SAF Number: NA Sample Date: 04/18/06 Receive Date:04/19/06	RO					•																		-							
	SAF Number: NA Sample Date: 04/18 Receive Date:04/19	Upper Lîmit	125.000	125.000	125.000	125.000	126.000	125.000	1 26-000	1 25.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20,000	20.000	20.000	20.000	20,000	20,000	- 20.000	20.000	20,000	20.000	20.000	20.000
		Lower Limit	75.000	75.000	75,000	75.000	75.000	75,000	75,000	76.000	0.000	0.000	0.000	0,000	0.000	0.000	0.000	0.000	0.000	0.000	0,000	0,000	0.000	0.000	0,000	0.000	0.000	0.000	0000	0:000	0.000	D.000
		Analysis Date	05/03/08	05/03/08	05/03/05	80/00/90	05/03/06	90/00/50	90/00/50	05/03/06	BO/80/50	05/03/06	05/03/08	05/03/06	05/03/08	D6/D3/DB	05/03/06	90/00/50	80/60/50	02/03/08	00/E0/90	05/03/06	05/03/08	05/03/08	02/03/08	05/03/06	90/E0/90	05/03/06	05/03/06	05/03/06	05/03/06	90/00/90
		Units	% Recov	% Recov	VOCAR 25	% Recov	% Recov	% Recov	% Recov	% Hecov	CLAR	0HH	<b>0</b> 2	<b>P</b> PO	APD.		CHP D	RPD	aro O	<b>R</b>	<b>CFI</b> F	ele BPD	0.HR	ę.	<b>PPO</b>	0 He		<b>Chi</b>	đ,	Q-H	RP0	<b>O</b> LE
		OC Yield	e u	63.902	в/п	в/в	48.780	вуu	<b>8</b> 10	n/a	9.861	6/11	nła	<b>6/1</b>	n/a	11.644	Ę	<b>2</b> 0	13.542	n/a	n/a	e/u	e/a	n/a	24.971	<b>e</b> /u	e/4	B/CI	nta	n/a	ព/ធ	<b>6</b> /U
		OC Found	AN N	172	MA	NA	) an	¥	W	AN A	94.146					103.415			20.732						88.146							
		CAS#	7440-21-3	7440-31-5	7440-24-6	7440-32-8	7440-28-0	7440-62-2	7440-68-6	7440-67-7	7440-22-4	7428-90-5	7440-88-2	7440-42-8	7440-38-3	7440-41-7	7440-69-9	7440-70-2	7440-43-5	7440-48-4	7440-47-3	7440-50-8	7439-89-6	7440-09-7	7439-93-2	7439-95-4	7439-96-5	7439-98-7	7440-23-5	7440-02-0	0-41-6277	7438-92-1
	SDG Number: 20060349 Martix: SOLID Test: ICP - All possible metals	Analyte	Silicon by ICP	Tite .	Stronthum by ICP	Titunium by ICP	Thalium by ICP	Vanadium by ICP	Zins by ICP	Zaconium by ICP	Silver by ICP	Aluminum by ICP	Arsenic hy ICP	Boron by ICP	Sarium by ICP	Beryllium by ICP	Bismuth by ICP	Coldum by ICP	Cadmium by ICP	Cohahi by ICP	Civorium by ICP	Copper by ICP	iron by ICP	Pateseium by ICP	Lithium by ICP	Magnasium by ICP	Mangenese by KP	Meybdenum, ICP	Sedium by ICP	Nickel by ICP	Phosphorus by ICP	Lead by ICP
	SDG N Matrix: Test: I(	8 Å	USN	MSD	OSW	MSD	MSD	MSD	usp	OSM	SPK-RPD	SPK-RPO	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	SPK-RPD	5PK-RPD	SPK-RPD	CPR-RPD	CIAR-XAIS	SPK-RP0	SPK-RPD	SPK-RPO	GqA-XqS	BPK-RPD	SPK-RPD

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SAF Number: NA Sample Date: 04/18/06 Receive Date: 04/19/06	Ŋ												Þ	Ð	2	₽	2	D	2			Ð	D		5	-	2	ŋ	2	
SAF Number: NA Sample Date: 04/18 Receive Date:04/19	Upper Limk	20.000	20:000	20:000	20.000	20.000	20.000	- 000.0Z	igoia oz	2000.02	20:00																			
	Lower Limit	0.000	0.000	0.000	0:00	0.000	0.000	0.000	0.000	0.000	0:000																			
	Analyzis Date	05/03/06	06/03/06	05/03/06	02/02/50	OE/CG/IDB	06/03/06	06/03/09	05/03/06	05/03/06	05/03/06		CENTENDE	OE/D3/D6	02/03/02	06/03/06	OE/DB/OB	OE/DB/DG	05/03/06	DEMBOR	05/103/06	06/03/08	05/03/06	05/03/06	05/03/06	60/20/50	02/03/06	05/03/06	05/03/06	05/03/06
	Units	ВР)	( <b>1</b> 4)	<b>C</b> -14	048		<b>GPD</b>	C <sup>M</sup> R	Call I	RPD	Cr N		101	-10n	y/Bra	101	400	101	ng L	ղմո	νŝγ	ug/L	ղնո	ng'L	tert.	100	- ngu	тđи	ug/L	nga.
	OC Yield	3.825	1441	82	14 119	970	es	40 748	0/0	n/a	ein		eju	n/n	ş	Ş	979	a's	8/L	0.017	a/a	n/a	4/H	0.018	a/a	n/a	e)z	n/a	n/a	0.004
	OC Found		106.829		83.902			48.780					<1.6443	< 2.74-2	<2.2-2	<2.6+2	6.16-3	< 1e-3	<2.26-2	1.74-2	< 18-3	A 1.24-3	5 <b>87.</b> 5 A	1.64-2	< 3, 1 2	< 0.115	<li>&lt; 1≞-3</li>	<1.8-2	< 18-3	5.04
	CAS#	7440-35-0	7782-49-2	7440-21-3	7440-31-5	7440-24-6	7440-32-6	7440-29-0	7440-62-2	7440-88-8	7440 67-7		7440-22-4	7428-90-5	7440-38-2	7440-42-8	7440-39-3	7440-41-7	7440-59-9	7440-70-2	6-64-0442	7440-48-4	7440-47-3	7440-50-B	7439-89-6	7-040-09-7	7439-93-2	7438-95-4	7438 96.5	7438 98.7
SDG Number: 20060349 Martix: S01.UD Text: ICP - All possible metals	Andrie	Antimony by ICP	Selection by ICP	Silicon by ICP	Tun	Strendium by ICP	Trientum by ICP	Thatian by ICP	Vanadium by ICP	Zine by ICP	Zheonium by (CP	łoc	Silver by ICP	Alumbum by (CP	Arsonic by ICP	Baron by ICP	Barium by KCP	Beryllium by ICP	Bismuth by ICP	Calcium by ICP	Cadmium by IOP	Cebait by ICP	Chomium by ICP	Copper by ICP	from by ICP	Potestium by ICP	Lithium by ICP	Magnesium by ICP	Mangundae by ICP	Michybdenum, YCP
SDG N Matrix: Test: 10	8 S a	BPK-RPU	OPR-242	SPK-APD	SPK-RPD	OLUH-YANS	SPK-RPD	SPK. RMD	CHR-X45	SPK-RPD	SPK. R/D	BATCH OC	BLANK	BLANK	<b>BLAWK</b>	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	DLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK

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	SAF Number: NA Sample Date: Receive Date:	Upper Limit				·											155.000	157.000	121.000	156.000	120.000	119.000	120.000	124.000	120.000	115.000	172.000	120.000	152.000	136.000	120.000	129.000
		Lower Limit															45.000	44.003	79.000	45.000	80.009	81.003	80.003	76.000	60.000	85.000	000.11	B0.000	47.000	64.000	80.000	71.000
		Anałysis Date	05/03/08	05/03/06	00/00/00	05/03/08	05/03/06	05/01/06	05/03/06	05/03/08	02/03/00	05/03/06	05/03/08	05/03/08	05/03/06	05/03/06	05/03/06	05/03/06	00/00/00	05/03/DB	90/60/50	05/03/06	05/03/06	90/20/50	00/20/50	02/03/08	90/10/50	02/03/08	02/03/08	80/60/50	02/03/06	05/03/06
		Units	n0/L	ւթնո	ug/L	ug/L	-UQU	ենս	Ъ	ng/L	, L	ug/L	ng∕L	ug/L	ղջո	un/L	A Recov	* Rucav	🖌 Recov	🖌 Recov	A Recov	🖈 Recav	👫 Recov	A Recov	% Recov	A Recov	🖈 Recov	🖈 Recov	A Recov	74 Recov	% Recov	A Recov
		QC Yield	8/u	P:004	nta	e/u	ej u	n/a	D.112	Β/U	n/a	eju	0.046	пłа	цfa	п/в	109.231	99-225	113.043	110.883	108.127	115.486	93.237	109.880	110.938	107.102	108.058	112.838	145.625	104.219	58.389	109.167
		QC Found	<0.198	9 5 6	<4.8a 2	<2.18-2	<2.16-2	<1.8e-2	0.112	<1.6a-2	<1.34-3	1.46-3	4.6a-2	6.9€∧ ∧	9. 18 1	<1.6+3	142	6271	182	108	275	109	193	3646	142	37.7	75.1	187	16310	2001	3.48	2227
		CAS#	7440-23-5	7440-02-0	7723 14.0	7439-82-1	7440-36-0	7782-49-2	7440-21-3	7440-31-5	7440-24-6	7440-32-8	7440-28-0	7440-62-2	7440-86-8	7440-67-7	7440-22-4	7429 80 5	7440-38-2	7440-42-8	7440-39 3	7440-41-7	7440-69-9	7440-70-2	7440-43-9	7440-48-4	7440-47-3	7440-50-3	7439-69-6	7440-09-7	7430-93-2	7439-95-4
	SDG Number: 20060349 Matrix: SOLID Test: ICP - All possible metals	Analyte	Sodium by ICP	Nickel by ICP	Phosphorus by ICP	Lead by KCP	Antimony by ICP	Satenhum by ICP	Silicon by ICP	Tip	Strentium by #CP	Titanium by ICP	Thellium by ICP	Vanedium by ICP	Zine by ICP	Zirconium by (CP	Silver by KP	Aluminum by ICP	Arsanic by ICP	Boron by ICP	Barium by ICP	Benythium by ICP	Bismuth by ICP	Calcium by ICP	Cadmium by ICP	Cabatt by KCP	Chromium by ICP	Copper by (CP	tron by ICP	Potassium by ICP	Lithium by ICP	Magnasium by ICP
	SDG Matrix Test: I	Э <sup>дуг</sup> Эдүг	BLANK	BLANK	BLANK	BLANK	BLANK	<b>BI ANK</b>	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	ECS.	iCs	LCS	LCS	ខ្ម	8	ឮ	ខ្ម	ខ្ម	23	ខ្ម	ß	ខ្ម	ŝ	ស្ត	ខ្ម

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SAF Number: NA Sample Date: Receive Date:	Upper Limit	124.000	121.000	143.000	121.000	123.000	123.000	205.000	128.000	120.000	121.000	126.000	191.000	128.000	129.000	123.000	120.000
	Lower Limit	78.000	79.000	51.000	74.000	76.000	77.000	53.000	74.000	80.000	80.000	74.000	00016	21.000	70,000	77.000	80.000
	Analysis Date	05/03/08	05/03/08	06/03/06	05/03/06	BQ/E0/SO	05,03/06	02/03/08	00/00/50	05/03/06	05/03/06	05/03/06	05,03,06	02/10/20	90/03/08	02/03/06	BO/EO/SO
	Units	% Recov	% Recov	N Recov	A Recov	% Recov	Recov	MINCOV	% Recov	% Recov	% Recov	👫 Recov	Recov	S Recov	% Recov	K Recov	4 Racov
	QC Vield	112.500	114.368	103.371	108.844	108.824	118.310	282.726	129.128	33.608	110.820	5712.143	106.462	113.333	117.163	127.879	80.676
	OC Found QC Yield	459	<b>36.</b> 2	460	1 <del>6</del> 0	481	1689	160	82.9	245	67.6	54.2	055	95.2	114	211	167
	CAS#	7430-96-5	7439-38-7	7440-23-5	7440-02-0	7723-14-0	7439-92-1	7440-36-0	7782-48-2	7440-21-3	7440-31-5	7440-24-6	7440-32-6	7440-28-0	7440-62-2	7440-66-6	7440-67-7
SDG Number: 20060349 Matrix: SOLID Test: ICP - All possible metals	Anulyte	Manganese by ICP	Molybdanum, KCP	Sodium by ICP	Mickel by ICP	Phosphorus by ICP	Lead by ICP	Antimony by ICP	Selenium by ICP	Silicon by ICP	Tin	Strentium by ICP	Titentum by ICP	Thattium by ICP	Venadium by ICP	Zine by ICP	Zirconium by JCP
SDG 7 Matrix Test: 1	S ave	S	<b>S</b> J	ខ្ម	ខ្ម	ß	8 <u>1</u>	CCS	8	ಶ್ರ	ខ្ម	501	ຮ	ខ្ម	521	<b>S</b> J	ខ្ម

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w13qlog v1 04-may-2006 06:30:11

W13q Worklist/Batch/QC Report for Group# 20060349

WL#	S#	Batch	QC#	тгау Туре	Sample#	Test
28503 28503 28503 28503 28503 28503 28503 28503	8 3 5 6 7	28875 28875 28875 28875 28875	32709 32709 32709 32709 32709 32709 32747	BLANK BLANK LCS DUP MS MSD SAMPLB DUP	W060000848 W060000848 W060000848 W060000848 W060000848	Anions by Ion Chromatography Anions by Ion Chromatography PH Soil and Waste Measurement
28532 28532 28532	2	28902 28902 28902 28902	32769	SAMPLE LCS DUP SAMPLE BLANK LCS MS	W060000848 W060000848 W060000848 W060000848	<pre>pH Soil and Waste Measurement Conductivity Conductivity Conductivity ICP - All possible metals ICP - All possible metals ICP - All possible metals</pre>
28532 28532 28532 28532	5	28902	32769 32769	MSD SAMPLE SPK-RPD	W060000848 W060000848 W060000848	ICP - All possible metals ICP - All possible metals ICP - All possible metals ICP - All possible metals

## WSCF ANALYTICAL RESULTS REPORT

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Fast Flux Test Facility

Richland, WA

Attention: M EBY/JW Rich

John Trechter Analytical: Keeling Rauffur 5/11/06 raliter Client Services: Jolun 7

All results are reported on an "as received" basis unless otherwise noted in the comment section.

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Report#: 20060391 Report Date: 11-may-2006 Report W005/ver. 1.2 Fast Fluc Test Facility

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## ANALYTICAL RESULTS REPORT WSCF

Attention: Project:		M EBY/JW Rich MISC: MISC								Group #:	p #: 20060391	-
					WSCF							
Sample # Client ID		CAS#	Test Performed	Matrix	Method	RQ	Result	Unit	90	MIM	Analyze Sample Receive	٤1
Inorganic												
WOBDOUDBEE DRWC#8-1	1-84	CONDUCT	Conductivity	WATER	LA-519-4C1		2.15++03	uS/cm	8	0.49	05/06/06 04/25/08 04/28/08	8
W06000956 DSWC#8-1	148-1	H	pH Direct Measurement	WATER	LA-212-402		71.7	H H	8. 1	01010	05/06/08 04/25/08 04/28/06	8
WOSCOODESE DEWC#8-1	1-84	15084-48-3	Pluoride (F) by IC	WATER	LA-533410	∍	< 0.800 >	γbu	20,00	0.80	04/26/06 04/25/06 04/28/08	80
	181	16887-00-5	Chioride (Ci) by (C	WATER	LA-533410		21.7	Ч <sup>р</sup> ш	20:02	0.66	04/28/06 04/26/00 04/28/08	8
WO6COCCESE DSWC#8-1	1-84	NO2-N	Nitrite (N) by IC	WATER	LA-533-410	5	< 0.196	₩0/L	20.00	0.20	04/28/06 04/25/08 04/28/08	98
	148-1	24059-87 9	Bromide (Br) by IC	WATER	LA-533410	5	<ul><li>▲ 1.85</li></ul>	Лрт	00.02	1.9	04/28/06 04/25/06 04/28/06	8
	L-80	NO3-N	Nitrate (N) by IC	WATER	LA-538-410	5	< 0,360 ×	mg/L	20.02	0.36	04/28/06 04/28/06 04/28/06	8
W060000666 DSWC/8-1	1.8-1	P04-P	Phosphere (P) by KC	WATER	LA-533-410	7	<li>۸.5Å</li>	щg/L	20.00	1.6	04/23/08 04/25/08 04/28/08	9
W06000956 DSW0/0-1	248-1	14808-79-8	Sultate (SD4) by IC	WATER	LA-533-410		1.339+03	щ6,Г	5.01e + D02	58	04/28/06 04/25/06 04/28/06	8
W060000967 0SW0#8-2	18-2	CONDUCT	Conductivity	WATER	LA-519-401		2.206+03	uS/cm	<b>8</b> 97	040	05/08/06 04/25/08 04/28/06	8
W06000957 DSWC#9-2	218-2	Ŧ	pH Direct Medsurement	WATER	LA-212-402		7.12	Æ	1,00	0.010	05/08/06 04/25/06 04/26/06	8
W00000057 D5WC#3-2	18-2	18964-48-8	Fuoride IF) by IC	WATER	LA-533-410	∍	< 0.800	Ч	20.00	0.80	04/28/06 04/25/06 04/28/06	8
W06D000857 DSWC#8-2	3#8-2	15667-00-0	Chloride [CII by IC	WATER	LA-533-410		30.8	70W	20.02	0.88	04/28/06 04/26/08 04/28/08	8
W06000957 DSWC/8-2	208-2	NQ2-N	Nitrite (N) by IC	WATER	LA-533-410	5	< 0.196	тgЛ	20,02	070	04/28/06 04/25/06 04/28/06	8
W06000867 DSWC#8-2	18.2	24959-67-9	Bromide (Brt by IC	WATER	LA-633-410	5	< 1.6d	mg/L	20.00	ę. r	04/28/06 04/26/08 04/26/06	8
WOEDOOGET DSWC48-2	18-2	N-CON	Nitrime (N) by 4C	WATER	LA-633-410	J	< 0.360 >	mg/L	20.00	0,36	04/28/06 04/25/08 04/28/08	8
W06000957 DSWC#8-2	348-2	PO4-P	Phosphate (P) by IC	WATER	LA-533-410	Þ	<ul><li>1.56</li></ul>	mg∕L	20.00	1'B	04/28/06 04/25/08 04/28/06	8
W06000957 DSWC#3-2	18-2	14808-78-8	Sultate (SO4) by IC	WATER	LA-533-410		$1.34 \pm 0.03$	դմա	5.01e+002	3	04/28/06 04/25/06 04/28/06	8
W06000958 05W043-3	18.2	CONDUCT	Conductivity	WATER	LA-519-401		2.18e+03	maysn	1,00	<b>0</b> ₩.0	05/08/06 04/25/08 04/28/06	8
W080000958 DSW048-3	348-3	£	pH Direct Measurement	WATER	LA 212 402		7.14	Ŧ	81	0.010	05/08/06 04/26/08 04/28/06	8
W06000058 D5WC#3-3	218-3	10984-48-8	Fluoride (f) by IC	WATER	LA-533-410	⇒	< 0.000 ×	μĝu	20.00	0.80	04/28/06 04/25/06 04/26/06	8
W06000958 DSWC//8-3	348-3	16887-00-6	Cheride (Ch by IC	WATER	LA-533-410		7.58	mg/L	20.00	0.69	04/28/06 04/25/08 04/28/08	8
WORCOODER DSWC18-3	198-13	NO2-N	Nitrite (N) by IC	WATER	LA-533-410	7	A 0.196	mg/L	20.00	0.20	04/28/06 04/25/08 04/28/06	8
W06000968 DSWC#8-3	20-3	24959-67-9	Brornide (Bri by IC	WATER	LA-533-410	J	<ul><li>1.86</li></ul>		20.00	6.1	04/28/08 04/25/08 04/20/06	8
W06000958 DSWC/8-3	0.8-3	NC3 N	Nitrate (Ni by KC	WATER	LA-533-410	J	< 0.360	ղթո	20.00	0°.30	04/28/06 04/25/08 04/28/08	g
WOBCOODER DSWC/8 3	2 B R	PO4-P	Phoephate (P) by NC	WATER	1 A-533-410	2	9q.l >	mg/L	20.00	1.6	04/28/06 04/25/06 04/28/06	8
MDL=Minimum De RQ=Result Qualifier	MDL = Minimum Detection Limit RQ = Result Qualifier	E - Analyte is an	E - Avrelyte is an estimate, has potentially larger erors			J - Analyze	U - Analyzed for but not detected above firmbing initeria.	teoted ab	ove firmiting t	atteria.		1

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DF=Dilution Factor • - Indexate results that have NOT been valuated: + - Indexate results that have NOT been valuated: Report WOOS/ver. 1.2 Fast Flux Tex Factliny

## WSCF ANALYTICAL RESULTS REPORT

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Ê	Project: MIS	MISC: MISC									
					WSCF						
Sample #	Client D	CAS#	Test Performed	Matrix	Method	ВQ В	Result	Cait	DF	MDL	Analyze Sample Receive
W06000058	DSWC#8-3	14808-79-8	Sulfine (604) by IC	WATER	LA-533-410		1.32a+03	1,0ա	5.01e+002	ê5	04/26/06 04/25/08 04/28/06
M06000959	DSWC#8-4	7429-80-5	Aluminum by ICP	anos	LA-505-411		7.486 + 03	0/6n	1.01e+002	2.7	05/10/06 04/25/06 04/28/05
W060000859	DSWC#8-4	7440-36-0	Antimony by ICP	SOLD	LA-505-411	כ	< 2,13	ð/ðn	1.01e ± 002	2.1	05/10/06 04/25/06 04/28/06
	DSWC4-4	7440-38-2	Araanic by ICP	anos	LA-605-411	5	< 2.23	ByBn	1.01=+002	2.2	05/10/06 04/25/06 04/28/06
WD80000858	DSWORB-4	7440-39-3	Barium by ICP	20110	LA-505-411		1.07e ± 03	0,0n	1.01e + 004	ç	05/10/06 04/25/06 04/28/06
W060000553	DSWC#3-4	7440-41-7	Barylium by ICP	SOLD	LA-505-411		0.109	0/8n	1.01=-002	0.10	05/10/06 04/25/06 04/28/06
W060000659	D SWCa B- 4	7440-43-8	Cadmium by ICP	SOLID	LA-605-411	Þ	< 0.101 ×	0yan	1,01e - 002	0.10	05/10/06 04/25/06 04/28/06
	D BWC#8-4	7440-70-2	Calcium by ICP	SOLID	LA-505-411		3.836+04	6y8n	1,016±004	1.6ia +02	05/10/06 04/25/06 04/28/06
WD80000859	DSWC#8-4	2440-48-4	Cobart by ICP	SOUD	LA-505-411		16.3	cy Sn	1.D1e - 002	0.12	05/10/06 04/25/06 04/28/06
W06000059	DSWC#8-4	7440-47-3	Chromates by ICP	20105	LA-505-411	ىد	152	0,0n	1.01e - 002	0.32	05/10/06 04/25/08 04/28/06
	OSWC#8-4	7440-50-8	Copper by ICP	SOLID	LA-505-411		158	0y8n	1.01++002	0.33	05/10/06 04/25/06 04/28/06
W06000955	DSWC#8-4	7439-89-8	fron by ICP	SOLID	LA-505-411		1.46e + 06	QQn	1.01e - 004	2.1e+02	05/10/06 04/25/06 04/28/06
- 656000000W	CSWCEB-4	4-00-0042	Magnesium by ICP	SOLID	LA-505-411		3.92e+03	8yen	1.01e-002	1.9	05/10/06 04/25/06 04/28/06
W06000089	OSWC/18-4	7438-96 5	Manganese by ICP	SOLID	LA-505-411		1.38++03	6/Bn	1,01e - 004	10	05/10/06 04/25/06 04/28/06
W060000659	DSWCf8-4	7440-02-0	Nickel by KCP	20105	LA-505-411		221	0y0n	1.01e - 002	0.14	05/10/06 04/25/06 04/28/06
1 855000090M	DSWE#8-4	7440-09-7	Putessium by ICP	SOLD	LA-505-411		405	eyen	1.014 - 002	21	05/10/06 04/25/06 04/26/06
M060000558	OSWC#8-4	7440-22-4	Silver by ICP	SOLID	LA-505-411		0.341	<b>B</b> yon	1.016-002	0.18	05/10/06 04/25/08 04/28/06
W060000959	DSWC#8-4	7440-23-5	Sedium by ICP	SOLID	LA-505-411		272	by Den	1 D1e - D02	20	D5/10/06 04/25/06 04/26/06
W06000059	DSWC#8-4	7439-62-1	Lead by 1CP	soup	LA-505-411		4,16	<b>DyB</b> m	1.01e - 002	2.1	D5/10/06 04/25/05 04/26/06
W060000959	DSWCr8-4	7782-49-2	Selentum by ICP	SOLID	LA-505-411	0	<ul><li>1.82</li></ul>	20	1.016 - 002	1.8	05/10/06 04/25/08 04/26/06
W060000959	DSWC#8-4	7440-28-0	Theilium by KCP	SOLID	114-505-411	5	< 2.02 ×	<b>b</b> yðn	1.014 - 002	2.0	D5/10/06 04/25/08 04/28/06
W06000059	DSWC#8-4	7440-32-6	Titanium by ICP	COLID	LA-505-411	ш	575	0y0n	1.016 - 004	4	05/10/06 04/25/08 04/25/08
	DSWC#8-4	7440-62-2	Vanedium by ICP	SOLD	LA-505-411		30.2	oyên	1.01e - 002	0:30	05/10/06 04/25/08 04/28/06
	DSWC#8-4	7440 66 6	Zine by ICP	SOLD	LA-505-411		89.7	SyBn	1.01=-002	0.0	D5/10/06 04/25/06 04/26/06
WD80000959	DSWC#8-4	7440-21-3	Silicen by ICP	SOLD	LA-505-411		283	ხცმი	1.016 - 002	1.7	05/10/06 04/25/06 04/20/06
W06000069	DSWCra-4	1439-93-2	Lithlum by ICP	20105	LA-505-411		6.08	0/0n	1.01#-002	0.10	05/10/06 04/25/06 04/28/06
W060000959	DSWC#8-4	7440-42-8	Beron by ICP	SOUD	LA-605-411		61.3	₿y₿n	1.01e - 002	2.6	05/10/06 04/25/06 04/28/06

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 $DF=Dilution\ Factor$ - Indicates more than six qualities symbols Report WDDS/ver. 1.2 Fact Flux Test Facility

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D         CAS #         Test Performed         Matrix         Method         RQ         Res           1         7723-14.0         Prospherus by ICP         SOUID         1.4:66-411         1         2 <td< th=""><th>Pro</th><th>Attention: Project:</th><th>M EBY/JW Rich MISC: MISC</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Gro</th><th>Group #:</th><th>20060391</th></td<>	Pro	Attention: Project:	M EBY/JW Rich MISC: MISC								Gro	Group #:	20060391
7723-140         Prosphorus by ICP         SOLID         I.A.565-411           7723-349         Suffur by TCP         SOLID         I.A.565-411           770-349         Suffur by TCP         SOLID         I.A.565-411           740-345         Strendum by ICP         SOLID         I.A.565-411           7440-345         Zirconture by ICP         SOLID         I.A.565-411           7440-31-5         Zirconture by ICP         SOLID         I.A.565-411           7440-31-5         Zirconture by ICP         SOLID         I.A.565-411           7440-31-5         To         SOLID         I.A.565-411           7440-33-7         Tontot I.CP         SOLID         I.A.565-411           7440-33-7         Tontot I.CP         SOLID         I.A.566-411           7440-57-5         Gald by ICP         SOLID         I.A.566-411           7440-57-5         Gald by ICP         SOLID         I.A.566-411 </th <th>Semule #</th> <th></th> <th>1 2 2 C</th> <th>Test Berfarmed</th> <th>Matrix</th> <th>WSCF</th> <th>C a</th> <th>Damit</th> <th></th> <th>Trdt DF</th> <th>jų,</th> <th>A no lette C</th> <th>Arab<del>ria</del> Comula D<i>oni</i>na</th>	Semule #		1 2 2 C	Test Berfarmed	Matrix	WSCF	C a	Damit		Trdt DF	jų,	A no lette C	Arab <del>ria</del> Comula D <i>oni</i> na
7704-34-9       Sulfur by CP       SoulD       LA 505-411         5CANDRMN       Scendum by ICP       SOUD       LA 505-411         740-34-6       Synontium by ICP       SOUD       LA 505-411         740-31-6       Synontium by ICP       SOUD       LA 505-411         740-31-5       Yrtinium by ICP       SOUD       LA 505-411         740-31-5       Zicconium by ICP       SOUD       LA 505-411         743-38-7       Zicconium by ICP       SOUD       LA 505-411         743-38-90-3       Talmulum by ICP       SOUD       LA 505-411         743-38-90-3       Talmulum by ICP       SOUD       LA 505-411         7430-31-5       T       SOUD       LA 505-411       -         7430-31-5       T       SOUD       LA 505-411       -         7440-33-7       LangetonEP       SOUD       LA 506-411       -       -         7440-57-5       Calif by ICP       SOUD       LA 506-411       -       -       -       -         7440-57-5       Calif by ICP       SOUD       LA 506-411       -       -       -       -       -       -       -       -       -       -       -       -       -       -       - </th <th>1 63600090M</th> <th>DSWC#8-4</th> <th>7723-14-0</th> <th>Phosphonis by ICP</th> <th>CILICS</th> <th>14-505-411</th> <th></th> <th>2.4</th> <th>1</th> <th>1 (1a+00)</th> <th></th> <th></th> <th>OSUIDAS DUTEDA DUTEDA</th>	1 63600090M	DSWC#8-4	7723-14-0	Phosphonis by ICP	CILICS	14-505-411		2.4	1	1 (1a+00)			OSUIDAS DUTEDA DUTEDA
SCANDIM         Scandum by ICP         SOLID         LA505-411           7440-24-6         Svordum by ICP         SOLID         LA505-411           7440-24-6         Svordum by ICP         SOLID         LA505-411           7440-24-6         Svordum by ICP         SOLID         LA505-411           7440-31-5         Zivonium by ICP         SOLID         LA505-411           7430-31-5         Zivonium by ICP         SOLID         LA505-411           7430-31-5         T         Maybdemun, ICP         SOLID         LA505-411           7430-31-5         T         SOLID         LA505-411         V<           7430-31-5         T         SOLID         LA505-411         V           7430-31-5         Cedite by ICP         SOLID         LA505-411         V           7440-33-7         Langtan, ICP         SOLID         LA505-411         V           7440-57-5         Gald by ICP         SOLID         LA505-411         V           7440-57-5         Gald by ICP         SOLID         LA505-411         V           740-57-5         Gald by ICP         SOLID         LA505-411         V           740-57-5         Gald by ICP         SOLID         LA505-411         V     <	W060000559 L	DSWC48-4	7704-34-9	Sulfur by ICP	CINOS	LA-505-411		đ		8	0.0	02/10/06 04	02/10/06 04/25/D6 04/26/08
740-24-6       Storettum by ICP       SOLD       L4-505-411         740-24-6       Storettum by ICP       SOLD       L4-505-411         740-81-5       Yttirum by ICP       SOLD       L4-505-411         740-81-5       Timum by ICP       SOLD       L4-505-411         740-81-5       To       Molychemum, ICP       SOLD       L4-505-411         743-80-3       To       SOLD       L4-505-411          755-80-3       To       SOLD       L4-505-411          755-80-3       To       SOLD       L4-505-411          755-84-30-3       Towne by ICP       SOLD       L4-505-411          755-840-3       Towne by ICP       SOLD       L4-505-411          755-840-3       Towne by ICP       SOLD       L4-505-411          7440-33-7       Longethy ICP       SOLD       L4-505-411          7440-57-5       Geld by ICP       SOLD       L4-505-411           7440-57-5       Geld by ICP       SOLD       L4-505-411            7440-57-5       Geld by ICP       SOLD       L4-505-411	W000000898	DSWC#8-4	SCANDRAM	Scandium by ICP	CINOS	LA-505-411		ž	5/8n	<b>1</b> ,00	0.0	05/10/06 04	05/10/06 04/25/06 04/28/08
740-05-5         Yttrårn by ICP         SOLID         LA-505-411           7440-05-7         Zieraniur by ICP         SOLID         (A-505-411)           7433-90-7         Zieraniur by ICP         SOLID         (A-505-411)           7433-90-7         Zieraniur by ICP         SOLID         (A-505-411)           7440-31-5         7.n         SOLID         (A-505-411)           7440-31-5         7.n         SOLID         (A-505-411)           7440-31-5         7.n         SOLID         (A-505-411)           7440-31-5         7.n         SOLID         (A-505-411)           7440-31-7         1.angsten, ICP         SOLID         (A-505-411)           7553-49-2         Leffine by ICP         SOLID         (A-505-411)           7440-37-5         Gold by ICP         SOLID         (A-505-411)           7440-57-5         Gold by ICP         SOLID         (A-505-411)	W080000358	DSWC/B-4	7440-24-6	Strontfum by ICP	SOLID	LA-505-411		145	6/6A	1.01e+002	0.13	06/10/06 04	06/10/06 04/25/06 04/28/08
7440.87-7         Zieradiur by ICP         SOUD         (A-505.411)           7433-96-7         Motybdenum, ICP         SOUD         (A-505.411)           7433-96-7         Motybdenum, ICP         SOUD         (A-505.411)           7440-31-5         7.n         SOUD         (A-505.411)           7440-31-5         7.n         SOUD         (A-506.411)           7440-31-5         7.n         SOUD         (A-506.411)           7440-31-5         7.n         SOUD         (A-506.411)           7553-36-2         Icofine by ICP         SOUD         (A-506.411)           7440-37-7         1.angsten, ICP         SOUD         (A-506.411)           7440-37-6         Gold by ICP         SOUD         (A-506.411)           7440-37-7         1.angsten, ICP         SOUD         (A-506.411)           7440-37-6         Gold by ICP         SOUD         (A-506.411)           7440-37-7         1.angsten, ICP         SOUD         (A-506.411)	W000000559	DSWC#8-4	7440-85-5	Yttrium by ICP	CITOS	LA-505-411		٩N	6/6n	1.00	0.0	05/10/06 D4	05/10/06 D4/25/06 C4/28/06
7433-96-7         Morybdenum, ICP         SqLub         (A-SGE-411         C           7440-31-5         7.n         SQLub         (A-SGE-411         U         <           1         7440-31-5         7.n         SQLub         (A-SGE-411         U         <           1         7440-31-5         7.n         SQLub         (A-SGE-411         U         <           1         7440-31-5         7.ehr/um by ACP         SQLub         (A-SGE-411         <         <           1         7440-37         1.angsten, ICP         SQLub         (A-SGE-411          <           7440-37         1.angsten, ICP         SQLub         (A-SGE-411          <            7440-57-5         Geld by ICP         SQLub         (A-SGE-411              7440-57-5         Bismuth by ICP         SQLub         (A-SGE-411 <th>W060000959 1</th> <td>DSWCR8-4</td> <td>7440-87-7</td> <td>Ziconium by ICP</td> <td>source</td> <td>LA-505-411</td> <td></td> <td>2.11</td> <td>eyen</td> <td>1.016+002</td> <td>0.18</td> <td>02/10/06 04</td> <td>05/10/06 04/25/06 04/28/06</td>	W060000959 1	DSWCR8-4	7440-87-7	Ziconium by ICP	source	LA-505-411		2.11	eyen	1.016+002	0.18	02/10/06 04	05/10/06 04/25/06 04/28/06
1     740-31-5     7 n     SOLID     1.4-506-411     U     < 1       1     13494-80-3     7-64/number KCP     SOLID     1.4-505-411     < 1       1     7349-80-3     7-64/number KCP     SOLID     1.4-505-411     < 1       1     7349-37     1.4/0-337     1.4/0-505-411     < 1     < 1       1     7440-337     1.4/0-337     1.4/0-305-411     < 1     < 1       1     7440-375     Gold by ICP     SOLID     1.4-505-411     < 2       1     7430-89-8     Merruw by ICP     SOLID     1.4-505-411     < 2       1     7430-89-8     Bernuth by ICP     SOLID     1.4-505-411     < 2	W06000039 1	DSWCr8-4	7439-98-7	Molybdenum, ICP	20105	LA-506-411		30.05	0/0n (	1.015+002	0.40	05/10/06 04	05/10/06 04/25/06 04/28/05
13494-80-3         Tehrulum by KP         SOLID         LA-505-41           7553-56-2         Lotine by ICP         SOLID         LA-505-41           7553-56-2         Lotine by ICP         SOLID         LA-505-41           7440-37-5         Gold by ICP         SOLID         LA-505-41           7440-57-5         Gold by ICP         SOLID         LA-505-41           7430-69-9         Bernuth by ICP         SOLID         LA-505-41           7430-69-9         Bernuth by ICP         SOLID         LA-505-411	W060000959 1	DSWC#8-4	7440-31-5	Tn	SOLID	LA-506-411	5	1.62	B/Bn	1.016+002	9.1	0 90/01/90	05/10/06 04/25/08 04/28/06
7553-56-2         Lotine brice         \$0,00         LA-505-41           7440-33-7         1 ungeton. ICP         \$0,00         LA-505-41           7440-57-5         Gold by ICP         \$0,00         LA-505-41           7440-57-5         Gold by ICP         \$0,00         LA-505-41           7440-57-5         Gold by ICP         \$0,00         LA-505-41           7440-59-6         Meroury by ICP         \$0,00         LA-505-41           7440-59-9         Bernuth by ICP         \$0,00         LA-505-41	W000000659 L	DSWC48-4	13494-80-9	Tellurium by ICP	SOLID	LA-505-411		AN	6/0n	<b>8</b> .1	0.0	05/10/06 0/	06/10/06 01/25/09 04/28/08
1         740-33.7         Tungton. ICP         SOUD         1A:506-41           2         2440-57-5         Geld by ICP         SOUD         1A:506-41           7         7430-97-6         Memory by ICP         SOUD         1A:506-41           7         7430-89-9         Bernuth by ICP         SOUD         1A:506-41            7         7430-89-9         Bernuth by ICP         SOUD         1A:506-41	W00000029 I	DSWC#8-4	7553-58-2	lodine by ICP	SOLID	LA-505-411		AN	0/ôn	<b>00</b> .1	0.0	05/10/06 04	05/10/06 04/25/06 04/28/06
7440-57-5         Gold by ICP         SOLID         I.A.505-411           7420-37-6         Mervary by ICP         SOLID         I.A.505-411           7440-88-9         Bismuth by ICP         SOLID         I.A.505-411           7440-89-9         Bismuth by ICP         SOLID         I.A.505-411	W060000559 1	DSWC#8-4	7440-33-7	Tungsten, ICP	anos	LA-505-411		NA	0/0n	8'1	0.0	05/10/06 04	05/10/06 04/25/06 04/28/06
7429-97.6         Merrury by ICP         SOLID         LA: 505-411         U         < 2	W060000659 1	DSWC#8-4	7440-57-5	Gold by ICP	SOLD	LA-505-411		AN	Cydn -	1.00	0.0	05/10/06 04	05/10/06 04/25/06 04/28/08
7440-86-9         Bismuth by ICP         SOUD         L4-505-11         U         < 2	W06D000859 1	DSWC#B-4	2438-97-6	Mercury by ICP	soup	LA-505-411		AN	ê/ôn	00 <sup>°</sup> 1	0.0	05/10/08 04	05/10/08 04/26/08 04/23/08
the second se	1 655000090M	DSWC#8-4	2440-68-9	Bismuth by ICP	SOLD	111-205-411	5	< 2.23	6,6n	1.01++002	2.2	05/10/06 04	05/10/06 04/25/06 04/28/06
	W06000059 DSWC#8-4	DSWC#B-4	1440-61-1	Uranium by KCP	SOLID	LA-505-411		AM	C/On	1.00	0.0	02/10/06 04	05/10/06 04/25/08 04/28/06

U - Analyzed for buil not detected above limiting criteria. E - Analyte is un estimate, has potentially larger errors MDL = Minimum Detection Limit RQ = Result Qualifier

 $DF\approx Dh$  indicates results that have NOT over valuated: + - indicates results that have NOT over valuated: + - indicates more than six qualities symbols Report WODS/ver, 1.2 Fast Flux Test Facility

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## WSCF ANALYTICAL COMMENT REPORT

Attention: Project Number	M EBY/JW Rich MISC		Group #:	20060391	
Sample # Citent ID	Lab Area	Tar I	Comment		
	VALGROUP		(CP-AE8: Mah preparation blank results for phonghrona, elicen, bismuch, venedium, copper, mangenese, and potassuum: 'C' flags if applicable. High antimony and zite and low disontum LCS restovenes, no flags is usued because often tC is acceptable. High titerain and low channes, solve dupicals (graite it applicable). Low silver and sticon and high sodium golfs recoveries; no flags is usued because all other CC is acceptable. Annihum, berium, cation, and trigh sodium splite recoveries; no flags is usued because all other CC is acceptable. Annihum, berium, cation, insurresium, and unangarese sample results beyond effective aplice range (golion results marked "MA").		
Lab Arcas: VALGROUP - LoGSAMP - 1 This report may not be represented, escaption	ROUP - Group Validation AMP - Login for Sample at ease in the antiety without the antien	- Group Validation VALTEST - Test Validation Login for Sample LOGTEST - Login for Tests in the minety without the written approval of the WSCF Laboratory.	TESTDATA - Test Data Entry	-	
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## TENTATIVELY IDENTIFIED PEAK REPORT WSCF

Group #: 20060391	RT RQ Result Units
	CAS¢
	Peak Name
	Test Name
Attention: Project Number	Sumple # Clicari ID

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This record may not be reproduced, namept in the entirety without the written approval of the WISCF Laboratory. Report Date: 12-may-2006

RQ=Result Qualifier

W\_005E v 1 Report#: 2006/391

						FFTF-31477 Revision 0 Appendix G
WSCF METHOD REFERENCES REPORT	The tesuks provided in this report were generated using the following WSCF Laboratory procedures. For your convenience, this table provides a listing of the regulatory or industry methods that are referenced by each of these WSCF procedures. Please note that the most recent version of the regulatory or industry method is listed here even though the WSCP procedure may reference an older version of the method. Also, a reference to a regulatory or method here does not necessarily indicate a verbatim implementation of that method.	LA-212-402 Determination of pH Direct Measurement E7A SW-346 9040B pH ELECTROMETRIC MEASUREMENT E7A-600/4-79-020 ISO.1 pH	LA-505-411 LA-505-411: ELEMENTAL ANALYSIS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPE EPA SW-846 6010B INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY	LA-519-401     I.A-519-401: SPECIFIC CONDUCTANCE       ASTM D1125     Standard Test Methods for Electrical Conductivity and Resistivity of Water       EPA 5W-546 9050A     SPECIFIC CONDUCTANCE       EPA 5W-79-020     I20.1     CONDUCTANCE	LA-533-410 LA-533-410: ANION ANALYSIS BY ION CHROMATOGRAPHY EPA-600/R-94-111 300.0 DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY	Note: A complete list of WSCF analytical procedures and referenced regulatory or industry methods is available online at \\apU06\uspfcosydocs\WSCF\Sample Mgmt\ProcedureMethodCrossReference.pdf. This document includes on-line links to full-text versions of the procedures and methods, where available. Report Date: 12.resy.2005 Report w_co60331 Report w_co6001

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	SAF Number: NA Sample Date: 04/25/06 Receive Date:04/28/06	RQ			5		Þ	Þ	Þ	Þ																		5	Þ	
	SAF Number: NA Sample Date: 04/25 Receive Date:04/25	Upper Limit			20,000	20.000	20.000	Z0.000	20.000	20.000	20.000	125.000	125.000	125.000	125,000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000			300,000	300,000	
PORT		Lower Limit			0.000	0.000	0:000	0.00	0.000	0.000	0.000	75.000	75.000	75,000	75,000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75,000			0.000	0.000	1
Y QC RE		Analysis Date			04/28/06	04/28/08	04/28/06	04/28/06	04/28/06	04/28/06	04/28/08	04/28/06	04/28/06	04/26/04	04/28/06	04/28/06	04/28/08	04/28/06	04/28/06	04/2B/06	04/28/08	04/28/06	04/28/06	04/28/06	04/28/05			04/28/06	04/28/08	
RATOR		Units			Q.J.	Q.	<b>Q</b> ab	Qur.	Q4F	Odk	Ē.	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Record	% Recev	A Recov	% Recov	X Racev	% Recov	% Racev			тQЛ	mg/t	1
LABO		QC Yield			n/a	4.898	u/a	n/a	e/u	8/L	0.749	919.19	104.124	95.354	97,160	92.414	92.760	112.626	90.404	106.155	95.360	86.843	158,86	C69759	100.001			e/u	e/u	
LYTICAL		QC Found			<1.86a0	7.53e+U0	< 8.00+1	< 1.96e-1	< 3.60+1	< 1.56e0	1.34e+03	1.82a +00	1.010+00	4,728-01	4.799-01	4.028-01	8.84a-01	2.238+00	1.7%++00	1.02e+00	4.75e-D1	4.730-01	4.30e-01	8.08e-01	2.16e+00			< 9.304-2	<:5.30e-2	
WSCF ANALYTICAL LABORATORY QC REPORT	ography	CAS#		<b>JED WITH SAMPLE</b>	24958-67-B	16687-00-6	16984-48-8	N-ZON	NC3-N	PT(M_P	14908-79-8	24359-07-8	16887-00-6	16934-48-8	NQ2-M	NC3-N	e-bOd	14808-79-8	24969-67-9	16887-00-6	8-84-49601	N-20N	N-CON	P04-P	14808-79-8			24959-67-9	24959-67-9	
	SDG Number: 20060391 Matrix: WATER Test: Anions by Ion Chromatography	Analyte	): W06000056	BATCH QC ASSOCIATED	Bromide (Bit) by IC	Chioride (Ci) by IC	Fluojide (F) by IC	Mitrile (MF by IC	Nitrate (N) by IC	Phosphate (P) by IC	Suffate (SD4) by IC	Bromide (Br) by IC	Chloride (CI) by IC	Fluende (F) by IC	Nitrite (N) by IC	Nitrate [N] by IC	Phosphate (P) by IC	Sulfate (SO4) by (C	Bromide (Br) by (C	Chloride (CB by IC	Fluorida (F) by (C	Nitrite (N) by IC	Nitrate (N) by IC	Photohute (P) by IC	Sufferen (SO4) by IC			Bromitcie (Bit) by IC	Bromide (Br) by IC	
	SDG ] Matriy Test: J	Type C	Lab ID:	BATC	DU*	909	ß	909	400	ano	đ	ŝN	N5	Ŵ	ws	SM	5W	SM	QSW	NSO	MSD	NSD	OSM	MSD	USN	D T T T	האורם לר	BLANK	BLANK	

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SAF Number: NA Sample Date: Receive Date: ĝ ⇒ Þ ∍ ∍ 300.005 300.000 300.000 300.000 300.000 300.000 300,000 300.000 300:00E 300.000 300.005 120.000 120.000 120.000 120.000 300.000 300.000 300.000 120.000 120.000 120.000 120.000 300.000 300.000 120.000 Upper Limit 90.000 80,000 0.000 0.000 0.00 0.000 0.000 0.00 0.00 880 0.000 0.00 0.000 000010 0.000 0.000 80.000 80.000 80.000 80.000 90:000 90.000 90.00 90.000 0.000 0.000 30.000 0.000 Lower Limit Analysis 04/28/06 04,29,06 04/28,06 04/29/06 04/28/06 04/28/06 04/28/06 04/28/08 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/06 04/28/08 04/28/06 04/28/08 04/2B/06 04/28/06 04/28/08 04/28/06 Date % Recov % Pecor % Recov 96 Recov % Recov % Recov A RECOV 6 Pecov % Recov Sh Recov % Record & Recov Units 님 Ě ě ц Зб ۲ R ہے R ž 뒅 ř Ĕ 뮙 **P** 鸉 d de ĥ QC Yield 000.68 101.000 87.869 103.571 91,300 000.001 94-378 89.645 104.437 98.193 55,085 105.455 ŝ 2 2 2 2 222222 ۲, S. 2 e/u OC Found < 1.80e-2 <1.30<del>6</del>-1 <1.30<del>6-</del>1 50 + 626' l 9.13+401 <1.80e-2 <7.80e-2 < 7.80e-2 3.56e+02 1.16a+01 03e+02 <3.40e 2 < 4.00a-2 4.04e+D2 2.03+ 62 ,04e+02 .83ie+02 < 3,40e-1 <3.40e-2 < 4.00e-2 < 1.00<sub>8</sub>-2 < 9.80e-3 < 9.80e-3 < 9.80e-3 < 1.80e-2 <7.80e-2 <1.30e-1 9.409+01 9.784+01 1.78e+01 0-00-6880 16887-00-6 16887-00-8 9-00-6889 6964-48-8 6964-49-8 0984-40-8 6887-00-8 4906-79-6 14808-79-8 14808-79-8 24959-87-9 24959-67-9 16884-48-8 16994-48-8 CAS# N02-N N02-N N-DOM N-CON NO3-N NO2-N N-ZON N02-N P04P NEON PO4-P P04-P 9-40 1-10 <u>64</u>5 **[est: Anious by Ion Chromatography** SDG Number: 20060391 Matrix: WATER Phosphate (P) by IC Phosphata (P) by IC Phosphere (P) by KC Sulfate (SO4) by (C Sulfate [SO4] by IC Subtate (SO4) by IC Photophate (P) by IC Phosphate (F) by #C Chloride (CI) by IC Chloride (Cit by IC Chloride (Cit by IC Bromide (Br) by IC Bromide (Br) by IC Chioride (C) by IC Chloride (CI) by K Fluoride (F) by (C Fluoride (F) by (C Fluoride (F) by IC Fluoride (F) by IC Fluorida (F) by (C Nitrate (N) by IC Nitrate (N) by IC Nerate (N) by IC Nitrate (N toy IC Nitrate (N by IC Narries (N) by IC Nerie (N) by IC Nitrite (N) by IC Marite (Ni by IC Nitrito (N) by IC Analyte BLANK BLANK BLANK BLANK BLANK BLANK BLANK BLANK BLANK 9LANK BLANK 8 ĨĴ **NANK** BLANK BLANK BLANK BLANK BLANK AI ANK 8 ŝ ő S) I g 

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QC REPORT	
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ber: NA ate: ate:	ĝ
SAF Number: Sample Date: Receive Date:	Upper L/mit 120.000
	Lower Limit 80.000
	Analysis Date 04/28/06 04/28/06
	L'Inits % Recov
	QC Yield 86.250 89.750
	QC Found 3.81e + D2 3.99e + 02
lography	CAS# 14808-79-8 14808-79-8
SDG Number: 20060391 Matrix: WATER Fest: Anions by Ion Chromat	Analyte Suitate (SO4) by IC Suitate (SO4) by IC
SDG ) Matrix Test: /	S H S S

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Y QC REPORT	
WSCF ANALYTICAL LABORATORY	

SDG Matri Test: 1	SDG Number: 20060391 Matrix: WATER Test: pH Direct Measurement							SAF Nun Sample D Receive I	SAF Number: NA Sample Date: 05/08/06 Receive Date:05/08/06	
S ar	Analyte	CAS#	QC Found QC Yield Units	QC Yield	Units	Analysis Lower Date Limit	Lower Lámit	Upper Limit	RQ	
Lab II BATC	Lab ID: W06W000037 BATCH QC ASSOCIATED WITH	ITH SAMPLE								
U/P	pH Dhact Measuranem	£	6.310	<b>7537</b>	Calif	05/08/08	0.000	20.000		
	BATCH QC LCS pH Direct Masseurymment	æ	7.867	968.0	Ratio	05,08/08	0.900	1.100		

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SAF Number: NA Sample Date: 04/25/06 Receive Date:04/28/06	RQ		
SAF Numb Sample Da Receive Da	Upper Limit	20,000	000.011
	Lawer Limit	0000	000.06
	Analysis Date	06,008/08	05,008,008
	Units	C <sub>2</sub> 4	<b>8</b> 왕
	<u>O</u> C Yield	ê79.	100.385
	QC Found QC Yield Units	61 ci	130.5
	CAS#	WITH SAMPLE conduct	CONDUCT
SDG Number: 20060391 Matrix: WATER Test: Conductivity	Analyte	Lab ID: W06000956 BATCH QC ASSOCIATED W oup conductivity	QC Conductivity
SDG Nur Matrix: V Test: Con	OC Type	Lab ID: BATCH ( <sup>DUP</sup>	BATCH QC LCS Condu

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ICE N	SDG Number: 20060391 Matrix: SOLID Test: ICP - All possible metals							SAF Number: NA Sample Date: 04/25 Receive Date:04/28	SAF Number: NA Sample Date: 04/25/06 Receive Date:04/28/06
Type Type	Апајуtе	CAS#	QC Found	QC Yield	Units	A nulysis Date	Lower Limit	Upper Limit	RQ
Lab ID: BATCH	Lab ID: W06000059 BATCH OC ASSOCIATED WITH SAMPLE	H SAMPLE							
	Silver by ICP	7440-22-4	165.859	83.866	% Recov	05/10/08	76.000	125.000	
•	Aluminum by ICP	7429-90-5	MA	п/е	% Recov	00/10/08	75.000	126.000	
1	Arsenic by ICP	7440-39-2	196	100.001	% Recov	05/10/08	75.000	125.000	
-	Baron by ICP	7440-42-8	186.7	94.293	% Recov	06/10/08	75.000	126.000	
-	Barlum by KCP	7440-39-3	<b>N</b> A	е/и.	% Recov	05/10/08	75.000	125.000	
-	Berylium by ICP	7440-41-7	93.391	96,334	% Recov	05/10/08	76.000	125.000	
	Bismuth by ICP	7440-69-8	167	84.343	The Recov	06/10/08	75.000	125.000	
	Celcium by ICP	7440-70-2	AN	e/u	% Recov	05/10/08	76.000	125.000	
Ŭ	Cedmium by ICP	7440-43-9	189	96.466	S Recov	05/10/08	75.000	125.000	
	Cobait by ICP	7440-48-4	184.2	36.030	The Record	00/10/08	75.000	125.000	
Ĩ	Chromium by ICP	7440473	150	љ.758	Recov	05/10/06	75.000	125.000	
2	Copper by ICP	1440-50-B	193	97,476	% Recov	02110/08	75.000	125.000	
-	tion by ICP	7439-89-8	MA	n/a	W Recov	05/10/06	75.000	125.000	
	Potassium by ICP	7440-09-7	2018	818.101	% Recov	02/10/08	75.000	125.000	
	Eithium by ICP	7439-93-2	<b>98.92</b>	36.919	16 Recov	80/QL/50	70.000	130.000	
-	Magnesium by ICP	7438-95-4	A.A.	n/a	% Recov	05/10/06	75.000	125.000	
-	Manganase by ICP	7428-86-5	NA	е/ч	% Recov	02/10/06	76.000	125.000	
-	Molybdenum, ICP	7439-96-7	178	6639-663	% Recov	05/10/06	76.000	126.000	
	Sadium by ICP	7440-23-5	226	114,141	% Recov	02/10/08	76.000	125,000	
-	Nickel by ICP	7440-02-0	198	100.000	% Recov	05/10/06	75.000	125.000	
-	Phospherus by KCP	7723-14-0	622	115.857	% Recov	05/10/06	70.000	130.000	
	Least by ICP	7439-92-1	190.84	96.384	% Recov	02/10/06	76.000	125.000	
-	Antimony by ICP	7440-36-0	175	86.384	% Recov	00/01/50	75.000	125.000	
63	Selenium by ICP	7783-49-2	171	56.384	% Recov	05/10/06	76.000	126.000	
43	Shicon by ACP	7440-21-3	159	B0.303	% Recov	05/10/06	75.000	125,030	
	ji ji	7440-31-5	174	87,879	% Recov	05/10/08	75.000	125.000	

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SAF Number: NA Sample Date: 04/25/06 Receive Date:04/28/06	ВQ В																									•					
SAF Nun Sample I Receive I	Upper Limit	130.000	125.000	126.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	1 25.000	1 25.000	125.000	125.000	125.000	125.000	125.000	125.000	126.000	125.000	125.000	125.000	125.000	125.000
	Lower Limit	70.000	75.000	75,000	75.000	75.000	75.000	75.000	75,000	75.000	75,000	75.000	75.000	75.000	75.000	75.000	76.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	75.000	76.000	75.000	75,000	75.000	75.000	75.000
	Analysis Date	06/10/06	05/10/08	02/10/08	02/10/08	05/10/06	05/10/06	05/10/06	00/10/00	05/10/06	00/10/00	05/10/06	05/10/06	05/10/06	05/10/05	05/10/06	05/10/06	02/10/06	02/10/00	05/10/06	05/10/06	05/10/06	05/10/06	08/10/08	05/10/06	06/10/06	05/10/06	02/10/06	65/10/08	06/10/06	05/10/06
	Units	# Recov	% Record	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recov	% Recor	% Record	% Recor	% Recov	% Recov	% Recor	% Herow	% Recov	% Recov	% Recov	14 Herov	% Recov	% Aeoov	% Recor	R Recov	N Recov	A Record	% Recov	% Recov
	QC Yield	76.768	211.616	75,253	545,44	130,58	100.758	58,499	n/a	103.061	95.255	n/a	94,379	85.714	6/U	96.429	92.449	63.776	96,939	n/a	102.296	968 86	n/a	n/a	887.68	144.898	95.B18	101.531	97.367	<b>89.79</b> 8	<b>36</b> .224
	QC Found	76	419	<b>†4</b> 0	166.8	164.3	199.5	114.659	A M	202	186.7	AA	92,491	168	<b>N</b> A	169	181.2	125	190	MA	2006	96.92	NA	MA	175	284	159	661	190.64	-76	69:
	CAS #	7440-24-6	7440-32-6	7440-28-0	7440-62-2	7440-66-6	7440-67-7	7440-22-4	7429-90-5	7440-38-2	7440-42-8	7440-39-3	7440-41-7	7440-69-9	7440-70-2	7440-43-9	7440-48-4	7440-47-3	7440-50-8	<b>3-68-6</b> 542	7440-09-7	7438-83-2	7438-85-4	7439-96-5	7439-98-7	7440-23-5	7440-02-0	7723-14-0	7439-92-1	7440-36-0	7782-49-2
SDG Number: 20060391 Matrix: SOLID Test: ICP - All possible metals	Analyte	Segnitum by ICP	Tranium by KCP	Thatkium by ICP	Varedium by ICP	Zina by ICP	Zirsonum by ICP	Salver by ICP	Aluminum by ICP	Arsenic by ICP	Blaron by ICP	Barium by ICP	Beryllium by ICP	Bismuth by ICP	Calcium by ICP	Cadmium by ICP	Cobalt by ICP	Cheamium by ICP	Copper by ICP	Iron by ICP	Potassium by ICP	Lithium by ICP	Magnasium by ICP	Mengenese by (CP	Molybdenum, ICP	Sadium by KCP	Micket by ICP	Phosphorus by ICP	Lead by ICP	Antimory by (CP	Selentum by ICP
SDG } Matrix Test: I	8 <u>8</u>	SN N	ŝ	SM	MS	ŞM	WS	MSD	MSD	MSD	MSD	MSD	MSD	MSD	MSD	OSM	OSW	MSD	asm	OSW	NSD	NSD	NSD	(USIN)	MSD	CIŞIN	USIN	osw	NSO	OSW	NŞD

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Ĩ	5/06 8/06																															
	SAF Number: NA Sample Date: 04/25/06 Receive Date:04/28/06	õ	-			-					•																		•			
	SAF Nur Sample L Receive )	Upper Limit	126.000	125,000	125.000	125.000	1 ZE.000	125,000	126.000	125.000	20.000	20.000	20.000	20.000	20.000	20:00	20.000	20.000	2000.02	20.00	20.002	20,000	20.000	20.000	20.000	000'02	20,000	20.000	20:000	20.00	20,000	20,002
		Law <del>ar</del> Limit	75.000	75.000	75.000	75.000	75.000	75,000	75 000	75.000	0.000	0.000	0:00	0.000	0000	0.000	0,000	0.000	0000	0.000	0.000	0.000	0.000	0,000	0:000	000.0	0.000	000 8	0,000	0000	0.000	0.000
j.		Analysis Date	05/10/06	90/01/50	90/01/50	06/10/06	90/0L/00	05/10/08	05/10/06	90/01/90	02/10/06	05/10/06	05/10/06	06/10/08	90/00/50	06/10/08	02/10/06	05/10/20	05/10/06	00/01/50	00/10/00	05/10/08	06/10/08	00/10/08	05/10/06	05/10/08	05/10/06	05/10/06	05/10/08	\$0/01/60	05/10/06	05/10/06
		Units	% Recov	% Hecov	% Placov	M Recov	X6 Recov	% Recov	% Recov	% Recov	60 D		Q.X	C 2	OHE	ę	<b>PPO</b>	One	<b>C</b> HR	RPD	C.	04	RPD	RPD	<b>C</b>	C a	RPD	RPD	CHR	O'B		Q.
		OC Yield	82,755	87,755	66.735	181.633	76.020	84 288	103.724	100.255	35.405	eyu	3.015	1.015	n/a	0.048	1.612	n/a	1.015	0.828	17.174	0.551	11/B	0.468	1.027	n/a	n/a	0.884	23.747	4,167	13.008	1.015
		OC Ferred	123	172	<b>4</b> 6	356	145	184,8	203.3	1.961	58.438		103.061	95.255		94.0.46	85.714		96,429	92.449	63.776	96.939		102.298	<b>38.89</b> 8			39.230	144,898	95.918	101.531	97.367
		CAST	7440-21-3	7440-31-5	7440-24-6	7440-32-6	7440-28-0	7440-62-2	7440 66.6	7440-67-7	7440 22 4	7429-90-5	7440-38-2	7440-42-8	7440-3B-3	7-14-044-1	7440-69-9	7440-70-2	7440-43-9	7440-46-4	7440-47-3	7440-50-8	7 438-89-6	7-940-06-2	7439-93-2	1439-85-4	7439-56-5	7438-88-7	7440-23-5	7440-02-0	7723-14-0	7438-82-1
	SDG Number: 20060391 Matrix: SOLID Test: ICP - All possible metals	Analyte	Silicon by ICP	Tā	Strandum by ICP	Titanium by ICP	Thattum by ICP	Vanadium by ICP	Zine by KCP	Ziroonlum by ICP	Silver by ICP	Aluminum by ICP	Arsanic by ICP	Boron by ICP	Barium by ICP	Beryllium by 1CP	Bismuth by ICP	Calcium by ICP	Cadmium by ICP	Cobat by ICP	Cheomium by ICP	Coppart by ICP	hon by ICP.	Potassium by ICP	Linhum by ICP	Megnesium by ICP	Mangemeet by ICP	Molybdercum, ICP	Sodium by ICP	Nickel by ICP	Photphorus by ICP	Lead by ICP
ļ	SDG Number: Matrix: SOLID Test: ICP - All	8Ĕ	MSD	MSD	MSD	MSD	MSD	MSD	NED	0SM	SPK-RPD	SPK-RPD	SPK.RPD	CICH-MOS	CMR-N4S	SPIC-RPD	SPK-RPD	SPK-RPD	SPK RPD	Clob-State	ерк. к <del>р</del> о	GPK-RPD	SPK-RPD	SPK-RPD	SPK-APD	CIAR-X42	SPK-APD	SPK-RPD	SPK.APD	SPK.APD	CHP. MAS	CIPH-MPD

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SDG N Matrix: Test: IC	SDG Number: 20060391 Matrix: SOLID Test: ICP - All possible metals							SAF Number: NA Sample Date: 04/25 Receive Date:04/28	er: NA e: 04/25/06 b::04/28/06
ခ်င်	Analyte	CAST	OC Found	OC Yield	Units	Analysis Date	Lower Limit	Upper Limit	M
SPIK-RPD	SPK-RPD Antimony by ICP	7440-35-0	88.796	1.585	<b>BPD</b>	05/10/06	0.000	20.000	
SPIC-RPD	Selenium by ICP	7782-49-2	86.224	0.182	C-BJ	05/10/06	0.000	20.020	
SPK-RPD	Silicon by ICP	7440-21-3	62.755	24.533	C-RL	05/10/06	0.000	20.000	
SPK-RPD	Tia	7440-31-5	87.755	0.141	C-R-D	05/10/06	000	20,000	
SPK-RPD 1	Strewturn by ICP	7440 24-6	86.735	12.192	RPD	06/10/06	0.003	20.000	
SPK-RPD	Titersium by ICP	7440-32-6	181.633	15.249	<b>RPD</b>	08/10/06	0.003	20.000	
SPK-RPD	Thallach by ICP	7440-28-0	76.020	1.014	ArD	02/10/00	0.003	20.000	
SPIC-RPD		7440-62-2	94.286	0.060	RPD-	05/10/08	0,000	20.000	
SPK-RPD		7440-56-6	103.724	10.816	GUD	05/10/08	0.000	20.000	
SPK-RPD		7440-67-7	100.255	0.500	RPD	05/10/06	0.000	20.000	

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W13g Worklist/Batch/QC Report for Group# 20060391

WL#	S#	Batch	QC#	Тгау Туре	Sample#	Test
28527	2	28898	32744	BLANK		Anions by Ion Chromatography
28527	_	28898		BLANK		Anions by Ion Chromatography
		28898	+	BLANK		Anions by Ion Chromatography
28527	3			LCS		Anions by Ion Chromatography
28527	-	+		LCS		Anions by Ion Chromatography
28527		28898		DUP	W060000956	Anions by Ion Chromatography
28527	_	28898		MS	W060000956	Anions by Ion Chromatography
28527	-	28898		MSD	W060000956	Anions by Ion Chromatography
28527	•	28898		SAMPLE	W060000956	Anions by Ion Chromatography
28527	_	28898		SAMPLE	W060000957	Anions by Ion Chromatography
		28898		SAMPLE	W060000958	Anions by Ion Chromatography
				•		
28588	4	28959	32801	LCS		pH Direct Measurement
28588	-	28959		SAMPLE	W060000956	pH Direct Measurement
28588	ġ	28959	32901	SAMPLE	W060000957	pH Direct Measurement
28588	10	28959	32801	SAMPLE	W060000958	pH Direct Measurement
28588		28959	32801	DUP	W06W000037	pH Direct Measurement
						-
28589	1	28960	32803	LCS		Conductivity
28589	3	28960	32803	DUP	W060000956	Conductivity
28589	2	28960	32803	SAMPLE	W060000956	Conductivity
28589	4	28960	32803	SAMPLE	W060000957	Conductivity
28589	5	28960	32803	SAMPLE	W060000958	Conductivity
28592	9	28963	32815	MS	W060000959	ICP - All possible metals
28592	10	28963	32915	MSD	W060000959	ICP - All possible metals
28592	. 8	28963	32815	SAMPLE	W060000959	ICP - All possible metals
28592	10	28963	32815	SPK-RPD	W060000959	ICP - All possible metals
						-