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Revision 0

Compilation of Disposable Solid Waste Cask Evaluations

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

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

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J. R. Thielges
Fluor Hanford, Inc.

S. A. Chastain
Fluor Hanford, Inc.

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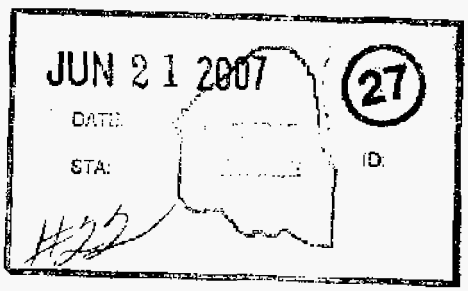

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COMPILATION OF DISPOSABLE SOLID WASTE CASK EVALUATIONS

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

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 Area 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 until they were permanently covered in September 1990. Permanent covers for these four 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:

Cask	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 Ø36 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 ~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 seen in the initial scan plus located additional rebar.

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

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,

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 11½-inch wide, 14-inch long, and 2½-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

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.

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

The condition and configuration of the five DSWCs currently stored on the 400 Area 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.

Table 1. Summary of DSWC Evaluations/Inspections

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. Some rust spots were noted in the floor and wall. No cracks or pitting were noted at the weld interface.	Acceptable	N/A
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. Some rust spots were noted in the floor and wall. No cracks or pitting were noted at the weld interface.	Acceptable	N/A

DSWC	Liner Inspection	Corrosion Evaluation	Weld 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. Some rust spots were noted in the floor and wall. No cracks or pitting were observed at the weld interface.	Acceptable	N/A
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. 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.	Acceptable	N/A
Impact Limiters	N/A	N/A	Acceptable

Table 2. Summary of Modifications

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

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.

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

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

APPENDIX A LIFTING ANCHOR BOLT INSTALLATION INFORMATION

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.

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.

DSWC ANCHOR INSTALLATION INFORMATION

DSWC S/N-004						
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	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 GROUP 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	----------	----------	----------	NO	----------
4	NO	----------	----------	----------	NO	----------
HOLE GROUP 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	NO	----------	----------	----------	NO	----------
4	NO	----------	----------	----------	NO	----------

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	~¾ BAR THICKNESS
2	YES	EXPLORATORY	<1/16" TOP R.S.	LONG (Assumed)	YES	FULL BAR THICKNESS
3	NO	----------	----------	--------	NO	---------
4	NO	----------	----------	--------	NO	---------
HOLE GROUP 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	----------	----------	--------	YES	~ ¼ BAR THICKNESS
2	NO	----------	----------	--------	NO	---------
3	NO	----------	----------	--------	YES	~ ¼ BAR THICKNESS
4	NO	----------	----------	--------	YES	~ ¼ BAR THICKNESS
HOLE GROUP 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	YES	FINAL	<1/16" R.S.	LONG (Assumed)	NO	---------
3	NO	----------	----------	--------	NO	---------
4	NO	----------	----------	--------	NO	---------

DSWC S/N-007						
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	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 GROUP 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 GROUP 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	EXPLORATORY	<1/16" TOP L.S.	LONG (Assumed)	YES	¾ BAR THICKNESS
2	NO	----------	----------	--------	NO	---------
3	NO	----------	----------	--------	NO	---------
4	NO	----------	----------	--------	NO	---------

DSWC S/N-008						
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	EXPLORATORY	~1/16" R.S.	LONG	NO	--------
2	NO	----------	---------	--------	NO	---------
3	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NO	---------
4	YES	EXPLORATORY	~¼" TOP L.S.	LONG	NO	---------
HOLE GROUP 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 R.S.	SHORT (Assumed)	YES	¼ BAR THICKNESS
2	YES	EXPLORATORY	~1/16" R.S.	UNK.	NO	---------
3	NO	----------	---------	--------	NO	---------
4	NO	----------	---------	--------	NO	---------
HOLE GROUP 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	---------

DSWC S/N-010						
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	NO	----------	----------	--------	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 GROUP 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	----------	----------	--------	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 GROUP 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	EXPLORATORY	<1/16" TOP R.S.	LONG	NO	---------
2	YES	EXPLORATORY	<1/16" TOP R.S.	LONG	NO	---------
3	YES	FINAL	~1/8" R.S.	LONG	NO	---------
4	YES	EXPLORATORY	NONE	LONG	NO	---------

TABLE NOTES FROM ANCHOR INSTALLATION:

Exploratory drilling drill bit sizes ranged from ¼" up to 1¼". Normally very little material was removed from rebar that was encountered during the exploratory drilling. Typically the rebar was just nicked with less than 1/16" material removed. Notations of < 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 (¼, ½, ¾ or Full Bar Thickness). These are only estimates base on field notes and sketches.

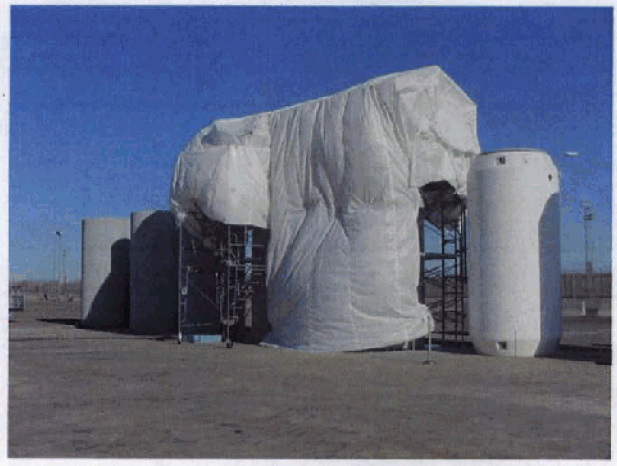
Radial rebar is #6 rebar (¾" diameter). Hoop rebar is #4 rebar (½" diameter).

DSWC LIFTING ANCHOR INSTALLATION

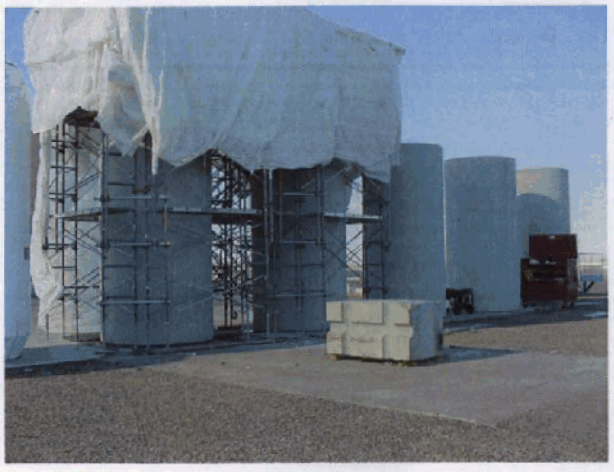
Performed per 4A-04-7583/M
during October and November of
2006

DSWC S/N-006 on ISA Pad

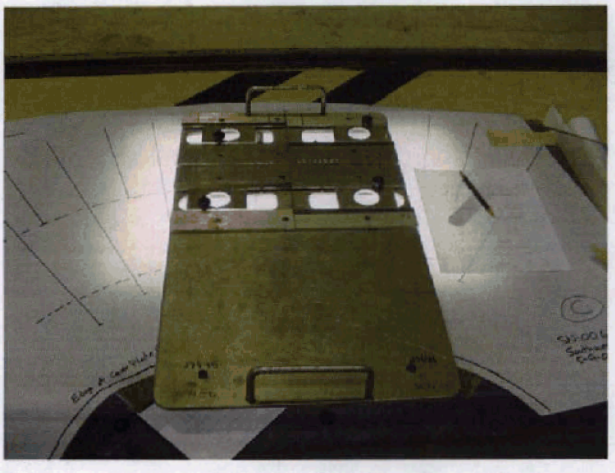
DSWCs S/N-007 & S/N-010 with scaffolding & weather enclosure.



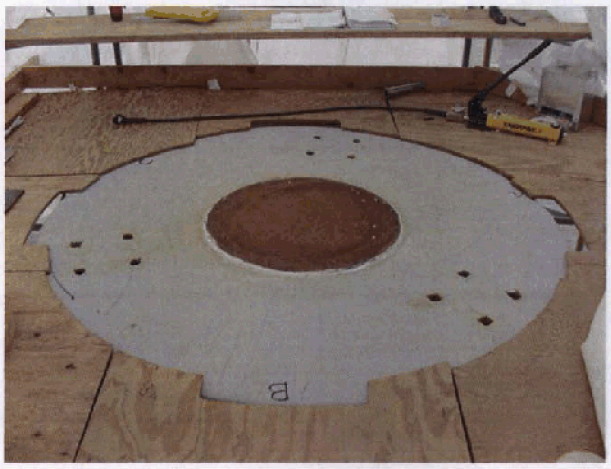
DSWCs S/N-007 & S/N-010 with scaffolding & weather enclosure.



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

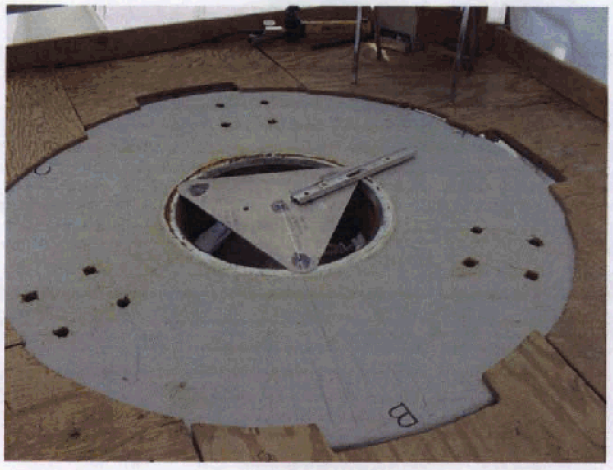


Prior to drilling. Temporary cover still installed. New anchor hole group letters have been assigned.

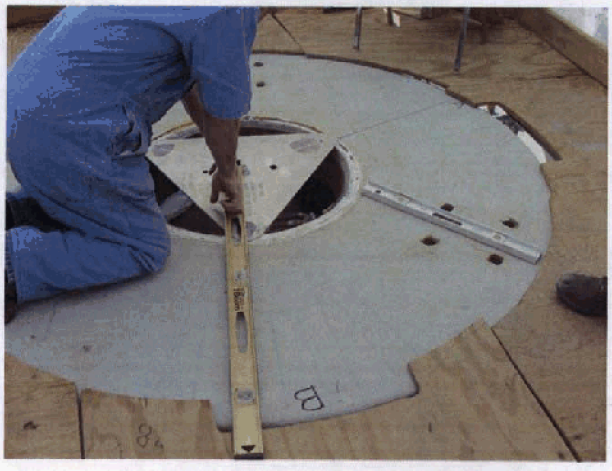


Temporary steel cover has been removed. Cask ID was used to locate Adjustable Template and Hole Pattern Angle Locating Template.

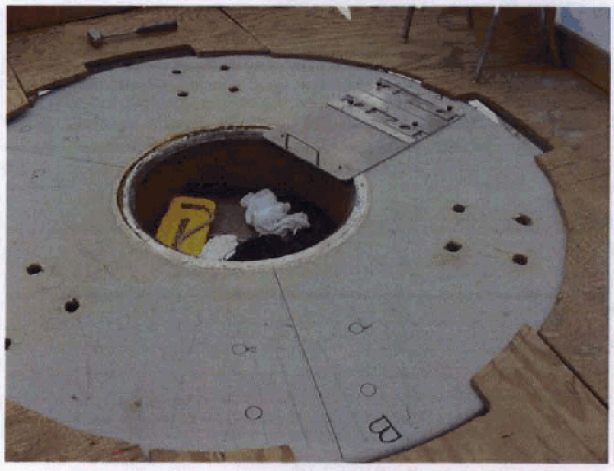
Hole Pattern Angle Locating Template placed in cask ID.



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

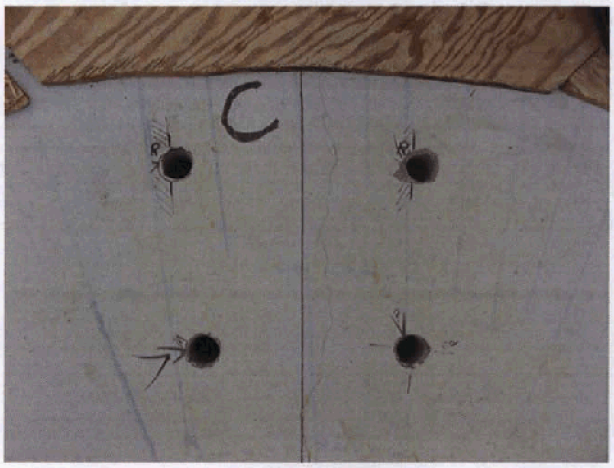


Adjustable Template used to mark start points for exploratory drilling.



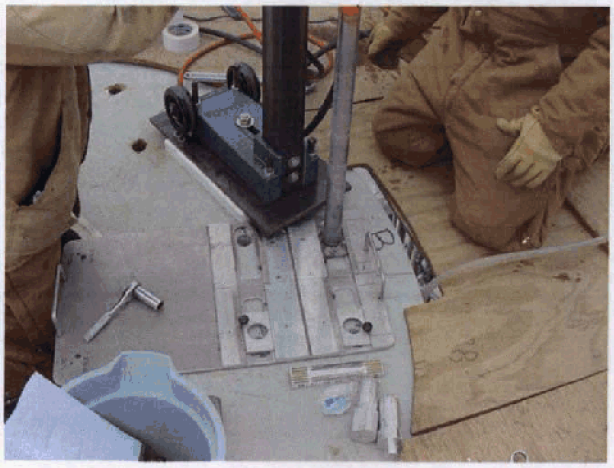
Exploratory drilling, dry with Hilti concrete drill bits.

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.

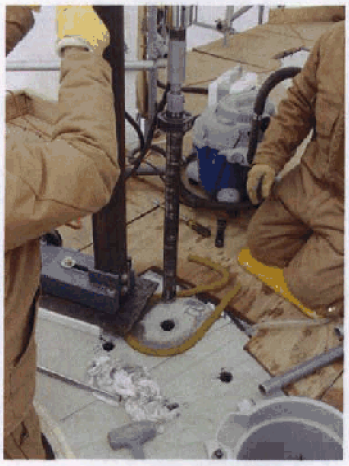
Starting core drilling using Adjustable Template with Core Drill Guide Bushing installed.



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

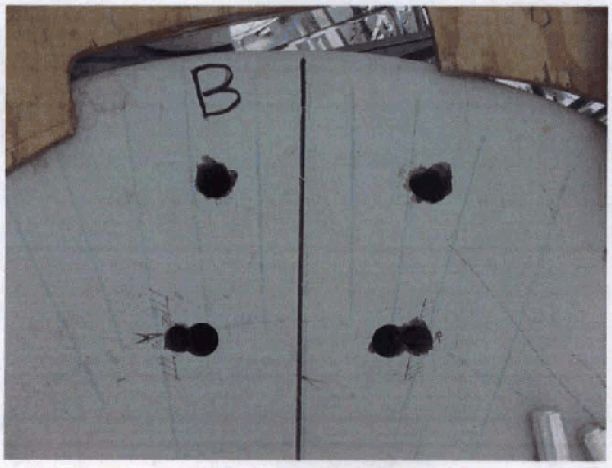
Continuation of core drilling without aid of Adjustable Template.

Drillco Undercut Tool installed on Drillco Drilling Machine.

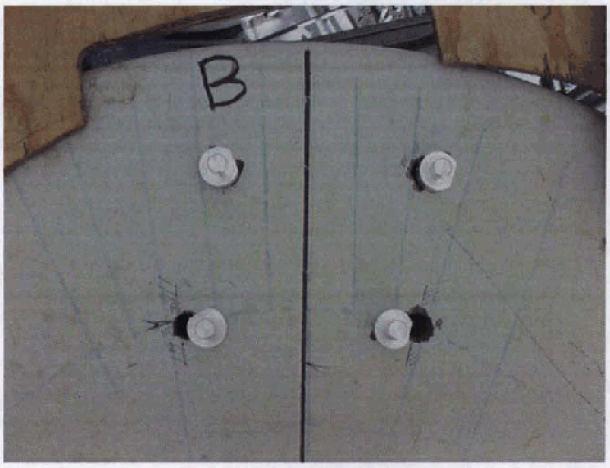


Undercutting hole with Drillco Undercut Tool.

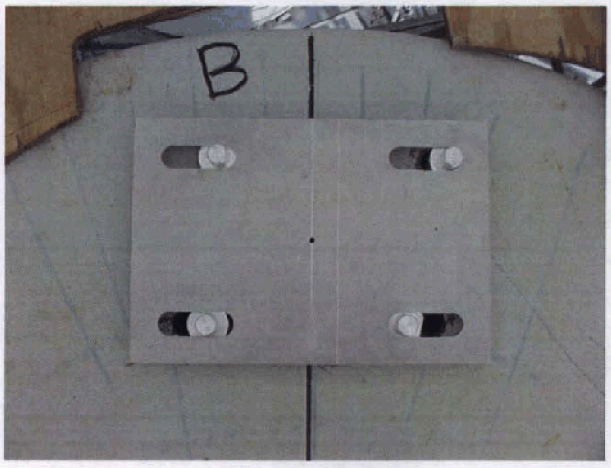
Completed core drilled holes at hole group B. Note relocated holes at locations B-2, B-3 & B-4.



Gauge pins inserted in completed anchor holes.

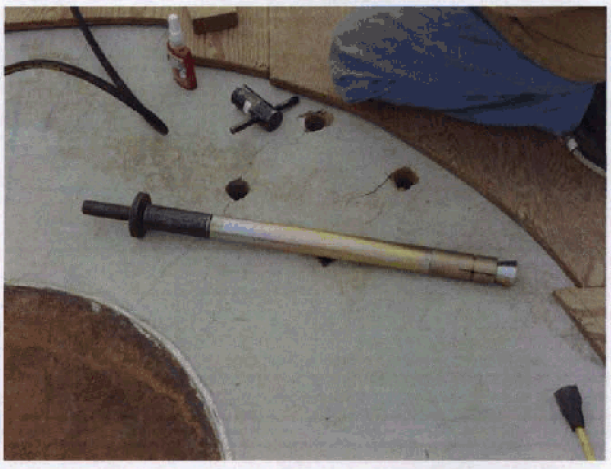


Lift Lug template set over gauge pins to verify proper location of anchor holes.

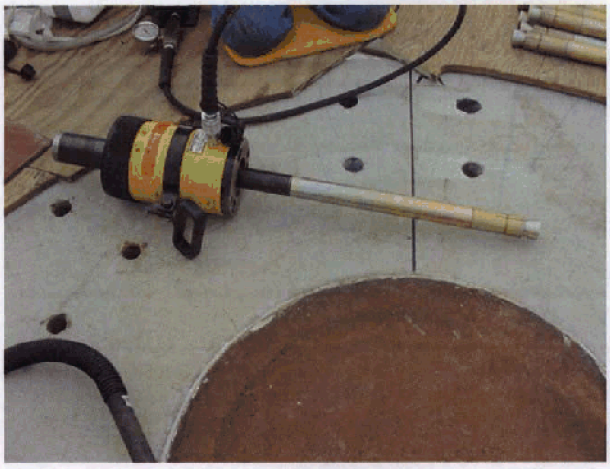


Drillco Flush Mount Anchors.

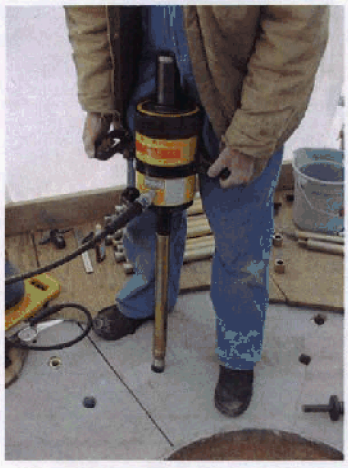
Drillco Flush Mount Anchor with some of the setting tooling (black items) attached.



Drillco Flush Mount Anchor inserted in hydraulic setting tooling.

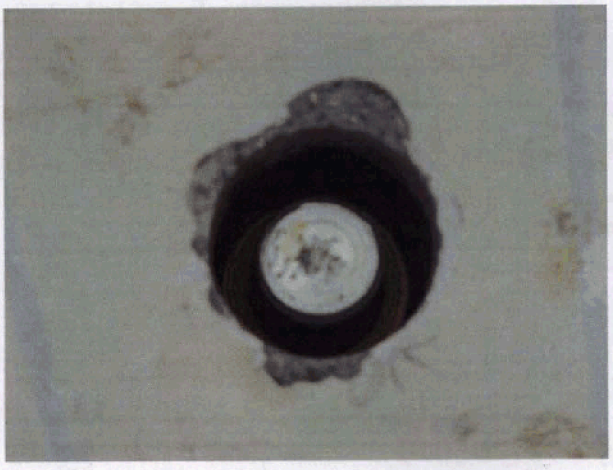


Drillco Flush Mount Anchor in hydraulic setting tooling being inserted in hole.



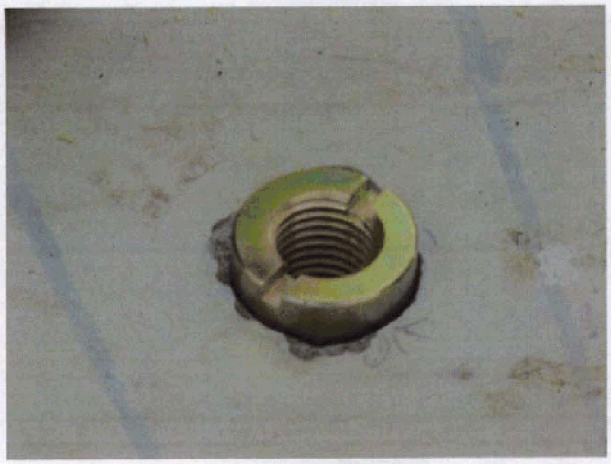
Setting Drillco Flush Mount Anchor using hydraulic setting tooling.

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

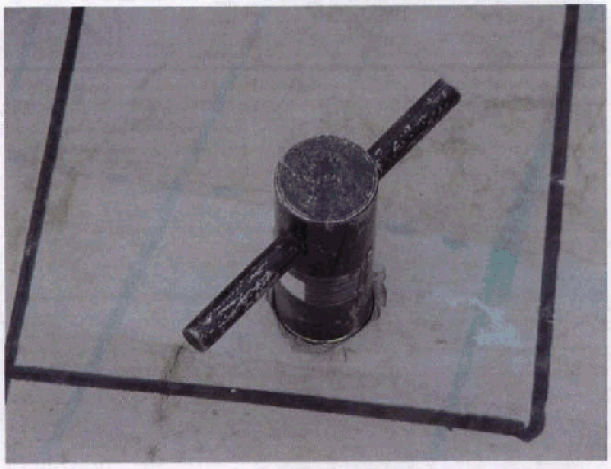


Drillco Flush Mount Anchor Coupler
(aka Coupler Nut).

Installing Coupler.

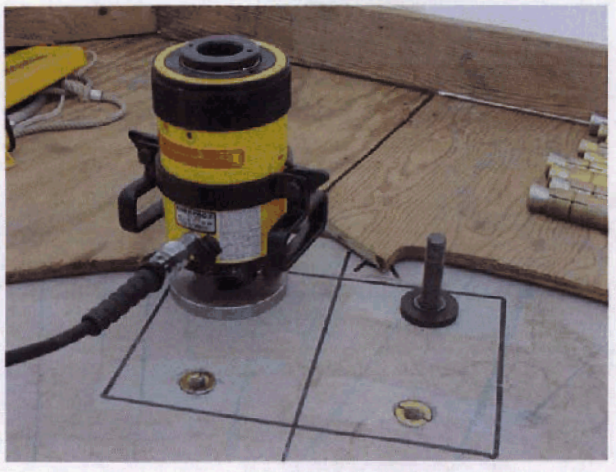


Installing Coupler using installation tool.

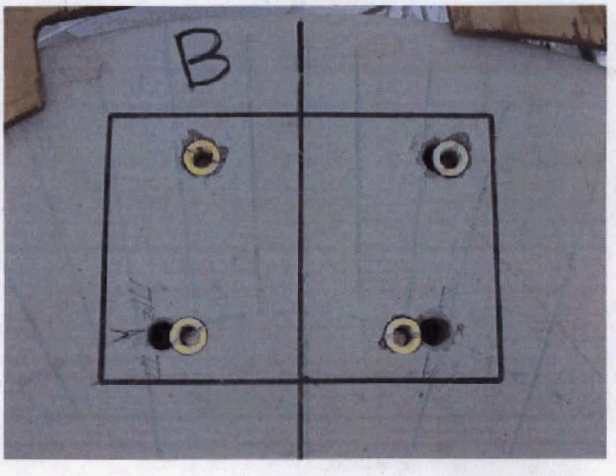


Coupler after installation, flush with cask surface.

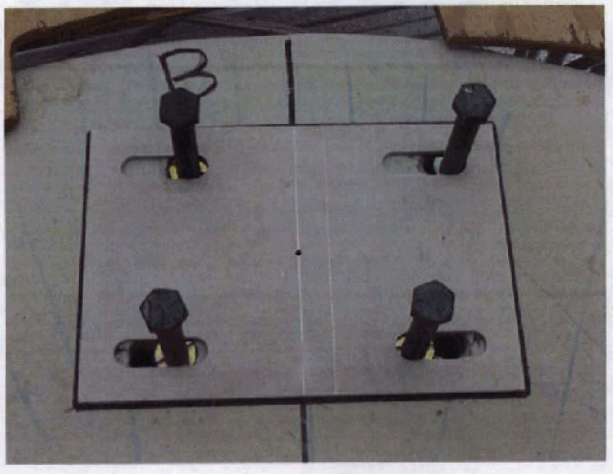
Individual anchor proof testing using hydraulic unit.



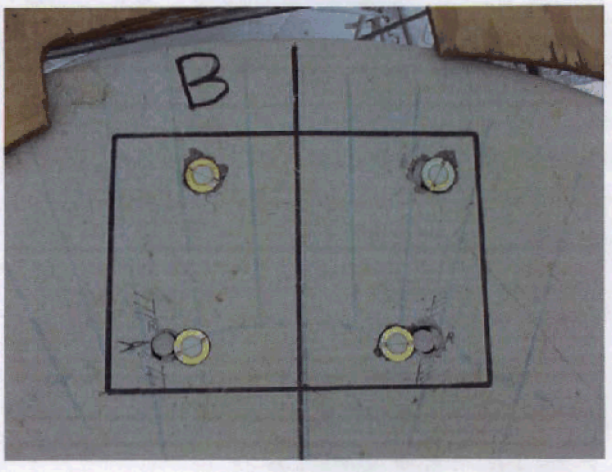
Hole Group B with Drillco Flush Mount Anchors completely installed and individually proof tested.



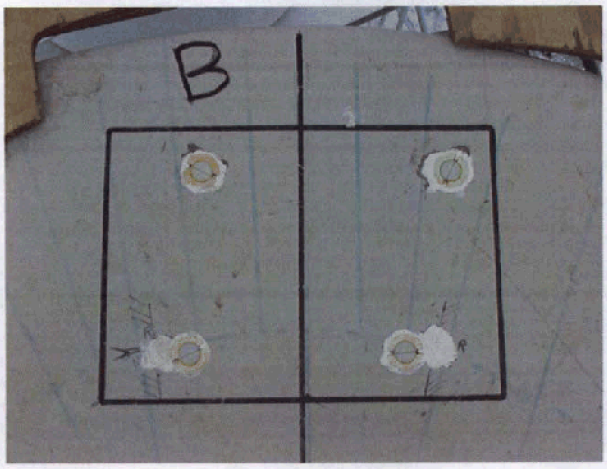
Using Lift Lug Template to mark position of location striping (to be painted on later).



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 sealed 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	#6 and #10
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 Ø36 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

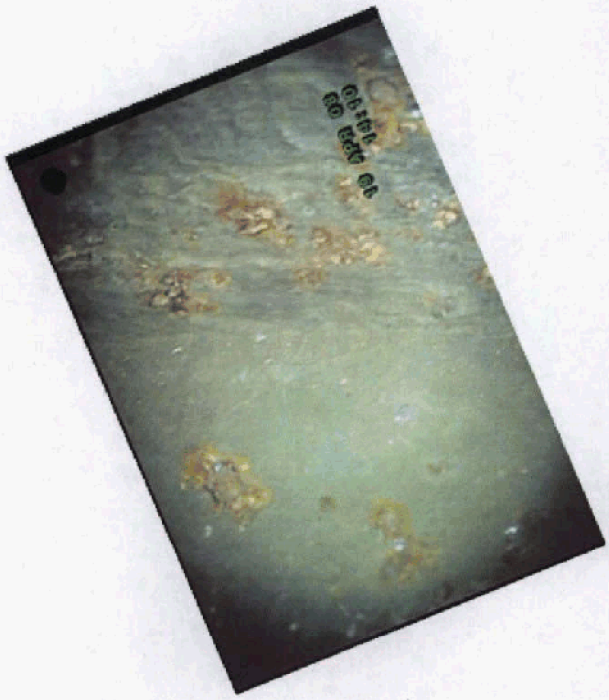
History: DSWC #4 was fabricated in 1983, shipped to the 400 Area and stored outside. The shield plug was in the cask and a plywood disk was placed over the hole. Plastic sheeting was draped over the cask and down the side. The plastic covering was replaced at least once prior to moving the cask indoors 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.

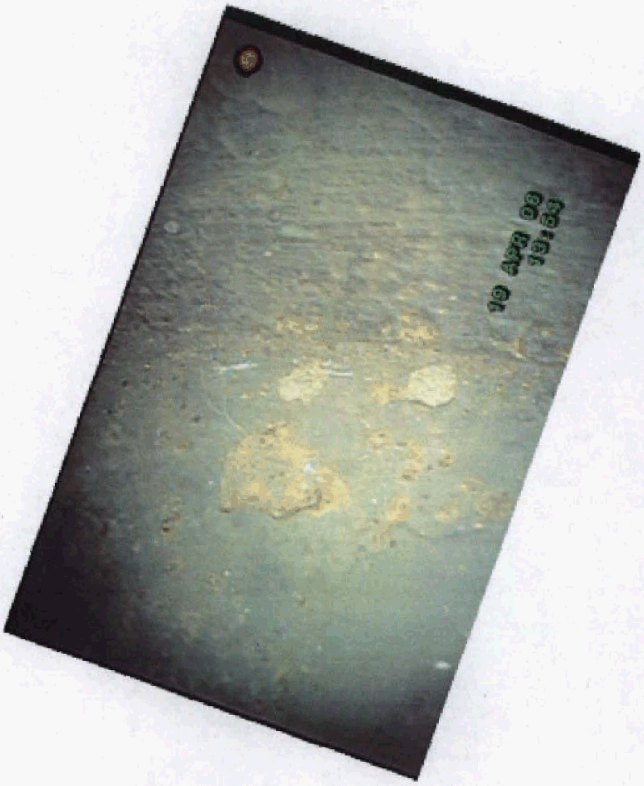
Initial observations: This cask had approximately 20 gallons of water and was not covered. This cask had a wooden cover which presumably had blown off leaving this cask open to the environment. Bird feathers, sand, and RTV debris were found in this cask. The neoprene gasket at the shield plug setdown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

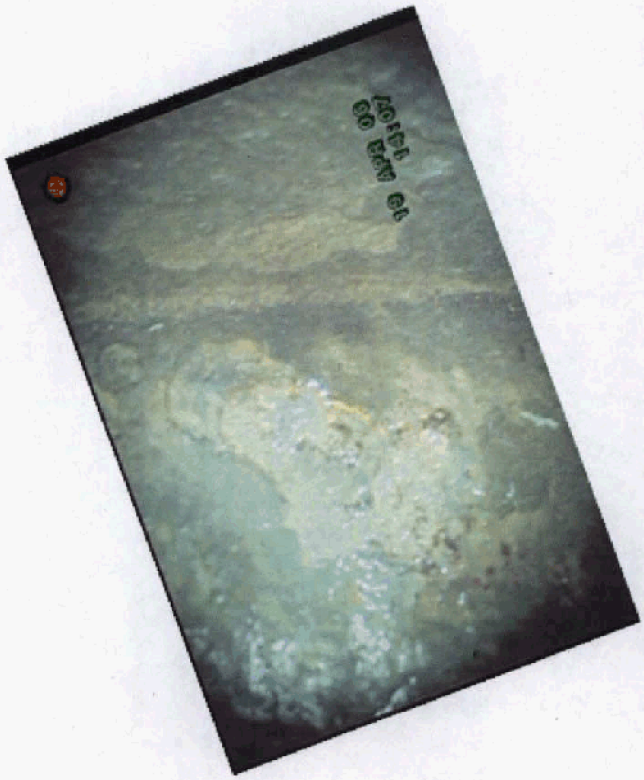
- East interface has some rust. Approximately ½ inch of the interface isn't distinct. No cracks or pitting were noted in the interface. The interface is difficult to distinguish.



- 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.

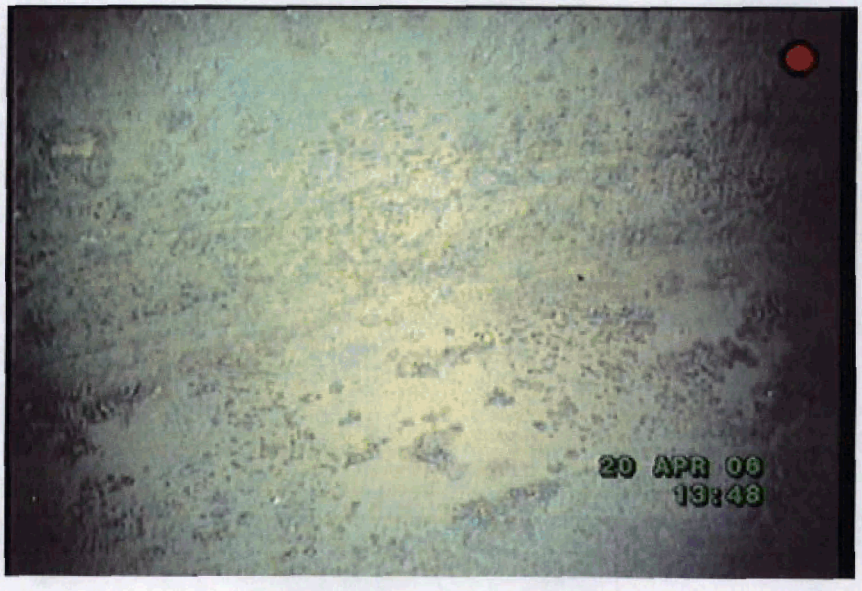
DSWC #7

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.

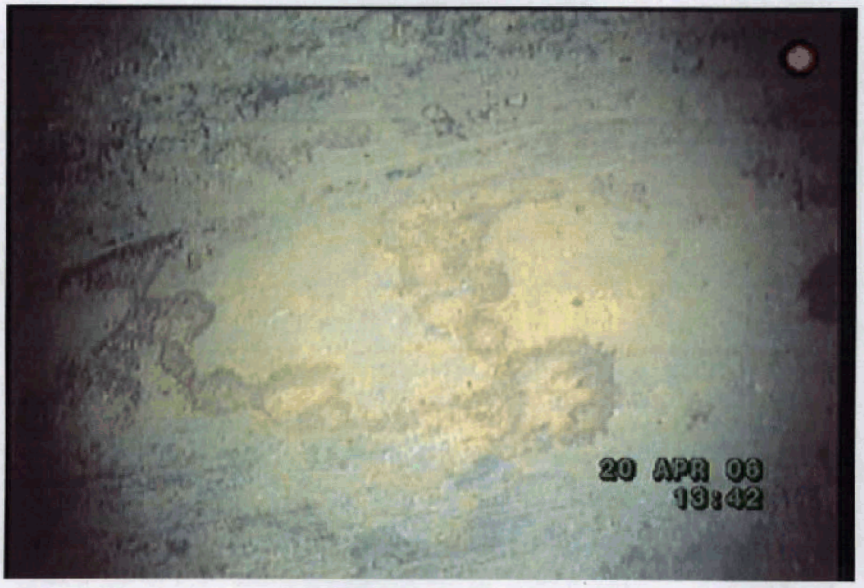
Summary: this cask is satisfactory; the liner seam weld is in the southwest, as stated in the video. While facing the cask nameplate the seam weld is about 50 degrees to your right.

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.

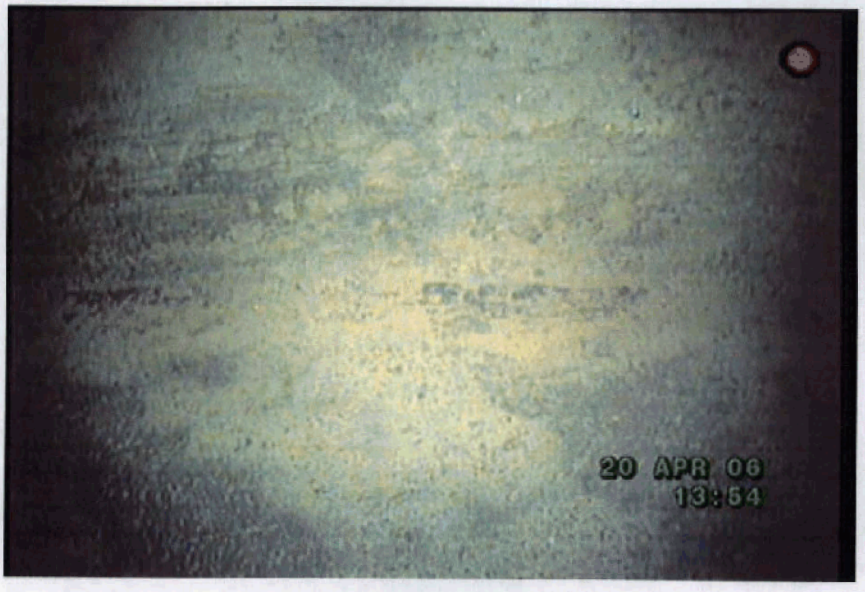
- East interface is a bit uneven, some rust near the interface, no cracks or pitting.



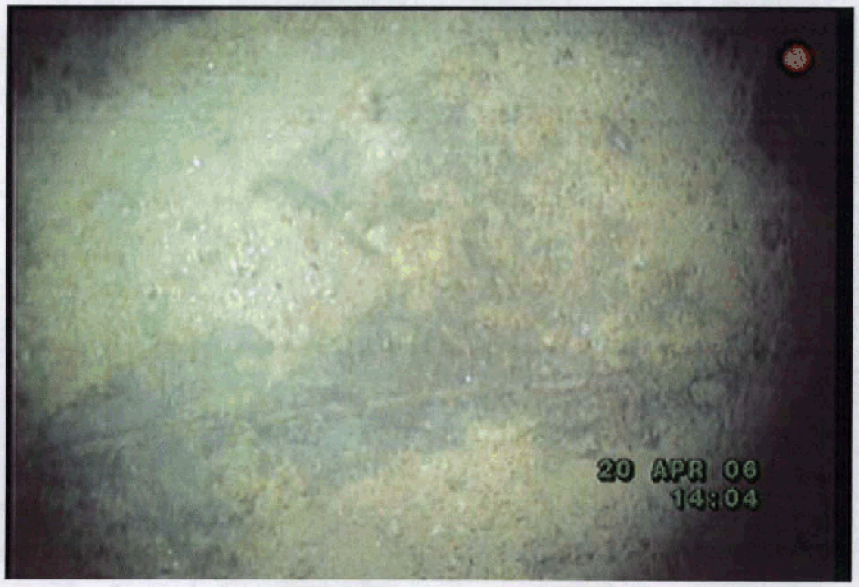
- North interface is satisfactory, no cracks or pitting



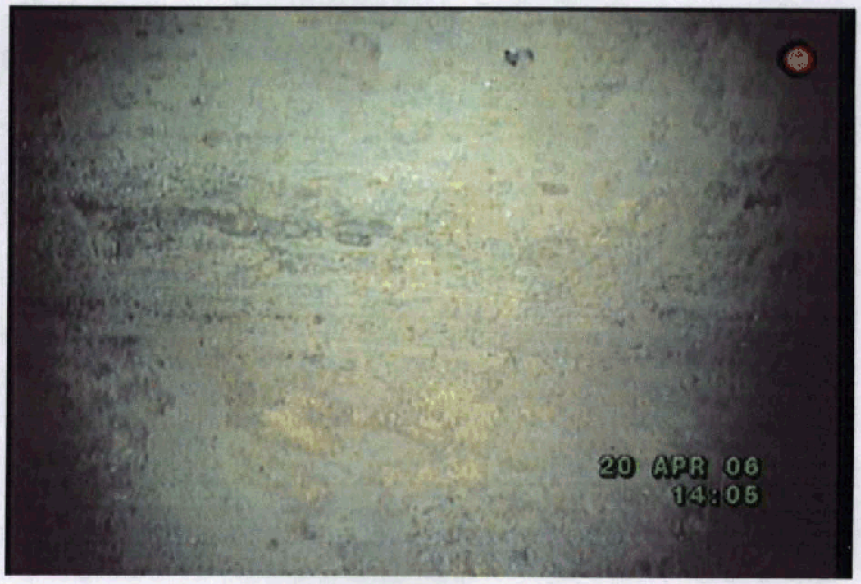
- South interface has no cracks or pitting



- West interface has no cracks or pitting.



Some rust on the bottom plate.



DSWC #8

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.

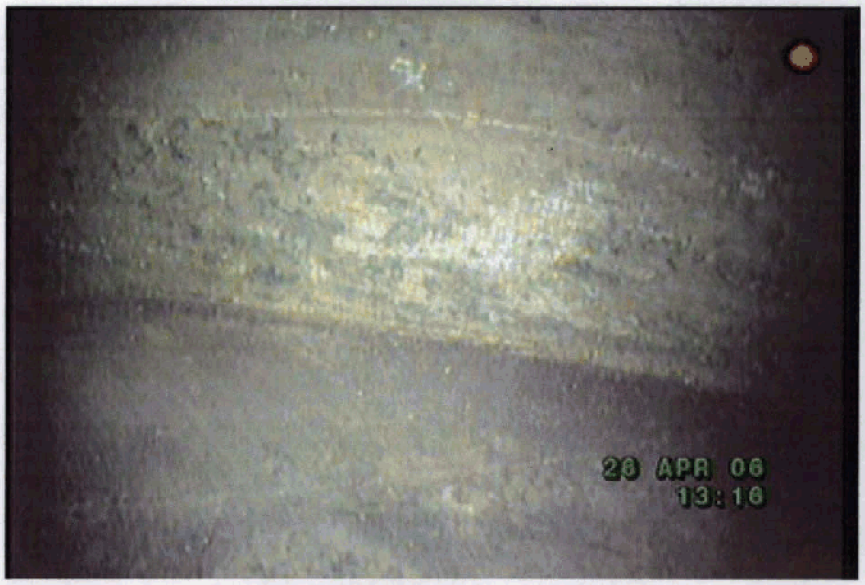
Summary: this cask is satisfactory. The liner seam weld is in the north side. While facing the nameplate the seam weld is about 165 degrees to the right.

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[1] 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[2]. 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.

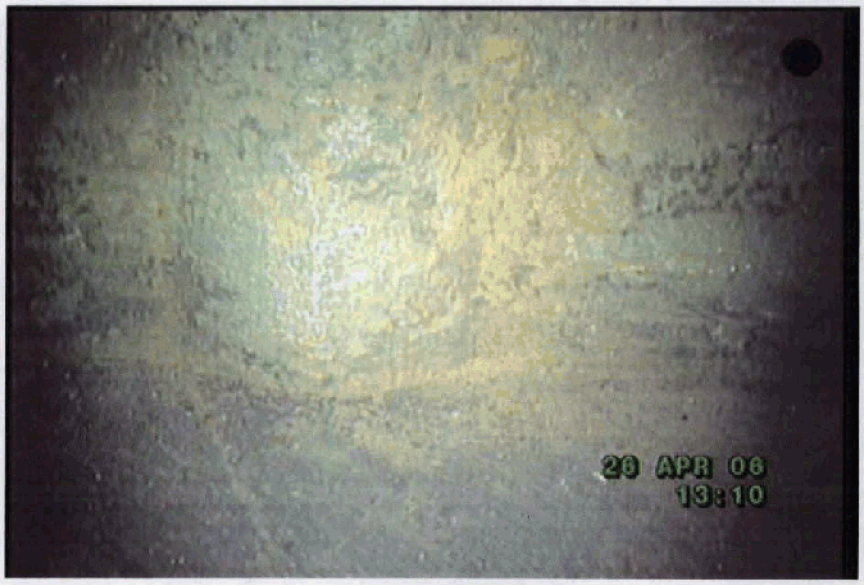
[1] Drierite Compartment No.3 Desicator, anhydrous calcium sulfate, manufactured by W.A. Hammond DrieRite Co., Xenia OH, phone 937.376.2927

[2] Reference John Rush, weld engineer, identified the rough surface as mill scale will be removed prior to welding the cover plate.

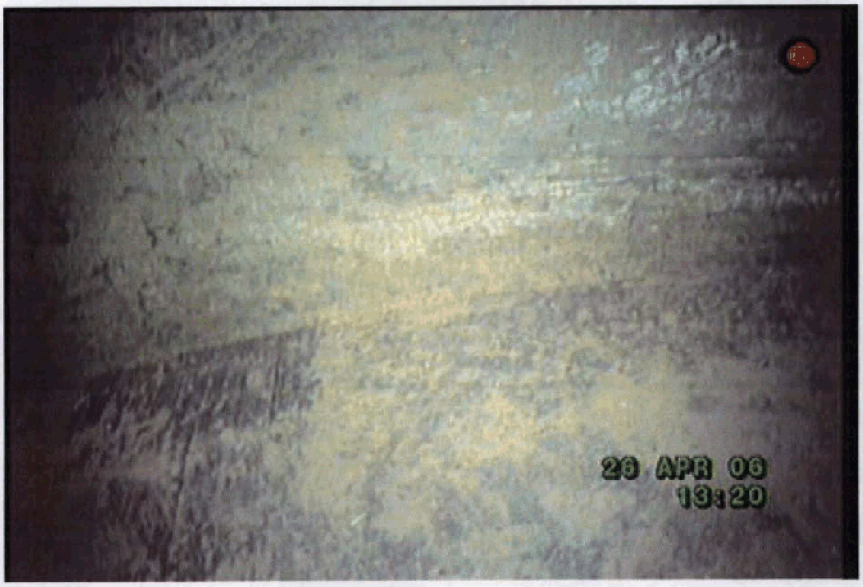
- East - a small part of the interface is uneven, no cracks or pitting



- 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

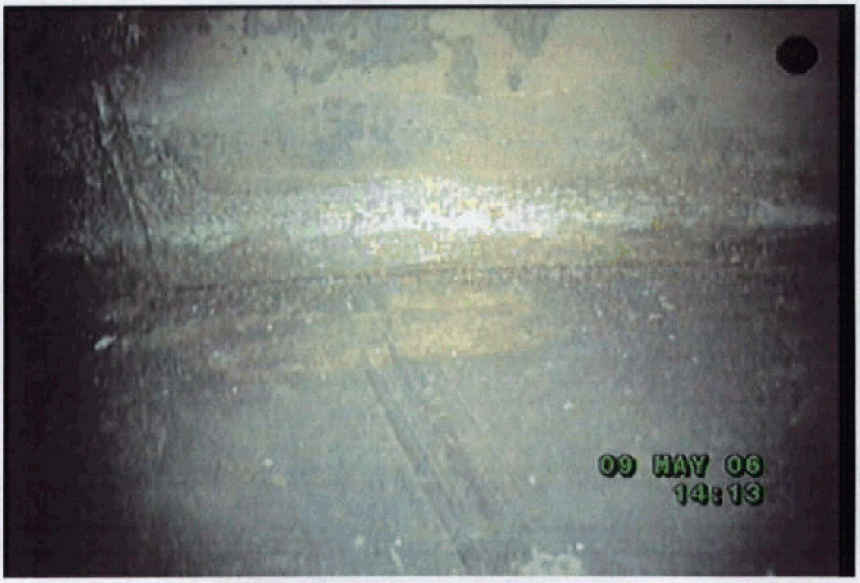
DSWC 10

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

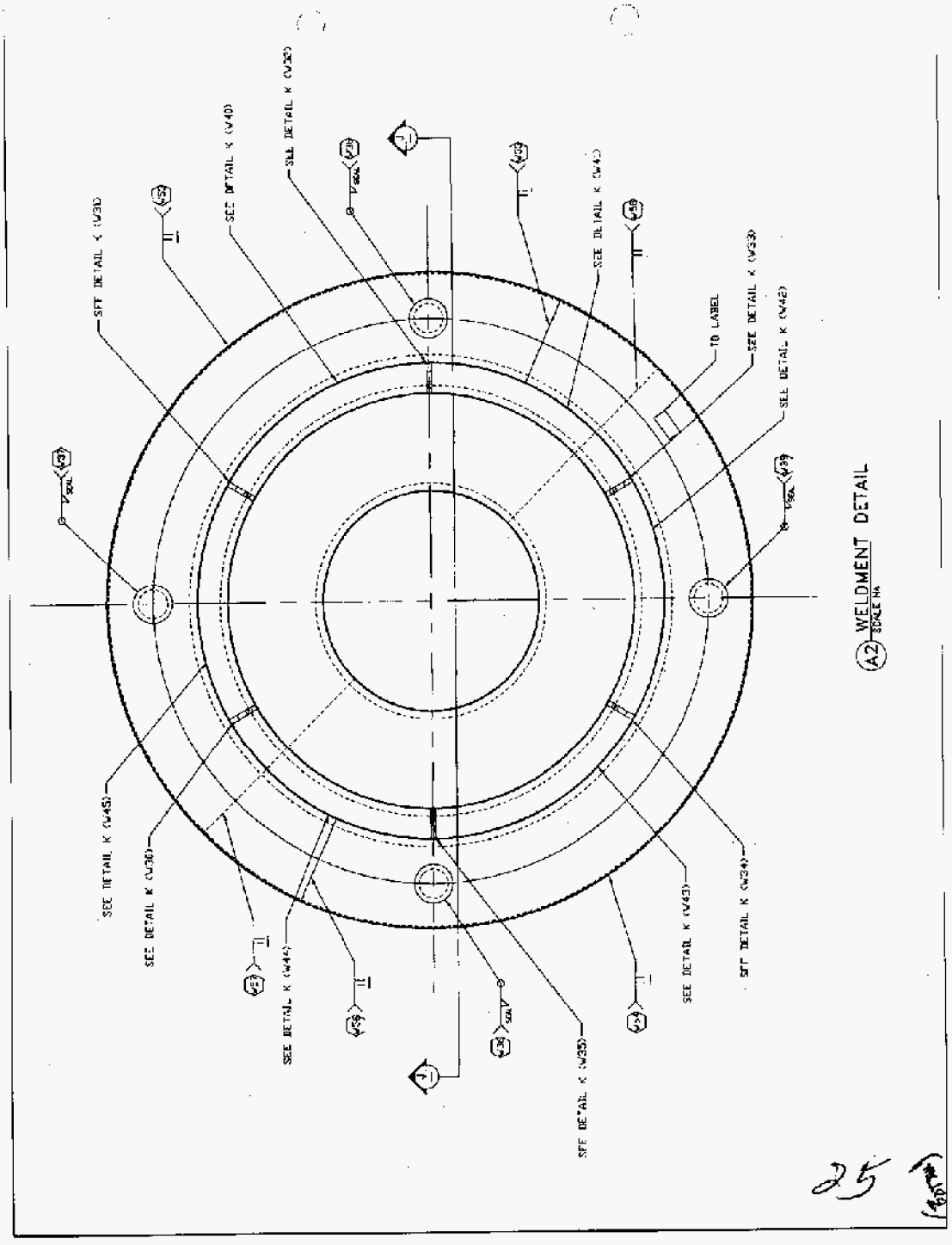


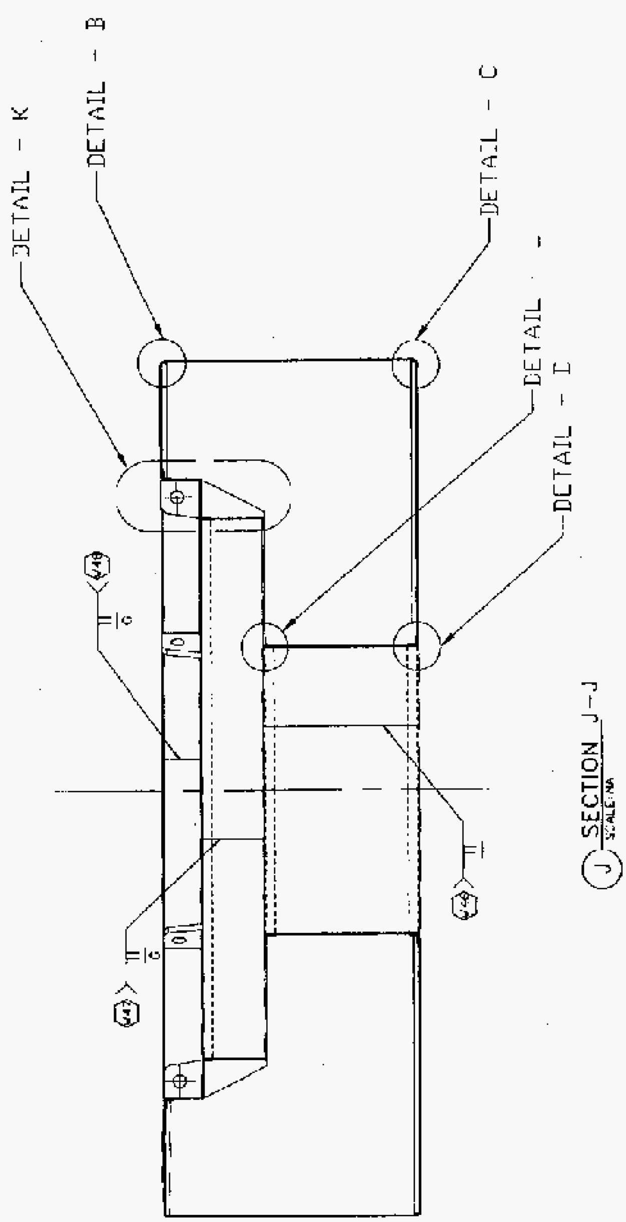
- North interface has no pitting or cracks, light rust, RTV debris.

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

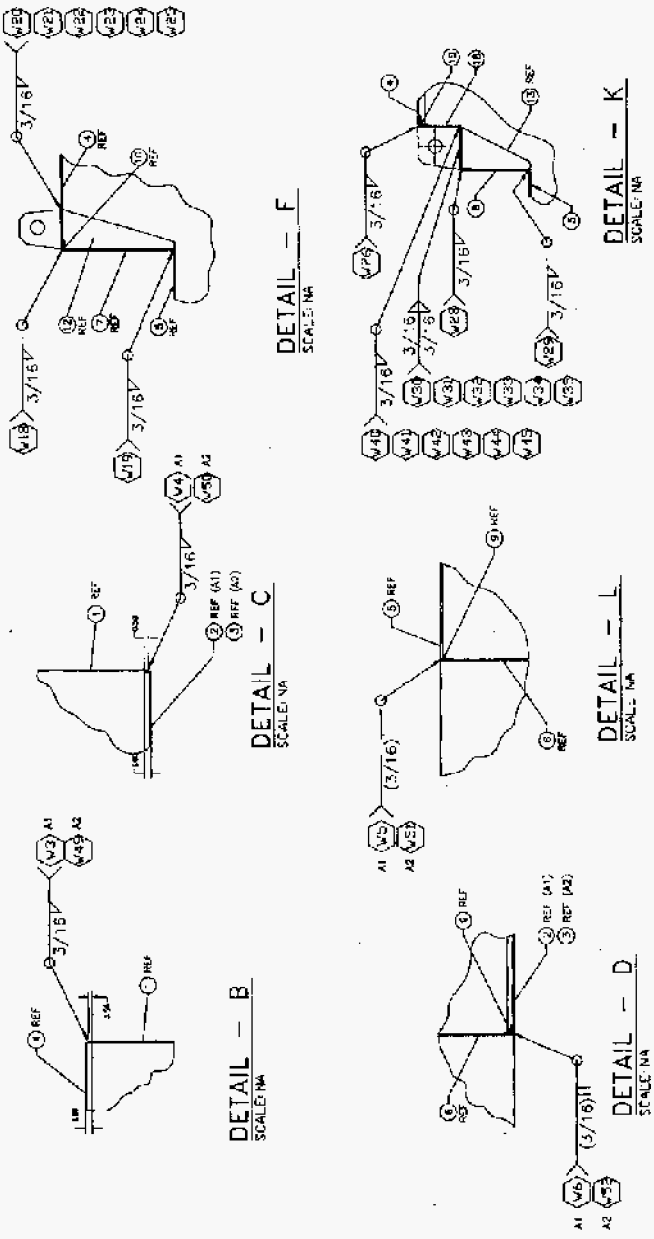
- West interface has no cracks or pitting, liner seam weld in the southwest hampered cleaning the interface.

APPENDIX C. OVERPACK WELD INSPECTION INFORMATION

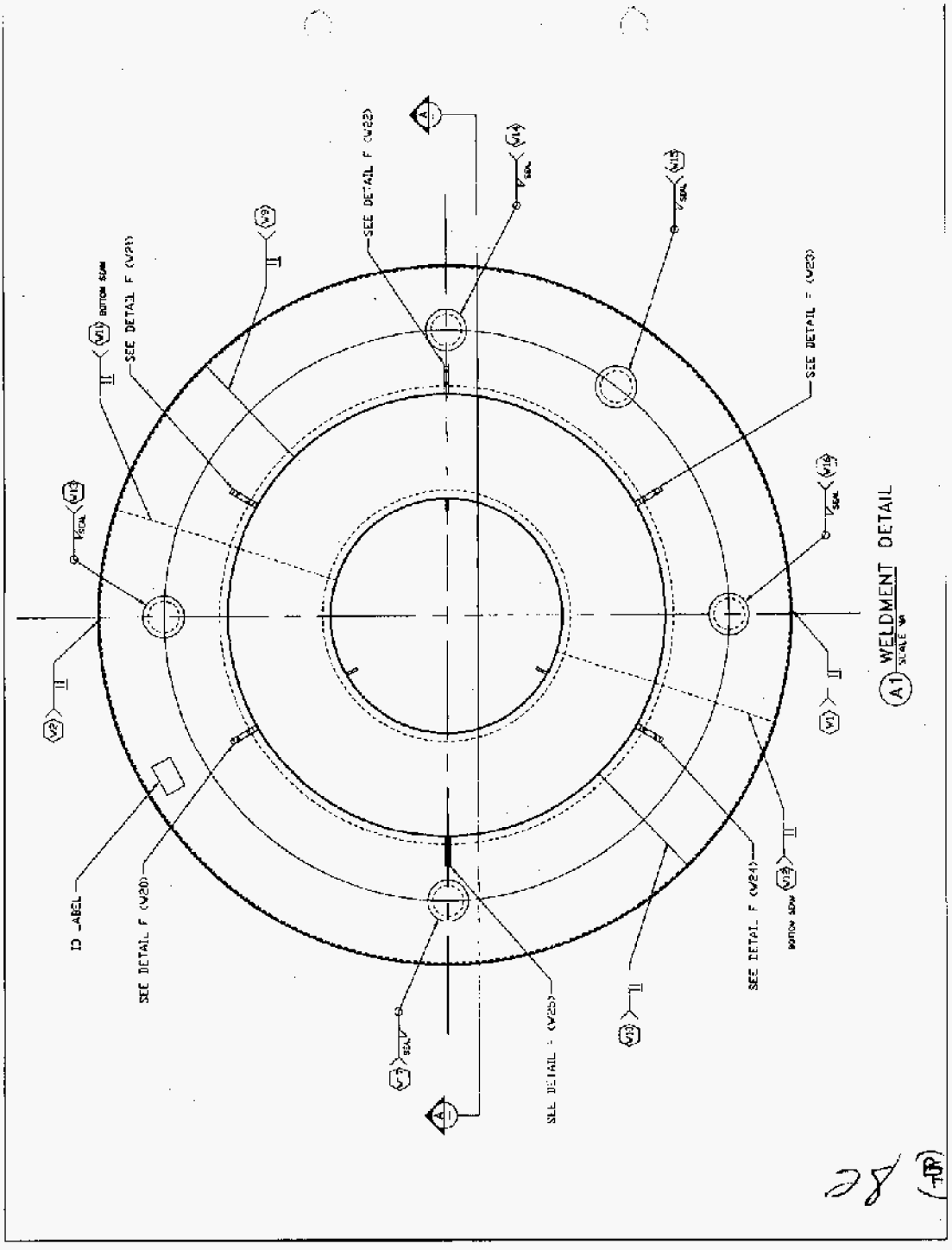

SEE DETAIL K (W30)
SEE DETAIL K (W40)
SEE DETAIL K (W39)
SEE DETAIL K (W43)
SEE DETAIL K (W38)
TO LABEL
SEE DETAIL K (W42)
SEE DETAIL K (W39)
SEE DETAIL K (W45)
SEE DETAIL K (W36)
SEE DETAIL K (W44)
SEE DETAIL K (W35)
SEE DETAIL K (W43)
SEE DETAIL K (W34)
(A2) WELDMENT DETAIL
SCALE NA



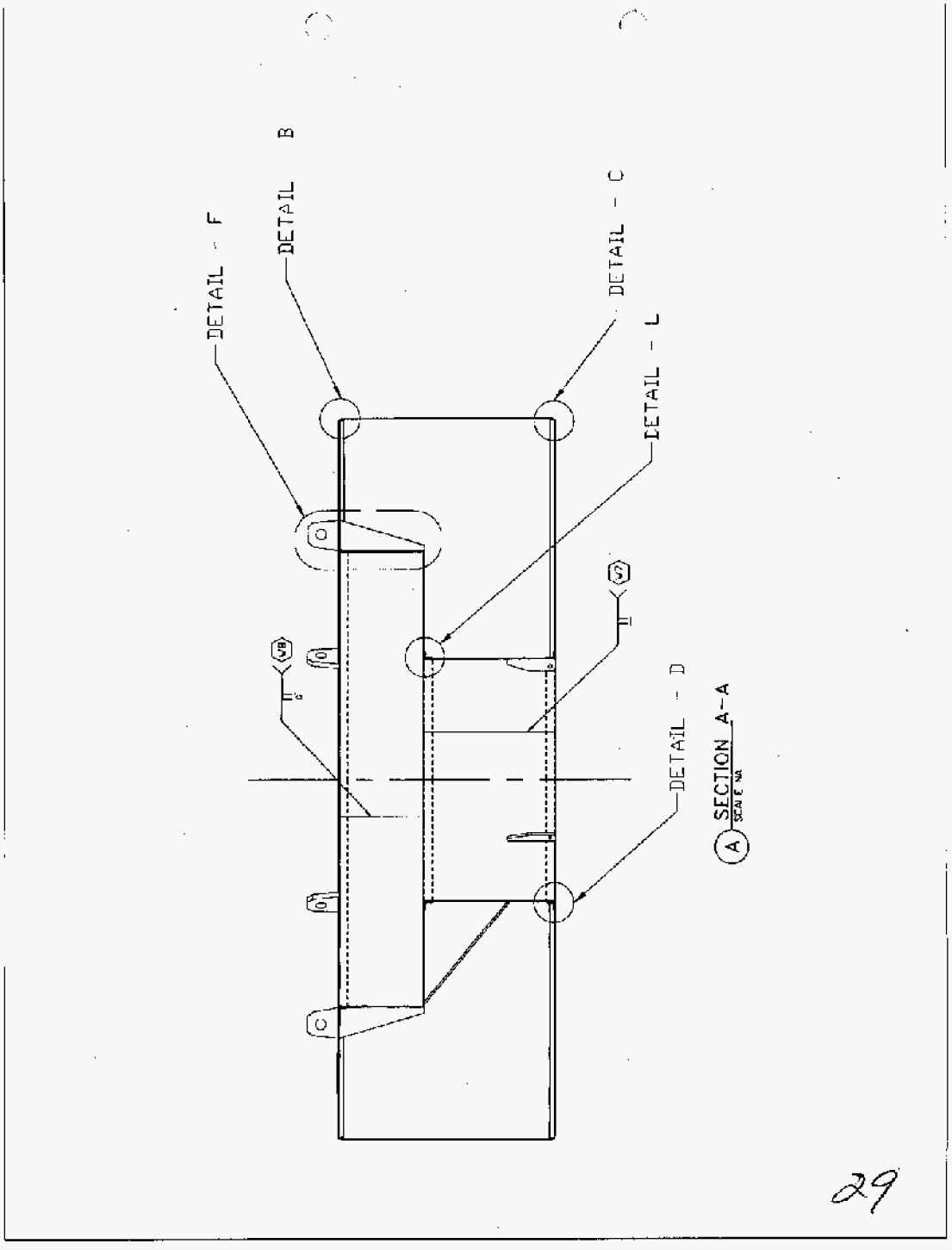
26


DETAIL – F
SCALE: NA
DETAIL – K
SCALE: NA
DETAIL – C
SCALE: NA
DETAIL – L
SCALE: NA
DETAIL – B
SCALE: NA
DETAIL – D
SCALE: NA

21



A1 WELDMENT DETAIL
SCALE 3/8


DETAIL - F
DETAIL B
DETAIL - C
DETAIL - L
DETAIL - D
SECTION A-A
29

DSWC OVERPACK WELD INSPECTION

WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC/ DATE	ENGINEERING ACCEPTANCE	DATE
W1	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W2	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W3	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W4	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W5	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W6	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W7	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W8	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W9	Weld is satisfactory	BBC 6/23/06		6/23/06
W10	Light rust, weld is satisfactory	BBC 6/23/06		6/23/06
W11	Light rust, weld is satisfactory	BBC 6/23/06		6/23/06
W12	Light rust, weld is satisfactory	BBC 6/23/06		6/23/06
W13	Light rust, weld is satisfactory.	BBC 6/27/06		6/27/06
W14	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06

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DSWC OVERPACK WELD INSPECTION				
WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC/ DATE	ENGINEERING ACCEPTANCE	DATE
W15	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W16	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W17	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W18	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W19	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W20	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W21	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W22	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W23	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W24	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W25	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W26	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W27	NA	NA	NA	NA
W28	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06

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DSWC OVERPACK WELD INSPECTION

WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC/ DATE	ENGINEERING ACCEPTANCE	DATE
W29	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W30	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W31	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W32	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W33	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W34	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W35	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W36	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W37	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W38	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W39	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W40	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W41	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06
W42	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/29/06

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DSWC OVERPACK WELD INSPECTION				
WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC DATE	ENGINEERING ACCEPTANCE	DATE
W43	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W44	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W45	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W46	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W47	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W48	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W49	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W50	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W51	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W52	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W53	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W54	Light rust, weld is satisfactory.	BBC 6/23/06		6/23/06
W55	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06
W56	Light rust, chipped paint weld is satisfactory	BBC 5/26/06		6/23/06

33

DSWC OVERPACK WELD INSPECTION				
WELD NUMBER	OBSERVED CONDITION/PREP REQUIRED	QC/ DATE	ENGINEERING ACCEPTANCE	DATE
W57	Light rust, chipped paint weld is satisfactory	RBC 5/26/06	[signature]	6/23/06
W58	Light rust, weld is satisfactory	RBC 6/23/06	[signature]	6/23/06

7.0 **RETEST**
No Retest Required.

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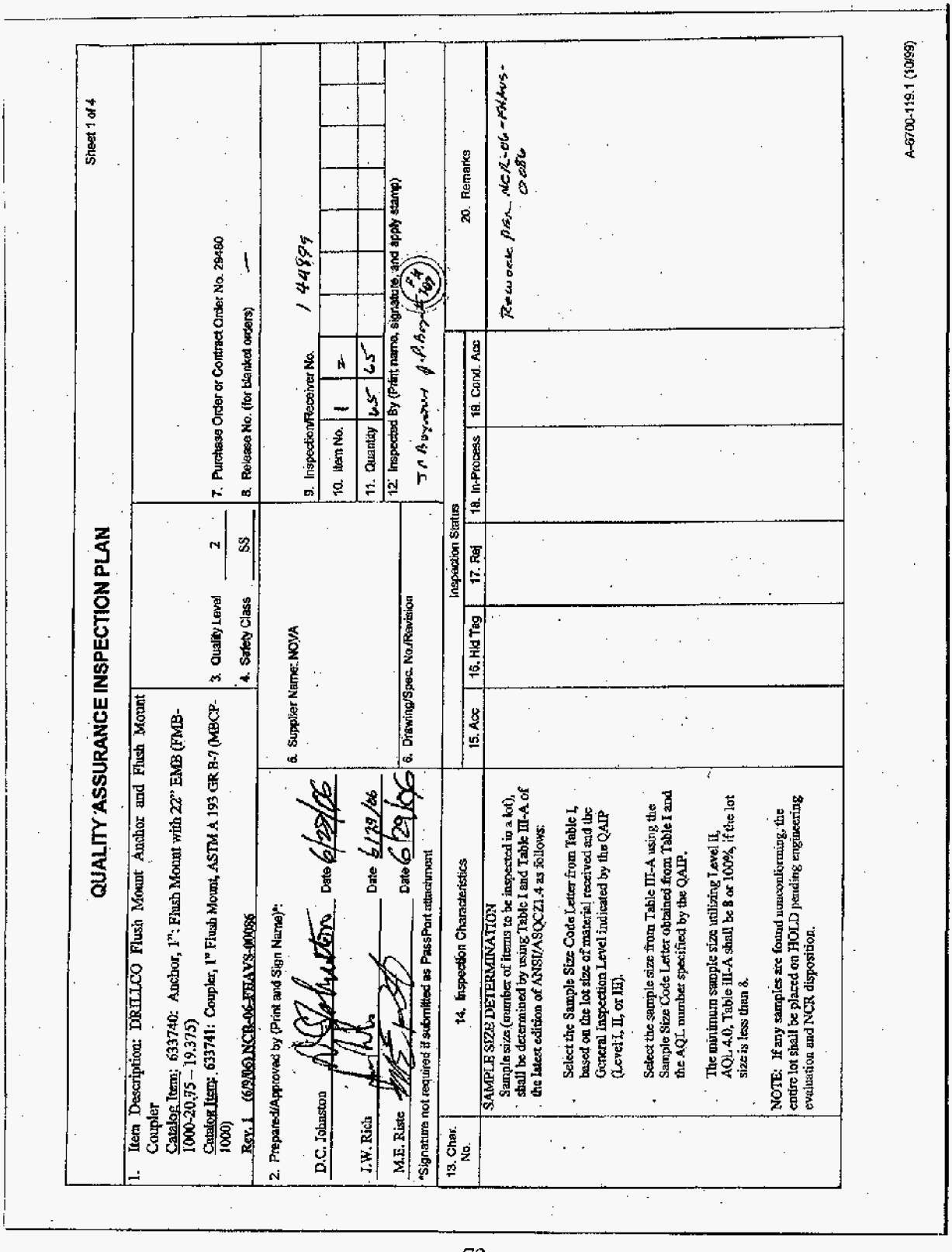
APPENDIX D. LIFTING ANCHOR BOLT, COUPLER AND ALTERNATE LIFT LUG INFORMATION

ANCHOR BOLT AND COUPLER INFORMATION



QUALITY ASSURANCE INSPECTION PLAN

Sheet 1 of 4

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler
Catalog Item: 633740: Anchor, 1"; Flush Mount with 22" EMB (FMB-1000-20.375 – 19.375)
Catalog Item: 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000)
Rev. 1 (6/9/06) NCR-06-FHAVS-00086

3. Quality Level 2
4. Safety Class SS

7. Purchase Order or Contract Order No. 29460
8. Release No. (for blanket orders) —

2. Prepared/Approved by (Print and Sign Name)*:
D.C. Johnston Date 6/29/06
J.W. Rich Date 6/29/06
M.E. Riste Date 6/29/06
*Signature not required if submitted as PassPort attachment

6. Supplier Name: NOVA

6. Drawing/Spec. No./Revision

9. Inspection/Receiver No. / 44899
10. Item No. 1 2
11. Quantity 65 65
12. Inspected By (Print name, signature, and apply stamp)
T.P. Bryson T.P. Bryson

13. Char. No.	14. Inspection Characteristics	Inspection Status 15. Acc	16. Hld Tag	17. Rej	18. In-Process	18. Cond. Acc	20. Remarks
	SAMPLE SIZE DETERMINATION Sample size (number of items to be inspected in a lot), shall be determined by using Table I and Table III-A of the latest edition of ANSI/ASQCZ1.4 as follows: • Select the Sample Size Code Letter from Table I, based on the lot size of material received and the General inspection Level indicated by the QAIP (Level I, II, or III). • 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. • 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 placed on HOLD pending engineering evaluation and NCR disposition.						Rev code pkg. NCR-06-FHAVS-00086

A-6700-119.1 (10/99)

QUALITY ASSURANCE INSPECTION PLAN

Sheet 2 of 4

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler
Catalog Item: 633740: Anchor, 1"; Flush Mount with 22" EMB (FMB-1000-20.75 – 19.375)

Catalog Item: 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000)

Rev. 1 (6/9/06) NCR-06-FHAVS-00086

3. Quality Level: 2
4. Safety Class: SS

7. Purchase Order or Contract Order No. 29480
8. Release No. (for blanket orders)

	14. Inspection Characteristics	Inspection Status					20. Remarks
		15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	
	NOTE: This revision of the QAIP is a result of an NCR (NCR-06-FHAVS-00086) written by AVS documenting problems noted during 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 below steps were completed in the original QAIP and were found to be acceptable, mark the step as "N/A" per this note.						
1)	Verify compliance with Quality Assurance Clauses specified on Purchase Order. NOTE: See inspection item 2 note for clarification on CMTR's.	FM 7/7/06					

A-6700-119.1 (10/99)

QUALITY ASSURANCE INSPECTION PLAN

Sheet 3 of 4

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler
Catalog Item: 633740: Anchor, 1": Flush Mount with 22" EMB (FMB-1000-20.75 – 19.375)

Catalog Item: 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000)

Rev. 1 (6/9/06) NCR-06-FHAVS-00085

3. Quality Level: 2
4. Safety Class: SS
7. Purchase Order or Contract Order No. 29480
8. Release No. (for blanket orders)

	14. Inspection Characteristics	Inspection Status					20. Remarks
		15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	
2)	**Test Report:** **The following items will have CMTR's:** **Anchor Assembly:** (Part No. FMB-1000-20.75-19.375) • Conical Nut: ASTM A193 Grade B7 • Expansion Sleeve: ASTM A513 Type 5 • Threaded Stud Bolt: ASTM A193 Grade B7 • Distance Tube: ASTM A513 Type 5 **Coupler:** (Part No. MBCP-1000) • Coupling Nut: ASTM A193 Grade B7 Perform a review of documentation submitted for the chemical and mechanical properties per the following: **NOTE: The CMTR'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 QAIP.** 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 • Mechanical Properties – N/A	FM 7/07 7/7/06					

A-6700-119.1 (10/99)

QUALITY ASSURANCE INSPECTION PLAN

Sheet 4 of 4

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler
   Catalog Item: 633740: Anchor, 1": Flush Mount with 22" EMB (FMB-1000-20.75 – 19.375)

   Catalog Item: 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000)

Rev. 1 (6/9/06) NCR-06-FHAVS-00088

3. Quality Level 2
4. Safety Class SS

7. Purchase Order or Contract Order No. 29480
8. Release No. (for blanket orders)

	14. Inspection Characteristics	Inspection Status: 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
3)	Identification Sample per Level II, AQL 4.0, Table III-A Verify Anchors and Couplers are identified with part number on the items or on the packaging for the anchors.	FH 107 7/7/06					Sample Size:
4)	Visual Inspection Sample per Level II, AQL 4.0, Table III-A Verify Anchors and Couplers are free from damage.	FH 107 7/7/06					Sample Size:
5)	Attach an A&RH Tag to each Box or lot of items per instructions included in the attached "FFTF General Procurement" instruction.	FH 107					
6)	Forward a copy of the Completed QAIP's to: FFTF QA N2-11	FH 107 7/7/06					

A-6700-119.1 (10/99)

Sheet 1 of 2

QUALITY ASSURANCE INSPECTION PLAN

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler
Catalog Item: 633740: Anchor, 1": Flush Mount with 22" EMB (FMB-1000-20.75 – 19.375) 21.5 19.375
Catalog Item: 633741: Coupler, 1" Flush Mount, ASTM A 193 GR B-7 (MBCP-1000)

3. Quality Level 2
4. Safety Class SS

7. Purchase Order or Contract Order No. 28480
8. Release No. (for blanket orders) —

2. Prepared/Approved by (Print and Sign Name)*:
D.C. Johnston [signature] Date 5/18/06
J.W. Rich [signature] Date 5/22/06
M.E. Risse [signature] Date 5/18/06
*Signature not required if submitted as PassPort attachment

5. Supplier Name: NOVA

6. Drawing/Spec. No./Revision

9. Inspection/Receiver No. 144877

10. Item No.	1	2						
11. Quantity	65	65						

12. Inspected By (Print name, signature, and apply stamp)
J P Boynton [signature] [stamp]

13. Char. No.	14. Inspection Characteristics	15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
	SAMPLE SIZE DETERMINATION Sample size (number of items to be inspected in a lot), shall be determined by using Table I and Table III-A of the latest edition of ANSI/ASQCZ1.4 as follows: • Select the Sample Size Code Letter from Table I, based on the lot size of material received and the General Inspection Level indicated by the QAIP (Level I, II, or III). • 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. • 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 placed on HOLD pending engineering evaluation and NCR disposition.						Item reinspected per Rev 1 of QAIP per NCR-06-FHANS-0086 [initials]
1)	Verify compliance with Quality Assurance Clauses specified on Purchase Order.		X				NCR-06-FHANS-0086

A-6700-119.1 (10/99)

QUALITY ASSURANCE INSPECTION PLAN

Sheet 2 of 2

1. Item Description: DRILLCO Flush Mount Anchor and Flush Mount Coupler Catalog Items:	3. Quality Level 2 4. Safety Class SS	7. Purchase Order or Contract Order No. 29480 8. Release No. (for blanket orders)

13. Char. No.	14. Inspection Characteristics	Inspection Status 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
2)	**Test Report:** **The following items will have CMTR's:** **Anchor Assembly:** (Part No. FMB-1080-20.75-19.375) • Conical Nut: ASTM A193 Grade B7 • Expansion Sleeve: ASTM A513 Type 5 • Threaded Stud Bolt: ASTM A193 Grade B7 • Distance Tube: ASTM A513 Type 5 **Coupler:** (Part No. MBCP-1000) • Coupling Nut: ASTM A193 Grade B7 Perform a review of documentation submitted for the 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 • Mechanical Properties – N/A	FH 107					
3)	Identification Sample per Level II, AQL 4.0, Table III-A Verify Anchors and Couplers are identified with part number on the items or on the packaging for the anchors.	FH 107					Sample Size:
4)	Visual Inspection Sample per Level II, AQL 4.0, Table III-A Verify Anchors and Couplers are free from damage.	FH 107					Sample Size:
5)	Attach an A&RH Tag to each Box or lot of items per instructions included in the attached "FFTF General Procurement" instruction.						

A-6700-119.1 (10/99)

NOVA MACHINE PRODUCTS

18001 Sheldon Road
Middleburg Heights, OH
44130

216 267 3200
FAX 216 433 1840

CERTIFICATION

[x] CERTIFICATE OF COMPLIANCE/CONFORMANCE [ ] MATERIAL TEST REPORT

CERT # 40882	CERT DATE: 19-MAY-06	PO #	00023480 REV. 002
Fluor Daniel Hanford		REL #	
Fluor Hanford		SO #	114125
Hanford Reservation		LINE #	1
2355 Stevens Drive		QTY	65 EA
Richland WA 99352 US		LOT #	50078287
		HEAT #	See attached certs
		DRWG #	

CL/STOCK:
0000633740 2

ITEM DESC:
DRILLCO FMB-1000-20.75-19.375 PROPRIETARY MFG. PART NUMBER

CUSTOMER SPECIFICATIONS:
A193 GRADE B7

MATERIAL SPECIFICATIONS:
Per Part Number requirements

HEAT SPECIFICATIONS:
Heat treated per the material specification (As applicable).

QUALITY SPECIFICATIONS:
Meets applicable portions of ANSI/ASME NQA-1 ('83 ED., '83 Add., and the '94 Edition)i 10CFR21 Applicat00% visually examined and accepted per Nova Work Instruction 8.1.3 Rev.5 which meets the requirements of SA/A-014, Nx-2500, F-788 & F-812|| Domestic Manufactured;;

PROGRAM STATEMENT:
Nova Machine Products Corporation certifies the material, parts, components, or services processed on this purchase order have been supplied in accordance with, and therefore meet or exceed the quality requirements established by the references or specifications cited in this order. The material was processed in accordance with the applicable portions of Nova Machine Products Corporation Quality Assurance Manual (ISO/NPT) Manual Edition 7 Rev. 0 dated 9-14-05.

I certify these results are a true and correct copy of records prepared and maintained by Nova Machine Products in compliance with the requirements of the purchase order and specifications cited. No welding was performed by Nova and the items were maintained mercury and asbestos free by Nova.

Processed per ISO-9001(2000), Certificate #SQC 211
Fastener products received from Nova are FQA compliant.

YOUR SALESPERSON IS: Skuba, Mr. James

Sheila Galaday, Certification Specialist

CERT # 40882 CERT DATE: 19-MAY-06 Page: 1 of 1

NOTE: Knowingly and willfully falsifying or concealing a material fact on this form or making false or fictitious or fraudulent entries on this form could constitute a felony punishable under federal statutes.

FM 197 7/6/06

DRILLCO DEVICES LTD.
24-32 44TH 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 material specification as follows:

Maxi-Bolt or Maxi-Bolt component: FMB-1000-20 ¾-19 3/8 "Flush-Mount Maxi-Bolt"

Part Number	Description	ASTM/ASME Specification
0001	Threaded Cone	A/SA 193 B7
0002	Expansion Sleeve	A 513 Type 5
0003	Threaded Rod	A/SA 193 B7
0004	Distance Tube	A 513 Type 5
MBS	Maxi-Bolt Spacer	A 513 Type 5

Reference:
Nova Machine Products
Purchase Order No: 3036467
Report Number: NMP 009-1

Ship to:
Nova Machine Products
18001 Sheldon Road
Middleburg Heights, OH 44130

Lot Number 9232-D

Carton Number(s) 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.

Authorized Signature

6/28/04 Rev. 2
Date

Form F13-1A Rev. 2 9/12/97

7/6/06

JUN. 28. 2006 9:29AM NO. 2297 P. 3

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 ¾-19 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, type of analysis, test 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.

Authorized Signature

Form 13-0 Rev. 3 9/2/97

JUN. 28. 2006 9:29AM NO. 2297 P. 2

04

6-07-97 3:21pm p. 2 of 3

Republic Engineered Steels

401 ROSE AVE S E
MASSILLON, OH 44646 FAX 330-837-7817

CERTIFICATE OF TESTS

FEBRUARY 07, 1997
PAGE: 1 OF 2

PURCHASE ORDER: 3117
PART NUMBER :
REPUBLIC ORDER: 07-14200-07 821
HEAT . . . . . : 8979349

PURCHASE ORDER DATE: 08/28/96
ACCOUNT NUMBER . . : 21934001
SCHEDULE . . . . . . : 59479-

CHARGE ADDRESS

DRILLCO DEVICES LIMITED
P O BOX 6205
LONG ISLAND CITY NY 11106

SHIP TO

DRILLCO DEVICES LTD
1005 38TH AVE
LONG ISLAND CITY NY 11106

CUST. Hero Daniel
P.O. # 0062-1480
S.O. # 114125 ITEM # 1
LOT # 50075287

MATERIAL DESCRIPTION

COLD FINISHED STEEL BARS ALLOY ASTM A 193-95 GRD B7 PLUS SURF BHN NRC 10CFR21
AISI-4140 FINE GRAIN COLD DRAWN QUENCH & TEMP BEFORE CD/SRA AFT CD REST SIZE
TOL QUAL ASSURANCE DOC & T MAX LIFT MAG TEST

SIZE: RDS 1.6390/1.6450 X 12 FT

LADLE CHEMISTRY

C	MN	P	S	SI	CU	NI	CR	MO	AL
0.420	00.87	.011	.031	0.220	0.24	00.15	00.99	0.200	00.024

V
0.004

SEMI-FINISH RESULTS

AUSTENITIC GRAIN SIZE
AUST GRAIN SZ 7.

FINISH SIZE RESULTS SCHEDULE: 59479

BHN HT TRTD (LAB) ASTM E10 ASTM A370
PCE 01 SURFACE 269. MIDRADIUS 269.
PCE 02 SURFACE 269. MIDRADIUS 269.

NOVA MACHINE
QA REVIEW
APPROVED [signature]
DATE 5-8-06

MACROETCH SRC ASTM E381 MIL STD 430
PCE 1 SURFACE 1. RANDOM 1. CENTER 1.

TENSILE HT TRTD ASTM E8 ASTM A370

AUSTENITIZE DEG F	QUENCHANT	TEMPER1 DEG F	TEMPER2/SR DEG F
1600.	OIL	1120.	1050.

TEMP1 TIME HOURS	TEMP2 TIME HOURS	AUST TIME HOURS
6.0	3.0	1.1

	TENSILE PSI	YIELD(.2%) PSI	REDUCTION AREA PERCENT	ELONGATION PERCENT
PCE 01	128000.	112000.	63.5	23.0
PCE 02	131920.	115000.	64.7	23.0

NOTES

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 METHODS PRESCRIBED IN THE GOVERNING SPECIFICATIONS AND BASED UPON THE RESULTS OF SUCH INSPECTION AND TESTING HAS BEEN APPROVED FOR CONFORMANCE TO THE SPECIFICATIONS.

MATERIAL WAS PROCESSED IN ACCORDANCE WITH THE CANTON HOT ROLLED PLANT QUALITY ASSURANCE PROGRAM MANUAL, REV. 4 DATED 5/1/95 AND THE MASSILLON COLD FINISH PLANT QUALITY ASSURANCE PROGRAM MANUAL REV. 0 DATED 01/08/96.

DEVICES LTD.
QA ACCEPTED

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

[signature] [signature] W. Joseph Simko 7/6/06

From: MASSILLON CFB 2-07-97 3:21pm p. 1 of 3

Republic Engineered Steels

401 ROSE AVE S E
MASSILLON, OH 44646

FAX 330-837-7817

CERTIFICATE OF TESTS

FEBRUARY 07, 1997
PAGE: 2 OF 2

PURCHASE ORDER:	9117	PURCHASE ORDER DATE:	08/28/96
PART NUMBER :		ACCOUNT NUMBER . . :	21934981
REPUBLIC ORDER:	97-14268-07 821	SCHEDULE . . . . . :	39479-
HEAT . . . . . :	8979349		

NOTES (CONTINUED)

ALL TESTING HAS BEEN PERFORMED USING THE CURRENT REVISION OF THE TESTING SPECIFICATIONS.

MFG IN THE U.S.A.

CC

FAX BY FAX PC 1 COPY 718-956-3759
FILE 2 COPIES

NOVA MACHINE
QA REVIEW
APPROVED
DATE

CUST: Huey Daniel
P.O. # 0002940
S.O. # 11475 ITEM # 1
LOT # 5007628-1

[illegible]
DEVICES LTD.
QA ACCEPTED
2/7/97

PART #: 1001-0 THREADED CORE
LOT #: 9232-0
CARTON #: 1 of 5 Pieces
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER #: 3054 WGT
REPORT NUMBER: NMP 009-1
(45) FMB-1000-20 Rev-14/6

5/14/96

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

FM 187

2/6/96

P. Symanski A. J. Blondheim W. Joseph Sinks

To: 5 718-956-3759 From: MASSILLON CFS 7-21-98 7:37am p. 2 of 3

Republic Engineered Steels®

4401 ROSE AVE S E
MASSILLON, OH 44646

FAX 330-837-7017

CERTIFICATE OF TESTS

JULY 24, 1998
PAGE: 1 OF 2

PURCHASE ORDER: 4100
PART NUMBER :
REPUBLIC ORDER: 07-25432-02 821
HEAT : 8972538

PURCHASE ORDER DATE: 01/12/98
ACCOUNT NUMBER : 2193400I
SCHEDULE : 89025

CHARGE ADDRESS

DRILLCO DEVICES LIMITED
P O BOX 6289
LONG ISLAND CITY NY 11106

SHIP TO

DRILLCO DEVICES LTD
1085 55TH AVE
LONG IS CY NY 11106

NOVA MACHINE QA REVIEW
APPROVED
DATE

MATERIAL DESCRIPTION

COLD FINISHED STEEL BARS ALLOY ASTM A 193-96A GRD B7 PLUS SURF BHN NRC 10CFR21
AISI-4140 FINE GRAIN COLD DRAWN QUENCH & TEMP BEFORE CC/SRA AFT CC REST SIZE
TOL QUAL ASSURANCE DOC T MAX LIFT MAG TEST

SIZE: ROS .9120/.9160 X 12 FT

LADLE CHEMISTRY

C	MN	P	S	SI	CU	NI	CR	MO	AL
0.410	00.86	.019	.030	0.240	0.24	00.25	00.97	0.200	00.024

0.014

SEMI-FINISH RESULTS

AUSTENITIC GRAIN SIZE
AUST GRAIN SZ 7.

FINISH SIZE RESULTS SCHEDULE: 89025

BHN HT TRTD (LAB) ASTM E10 ASTM A370
PCE 01 SURFACE 277. MIDRADIUS 285.
PCE 02 SURFACE 285. MIDRADIUS 285.

MACROETCH SRC ASTM E381 MIL STD 410
PCE A SURFACE 1. RANDOM 1. CENTER 1.
PCE B SURFACE 1. RANDOM 1. CENTER 1.

CUST: Lian Daniel
P.O.# 0007294 80
B.O.# 114125 ITEM # 1
LOT# 900750287

TENSILE HT TRTD	TEMPER1 DEG F	ASTM E8 TEMPER2/SR DEG F	ASTM A370 TEMP1 TIME HOURS	TEMP2 TIME HOURS
	1100.	1350.	8.0	3.0

	TENSILE PSI	YIELD(.2%) PSI	REDUCTION AREA PERCENT	ELONGATION PERCENT
PCE 01	154400.	142000.	58.1	18.5
PCE 02	154600.	143000.	58.9	19.0

NOTES

THE MATERIAL WAS NOT EXPOSED TO MERCURY OR ANY METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURE DURING PROCESSING OR WHILE IN OUR POSSESSION.

CHEMICAL ANALYSIS CONFORMS TO APPLICABLE SPECS:
ASTM E 327 ASTM E 1086 ASTM E 415 ASTM E 1019 ASTM E 1085 ASTM E 572.

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 APPROVED FOR CONFORMANCE TO THE SPECIFICATIONS.

CERTIFICATE OF TESTS SHALL NOT BE REPRODUCED EXCEPT IN FULL.

ALL TESTING HAS BEEN PERFORMED USING THE CURRENT REVISION OF THE TESTING SPECIFICATIONS.

MFG IN THE U.S.A.

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

F# 197
7/16/98

To: 9 718-956-3759 From: MASSILLON CFB 7-24-98 7:37am p. 3 of 3

Republic Engineered Steels®

461 ROSE AVE S E
MASSILLON, OH 44646 FAX 330-837-7017

CERTIFICATE OF TESTS

JULY 24, 1998
PAGE: 2 OF 2

PURCHASE ORDER: 4100 :
PART NUMBER :
REPUBLIC ORDER: 07-25432-02 821
HEAT . . . . . : 8972530

PURCHASE ORDER DATE: 01/12/98
ACCOUNT NUMBER . . : 21934001
SCHEDULE . . . . . . : 89028-

CC

FAX BY FAX PC : COPY 718-956-3759
FILE - : COPY

NOVA MACHINE QA REVIEW
APPROVED 2016
DATE 2-19-06

CUST: Hugh Daniel
P.O. # 00029480
B.O. # 114175 ITEM #
LOT # 5075287

DRILLCO DEVICES LTD.
QA ACCEPTED
7/24/98

PART No: 1003-DLS THREADED ROD.
LOT No: 9232-D
CARTON No: 1 665-PIECES
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER No: 3036467
REPORT NUMBER: NMP009-1
(65)FMB-1000-20%-19%

J.W. 5/10/06

FM 107 7/6/06

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

P. Szymanski A.J. Blondheim W. Joseph Simko

10:54 MARGARET CASTOR TEL:7243467238 P. 002

359313-01

DEC 6 2000

AK Steel SAWHILL TUBULAR DIVISION

SHIPPING TALLY AND TEST REPORT

AK STEEL CORPORATION • SAWHILL TUBULAR DIVISION • BOX 11 • SHARON, PA 16146-0011

Sold to:
TIOGA PIPE & SUPPLY
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

8052

Ship to: 12/07/00
TIOGA PIPE & SUPPLY
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

Sales Dist.	Customer Order	Date	Shipping Instructions	Sawhill Order
218	101200	12/08/00	TRUCK	359313-01

Mill Order No.	----Weight--- Gross	Net	Total Pieces	Length	Footage
.026 DOM A513/5-98 1.6250 OD X1.0200 ID					Part-22979
ITM SUP S5 & S8					
359313-01 BD# 9713		3,362	29	27'/31' R/L	783'
BD# 9714		3,362	29		783'
BD# 9715		579	5		135'
BD# 9716		2,078	19		484'
Heat# 720705					
Total BD 4		9,381	82		2,185

NOVA MACHINE QA REVIEW APPROVED DATE

FOB: MONROE, NY
TYPE 1026 , ADT,

TIOGA PIPE QA ACCEPTANCE BY DATE

CUST. P.O.# 400294B S.O.# 111175 REV 1 LOT # 2557250

CERTIFICATE OF TESTS

ALL SAWHILL PIPE AND TUBING IS MANUFACTURED IN THE U.S.A.

KIA ACCEPTED 12/6/00

*** Chemical Analysis ***

Heat No. 720705					
	C -.250	MN-.860	P -.013	S -.004	SI-.014
	CU-.016	NI-.012	CR-.028	MO-.002	V -.002
	TI-.000	AL-.047	SN-.001	CB-.000	

*** Mechanical Properties ***

RB 99/100	Yield Strength	Tensile Strength	Elongation in 0"
			359313-01

I hereby certify that the above figures are correct as contained in the records of the Company. J. Walker, Chief Quality Assurance Auditor - Tubing.
WHEATLAND PLANT

PART #: 1002-D EXPANSION SLEEVE
LOT #: 47338-D

FM 197

7/6/16

(PAGE 1 OF 2)

MANAGER CUSTOMER SERVICE

TIOGA

PIPE SUPPLY COMPANY INC. □ 2460 WHEATSHEAF LANE, P.O. BOX 8997 PHILADELPHIA PA. 19167 □ 215 831 0700
WATS NUMBER 800 523 3375 □ TELEX 83-4850
TWX # 710-670-1600 □ TELECOPIER 215-831-1645

Certificate of Analyses and Tests

January 18, 2001

NOVA MACHINE
QA REVIEW
APPROVED
DATE 5-19-01

Drillco Devices LTD
10-05 35th Avenue
Long Island City, NY 11106

F DRILLCO DEVICES LTD. QA ACCEPTED

CUSTOMER P.O.#	TIOGA S.O.
005225	111856

CUST: Huen Daniel
P.O.# 00029480
S.O.# 114175 ITEM # 1
LOT # 39875287

ITEM # 1

HEAT # 720705

SIZE: 1.625" O.D. X 1.020" I.D.

SPECIFICATION: ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TUBING TYPE 5

A) Chemical analyses were performed in accordance with ASTM A513-98 and Tioga Pipe Supply Procedure NO. TI-2 REV.I with results as follow on Pages 2 , 3 & 4

B) A tension test was performed in accordance with ASTM A513-98 and Tioga Pipe Supply Procedure TI-3 Rev. I with results as shown below:

YIELD PSI	TENSILE PSI	ELONGATION IN 2"
102,343 ✓	120,341 ✓	17.5% LONGITUDINAL STRIP LONG

LAB #'S C,T 26381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE

PART #: 1002-D EXPANSION SLEEVE
LOT #: 9232-D
CANTON #: 1649-PIECES.
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER #: 30XG017
REPORT NUMBER: NMP 004-1
(45) FNB-1000-20W4-1478

THIS IS TO CERTIFY THAT THE MATERIAL FURNISHED ON THE REFERENCED ORDER CONFORMS TO THE REPORTED ANALYSIS AS FURNISHED TO US BY OUR SUPPLIERS OR BY TESTS AND EXAMINATIONS PERFORMED BY ACCEPTED LABORATORIES.

1

(PAGE 2 OF 2)

BY: Danny Mills QA DATE: 1-18-01

FM 107

10:54 MARGARET CASTOR TEL:7243467338 P.002

359313-01
DEC 0 6 2000

AK Steel SAWHILL TUBULAR DIVISION

SHIPPING TALLY AND TEST REPORT

AK STEEL CORPORATION • SAWHILL TUBULAR DIVISION • BOX 11 • SHARON, PA 16146-0011

Sold to: TIOGA PIPE & SUPPLY 8052
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

Ship to: TIOGA PIPE & SUPPLY 12/07/00
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

Sales Dist.	Customer Order	Date	Shipping Instructions	Sawhill Order
216	101200	12/08/00	TRUCK	359313-01

Mill Order No.		Weight Gross	Weight Net	Total Pieces	Length	Footage
1026 DOM A513/5-98 1.6250 OD X1.0200 ID						Part-22979
ITH SUP S5 & S8						
359313-01	BD# 9713		3,362	29	27'/31' R/L	783'
	BD# 9714		3,362	29		783'
	BD# 9715		579	5		135'
	BD# 9716		2,078	19		484'
Heat# 720705						
Total BD	4		9,381	82		2,185'

FOB: MONROE, NY
TYPE 1026 , ADJ.

NOVA MACHINE QA REVIEW
APPROVED [signature]
DATE 5-19-05

CUST:
P.O. # 00029480
S.O. # 114125 ITEM # 1
LOT # S0075287

TIOGA PIPE
Q A ACCEPTANCE
BY [signature]
DATE 12-...

QA ACCEPTED [signature] 12/20/00

CERTIFICATE OF TESTS

ALL SAWHILL PIPE AND TUBING IS MANUFACTURED IN THE U.S.A.

*** Chemical Analysis ***

Heat No. 720705

C -.250	MN-.860	P -.015	S -.004	SI-.014
CU-.018	NI-.012	CR-.028	MO-.002	V -.002
TI-.000	AL-.047	SN-.001	CB-.000	

*** Mechanical Properties ***

RB	Yield Strength	Tensile Strength	Elongation in 0"
99/100			

359313-01

PART NO: 1001006 DISTANCE TUBE
LOT NO: 12320

...eby certify that the above figures are correct as contained in the ...rds of the Company. J. Walker, Chief Quality Assurance Auditor -- Tubing.
WHEATLAND PLANT

FM 107 7/1/...

(PAGE 1 OF 2) MANAGER CUSTOMER SERVICE

TIOGA
PIPE SUPPLY COMPANY INC. □ 2450 WHEATSHEAF LANE, P.O. BOX 5997 PHILADELPHIA PA. 19137 □ 215 831 0700
WATS NUMBER 800 523 3575 □ TELEX 83-4650
TWX # 710-670-1850 □ TELECOPIER 215-533-1845

Certificate of Analyses and Tests

January 18, 2001

NOVA MACHINE QA REVIEW
APPROVED
DATE 2-16-01

Drillco Devices LTD
10-05 35th Avenue
Long Island City, NY 11106

CUSTOMER P.O.#	TIOGA S.O.
005225	111356

DRILLCO DEVICES LTD. QA ACCEPTED

CUST: Drillco Devices
P.O. # 005225 180
S.O. # 114125 ITEM # 1
LOT # 20016287

ITEM # 1

HEAT # 720705

SIZE: 1.625" O.D. X 1.020" I.D.

SPECIFICATION: ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TUBING TYPE 5

A) Chemical analyses were performed in accordance with ASTM A513-98 and Tioga Pipe 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 Tioga Pipe Supply Procedure TI-3 Rev. 1 with results as shown below:

YIELD PSI	TENSILE PSI	ELONGATION IN 2"
102,343	120,341	17.5% LONGITUDINAL STRIP LONG

LAB #'S C,T 26381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE

PART #: 1004-015 DISTANCE TUBE
LOT #: 9232-D
CARTON #: 1 of 5 PIECES
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER #: 20144471
REPORT NUMBER: NMP 004-1
(65)TMS-1000-20[illegible]-1998

THIS IS TO CERTIFY THAT THE MATERIAL FURNISHED ON THE REFERENCED ORDER CONFORMS TO THE REPORTED ANALYSIS AS FURNISHED TO US BY OUR SUPPLIERS OR BY TESTS AND EXAMINATIONS PERFORMED BY ACCEPTED LABORATORIES.

FM 107

BY: QA DATE: 1-18-01

(PAGE 2 OF 2)

10:54 MARGARET CASTOR TEL:7243467338 P.002

359313-01

DEC 8 2000

AK Steel SAWHILL TUBULAR DIVISION

SHIPPING TALLY AND TEST REPORT

AK STEEL CORPORATION • SAWHILL TUBULAR DIVISION • BOX 11 • SHARON, PA 16146-0011

Sold to:
TIOGA PIPE & SUPPLY 8052
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

Ship to: 12/07/00
TIOGA PIPE & SUPPLY
2450 WHEATSHEAF LANE
PHILADELPHIA PA 19137

Sales Dist.	Customer Order	Date	Shipping Instructions	Sawhill Order
218	101200	12/06/00	TRUCK	359313-01

Mill Order No.	----Weight---- Gross	Net	Total Pieces	Length	Footage
.026 DOM A513/5-98 1.6250 OD X1.0200 ID WITH SUP 6S & S8					Part-22979
359313-01 HD# 9713	3,362		29	27'/31' R/L	783'
HD# 9714	3,362		29		783'
HD# 9715	579		5		135'
HD# 9716	2,078		19		484'
Heat# 720705					
Total HD 4	9,381		82		2,185'

NOVA MACHINE
QA REVIEW
APPROVED
DATE 12-9-00

TIOGA PIPE
QA ACCEPTANCE
BY
DATE 12-9-00

FOB: MONROE, NY
TYPE 1028 , ADI,

CERTIFICATE OF TESTS

ALL SAWHILL PIPE AND TUBING IS MANUFACTURED IN THE U.S.A.

KIA ACCEPTED

*** Chemical Analysis ***

Heat No. 720705					
	C -.250	MN-.860	P -.015	S -.004	SI-.014
	CU-.016	NI-.012	CR-.028	MO-.002	V -.002
	TI-.000	AL-.047	SN-.001	CB-.000	

*** Mechanical Properties ***

RB 99/100	Yield Strength	Tensile Strength	Elongation in 0"

359313-01

PART #: HSS-1000-1½ MAXI-BOLT SPACER
LOT #: 9132-0

I hereby certify that the above figures are correct as contained in the records of the Company. J. Weller, Chief Quality Assurance Auditor - Tubing
WHEATLAND PLANT

FH 107

7/16/01

(PAGE 1 of 2)

MANAGER CUSTOMER SERVICE

TIOGA
PIPE SUPPLY COMPANY INC. ☐ 2450 WHEATSHEAF LANE, P.O. BOX 6897 PHILADELPHIA PA. 19137 ☐ 215 831 0700
WATS NUMBER 800 523 3678 ☐ TELEX 84-4650
TWX # 710-670-1650 ☐ TELECOPIER 215-831-1643

Certificate of Analyses and Tests

January 18, 2001

NOVA MACHINE
QA REVIEW
APPROVED
DATE

Drillco Devices LTD
10-05 35th Avenue
Long Island City, NY 11106

CUSTOMER P.O.#	TIOGA S.O.
005225	111356

DRILLCO DEVICES LTD.
QA ACCEPTED

CUST:
P.O. #
S.O. # ITEM #
LOT #

ITEM # 1

HEAT # 720705

SIZE: .1.625" O.D. X 1.020" I.D.

SPECIFICATION: ASTM A513 1026, ADT, ELECTRIC-RESISTANCE-WELDED TUBING TYPE 5

A) Chemical analyses were performed in accordance with ASTM A513-98 and Tioga Pipe 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 Tioga Pipe Supply Procedure TI-3 Rev. 1 with results as shown below:

YIELD PSI	TENSILE PSI	ELONGATION IN 2"
102,343	120,341	17.5% LONGITUDINAL STRIP LONG

LAB #'S C,T 26381Q(1), C26381Q(2) thru C26381Q(82) INCLUSIVE

PART No: HMS-1000-4 1/4 MAXI-BOLT STAKER
LOT No: 9231-D
CARTON No: 1 of 45 PIECES
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER No: 30614CT
REPORT NUMBER: NMP 001-1
(48) THS-1000-20 1/4-1 1/8

THIS IS TO CERTIFY THAT THE MATERIAL FURNISHED ON THE REFERENCED ORDER CONFORMS TO THE REPORTED ANALYSIS AS FURNISHED TO US BY OUR SUPPLIERS OR BY TESTS AND EXAMINATIONS PERFORMED BY ACCEPTED LABORATORIES.

BY: QA DATE: 1-18-01

(PAGE 2 OF 2)

NOVA MACHINE PRODUCTS

18001 Sheldon Road
Middleburg Heights, OH
44130

216 267 3200
FAX 216 433 1940

CERTIFICATION

[X] CERTIFICATE OF COMPLIANCE/CONFORMANCE [ ] MATERIAL TEST REPORT

CERT # 40883	CERT DATE: 19-MAY-06	PO #	00029480 REV. 002
Fluor Daniel Hanford		REL #	
Fluor Hanford		SO #	114125
Hanford Reservation		LINE #	2
2355 Stevens Drive		QTY	65 EA
Richland WA 99352 US		LOT #	50076286
		HEAT #	See attached certs
		DRWG #	

CL/STOCK:
0000633741 2

ITEM DESC:
DRILLCO MBCP-1000 PROPRIETARY MFG. PART NUMBER

CUSTOMER SPECIFICATIONS:
A193 GRADE B7

MATERIAL SPECIFICATIONS:
Per Part Number requirements

HEAT SPECIFICATIONS:
Heat treated per the material specification (As applicable).

QUALITY SPECIFICATIONS:
Meets applicable portions of ANSI/ASME NQA-1 ('83 ED., '86 Add., and the '94 Edition): 10CFR21 Applies100% visually examined and accepted per Nova Work Instruction 8.1.3 Rev.5 which meets the requirements of SAVA-614, Nx-2500, F-786 & F-812;; Domestic Manufactured;;

PROGRAM STATEMENT:
Nova Machine Products Corporation certifies the material, parts, components, or services processed on this purchase order have been supplied in accordance with, and therefore meet or exceed the quality requirements established by the references or specifications cited in this order. The material was processed in accordance with the applicable portions of Nova Machine Products Corporation Quality Assurance Manual (SIC/NFT) Manual Edition 7 Rev. 0 dated 9-14-05.

I certify those results are a true and correct copy of records prepared and maintained by Nova Machine Products in compliance with the requirements of the purchase order and specifications cited. No welding was performed by Nova and the items were maintained mercury and asbestos free by Nova.

Processed per ISO-9001(2000), Certificate #GQC 211.
Fastener products received from Nova are FQA compliant.

YOUR SALESPERSON IS: *Skutca, Mr. James*

Sheila Galaday, Certification Specialist

CERT # 40883 CERT DATE: 19-MAY-06 Page: 1 of 1

NOTE: Knowingly and willfully falsifying or concealing a material fact on this form or making false or fictitious or fraudulent entries on this form could constitute a felony punishable under federal statutes.

5/19/06

DRILLCO DEVICES LTD.
24-32 44th 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 material specification as follows:

Maxi-Bolt or Maxi-Bolt component: MBCP-1000 "Maxi-Bolt Coupler"

Part Number	Description	ASTM/ASME Specification
MBCP	Maxi-Bolt Coupler	A/SA 193 B7

Reference:
Nova Machine Products
Purchase Order No: 3036467
Report Number: NMP 009-2

Ship to:
Nova Machine Products
18001 Sheldon Road
Middleburg Heights, OH 44130

Lot Number 9233-D

Carton Number(s) 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.

Authorized Signature

6/21/06 Rev 1
Date

Form F13-1A Rev. 2 9/12/97

7/6/06

Jun 21 2006 14:52 P.04

DRILLCO DEVICES LTD.
24-32 44TH STREET
LONG ISLAND CITY, NY. 11103
TEL: 718-726-9801
FAX: 718-956-3759

NOVA MACHINE
QA REVIEW
APPROVED
DATE

MATERIAL SUPPLIER REPORT

Date May 18, 2006 — No NMP 009-2

Customer Nova Machine Products, Inc. — Customer P.O. 3036467

Job Name — Location Middleburg Heights, OH 44130

Part Identification 1" Maxi-Bolt Coupler. — P.O. Item No. 2

Catalog Number MBCP-1000 — Quantity 65

Diameter 1.625" O.D. Length 2 ½" Embedment N/A

Chemical Composition

CUST: Flow Dorival
P.O. # 9000294480
S.O. # 119125 ITEM # 2
LOT # 5201 5288

X Certified Material Test Report
X Certificate of Compliance
_____ Certificate of Conformance

Supplementary Requirements: Yes _____ No X

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.

Authorized Signature

Form F 13-0 Rev. 3 09/02/97

7/6/06

Republic Engineered Steels

4761 ROSE AVE S E
MASSILLON, OH 44646 FAX 330-837-7817

CERTIFICATE OF TESTS

FEBRUARY 07, 1997
PAGE: 1 OF 2

PURCHASE ORDER: 3117
PART NUMBER :
REPUBLIC ORDER: 07-14200-07 821
HEAT : 8579349

PURCHASE ORDER DATE: 08/28/96
ACCOUNT NUMBER . . : 2193480
SCHEDULE . . . . . : 59479-

CHARGE ADDRESS

DRILLCO DEVICES LIMITED
P O BOX 6205
LONG ISLAND CITY NY 11106

SHIP TO

DRILLCO DEVICES LTD
1008 35TH AVE
LONG ISLAND CITY NY 11106

NOVA MACHINE
QA REVIEW
APPROVED
DATE

MATERIAL DESCRIPTION

COLD FINISHED STEEL BARS ALLOY ASTM A 193-95 GRD B7 PLUS SURF BHN NRC 10CFR21 AISI-4140 FINE GRAIN COLD DRAWN QUENCH & TEMP BEFORE CD/SRA AFT CD REST SIZE TOL QUAL ASSURANCE QOC 1 T MAX LIFT MAG TEST

SIZE: ROS 1.6390/1.6450 X 12 FT

LADLE CHEMISTRY

C	MN	P	S	SI	CU	NI	CR	MO	AL
0.420	00.87	.011	.031	0.220	0.24	00.18	00.99	0.200	00.024

B.004

SEMI-FINISH RESULTS

AUSTENITIC GRAIN SIZE
AUST GRAIN S2 7.

FINISH SIZE RESULTS SCHEDULE: 59479

BHN HT TRTD (LAB) ASTM E10 ASTM A370
PCE 01 SURFACE 269. MIDRADIUS 269.
PCE 02 SURFACE 269. MIDRADIUS 269.

MACROETCH SRC ASTM E381 MIL STD 430
PCE 1 SURFACE 1. RANDOM 1. CENTER 1.

TENSILE HT TRTD	AUSTENITIZE DEG F	ASTM E8 QUENCHANT	ASTM A370 TEMPER1 DEG F	TEMPER2/SR DEG F
	1600.	OIL	1120.	1050.

	TEMP1 TIME HOURS	TEMP2 TIME HOURS	AUST TIME HOURS
	6.0	3.0	1.1

	TENSILE PSI	YIELD(.2%) PSI	REDUCTION AREA PERCENT	ELONGATION PERCENT
PCE 01	128800.	112800.	65.5	23.0
PCE 02	131900.	115000.	64.7	23.8

CUST:
P.O. # 00029480
S.O. # 114125 ITEM # 2
LOT # 9007S288

NOTES

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 METHODS PRESCRIBED IN THE GOVERNING SPECIFICATIONS AND BASED UPON THE RESULTS OF SUCH INSPECTION AND TESTING HAS BEEN APPROVED FOR CONFORMANCE TO THE SPECIFICATIONS.

MATERIAL WAS PROCESSED IN ACCORDANCE WITH THE CANTON HOT ROLLED PLANT QUALITY ASSURANCE PROGRAM MANUAL, REV. 4 DATED 5/1/95 AND THE MASSILLON COLD FINISH PLANT QUALITY ASSURANCE PROGRAM MANUAL REV. 0 DATED 01/08/96.

DEVICES LTD.
QA ACCEPTED

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

P. Szymanski A.J. Blondheim W. Floyd Smith

2-07-97 3:21pm p. 3 of 3

REPUBLIC Engineered Steels®

401 ROSE AVE S E
MASSILLON, OH 44646 FAX 330-837-7017

CERTIFICATE OF TESTS

FEBRUARY 07, 1997
PAGE: 2 OF 2

PURCHASE ORDER: 3117	PURCHASE ORDER DATE: 08/28/96
PART NUMBER :	ACCOUNT NUMBER . . : 2193480
REPUBLIC ORDER: 07-14288-07 621	SCHEDULE . . . . . : 59478-
HEAT . . . . . : 8979349	

NOTES (CONTINUED)

ALL TESTING HAS BEEN PERFORMED USING THE CURRENT REVISION OF THE TESTING SPECIFICATIONS.

MFG IN THE U.S.A.

CC

FAX BY FAX PC | COPY
FILE 2 COPIES

716-966-3789

NOVA MACHINE
QA REVIEW
APPROVED
DATE 5-9-97

CUST: Huor Daniel
P.O. # 0002420
S.O. # 114125 ITEM # 2
LOT # 500 6288

QA ACCEPTED
2/7/97

PART №: HBCP-1000 HASP-BOLT COUPLER.
LOT №: 9133-D
CARTON №: 1 OF 5 PIECES.
NOVA MACHINE PRODUCTS, INC.
PURCHASE ORDER №: 3031467
REPORT NUMBER: NMP 009-2
(6E) HBCP-1000

5/10/96

KANTI JAIN
MANAGER MET & QC

A. J. BLONDHEIM
CERTIFICATION ANALYST

7/14/96

ALTERNATE LIFT LUG INFORMATION –

PARSONS

305 E. Ainsworth
Pasco, WA 99301

CERTIFICATE OF CONFORMANCE

Contract # 19985 **Release #** 97
Customer Fluor Hanford **Traveler #** P-FH-19985-136

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 **Date** 12/13/06

Page 1 of 1

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

TRAVELER PACKAGE FINAL INSPECTION CHECKLIST

Traveler No.: P-FH-19985-136

Traveler Description: ALTERNATE LIFT LUG WELDMENTS

Action	Acceptable	Rejected	Not Applicable
Traveler Package has been reviewed and accepted by Shop Superintendent or Project Manager	JA 12/11/06		
All associated NCR's are dispositioned and closed.			✓
Impacting issues from an audit/surveillance are closed.			✓
Product is complete and conforms to latest revision of drawing(s) (including red-line changes) and fabrication/procurement specifications.	JA 12/11/06		
Product is marked/tagged/identified as required.	JA 12/11/06		
M&TE used during fabrication is within calibration specification and service period.	JA 12/11/06		
Items are protected from damage.	JA 12/11/06		
QA records are adequate and complete:			
CMTR's	JA 12/11/06		
Weld Record Sheet & VT	JA 12/11/06		
NDE Reports (MT, RT, PT, UT)	JA 12/11/06		
Pressure Test Reports			✓
Other (list): Lift Test	JA 12/11/06		
Other Characteristics, as needed: List:			✓

Comments:

NA

QA Review		
Print Name/Sign: Jerry Smith	Title: QAE	Date: 12/8/06

QA Manager Release	
Print Name/Sign: Kevin Hooper	Date: 12/13/06

FPM-8-F8, Rev. 4(01-26-05) **Parsons Infrastructure & Technology Group, Inc.**

SUPPORTING DOCUMENT LOG/QC INSPECTION TEST RECORDS

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

SUPPORTING DOCUMENT LOG

Document Number	Description	Entered By	Date
SD-1	MAG PARTICLE REPORT (PRE-LOAD)	[signature]	12/5/06
SD-2	MAG PARTICLE REPORT POST-LOAD	[signature]	12/8/06
SD-3	Columbia Rigging "C of C"	[signature]	12/8/06
SD-4	Columbia Rigging "Load Test Certificate"	[signature]	12/8/06
SD-5	Advanced Technology Cert. of Verification	[signature]	12/8/06
SD-6, 6A & 6B	LIFT/LOAD TEST REPORTS	[signature]	12/8/06
SD-7	QAIP For Design Items 16 & 18	[signature]	12/11/06
SD-8	Client QAIP	[signature]	12/13/06

FPM-8-F7, Rev. 4(01-26-05) Parsons Infrastructure & Technology Group, Inc.

Traveler Package Number: P-FH-19965-138 Job Number: 406303

QUALITY ASSURANCE INSPECTION PLAN

Sheet 1 of 4 AJC 12-13-06

PHFI TRAVELER # PFH-19985-136

1. Item Description: **Alternate Lift Lug Weldments, Side Plates & Lift Plates (Source Inspection)**	3. Quality Level: 2 4. Safety Class: SS	7. Purchase Order or Contract Order No.: Contract# 19985 / CR# 8. Release No. (for blanket orders): 97
2. Prepared/Approved by (Print and Sign Name)*: per email confirmation 12-13-06 AJC Jim Rich (DA) Date 10/4/06 Mark Riste (QA) Date 10/2/06 Date *Signature not required if submitted as PassPort attachment	5. Supplier Name: Parsons Hanford Fabricators Inc. (PHFI) 6. Drawing/Spec. No./Revision: HNF-FMP-06-30682-R0	9. Inspection/Receiver No.: Source 06-RFDS-101 10. Item No.: ~~16~~ 18 19 20 ~~22~~ 23 A7 11. Quantity: 3 ~~3~~ 4 2 4 ~~4~~ 3 12. Inspected By (Print name, signature, and QA stamp): Gordon L. Cox FH 001 AJC 12-13-06 entered in error

13. Char. No.	14. Inspection Characteristics	Inspection Status 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
1.0	Verify that (3) Alternate Lift Lug Weldments, (4) Side Plates and (2) Lift Plates have been fabricated.	FH 001 12-13-06					
2.0	Verify a CMTR (B49) has been provided for the following items listed on HNF-FMP-06-30682-R0 (DWG H-4-65153, Sheet 2); • Plate, 1.75" thick, ASTM A36 carbon steel • Plate, 2.50" thick, ASTM A572, ** Grade 50 carbon steel • Plate, 1.75" thick, ASTM A572, * Grade 50 carbon steel	FH 001 12-13-06					** 30" Plate (A572, Gr. 50) was used per tech. Dir/Clarification #1. 12-13-06
3.0	Verify a C of C (B79) has been provided for the following items listed on HNF-FMP-06-30682-R0 (DWG H-4-65153, Sheet 2); • Bolt, Heavy Hex, 1.50-6UNC-2A by 9" long, ASTM A325, Type 1* • Nut, Heavy Hex, 1.50-6UNC-2B, ASTM A194, Grade 7 or Grade 2H	FH 001 12-13-06					

Received in PassPort

A-6700-119.1 (10/99)

101

FFTF-31477
Revision 0
Appendix D

QUALITY ASSURANCE INSPECTION PLAN

Sheet 2 of 4 — Exc 12-13-06

1. Item Description: **Alternate Lift Lug Weldments, Side Plates & Lift Plate (Source Inspection)**

3. Quality Level: 2

4. Safety Class: SS

7. Purchase Order or Contract Order No.: Contract# 19986 / CR# 145713

8. Release No. (for blanket orders): 97

13. Char. No.	14. Inspection Characteristics	Inspection Status: 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
4.0	Verify a C of C has been provided for the following Load Testing attachment devices; • (4ea.) Bolt, Heavy Hex, 1-8UNC-2A x 7" Long, ASTM A325, Type 1 • (4ea.) Nut, Heavy Hex, 1-8UNC-2B, ASTM A194, Grade 7 or Grade 2H • (8ea.) Washer, Circular, 1", ASTM F436, Type 1 *	FH 001 12-13-06					* Washers – 2 certs @ 4 washers each same heat and lot. Exc 12-13-06
5.0	Verify that all welds were visually inspected (VT) at the final pass, by qualified Weld Inspectors, per the SOW, 3.6.B, 1st bullet. Task 3.3. *See General Note 18 of Drawing H-4-65153, Sheet 2.*	FH 001 12-13-06					8-05
6.0	Verify that the 3 Alternate Lift Lug Weldments have been load tested per the SOW 3.6.B, 3rd bullet. Task 3.3	FH 001 12-13-06					
7.0	Verify that pre and post load testing Visual and Magnetic Particle Testing have been performed and documented in the PHFI Documentation Package per SOW, Task 3.3.	FH 001 12-13-06					
8.0	Verify that the M&TE of the load testing equipment has been documented within the PHFI Documentation Package	FH 001 12-13-06					

A-6700-119.1 (10/99)

QUALITY ASSURANCE INSPECTION PLAN

Sheet 3 of ~~3~~ 4 (initialed 12-13-06)

1. Item Description Alternate Lift Lug Weldments, Side Plates & Lift Plates (Source Inspection)	3. Quality Level 2 4. Safety Class SS	7. Purchase Order or Contract Order No. Contract# 19985 / CR# 145713 8. Release No. (for blanket orders) 97

13. Char. No.	14. Inspection Characteristics	Inspection Status: 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
9.0	Verify that the following items are documented within the PHFI Documentation Package per the SOW, 3.6.B, 1st bullet. Task 3.3 and Task 3.4. • Welder Identification ✓ PH-03 • Weld procedure utilized PCS-08 • Weld filler materials ✓ • Date of weld performance ✓ • Inspection (VT) results (weld ✓ acceptance)	FH 001 12-13-06					
10.0	Verify that dimensional inspections have been completed and documented in the PHFI Documentation Package per the Statement of Work (SOW), 3.6.B, 2nd bullet. Task 3.3 and Task 3.4.	FH 001 12-13-06					W/I step 45 8-05
11.0	Verify that dimensional inspections were performed by qualified inspectors per the SOW, 3.6.B, 2nd bullet. Task 3.3 and Task 3.4.	FH 001 12-13-06					
12.0	Verify that the identification verification have been properly documented within the release specific PHFI Documentation Package per the SOW, 3.6.B, 4th bullet. Task 3.3 and Task 3.4.	FH 001 12-13-06					
13.0	Verify PHFI Acceptance Tagging has been completed per the SOW, 3.6.B, 5th bullet. Task 3.3.	FH 001 12-13-06					
14.0	Verify the PHFI Documentation Package is complete and ready for shipment per the SOW, 3.6.C. Task 3.4.	FH 001 12-13-06					

A-6700-119.1 (10/99

Received in PassPort

QUALITY ASSURANCE INSPECTION PLAN

Sheet 4 of 4 12-13-06

1. Item Description
Alternate Lift Lug Weldments, Side Plates & Lift Plates
(Source Inspection)

3. Quality Level 2
4. Safety Class SS

7. Purchase Order or Contract Order No. Contract# 19985 / CR# 145713
8. Release No. (for blanket orders) 97

13. Char. No.	14. Inspection Characteristics	Inspection Status: 15. Acc	16. Hld Tag	17. Rej	18. In-Process	19. Cond. Acc	20. Remarks
15.0	Provide PHFI with a copy of this completed & accepted QAIP per the SOW, 6.6.A.	(initials) 12-13-06					
16.0	Notify BTR/Chet Hammack when this QAIP is completed as acceptable. A FAX Copy can be sent from PHFI, via their copy machine. Send to C C Jr Chet Hammack@rl.gov.	(initials) 12-13-06					372-1694
17.0	Provide the Facility Design Authority and Facility QA Engineer, listed on Page 2 of the SOW, with a copy of the completed and accepted QAIP.	(initials) 12-13-06					Jim Rich Mark Riste

8-05

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A-6700-119.1 (10/99)

PARSONS
Pasco Fabrication Facility

QUALITY ASSURANCE INSPECTION PLAN

Item Description:	Quality Level:	Safety Class:	Purchase Order:	Page:
Alternate Lift Lug Weldments	Nuc	2	406017-21018	1 of 1

Prepared/Approved By (Print & Sign)	Supplier Name:	Drawing/Spec. No./Revision
Name: Jerry Smith Date: 10/31/06 Name: Kevin Hooper Date: 10/31/06	~~Energy & Process Corp.~~ Consolidated Power Supply 11/17/06	406301

Inspected By: (Print & Sign or apply stamp)	Inspection/Receipt No.									
Name: Jerry Smith Date: 11/17/06	Item No.	2	4							
	Quantity	1	1							

Char. No.	Inspection Characteristics	Inspection Status					Remarks
		Accept	Hold	Reject	In-Process	Cond. Acc.	
1	Verify supplier is on Parsons ESL (NOTE: If supplier is not on Parsons ESL, accept items with a Conditional Accept Tag indicating that CGI dedication is required per PPM-18 prior to final acceptance. Also, reference the above PO on the Conditional Accept Tag.)	JA					
2	Verify 3" Thick Plate, 4' x 4'	JA					
3	Verify CMTR to ASTM A572, GR 50 Per B49 QA Clause and applicable code.	JA					
4	Verify 1.75 " Thick Plate, 3' x 3'	JA					
5	Verify CMTR to ASTM A572, GR 50 Per B49 QA Clause and applicable code.	JA					
6	Verify there is no damage to any of the items above.	JA					
7	Verify the above items have been maintained in a clean condition	JA					

PPM-5-F2 (Rev. 0, 02/03/05)

8 of 1 2-05

CONSOLIDATED POWER SUPPLY
NUCLEAR CERTIFIED PRODUCTS

3556 Mary Taylor Road
Birmingham, Alabama 35235
Phone (205) 655-5515
Fax (205) 655-5511

CERTIFICATION

CUSTOMER:
PARSONS CONSTRUCTORS
3005 E ANSIWORTH WHSE #5
PASCO WA 99301

DATE: 11/09/2006
CUSTOMER P.O. #: 406017 21018
SALES ORDER: 6566425 0 900 - 1

ITEM #	QUANTITY UM	MATERIAL DESCRIPTION	HEAT CODE
1.01	16.0 SF	PLATE 3" THK. ASTM A572 GR. 50 4' X 4' PART# PLATE3IN	NUCOR HT# 6107182 SN#6107182-07-1 C/C: D10J
2.01	9.0 SF	PLATE 1.75" THK. ASTM A572 GR. 50 3' X 3' PART# PLATE1.75	NUCOR HT# 6104903 SN#6104903-05-1 C/C: D20J

NO REPAIR WELDING WAS PERFORMED ON THE MATERIAL SUPPLIED

10CFR21 REQUIREMENTS/10CFR50 APPENDIX B AS APPLICABLE

CPS Q.A. PROGRAM 5TH EDITION REVISION 2 DATED 10/6/04

BASED UPON REVIEW OF THE ATTACHED DOCUMENTATION/TEST REPORTS, THIS CERTIFICATION AFFIRMS THAT THE CONTENTS ARE CORRECT AND ACCURATE, AND THAT ALL TEST RESULTS AND OPERATIONS PERFORMED BY CONSOLIDATED POWER SUPPLY OR ITS SUBCONTRACTORS ARE IN COMPLIANCE WITH THE MATERIAL SPECIFICATION(S), PROGRAMMATIC/REGULATORY REQUIREMENTS AS REFLECTED ABOVE, AND THE REQUIREMENTS OF YOUR REFERENCED PURCHASE ORDER. MATERIAL THAT WAS NOT PROCURED BY CONSOLIDATED POWER SUPPLY AS EITHER ASME CODE SECTION III AND/OR NON-CODE SAFETY RELATED IS SUPPORTED BY THE ATTACHED TEST REPORTS WHICH REPRESENTS ALL QUALIFIED TESTING THAT WAS CONDUCTED FOR COMMERCIAL GRADE DEDICATION. ADDITIONALLY, MANUFACTURER MARKINGS MAY HAVE BEEN SUPPLEMENTED OR REAPPLIED BY CONSOLIDATED POWER SUPPLY TO MAINTAIN COMPLIANCE WITH THE APPLICABLE CODES, STANDARDS, MATERIAL SPECIFICATIONS, AND CUSTOMER PURCHASE ORDER.

THE RECORDING OF FALSE, FICTITIOUS, OR FRAUDULENT STATEMENTS OR ENTRIES ON

PAGE: 1

SD-7 2 of 8

CONSOLIDATED POWER SUPPLY
NUCLEAR CERTIFIED PRODUCTS

3556 Mary Taylor Road
Birmingham, Alabama 35235
Phone (205) 655-5515
Fax (205) 655-5511

CUSTOMER:
PARSONS CONSTRUCTORS
3005 E ANSIWORTH WHSE #5
PASCO WA 99301

DATE: 11/09/2006
CUSTOMER P.O. #: 406017 21018
SALES ORDER: 6566425 0 900 - 1

THIS DOCUMENT MAY BE PUNISHED AS A FELONY UNDER FEDERAL STATUTES, INCLUDING FEDERAL LAW, TITLE 18, CHAPTER 47

ATTESTED BY: L Hallow DATE: 11/9/06

TITLE: QA REPRESENTATIVE

PAGE: 2

SD-7 3 of 8

Macsteel Service Centers USA
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 #	CUT CODE	HEAT #	SLAB #	# PIECES	SIZE	GRADE
1	D10J	6107182	07	1	3" x 48.0" x 48.0" Rect	A572 GR50
2	D10J	6107182	07	1 test coupon from same starting plate	3" x 3.0" x 12.0" Rect	A572 GR50
3	D20J	6104903	05	1	1.75" x 36.0" x 36.0" Rect	A572 GR50
4	D20J	6104903	05	1 test coupon from same starting plate	1.75"x3.0"x12.0" Rect	A572 GR50

Ronda M. Curtis

Ronda M. Curtis, Quality Manager
Macsteel Service Centers USA

CPS
QA REVIEW
Approved KS
Date 11/9/06

ISO9001 REGISTERED

SD-7-40f8

2005 GRASSLAND PARKWAY • ALPHARETTA, GA 30004 • PHONE: 770-751-1172 • MACSTEELUSA.COM

15:42 OCT 19, 2006 ID: NUCOR HERTFORD FAX NO: 3563583 #165798 PAGE: 2/2

NUCOR P.O.Box 279
PLATE MILL Winton, NC 27986
(252) 356-3700

Mill Test Report

Page 1

NUCOR It's our Nature.

Issuing Date : 10/18/2006 B/L No. : 146167 Load No. : 147580 Our Order No. : 47753/12 Cust. Order No. : 13206

Vehicle No: 7234

Specification : 3.0000" x 96.000" x 480.000"
ASTM A572 Grade 50-06/ASTM A709 Grade 50-06a/AASHTO M270-50
Type 2

Sold To : Macsteel Service Centers USA Inc
2005 GRASSLAND PARKWAY
ALPHARETTA,GA 30004

Ship To : FERRO UNION SOUTHEAST, INC.
2005 GRASSLAND PARKWAY
ALPHARETTA,GA 30004

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alz	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
6107182	0.20	1.28	0.018	0.004	0.18	0.20	0.05	0.11	0.01	0.024	0.056	0.005	0.001		0.0019	0.0003	0.007	0.46	0.29

Tensile Test							Charpy Impacts											
Plate Serial No	Pieces	Dir.	(psi) Yield	(psi) Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	1	(%) shear	2	(%) shear	3	(%) shear	Ave.	(%) shear	Size	Temp	Min Ave.
6107182-07	1	T	60,400	93,200	26.3													
		T	60,700	92,300	26.3													

OK
CPS
QA REVIEW
Approved KS
Date 11/19/06

OCT 20 2006

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material.
Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast as-rolled discrete plate.
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and manufactured in the USA. ISO 9001-2000 certified (#12443-0) by SRI Quality System Registrar (#0806-05). PED 97/23/EC Compliant.
DIN 50049 3.1.B/EN 10204 3.1.B(2004) compliant. For ABS grades only, Quality Assurance certificate No. 03-MMPQA-192

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

T. A. Depesta

T. A. Depesta, Metallurgist

10/19/2006 3:50:29 PM

406017-21018-1.01

SD-7 5 of 8

20:44 JUL 21, 2006 ID: NUCOR HERTFORD FAX NO: 3563882 #147059 PAGE: 2/2

NUCOR PLATE MILL P.O.Box 279 Winton, NC 27986 (252) 356-3700

Mill Test Report

Page 1

NUCOR It's our Nature

Issuing Date : 07/21/2006 B/L No. : 137378 Load No. : 135059 Our Order No. : 4587712 Cust. Order No. : 13023

Vehicle No: 5758

Specification : 1.7500" x 96.000" x 480.000" ASTM A572 Grade 50-06/ASTM A709 Grade 50-06/AASHTO M270-50 Type 2

Sold To : Macsteel Service Centers USA Inc 2005 GRASSLAND PARKWAY ALPHARETTA,GA 30004

Ship To : FERRO UNION SOUTHEAST, INC. 2005 GRASSLAND PARKWAY ALPHARETTA,GA 30004

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Alt	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
6104903	0.16	1.18	0.016	0.006	0.20	0.29	0.09	0.12	0.01	0.039	0.036	0.004	0.001		0.0007	0.0003	0.012	0.43	0.27

Tensile Test							Charpy Impacts										
Plate Serial No	Pieces	Dir.	(psi) Yield	(psi) Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	1	(%) shear	2	(%) shear	3	(%) shear	Ave.	(%) shear	Size	Temp	Min Ave.
6104903-01	1	T	55,700	82,300		17.0												
		T	56,700	83,000		18.0												
6104903-05	1	T	55,700	82,300		17.0												
		T	56,700	83,000		18.0												

CPS QA REVIEW
Approved KS
Date 1/9/06
ok

Manufactured to fully killed practice by Electric Arc Furnace. Welding or weld repair was not performed on this material.
Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast as-rolled discrete plate.
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and manufactured in the USA. ISO 9001-2000 certified (#12443-0) by SRI Quality System Registrar (#0469-06). PED 97/23/EC Compliant.
DIN 50049 3.1.B/EN 10204 3.1.B(2004) compliant. For ABS grades only, Quality Assurance certificate No. 03-NMPQA-192

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications.

T. A. Depratis

T. A. Depratis, Metallurgist

07/21/2006 9:23:28 PM

SD-7 6 of 8

406017-21018-2.01

CONSOLIDATED POWER SUPPLY
NUCLEAR CERTIFIED PRODUCTS

CERTIFIED MATERIAL TEST REPORT

3556 Mary Taylor Road
Birmingham, Alabama 35235
Phone (205) 655-5515
Fax (205) 655-5511

CUSTOMER	CUSTOMER P.O.
PARSONS CONSTRUCTORS	406017 21018

CPS PURCHASE ORDER	CPS SALES ORDER	CPS ITEM NUMBER
Z65-65167	6566425	N/A

MATERIAL SPECIFICATION
ASTM A572 GR.50

LINE ITEM	LAB NUMBER	CUT CODE	HEAT OR TRACEABILITY	ITEM DESCRIPTION
———	06-3862	D20J	6104903 S/N-6104903-05-1	1-3/4" THK PLATE

C	Mn	P	S	Si	V	Cb
0.182	1.233	0.016	0.004	0.217	0.055	0.015

TENSILE	YIELD POINT	ELONGATION in 2"	BEND
80.6 ksi	52.8 ksi	28 %	N/A

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.

Signature Dan Hutchens Date 11-9-06

Dan Hutchens
CPS Laboratory Technician

CPS
QA REVIEW
Approved
Date 11/9/06

SD-7 7 of 8

CONSOLIDATED POWER SUPPLY
NUCLEAR CERTIFIED PRODUCTS

3556 Mary Taylor Road
Birmingham, Alabama 35235
Phone (205) 655-5516
Fax (205) 655-5511

CERTIFIED MATERIAL TEST REPORT

CUSTOMER	CUSTOMER P.O.
PARSONS CONSTRUCTORS	406017 21018

CPS PURCHASE ORDER	CPS SALES ORDER	CPS ITEM NUMBER
Z65-65167	6566425	N/A

MATERIAL SPECIFICATION
ASTM A572 GR.50

LINE ITEM	LAB NUMBER	CUT CODE	HEAT OR TRACEABILITY	ITEM DESCRIPTION
———	06-3861	D10J	6107182 S/N-6107182-07-1	3" THK PLATE

C	Mn	P	S	Si	V	Cb
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 ksi	24 %	N/A

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.

Signature _____ Date 11-9-06

Dan Hutchens
CPS Laboratory Technician

CPS
QA REVIEW
Approved
Date 11/9/06

SD-8 12/14/06

SD-7 8 of 8

ADVANCED TECHNICAL SERVICES NW, INC.

Advanced Technical Services NW, Inc.
2718 S. Star Lake Rd.
Federal Way, WA. 98003
Phone: 253-529-5186 or 800-287-8046
Fax: 253-529-5261

Certificate of Verification

Issued To:

Columbia Rigging
P.O.Box 2717
802 S. Maitland
Pasco, WA. 99302

Attn: Kyle
509-545-4657

Certification No:	061023118
Instrument:	Testing Machine
Size - Range:	0 - 200,000 lb.f.
Mfg - Model:	ESCO
Serial No:	33118
Plant Location:	Columbia Rigging
Date of Test:	**10/23/06**
Recall Date:	**10/23/07**
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 attached.

The measurement uncertainty represents an expanded uncertainty expressed at approximately 95% confidence level with a coverage factor of k=2.

Machine Range (lb.f.)	Loading Range (lb.f.)
0 - 200,000	10,000 - 200,000

Received: In Tolerance
Returned: In Tolerance

Temperature: 60° F
Humidity: n/a

This certificate attests that this instrument has been calibrated under the stated conditions with standards traceable to the National Institute of Standards and Technology (NIST). The measurement standards used have been calibrated to their manufacturer's specified accuracy / uncertainty and compensation for temperature and humidity has been applied if appropriate. Evidence of traceability is on file at our metrology laboratory. An acceptable accuracy ratio between the standard(s) used and the item calibrated has been maintained. The results documented in this certificate relate only to the item(s) calibrated or tested. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of Advanced Technical Services NW, Inc.

Advanced Technical Services NW, Inc.

Anita Catalinich, Quality Assurance Manager

50-5a

Page 1 of 2

Advanced Technical Services NW, Inc.
Customer: Columbia Rigging
Test Data for: ESCO Testing Machine Certification No: 061023118
Test Date: 10/23/06

USE CODE	STANDARD VALUE lb.f.	TEST INSTR. Lb.f.	T.I. ERROR Lb.f.	T.I. ERROR %	USE CODE	STANDARD VALUE lb.f.	TEST INSTR.lb.f.	T.I. ERROR Lb.f.	T.I. ERROR %	Uncertainty lb.f.
		200,000 LBS.F.RANGE								
	RUN 1					RUN 2				
1	10,000	10,000	0	0.00	1	10,000	10,000	0	0.00	
1	19,800	20,000	200	1.00	1	19,800	20,000	200	1.00	
1	39,900	40,000	200	0.50	1	40,300	40,000	-300	-0.75	
1	80,500	80,000	-600	-0.75	1	80,500	80,000	-500	-0.63	
1	159,460	160,000	550	0.34	1	160,150	160,000	-150	-0.09	
1	198,500	200,000	1,500	0.75	1	199,600	200,000	1,400	0.70	

Return to Zero Indication: 0

Standards

Use Code	Standards	Serial #	Mfgr	Verified By	Date	NIST #	Class A	Uncertainty (lbf)
1	Strain Rod	WC102	Wash. Chain	Dynamark	08/04/06	5734902-B	n/a	n/a

SD-56

PAGE 2 of 2

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 200,000 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

SD-4

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

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 (I.E. 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

SD-3

NorthWest Inspection
5223 W. Deschutes, Suite 106 Kennewick, WA 99336
509 783-2308 Fax 509 783-2307

MAGNETIC PARTICLE REPORT

Job # 406303

Client Parsons Hanford		Date 12/08/06	Procedure No. MT-WTP Rev. 3
Project Alternate Lifting Weldments		Location Port of Pasco, Wa.	
Drawing No. See Below	Examination Std. ASME Sec V		Acceptance Std. AWS D1.1
Equipment Parker Probe s/n 7319 Cal due date 06/02/07	Particles Red	Coil ☐ Prods ☐ Yoke ☒ AC ☒ DC ☐	

Item	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
			POST LOAD TEST
			Drawing – H-4-65153 Sht. 2 Rev. 3
			Traveler # P-FH-19985-136
			No relevant Indications
			Noted at this time.

To the best of my knowledge, work inspected was in accordance with approved design drawings, specifications and applicable codes as noted above.

Examined By Randy J. Watkins Level II Date 12/08/06

SD-2 1071

NorthWest Inspection
6223 W. Deschutes, Suite 108 Kennewick, WA 99336
509 783-2308 Fax 509 783-2307

MAGNETIC PARTICLE REPORT

Job # 406303

Client Parsons Hanford	Date 12/05/06	Procedure No. MT-WTP Rev. 3
Project Alternate Lifting Weldments	Location Port of Pasco, Wa.	
Drawing No. See Below	Examination Std. ASME Sec V	Acceptance Std. AWS D1.1
Equipment Parker Probe s/n 7319 Cal due date 06/02/07	Particles Red	Coil ☐ Prods ☐ Yoke ☒ AC ☒ DC ☐

Item	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
			PRE LOAD TEST
			Drawing – H-4-65153 Sht. 2 Rev. 3
			Traveler # P-FH-19985-136
			No relevant Indications
			Noted at this time.

To the best of my knowledge, work inspected was in accordance with approved design drawings, specifications and applicable codes as noted above.

Examined By Randy J. Watkins Level II Date 12/05/06

SD-1 1 of 1

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

LIFT TESTING / WEIGHING REPORT

Description of item or device to be tested (include serial number if applicable):
ALTERNATE LIFT LUG WELDMENTS P/N A7
Dwg. H-4-65153 Assy. # A7-1

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 item 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.

SUPERINTENDENT L.A. Mercer L.A. Mercer Date 12/8/06
Printed Name / Signature

Design or Rated Capacity of Item/Device to be tested: 54,660 Lbs.

Calculate 125% of Design or Rated Capacity (test load): 68,325 120% 65,592 Lbs
RANGE 0-200,000 Lbs.

Certified Scale No. 33118 Cal. Due date: 10-23-07

Verify all load bearing welds have been visually inspected prior to load test.

QA/QC Terry Johns Terry Johns Date 12/8/06
Printed Name / Signature

If requested, verify NDE of load bearing welds prior to load test. Include NDE report with work package.

QA/QC Terry Johns Terry Johns Date 12/8/06
Printed Name / Signature

Actual test load or weight applied: 68,000 Lbs Hold time if required: N/A

SUPERINTENDENT Pilot Error FOR LARRY MARCER Date 12-13-06
Printed Name / Signature

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.

QA/QC Terry Johns Terry Johns Date 12/8/06
Printed Name / Signature
Visual For Post Lift Test Jerry Smith 12/13/06

Form FPM-32-F1 (Rev. 0B, 11/08/06)

Traveler Package Number: P-FH-19985-135 Job Number: 406303

5b-6

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

LIFT TESTING / WEIGHING REPORT

Description of item or device to be tested (include serial number if applicable):
ALTERNATE LIFT LUG WELDMENT P/N A7
Dwg. H-4-65153 Assy. A7-2

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 item 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.

SUPERINTENDENT L.A. MERCER [signature] Date 12/8/06
Printed Name / Signature

Design or Rated Capacity of Item/Device to be tested: 54,060 Lbs

Calculate 125% of Design or Rated Capacity (test load): 68,325 Lbs 120% 65,592 Lbs.
RANGE 0-200,000 Lbs

Certified Scale No. 33118 Cal. Due date: 10-23-07

Verify all load bearing welds have been visually inspected prior to load test.

QA/QC TERRY JOHNS [signature] Date 12/8/06
Printed Name / Signature

If requested, verify NDE of load bearing welds prior to load test. Include NDE report with work package.

QA/QC TERRY JOHNS [signature] Date 12/8/06
Printed Name / Signature

Actual test load or weight applied: 68,000 Lbs Hold time if required: N/A

SUPERINTENDENT [signature] FOR LARRY MERCER Date 12-13-03
Printed Name / Signature

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.

QA/QC TERRY JOHNS [signature] Date 12/8/06
Printed Name / Signature
Visual For Post Test [signature] 12/13/06

Form FPM-32-F1 (Rev. 0B, 11/08/06)

Traveler Package Number: P-FH-19988-136 Job Number: 486303

SD-60

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

LIFT TESTING / WEIGHING REPORT

Description of item or device to be tested (include serial number if applicable): A/A A7
ALTERNATE LIFT LUG WELDMENT
DWG. H-4-65153 Assy. # A7-3

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 item 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.

SUPERINTENDENT L.A. Mercer L.A. Mercer Date 12/8/06
Printed Name / Signature

Design or Rated Capacity of Item/Device to be tested: 54,660 Lbs

Calculate 125% of Design or Rated Capacity (test load): 68,325 Lbs 120% 65,592 Lbs.
RANGE 0-200,000 Lbs

Certified Scale No. 3311B Cal. Due date: 10-23-07

Verify all load bearing welds have been visually inspected prior to load test.

QA/QC TERRY JOHNS Terry Johns Date 12/8/06
Printed Name / Signature

If requested, verify NDE of load bearing welds prior to load test. Include NDE report with work package.

QA/QC TERRY JOHNS Terry Johns Date 12/8/06
Printed Name / Signature

Actual test load or weight applied: 68,000 Lbs Hold time if required: N/A

SUPERINTENDENT R.A. Burks FOR LARRY MERCER Date 12-13-06
Printed Name / Signature

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.

QA/QC TERRY JOHNS Terry Johns Date 12/8/06
Printed Name / Signature
Visual For Post Lift Test Jerry Arnold 12/13/06

Form FPM-32-F1 (Rev. 0B, 11/08/06)

Traveler Package Number: P-FH-19905-136 Job Number: 406303

SD-6B

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

50	**LOAD TESTING INSTRUCTIONS:** **Assembly 1 & 2** Alternate Lift Lug Weldment (P/N A7) shall be load tested as required by General Note #18 of Drawing H-4-65153, Sheet 2 (HNF-FMP-06-30682-R0 Page 12) and per FH approved, DOE-RL-92-36 (Chapter 11 "Load testing of Below the Hook Lifting Devices" Section 11.9.1.2 Rated Load Test) (Attachment C of SOW). Two (2ea) Alternate Lift Lug Weldment (P/NA7) at a time, are **bolted back to back** (the bolts are to be oriented in the slots to obtain maximum Center-to-Center spacing (~13.5 inches), with the use of P/N's 19 & 20 (Side Plates & Lift Plate) and Heavy Hex Bolts & Nuts 1-8UNC, shall be load tested at 125% of the rated Safe Working Load (SWL) of **54,660** Lbs. (load test value to be 68,325 Lbs. +0 / -3,416 Lbs.) The third Alternate Lift Lug Weldment (P/N A7) will be load tested in the same fashion as above using one Alternate Lift Lug Weldment (P/N A7) a second time. Ensure the test load is evenly distributed during load testing activities. M&TE S/N 33118 Date 10-23-07 SEE COPY OF CALIBRATION REPORT CERT. # 06102311B Load test at 68,325 Lbs. +0 / -3,416 Lbs. (125% of rated load). TESTED AT 68000 LBS. QC QC Signature Terry Soha Date 12/8/06 POST LOAD TEST MT REQUIRED INSPECT WELDS W-1-1thru W-1-3 PER AWS D14.1. SEE WELD DATA SHEETS FOR INSPECTION POINTS. QC QC Signature Jerry Smith Date 12/13/06 12/8/06

PARSONS
Pasco Fabrication Facility

Fabrication/Assembly and Inspection Traveler

55	**LOAD TESTING INSTRUCTIONS:** **Assembly 3** Alternate Lift Lug Weldment (P/N A7) shall be load tested as required by General Note #18 of Drawing H-4-65153, Sheet 2 (HNF-FMP-06-30682-R0 Page 12) and per FH approved, DOE-RL-92-36 (Chapter 11 "Load testing of Below the Hook Lifting Devices" Section 11.9.1.2 Rated Load Test) (Attachment C of SOW). Two (2ea) Alternate Lift Lug Weldment (P/NA7) at a time, are **bolted back to back** (the bolts are to be oriented in the slots to obtain maximum Center-to-Center spacing (~13.5 inches), with the use of P/N's 19 & 20 (Side Plates & Lift Plate) and Heavy Hex Bolts & Nuts 1-8UNC, shall be load tested at 125% of the rated Safe Working Load (SWL) of **54,660** Lbs. (load test value to be 68,325 Lbs. +0 / -3,416 Lbs.) The third Alternate Lift Lug Weldment (P/N A7) will be load tested in the same fashion as above using one Alternate Lift Lug Weldment (P/N A7) a second time. Ensure the test load is evenly distributed during load testing activities. M&TE 4N 33118 Date 10-23-07 SEE COPY OF CALIBRATION REPORT CERT # 06102118 Load test at 68,325 Lbs. +0 / -3,416 Lbs. (125% of rated load). TESTED AT 68,000 LBS. QC QC Signature Terry Johnson Date 12/8/06 POST LOAD TEST MT REQUIRED INSPECT WELDS W-1-1thru W-1-3 PER AWS D14.1. SEE WELD DATA SHEETS FOR INSPECTION POINTS. QC QC Signature Terry Smith Date 11/28/06

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60	QC apply acceptance tags to all successfully completed assemblies. The attached acceptance tag denotes the completed assemblies meet the acceptance criteria outlined.
QC	QC Signature _____ Date 12/7/06

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

Calculation/Technical Basis Cover Sheet and Revision Summary

Section 1: Identification

1. Project Number	2. Modification Description Title/Subject	3. Page i of iii
	Lifting Anchor Bolts Design for Disposable Solid Waste Cask	

4. Use of Form

☑ Calculation ☐ Engineering Analysis ☐ Software Installation ☐ Technical Basis ☐ Other

5. Job Title	6. WBS Number	7. Department/Organization
		FFTF

8. Calculation Number	9. Affected Building Numbers	10. Room	11. Floor
121745-C-01	400 Area		

12. Independent Verification Required? ☐ Yes ☐ No

13. Natural Phenomena Category (PC) ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☑ N/A

Section 2: Preparation, Review, and Approval

14. Rev. No.	15.	16. Designer(s) Date	17. Checker Date	18. Independent Verifier(s)/Date	19. Design Authority	20. Supersedes Calc. No. or Rev. No.	21. Field Confirmation Required?
0	Print Name	KC Tu	WJ Magruder				☐ Yes ☐ No
	Sign	KC Tu	WJ Magruder				
	Date	8/30/06	9/12/06				
	Print Name						☐ Yes ☐ No
	Sign						
	Date						
	Print Name						☐ Yes ☐ No
	Sign						
	Date						

Section 3: Revision Summary

22. Rev. No.	23. Description/Reason for Revision	24. Affected Pages
0	Initial Issue	i-iii, 1-16

Registration Stamp (as applicable):

Signature NSD: _____

Classification Review:

Signature NSD: _____

A-6033-083 (03/01)

Calculation/Technical Basis Sheet

Section 4: Conclusions

Drillco Maxi-Bolts are used to replace the rusted inserts. Three sets of (4) 1" Drillco ASTM A193 Grade B7 Maxi-Bolts (four bolts per set) with 20½" embedment (22" may be used for additional safety) are installed at 120 degrees 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. 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 lug base plates are 11 ½" wide, 17" long, and 2 ½" 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 Drillco Maxi-Bolts anchors is 1.36. The new anchor bolts are safer than the existing inserts.

Calculation/Technical Basis Sheet

Section 1: Identification		
1. Project Number	2. Modification Description Title/Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask	3. Page ii of iii
4. Calculation Number 121745-C-01		5. Rev. No. 0

Section 2: Scope, Objective, Method, Assumptions, Technical Basis

6. Scope and Objective

The inserts for the lifting on the Disposable Solid Waste Cask are rusted and are not able to be used. The objective is to design a set of anchor bolts to replace the inserts for lifting the cask.

7. Method

Hand calculations using MathCAD 13.0. MathCAD is a registered trademark of Mathsoft Engineering and Education, Inc.

8. Assumptions and Technical Basis

The design weight of the cask is 100,000 pounds without impact limiters.

Section 3: Design Inputs/References

9. Ref. No.	10. Inputs/References (with Revision and/or Date or Source)
ACI-318	"*Building Code Requirements for Structural Concrete (ACI 318-05)*", American Concrete Institute, 2005.
ACI-349-01	"*Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-01)*", American Concrete Institute, 2001.
ACI-349-80	"*Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-80)*", American Concrete Institute, 1980.
AISC	"Manual of Steel Construction – Allowable Stress Design", 9th Edition, American Institute of Steel Construction, Inc., 1989.
ASTM A193	Designation: A 193/A 193M-06a, "*Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications*".
ASME B1.1-2003	"*Unified Inch Screw Threads*", 2003.
DAR	NuPac, 1982, "*Design Analysis Report for Fast Flux Test Facility (FFTF) Disposable Solid Waste Cask (DSWC)*", D-1, (Released by EDT-118712, July 27, 1990) Revision 3, Westinghouse Hanford Company, Richland, Washington.
H-4-65155	Drawing H-4-65155, Sheet 2, Rev. 2, "*Steel Liner Weldment Details DSWC*", U. S. Department of Energy - Westinghouse Hanford Co., 1991.
H-4-65157	Drawing H-4-65157 , Rev. 3, "*Disposable Solid Waste Cask Concrete Assembly*", U. S. Department of Energy - Westinghouse Hanford Co., 1991.
ICBO-4133	Evaluation Report No. 4133, Drillco Maxi-Bolt Bearing Type, Undercut Anchors, ICBO Evaluation Service, Inc., February 1992.
Practice 134.215.1206	"*Design of Expansion Anchors*", Fluor Federal Services, Publication Date 01Jan06.

A-6003-034 (08/02)

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DESIGN ANALYSIS

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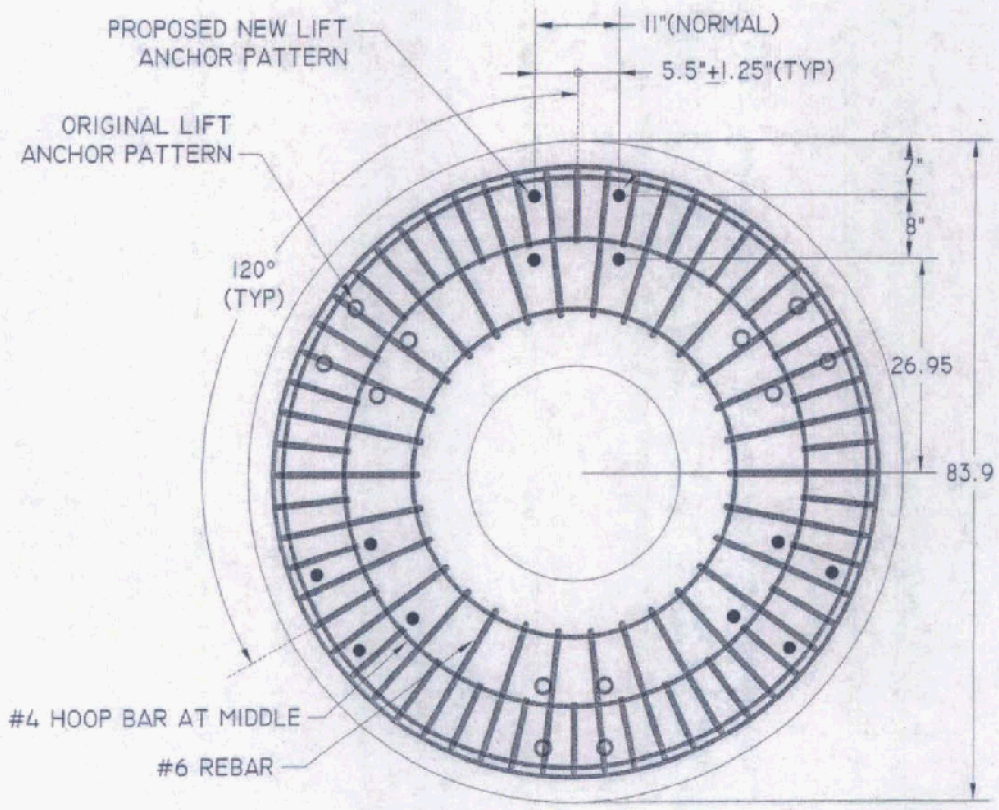
This is an assessment of expansion anchor installation in accordance in Practice 134.215.1206. Per ACI 349-01 Appendix B Anchoring to Concrete, Section B.4.1 - Strength Design of Anchors shall be based either on computation using methods that satisfy requirements at B.4.2 or test evaluation. This calculation documents the computation method to qualify the Drillco expansion anchors used for the cask lifting.



DISPOSABLE SOLID WASTE CASK TOP VIEW - ORIGINAL AND PROPOSED LIFT ANCHOR PATTERN

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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Disposable Solid Waste Cask

$OD_{cask} := (84.5 - 0.6)\cdot in$ minimum cask outside diameter (Ref. H-4-65157) $OD_{cask} = 83.9\,in$

$ID_{cask} := 28\cdot in$ cask concrete inside diameter (Liner O.D.)
Steel Liner ID = 27.25" (Ref. H-4-65155)

$DesignLoad := 100\cdot k$ loaded cask weight (Ref. DAR)

$FactoredLoad := 1.4\cdot DesignLoad$ concrete strength design with 1.4 load factor for dead load (the cask weight is calculated and is not a variable) $FactoredLoad = 140\,k$

$f'_c := 4000\cdot psi$ concrete strength (Ref. H-4-65157)

$f_y := 60000\cdot psi$ yield stress of rebar

Drillco Maxi-Bolt Anchor Bolts

use proposed bolt pattern and existing lifting device and new lifting lugs.
(3) lifting lugs and (4) ASTM A193 GradeB7 1" Drillco Maxi-Bolt anchor bolts per lug

$A_{bolt} := 0.7854\cdot in^2$ bolt nominal area

$A_s := 0.606\cdot in^2$ Tensile stress area (Reference: ASME B1.1-2003, Table 6)

$F_y := 105\cdot ksi$ bolt yield stress (ASTM A193)

$F_u := 125\cdot ksi$ bolt ultimate stress (ASTM A193)

$F_t := \min(0.6\cdot F_y, 0.5\cdot F_u, 60\cdot ksi)$ bolt allowable tensile stress (AISC & ICBO-4133) $F_t = 60\,ksi$

$T_{allowable} := \min\left(A_{bolt}\cdot F_t, A_s\cdot\frac{F_y}{3}, A_s\cdot\frac{F_u}{5}\right)$ 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.

$h_{ef} := 20.5\cdot in$ set the stud embedment - minimum

$d_{hole} := 1.69\cdot in$ drill hole diameter (Table III of Ref. ICBO-4133)

$s1 := 8\cdot in$ keep the existing bolt spacing in radial direction as shown in H-4-65157 to be able to use the existing lifing device

$s2 := 11\cdot in$ requested best bolt spacing in circumferential direction to avoid cutting rebars

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check the clear distance between the drilled bolt hole and the #6 rebars

$r_o := \sqrt{(0.5 \cdot OD_{cask} - 7 \cdot in)^2 + (0.5 \cdot s2)^2}$ outer anchor bolt radius $r_o = 35.38\,in$

Note: Use 0.5·s2 approximate average, since ±1.25" tolerence given in hole location.

$r_i := \sqrt{(0.5 \cdot OD_{cask} - 7 \cdot in - s1)^2 + (0.5 \cdot s2)^2}$ inner anchor bolt radius $r_i = 27.51\,in$

$c(R, \theta) := 2 \cdot R \cdot \sin(0.5 \cdot \theta)$ chord length formula

$\theta := \frac{2 \cdot \pi}{2 \cdot 30}$ angle between #6 rebars (60 total, H-4-65157) $\theta = 6\,deg$

$\alpha_o := \operatorname{asin}\left(\frac{0.5 \cdot s2}{r_o}\right)$ angle from the center line of bolt pattern to the outer anchor bolt $\alpha_o = 8.94\,deg$

$\alpha_i := \operatorname{asin}\left(\frac{0.5 \cdot s2}{r_i}\right)$ angle from the center line of bolt pattern to the inner anchor bolt $\alpha_i = 11.53\,deg$

$c(r_o, \alpha_o - \theta) - \frac{6}{2 \cdot 8} \cdot in - \frac{d_{hole}}{2} = 0.6\,in$

$c(r_o, 2 \cdot \theta - \alpha_o) - \frac{6}{2 \cdot 8} \cdot in - \frac{d_{hole}}{2} = 0.67\,in$

Placing center of bolt pattern at the location of #8 bars, clear distances between outer anchor bolt drilled hole and #6 bars at both sides. The bolt location is almost at the mid-point of the two adjacent bars for the bolts spacing s2 = 11 in.

$c(r_i, \alpha_i - \theta) - \frac{6}{2 \cdot 8} \cdot in - \frac{d_{hole}}{2} = 1.44\,in$

$c(r_i, 3 \cdot \theta - \alpha_i) - \frac{6}{2 \cdot 8} \cdot in - \frac{d_{hole}}{2} = 1.88\,in$

clear distance between #6 and inner anchor bolt drilled hole

$d_{slot} := d_{hole} + \frac{6}{8} \cdot in$ 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 $d_{slot} = 2.44\,in$

set $d_{slot} := 2.5 \cdot in$

then $s2_{max} := s2 + d_{slot}$ maximum and minimum possible bolt spacings $s2_{max} = 13.5\,in$

$s2_{min} := s2 - d_{slot}$ $s2_{min} = 8.5\,in$

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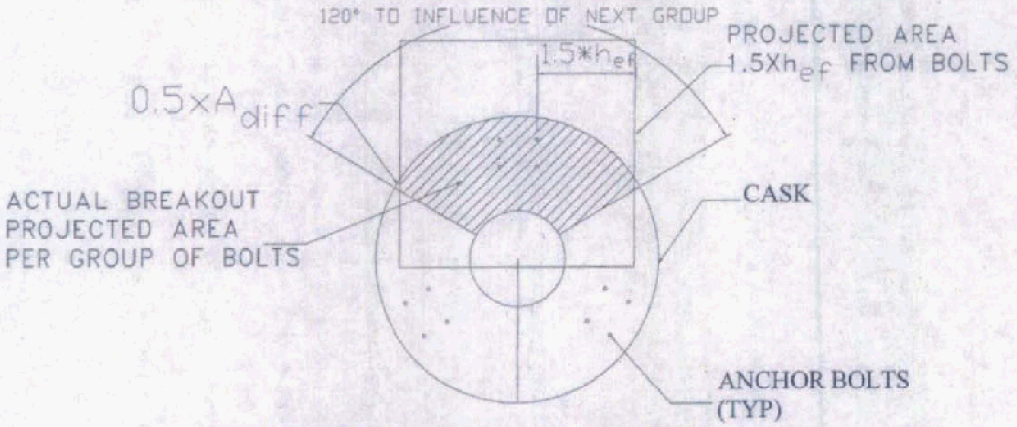
Concrete Breakout Strength

The breakout cone critical edge distance for an undercut anchor bolt is 1.5*hef (ACI-349 B.5.2.1). The breakout cones are overlapping between the groups of the anchor bolts as shown on the sketch below. The effective breakout cone for each group of the anchor bolts is about 1/3 of the cask concrete area as shown on the sketch below.

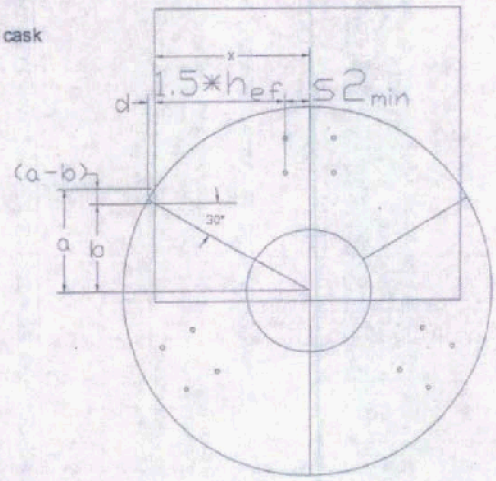


PLAN - CONCRETE BREAKOUT AREA FOR EACH GROUP OF LIFT ANCHORS

$2 \cdot 1.5 \cdot h_{ef} + s2_{min} = 70\,in$ maximum length of projected area

$< \quad c\left(0.5 \cdot OD_{cask}, \frac{2 \cdot \pi}{3}\right) = 72.66\,in$ chord length of 120° cask

The concrete breakout projected area for minimum anchor bolt spacing is less than the one-third of the cask cross-section area. The difference is



set $x := 1.5 \cdot h_{ef} + \frac{s2_{min}}{2}$

$a := \sqrt{\left(0.5 \cdot OD_{cask}\right)^2 - x^2}$

$b := x \cdot \tan(30 \cdot deg)$

$d := \left(\frac{1}{2} \cdot c\left(0.5 \cdot OD_{cask}, \frac{2 \cdot \pi}{3}\right) - x\right)$

$A_{diff} := 2 \cdot \frac{1}{2} \cdot (a - b) \cdot d$

$A_{diff} = 3.88\,in^2$

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$A_N := \frac{1}{3}\cdot\frac{1}{4}\cdot\pi\cdot\left(OD_{cask}^{\ 2} - ID_{cask}^{\ 2}\right) - 4\cdot\frac{1}{4}\cdot d_{hole}^{\ 2} - A_{diff}$ projected concrete failure area $A_N = 1630.87\,in^2$

$A_{No} := 9\cdot h_{ef}^{\ 2}$ $A_{No} = 3782.25\,in^2$ 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)

$k_c := 17$ for post-installed anchors (B.5.2.2 of ACI 349-01)

$N_b := k_c\cdot\sqrt{\frac{f'_c}{psi}}\cdot\left(\frac{h_{ef}}{in}\right)^{1.5}\cdot lbf$ $N_b = 99795.21\,lbf$ basic concrete breakout strength of a single anchor (formula B-6a of ACI 349-01)

$\Psi_1 := 1$ no eccentricity in tension (formula B-7 of ACI 349-01)

$c_o := 0.5\cdot OD_{cask} - \sqrt{\left(0.5\cdot OD_{cask} - 7\cdot in\right)^2 + \left(0.5\cdot s2_{max}\right)^2}$ edge distance from outside face $c_o = 6.35\,in$

$c_i := \sqrt{\left(0.5\cdot OD_{cask} - 7\cdot in - s1\right)^2 + \left(0.5\cdot s2_{min}\right)^2} - 0.5\cdot ID_{cask}$ edge distance from inside face $c_i = 13.28\,in$

$c_{min} := \min\left(c_o, c_i\right)$ minimum edge distance

$c_{min} = 6.35\,in \quad < \quad 1.5\cdot h_{ef} = 30.75\,in$

$\Psi_2 := 0.7 + 0.3\cdot\frac{c_{min}}{1.5\cdot h_{ef}}$ $\Psi_2 = 0.76$ modification factor for edge effect (formula B-8b of ACI 349-01)

$\Psi_3 := 1.0$ for no cracking in concrete and post-installed anchors (B.5.2.6 of ACI 349-01)

$N_{cbg} := \frac{A_N}{A_{No}}\cdot\Psi_1\cdot\Psi_2\cdot\Psi_3\cdot N_b$ breakout strength for four anchor bolts $N_{cbg} = 32789.13\,lbf$

$\phi_{conc} := 0.75$ strength reduction factor for anchor governed by concrete breakout (B.4.4 of ACI 349-01)

$\phi_{conc}\cdot N_{cbg} = 24592\,lbf$ concrete breakout design strength for a group of 4 bolts

$NewConcreteBreakoutStrength := 3\cdot\phi_{conc}\cdot N_{cbg}$ $NewConcreteBreakoutStrength = 73775.53\,lbf$

$\frac{NewConcreteBreakoutStrength}{FactoredLoad} - 1 = -0.47$ margin of safety < 0 if consider the breakout concrete only

utilize the reinforced steel to hold the concrete

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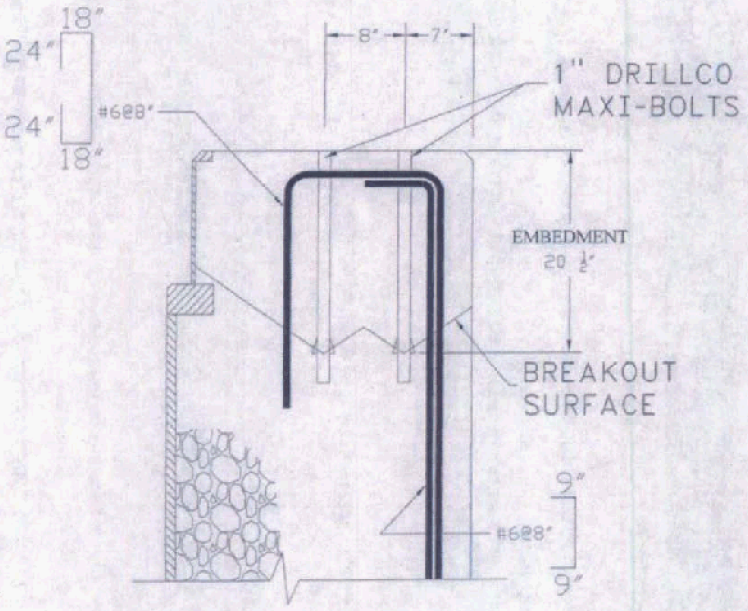
Strength of Reinforcement



SECTION

NOTE: Spiral and hoop reinforcing bars are not shown.

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.

$d_b := \frac{3}{4}\cdot in$ #6 bar diameter

$\alpha := 1$ 12.2.4 of ACI 349-01

$\beta := 1$

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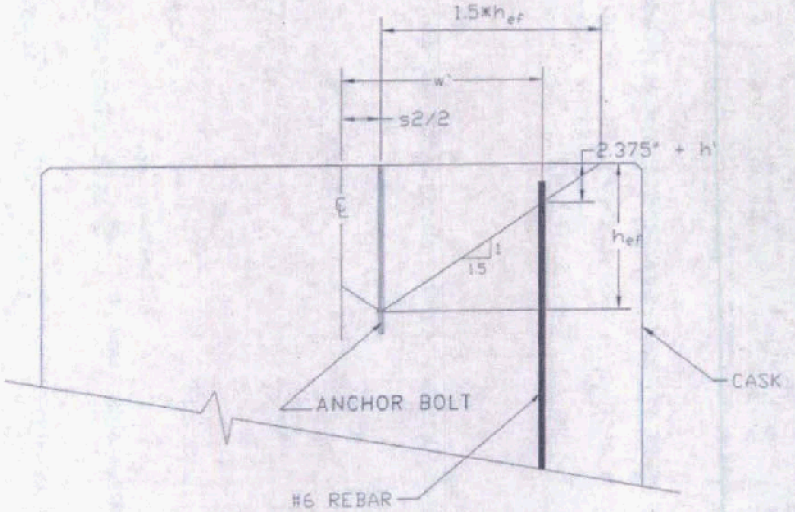
$$l_d := \frac{d_b \cdot f_y \cdot \alpha \cdot \beta \cdot \sqrt{psi}}{psi \cdot 25 \cdot \sqrt{f'_c}}$$ development length required (12.2.2 ACI 349-01) $l_d = 28.46\,in$

$$l_{hook} := \left[\left(\frac{h_{ef}}{in} - 2\right) - \left(7 - 3 - \frac{4}{8} - \frac{6}{2 \cdot 8}\right) \cdot \frac{1}{1.5} + 9\right] \cdot in$$ bar length above breakout surface along the center line of the lift anchors $l_{hook} = 25.42\,in$

Note: 2" top rebar clear distance
7" anchor bolt edge distance
3" side rebar clear distance
4/8 spiral or hoop bar diameter
6/2*8 half of bar diameter
1/1.5 cone
9" hook

$l_{hook} = 25.42\,in < l_d = 28.46\,in$ utilize the double U bars only (U shape on top)



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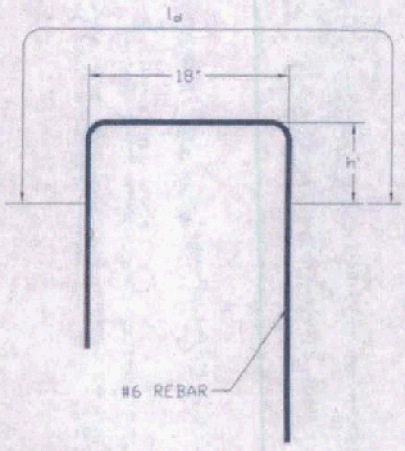
$$h' := \frac{1}{2}\cdot\left(l_d - 18\cdot in\right)$$ vertical bar length required to meet the development length

$h' = 5.23\,in$

$$w' := \left[h_{ef} - \left(2 + \frac{1}{2}\cdot\frac{6}{8}\right)\cdot in - h'\right]\cdot 1.5 + \frac{1}{2}\cdot s2_{min}$$

distance from center line to the last effective rebar (with development length above the breakout cone)

$w' = 23.59\,in$



total 30 #6 with U shape per cask

$$R_{bar} := \frac{1}{2}\cdot OD_{cask} - \left(3 + \frac{4}{8} + \frac{6}{8}\right)\cdot in$$

bar circle radius of outside vertical bars

$R_{bar} = 37.7\,in$

$$bars_{eff} := 2\cdot\frac{30}{2\cdot\pi}\cdot asin\left(\frac{w'}{R_{bar}}\right) - 2$$ number of bars per anchorage group (assume 2#5 have been cut) $bars_{eff} = 4.46$

$\phi_{tension} := 0.90$ strength reduction factor for tension-controlled sections (9.3.2.2(a) of ACI 349-01)

$$\phi P_n := 0.80\cdot\phi_{tension}\cdot f_y\cdot bars_{eff}\cdot\frac{\pi}{4}\cdot d_b^{\,2}$$ rebar strength per four bolts (formula 10-2 of ACI 349-01) $\phi P_n = 85056\,lbf$

Note: Only outer portion of the double U bars are considered.

$RebarStrength := 3\cdot\phi P_n$ total rebar strength $RebarStrength = 255\,k$

$\frac{RebarStrength}{FactoredLoad} - 1 = 0.8226$ the margin of safety > 0 O. K.

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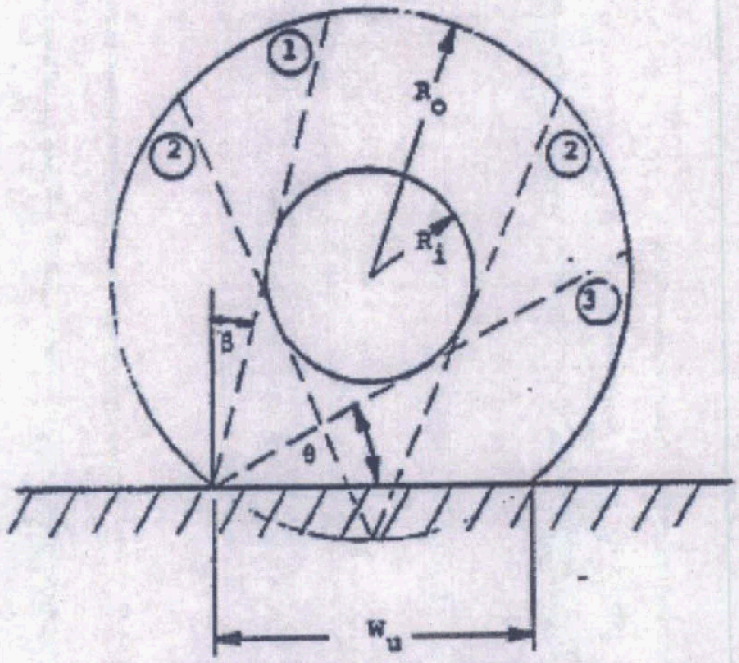
Check Shear Capacity of Reduced Reinforcing

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.

$A_{spiral} := \frac{2}{2 \cdot in} \cdot \pi \cdot \left(\frac{4}{2 \cdot 8} \cdot in \right)^2$ Cross-section area of #4 spiral at 2" through the plane twice $A_{spiral} = 0.1963 \frac{in^2}{in}$

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

$A_{studs} := \frac{14 \cdot \pi \cdot (0.5 - 0.75 \cdot in)^2}{L_{cask}}$ Cross-section area of studs per inch length of cask (14) 3/4" studs in line (Ref. page 4-31 of DAR) $A_{studs} = 0.0361 \frac{in^2}{in}$

$A_{hoop} := \frac{2 \cdot (7 - 1)}{L_{cask}} \left[\pi \cdot \left(\frac{4}{2 \cdot 8} \cdot in \right)^2 \right]$ Cross-section area of #4 hoop rebars in the plane per inch length of cask (1 cut & 6 twice) $A_{hoop} = 0.0137 \frac{in^2}{in}$

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Project FFTF Project Checked August 2006 By W. J. Magruder

Case 1) Assume that the top hoop #4 bar at the middle has been cut at several locations. The middle hoop bar is assumed to be eliminated from the shear plane 1 (Ref. DAR, page 4-51). Then, the reduced allowable shear stress is

$$\sigma_{allowable} := 226 \cdot psi \cdot \frac{A_{spiral} + A_{studs} + A_{hoop}}{0.2484 \cdot in} \qquad \sigma_{allowable} = 223.96\ psi$$

$$\frac{\sigma_{allowable}}{217 \cdot psi} - 1 = 0.032$$ margin of safety > 0 O. K.

Case 2) Potential Shear Failure Plane Missing Shear Studs (Figure 5.2.2-1 of DAR). A shear plane may be postulated which is inclined at such an angle as to actually miss the shear studs and thus forfeit their shear resistance. Check the shear failure under the accidental lateral impact condition if four of the top rebars have been cut per group of anchors at installation of the anchors. Refer to Section 5.2.2.2 on page 5-36 to 37 of DAR. The #6 rebars at top of the cask are utilized as the potential shear failure plane missing shear studs as shown on the following figure.

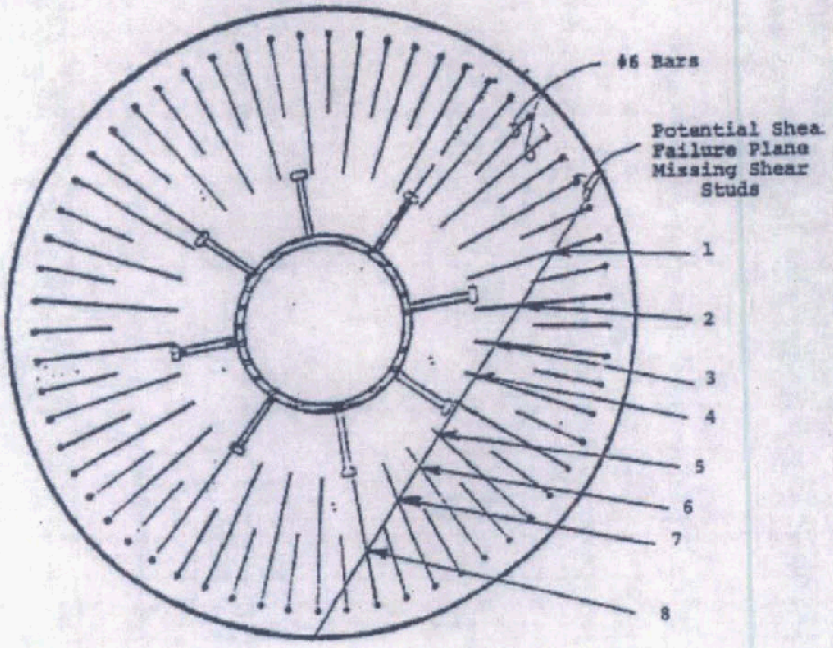

FIGURE 5.2.2-1

Y:\KC Tu\ImRich\LiftingDWSC\449r2.xmcd 8/30/2006

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$A_{rebars} := \frac{(8+6)\cdot 0.44\cdot in^2}{L_{cask}}$ Cross-section area of #6 rebars in the plane per inch length of cask (6 at top and 8 at bottom) $A_{rebars} = 0.0359 \frac{in^2}{in}$

$A_{hoop} := \frac{2\cdot(3)}{L_{cask}}\cdot\left[\pi\cdot\left(\frac{4}{2\cdot 8}\cdot in\right)^2\right]$ Cross-section area of #4 hoop rebars in the plane per inch length of cask (3 inner hoop bars are not included, 1 mid-bar has been cut and 3 outside face bars are counted twice) $A_{hoop} = 0.0069 \frac{in^2}{in}$

$\sigma_{allowable} := 226\cdot psi\cdot\left(\frac{A_{spiral} + A_{rebars} + A_{hoop}}{0.2484\cdot in}\right)$ reduced allowable shear stress by cutting 4 rebars per shear plane (per lifting plate too) $\sigma_{allowable} = 217.57\,psi$

$\frac{\sigma_{allowable}}{217\cdot psi} - 1 = 0.003$ margin of safety > 0 O. K.

Compare the Pull-out Loads of the New Drillco Maxi-Bolt and Existing Insert Based on the Same Procedure Used in the Original Design in DAR

The pull-out load in DAR is calculated using the method from PCA Design Handbook, 2nd Edition, Section 5.15. The cone is 45 degree (1 to 1 slope). The cluster inner insert strength is reduced to 28% of a single insert strength because of the 8" spacing between the inserts in the original design in page 5-7 of DAR. The outer insert strength is reduced to 21% because the 8" spacing and 7" outside edge distance. The inner edge distance is not considered because the inner liner is assumed to take the tension load of cracking concrete. The new bolts are spacing 8" in one direction and between 8.5 to 13.5" in the other direction. The minimum outside edge distance is $c_{min} = 6.35\,in$

$K(r,\theta) := \frac{1}{2}\cdot r^2\cdot(\theta - \sin(\theta))$ segment of circle formula

check reduction factor in DAR

$r := 18\cdot in$

$\theta := 2\cdot\acos\left(\frac{0.5\cdot 8\cdot in}{r}\right)$ $\theta = 154.32\,deg$

$\frac{\pi\cdot r^2 - K(r,\theta) - K(r,\theta)}{\pi\cdot r^2} = 28\%$ The overlap area of the two segments is ignored in DAR.

reduction factor for new lift bolt pattern

$\theta 1 := 2\cdot\acos\left(\frac{0.5\cdot 8\cdot in}{h_{ef}}\right)$ $\theta 1 = 157.5\,deg$

$\theta 2 := 2\cdot\acos\left(\frac{0.5\cdot s2_{min}}{h_{ef}}\right)$ $\theta 2 = 156.07\,deg$

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$$\frac{\pi \cdot h_{ef}^2 - K(h_{ef}, \theta 1) - K(h_{ef}, \theta 2)}{\pi \cdot h_{ef}^2} = 25\%$$

The overlap area of the two segments is ignored in DAR.

$A_o := \pi \cdot \sqrt{2} \cdot h_{ef}^2$ shear cone area per bolt $A_o = 1867.12\ in^2$

$\phi := 0.85$ shear reduction factor

$P_u := \phi \cdot 4 \cdot \frac{A_o}{in^2} \cdot \sqrt{\frac{f'_c}{psi}} \cdot lbf$ ultimate capacity pull-out per bolt $P_u = 401496.26\ lbf$

use the same reduction load factor for overlapping as DAR

$P_{cap} := \frac{2 \cdot P_u \cdot 28\% + 2 \cdot P_u \cdot 21\%}{5}$ pull-out capacity reference page 5-7 of DAR $P_{cap} = 78693.27\ lbf$

$\frac{P_{cap}}{33333 \cdot lbf} - 1 = 1.36$ the margin of safety

> 0.82, the margin of safety of existing inserts. Proposed lift anchors are more conservative than the existing inserts.

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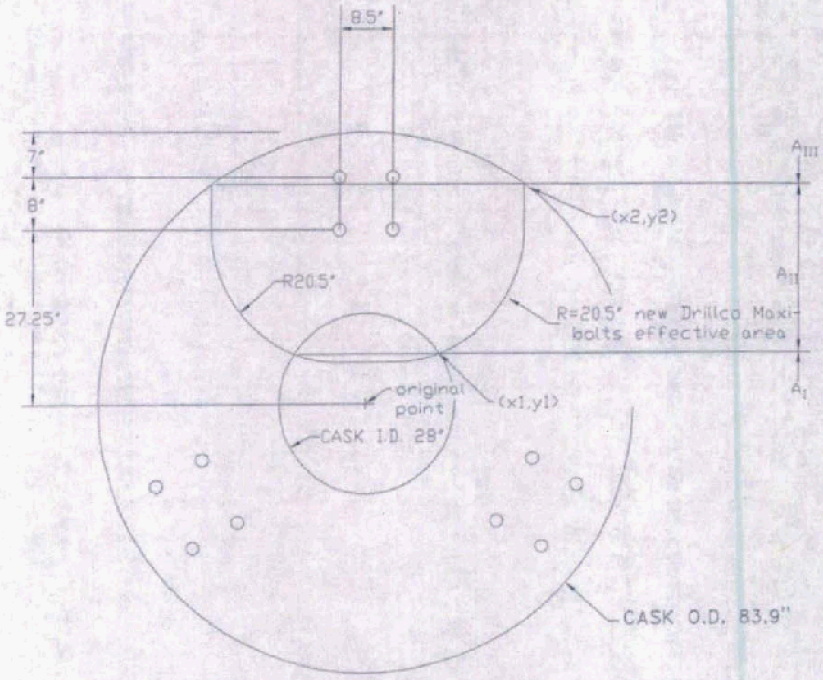
Pull-out Loads of the New Drillco Maxi-Bolt Based on ACI 349-80 Code

The concrete breakout cone is 35 degree (1.5 to 1 slope) on ACI 318-05 Appendix D and it is 45 degree (1 to 1 slope) on Appendix B, Steel Embedments of ACI 349-80. Based on the ACI 349-80 code, the effective failure areas are shown in following sketch.



PROJECTED AREA OF THE PROPOSED LIFT ANCHORS PER ACI 349-80 CODE

find point x1,y1

guess values $x := 32 \cdot in$ $y := 5 \cdot in$

Given

$x^2 + y^2 = (0.5 \cdot ID_{cask})^2$ cask inner circle

$(x - 0.5 \cdot s2_{min})^2 + [y - (0.5 \cdot OD_{cask} - 7 \cdot in - 8 \cdot in)]^2 = h_{ef}^2$ shear cone of inside bolt

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$$\begin{pmatrix} x1 \\ y1 \end{pmatrix} := \text{Find}(x,y) \qquad x1 = 11.61359061\,\text{in} \qquad y1 = 7.81817217\,\text{in}$$

find point x2,y2

Given

$x^2 + y^2 = (0.5 \cdot OD_{cask})^2$ cask outside surface

$x = 0.5 \cdot s2_{min} + h_{ef}$ shear cone of outside bolt

$$\begin{pmatrix} x2 \\ y2 \end{pmatrix} := \text{Find}(x,y) \qquad x2 = 24.75\,\text{in} \qquad y2 = 33.87093317\,\text{in}$$

$K(r,\theta) := \frac{1}{2} \cdot r^2 \cdot (\theta - \sin(\theta))$ segment of circle formula

$$\theta 1 := 2 \cdot \text{atan}\left(\frac{x1 - 0.5 \cdot s2_{min}}{0.5 \cdot OD_{cask} - 7 \cdot \text{in} - 8 \cdot \text{in} - y1}\right)$$

$A_I := -11 \cdot \text{in} \cdot \left[y1 - \left(0.5 \cdot OD_{cask} - 7 \cdot \text{in} - 8 \cdot \text{in} - h_{ef}\right)\right] - K(h_{ef}, \theta 1)$

$$\theta 3 := 2 \cdot \text{atan}\left(\frac{x1}{y1}\right)$$

$A_{II} := \frac{\pi}{2} h_{ef}^2 + s2_{min} \cdot h_{ef} + \left[y2 - \left(0.5 \cdot OD_{cask} - 7 \cdot \text{in} - 8 \cdot \text{in}\right)\right] \cdot \left(s2_{min} + 2 \cdot h_{ef}\right) - K(0.5 \cdot ID_{cask}, \theta 3)$

$$\theta 2 := 2 \cdot \text{atan}\left(\frac{x2}{y2}\right)$$

$A_{III} := K(0.5 \cdot OD_{cask}, \theta 2)$

$A_o := A_I + A_{II} + A_{III} - 4 \cdot \frac{1}{4} \cdot d_{hole}^2$ Drilco Maxi-Bolt effective area based on 45° fail cone angle $A_o = 1316.79\,\text{in}^2$

$\phi := 0.65$ reduction factor for anchor in tension zone

$P_u := 4 \cdot \phi \cdot \frac{A_o}{\text{in}^2} \cdot \sqrt{\frac{f_c}{\text{psi}}} \cdot \text{lbf}$ ultimate capacity pull-out $P_u = 216531.26\,\text{lbf}$

$P_{cap} := \frac{P_u}{5}$ pull-out capacity per HWS-2714 reference page 5-6f of DAR $P_{cap} = 43306.25\,\text{lbf}$

$\frac{P_{cap}}{33333 \cdot \text{lbf}} - 1 = 0.3$ the margin of safety >0, using 1980 nuclear related concrete code ACI 349-80

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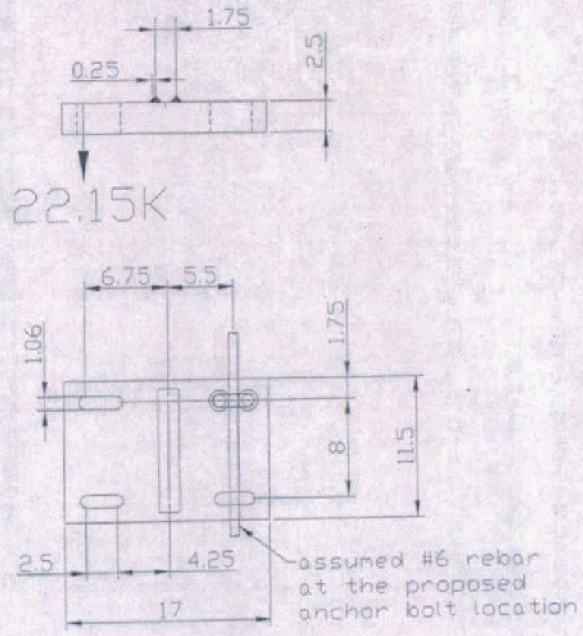
Attachment of Lift Lug Base Plates to Anchors

use 1" studs (ASTM 193, Grade B7) with Heavy hex nuts, ASTM A194, Grade 7

$T_{allowable} = 15.15k$ bolt allowable tension (see page 2 for calculation)

Lifting Lug Base Plate (11.5" wide 17" long and 2.5" thick)



LUG BASE PLATE

$F_y := 36000 \cdot psi$ A36 yield stress

$F_b := \min(0.66 \cdot F_y, 23.75 \cdot ksi, 12.76 \cdot ksi)$ allowable bending stress (pages 3-4 and 3-5 of DAR) $F_b = 12760$ psi

$f_b := \dfrac{22150 \cdot lbf \cdot (0.5 \cdot s2_{max} - 0.5 \cdot 1.75 \cdot in - 0.25 \cdot in)}{\frac{1}{6} \cdot 11.5 \cdot in \cdot (2.5 \cdot in)^2}$ bending stress (see page 5-5 of DAR for load) $f_b = 10401$ psi

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$f_b = 10401\,psi < F_b = 12760\,psi$ O. K.

$\frac{F_b}{f_b} - 1 = 0.23$ margin of safety > 0 O. K.

check prying action (reference p.4-90 of AISC) $k \equiv 1000 \cdot lbf$

$B := T_{allowable}$ allowable tension per bolt

$b := 0.5 \cdot (s1 - 1.75 \cdot in) - 0.25 \cdot in$ distance from bolt to weld (1/2) $b = 2.88\,in$

$d := 1.00 \cdot in$ bolt diameter

$b' := b - 0.5 \cdot d$

$a := 1.5 \cdot in$ edge distance 1.25 inches minimum edge distance use 1.5 conservative (ref. TABLE J3.5 of AISC)

$p := 0.5 \cdot 11.5 \cdot in$ length of flange tributary to each bolt $p = 5.75\,in$

$t_c := \sqrt{\frac{8 \cdot B \cdot b'}{p \cdot F_y \cdot in^2}}$ plate thickness required to develop B with no prying action 2.5" in thick is O. K. $t_c = 1.18$

$s2_{max} + 2 \cdot a = 16.5\,in$ 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

guess values $x := 11 \cdot k$ $y := 11 \cdot k$

Given $x + y = 22.15 \cdot k$

$x \cdot 0.5 \cdot s2_{max} = y \cdot 0.5 \cdot s2_{min}$

$\begin{pmatrix} X \\ Y \end{pmatrix} := Find(x,y)$ $X = 8.56\,k$ $Y = 13.59k$

$\frac{15.15 \cdot k}{Y} - 1 = 0.11$ the margin of safety > 0 O. K. (see page 2 for anchor bolt allowable)

HNF-FMP-06-30682-R0B

FMP (FACILITY MODIFICATION PACKAGE) FORM

Page 1 of 19

Design Package Identification

1. Mod Title:
DSWC Replacement Anchors and New Lift Lugs

Key Words:
DSWC, FFTF, Waste Cask

2. Project No./Work Package No.:
FFTF/4F-06-4307/M and 4A-04-7583/M

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

8. Release:
Release CACN 121745
MAY 22 2007
DATE:
STA: 15
HANFORD RELEASE
ID:
20

☐ Modification Work Complete and Field Verified
☐ Not Approved/Archive

Design Authority Print/Signature/Date

4. Area	5. Building	6. System No.	7. FMP Author
400	4717	41C	JW Rich

9. USQ Required? ☐ USQ ☒ CX ☐ NA No.: CX-12 RECannell 5/15/07

10. Environmental-Activity Screening Form Completed? ☐ YES ☒ NO
If Yes, is the Environmental-Activity Form Attached? ☐ YES ☒ NO

11. Distribution - Name	MSIN	Distribution - Name	MSIN
SA Chastain	N2-02	DE Swenson	A3-02
JW Rich	N2-02	SU Zaman	N2-57
SW Hiller	N2-02	MR Rodriguez	N2-60
ME Riste	N2-11	WJ Magruder	
PJ Hanny	H7-60		

12. Change Description (description and reason for requested change):

As noted in HNF-FMP-06-30682-R0, the load test specified for each group of anchors was based on the historical procedure LOT-03, Rev. 1, dated January 18, 1982, originally prepared by the DSWC designer Nuclear Packaging, Inc. Procedure LOT-3 required that one side of the cask be lifted ~1" off the ground using a single group of 4 Lift Anchors which would result in an approximate load of 54,650 pounds. After discussion with crafts that will be performing the load test, there is a concern that lifting of the DSWC as described using a mobile crane could result in loss of control of the load if the cask were to roll about its axis. As discussed in Block 23, the load test method described by LOT-03 exceeds that required based on Section 5.1.1 of the DSWC Design Analysis Report (DAR). Thus the load test criteria needs to be revised.

Calculation 121745-C-02, Revision 0, was included as pages 39 through 55 of HNF-FMP-06-30682-R0. The calculation inadvertently included three pages that should not have been included, pages 40, 41 and 42. Calculation 121745-C-02, Revision 0, is to be included with this revision of the FMP with these pages removed to correct this error. The calculations are unchanged.

Approvals

13. FMP Author	Design Authority	Engineering Management
JW Rich 5/15/07	SA Chastain 5/15/07	SW Hiller 5/16/07
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date
Title Transportation Safety	Title Quality Assurance	Title Nuclear Safety
Dennis L. McCall for attached E-Mail 5/11/07	ME Riste 5/15/07	SU Zaman 5/16/07
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date

14. Document Index

Action	Document Number	Sh/Pg	Rev	E/S	FMP Section Title	FMP Page	Release To Work?

A-6003-082 (08/05)

FMP (FACILITY MODIFICATION PACKAGE) FORM (continued)

17 Jul 5122

I	121745-C-02		0			4 - A	☐
							☐
							☐

15. Related FMPs/Changes:

16. Incorporated FMPs/EDCs/ECNs/DCNs:

17. Lead Engineering Discipline:
Fuel Handling

18. Affected Engineering Disciplines:

Modification Bases

19. *Engineering Request or Proposal:* CACN 121745

Revise the load test requirements to alleviate any safety concerns.

Replace calculation 121745-C-02 with a new copy of that calculation having the erroneous pages removed.

20. Change Status of Engineering Documents to be Modified:

Document Number	Sh/Pg	Rev	E/S	Outstanding ECN(s), DCN(s), FMP(s)	Work Complete?

Submit List to Document Control for Project Status? ☐ YES ☐ NO

21. Potentially Affected Documents Not Changed By This FMP:

Document Type	Document Number/Revision	Document Owner (Organization)	Technical Authority Notified	Date Notified

22. Conceptual Evaluations:

23. *Functions, Requirements, and Design Criteria:*

Functions:

The anchors must be capable of lifting the loaded DSWC Cask which has a bounding gross weight of 100,000 pounds per Section 3.3.1 of the DAR.

Requirements:

The requirements for lifting of the DSWC are documented in the DSWC DAR, Section 5.1.1. In order to avoid stringent requirements that existed at the time the DSWC was designed, all loads imposed on the reusable portion of the lifting hardware had a factor of 1.33 applied to the maximum expected load. The maximum expected load was determined to be 100,000 pounds (Section 3.3.1 of the DAR). The factored load of 44,400 pounds was then defined as the design Safe Working Load (SWL) for the reusable portion of the lifting hardware. All hardware was designed to meet or exceed this factored design Safe Working Load. In fact, the new Alternate Lift Lug Weldment was designed and tested for SWL of 54,660 pounds to allow its use for load testing of the anchor bolt group using the methods specified in the historical Load Test Procedure LOT-3. Although the analysis of the new Alternate Lift Anchors (Calculation 121745-C-01 included in HNF-FMP-06-30682-R0) considered a bounding factored load of 140,000 pounds as a design requirement, it should be noted that the new Alternate Lift Anchors are not part of the reusable portion of the lifting hardware. Thus the minimum allowed load test required to proof load each group of 4 new Lift Anchors is 125% of 1/3 of 100,000 pounds, or 41,670 pounds.

Design Criteria:

Revise the Design Criteria as follows:

Each Lifting Lug and associated hardware must be designed for a minimum Safe Working Load of 44.3 kips per the DSWC Design Analysis Report. To assure conservatism, the new Lift Anchors were also to be designed for a Safe working Load of 44.3 kips.

The proof test method to be used for the Alternate Lift Lugs shall be static load test of 125% of their Safe Working Load. The proof load test of the new Lift Anchor group

A-6003-082 (06/05)

FMP (FACILITY MODIFICATION PACKAGE) FORM (continued)

shall be no less than 125% of the maximum expected load (41,670 pounds) and no more than 54,660 pounds (which would result from lifting one side of the DSWC ~1" off the ground) not to exceed the Safe Working Load of the new Alternate Lift Lug.

24. Post-Installation Acceptance Test Criteria:

Proof test each new Lift Anchor to 17,000 pounds which is 125% of the maximum individual Lift Anchor load as determined by Calculation 121745-C-02, Revision 0.

Proof test each anchor group with a static test load of 41,670 pounds minimum and 54,660 pounds maximum.

25. Design Verification:

Verification by: ☒ Peer Review ☐ Formal Design Review ☐ Alternate Calculations ☐ Qualification Testing

Design Verification Record Form (A-6003-845) required per HNF-PRO-8336? ☐ YES ☒ NO

Additional Design Verification Documentation Prepared? ☐ YES ☒ NO

Design Verification Checklist Questions

a. Are the assumptions, functions, requirements, and design criteria appropriately selected? ☒ YES ☐ NO

b. Does the design meet the stated assumptions, functions, requirements, and design criteria? ☒ YES ☐ NO

c. Were the design inputs correctly incorporated into the design? ☒ YES ☐ NO

d. Is the design output reasonable compared to the design inputs? ☒ YES ☐ NO

e. Have suitable materials, parts, processes, and inspections and testing criteria been specified? ☒ YES ☐ NO

f. Have manufacture, maintenance, and operability been adequately addressed in the design? ☒ YES ☐ NO

g. Are all affected active design documents identified and appropriately changed? ☒ YES ☐ NO

A review of the design has been performed. The selected functions, requirements, and design criteria meet the stated engineering request. The verification completed by the method(s) noted that this FMP is accurate, and the design defined by this FMP and related documents meets the stated functions, requirements, and design criteria.

Design Verifier W J Mangan / W J Mangan 5/15/07
Print/Signature/Date

A-6003-082 (08/05)

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FMP CALCULATION FORM

Calculation Title: Lifting Anchor Bolts Design for DSNC

Calculation No. 121745-C-02 Rev. 0

(•) New ( ) Supercedes Calculation No. / Rev. No. _____ / _____

Calculation Description

This documents the Proof Test Values for Drilloo Maxi-Bolts and Lifting Lugs.

Use of Form

[X] Calculation [ ] Engineering Analysis [ ] Software Installation [ ] Technical Basis [ ] Other

Performance Category as defined in HNF-PRO-097

( ) 0 (•) 1 ( ) 2 ( ) 3 ( ) N/A

	Print	Signature	Date
Originator:	W.J. Magruder	WJ Mag	5/15/07
Checked By:	J.W. Rich		5/15/07

PE Stamp (if required)

A-6003-887 (06/04)

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DESIGN ANALYSIS

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

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

Reference:

1. **Calculation Number 121745-C1, Rev. 0**
2. **Work Package 4A-04-7883/M**
3. **Procedure for Proof Testing Lifting Inserts D.S.W.C., Procedure No. LCT-03, Revision 1, January 16, 1992 Nuclear Packing Inc.**
4. **DAR - NuPac, 1992, "*Design Analysis Report for Fast Flux Text Facility (FFTF) Disposable Solid Waste Cask (DSWC)", D-1, Released by* EDT-118712, July 27, 1990) Revision 3, Westinghouse Hanford Company, Richland, WA.**
5. **AISC Steel Construction Manual, Ninth Edition.**
6. **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

$k := 1000 \cdot lbf$

$A_{bolt} := 0.7854 \cdot in^2$ bolt nominal area

$A_s := 0.606 \cdot in^2$ Tensile stress area (Reference: ASME B1.1-2003, Table 6)

$F_y := 105 \cdot ksi$ bolt yield stress (ASTM A193)

$F_u := 125 \cdot ksi$ bolt ultimate stress (ASTM A193)

$F_t := 0.6 \cdot F_y$ bolt allowable tensile stress (page 3-4 of DAR)

$T_{allowable} := \min\left(A_{bolt} \cdot F_t, \frac{A_s}{3} \cdot F_y, \frac{A_s}{5} \cdot F_u\right)$ $T_{allowable} = 15.15\,k$

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

Allowable Tensile strength based on nominal area and F_t $T_{allow.nom} := A_{bolt} \cdot F_t$ $T_{allow.nom} = 49.48\,k$

Allowable Tensile strength based on 1/3 Yield Stress $T_{allow.yield} := \frac{A_s}{3} \cdot F_y$ $T_{allow.yield} = 21.21\,k$

Allowable Tensile strength based on 1/5 Ultimate Stress $T_{allow.stress} := \frac{A_s}{5} \cdot F_u$ $T_{allow.stress} = 15.15\,k$

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

Determine Proof Test Load $Proof_{load} := y \cdot 1.25$ $Proof_{load} = 16.99\,k$

FLUOR GOVERNMENT GROUP **DESIGN ANALYSIS**

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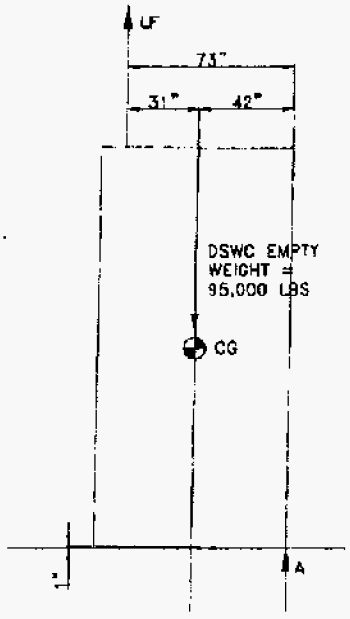
Use Proof Test Load of 17.0 kips

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.



Determine the lift force

$$LF := \frac{95000 \cdot lbf \cdot 42 \cdot in}{73 \cdot in}$$

$LF = 54.66\,k$

Check average Load per anchor

$$L_{anchor.avg} := \frac{LF}{4} \qquad L_{anchor.avg} = 13.66\,k$$

Check the maximum force due to minimum spacing per Ref. 1

From page 15 of Ref. 1

Load per 2 bolts = 22.15 k

$$L_{anchor} := \frac{22.15 \cdot k}{2} \qquad L_{anchor} = 11.07\,k$$

Max Load = $y = 13.59\,k$ $\qquad Load_{mult} := \frac{y}{L_{anchor}} \qquad Load_{mult} = 1.23$

$L_{anchor.avg} \cdot Load_{mult} = 16.77\,k$

This load is less than Proof Load of 17.0 k for each individual anchor and is adequate to test anchor group.

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

Determine Test Load on lifting lug

Lifting lugs are required to be load tested per the Hanford Hoisting and Rigging Manual.

Nominal load is 100 kips / 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 Loading the anchor group is LF = 54.66 k as described and calculated on the previous page.

Conclusion: Load Test Lift Lugs to 125% of load used when load testing anchor groups.

$Lug_{TL} := LF \cdot 1.25$ $Lug_{TL} = 68.32\,k$ Use 68,600 lbf test load

Calculate the Safe Working Load $SWL := \frac{68500 \cdot lbf}{1.25}$ $SWL = 54800\,lbf$

Check bending stress on lifting lug at proof load $Load_{2bolt} := \frac{68500 \cdot lbf}{2}$ $Load_{2bolt} = 34250\,lbf$

From Ref. 1 page 16

$s2_{max} := 13.5 \cdot in$

$F_{Y.A572} := 50000 \cdot psi$ ASTM A572 Grade 50 yield stress

$F_b := 0.60 \cdot F_{Y.A572}$ use AISC allowable for load test $F_b = 30000\,psi$

$$f_b := \frac{Load_{2bolt} \cdot (0.5 \cdot s2_{max} - 0.5 \cdot 1.75 \cdot in - 0.25 \cdot in)}{\frac{1}{6} \cdot 11.5 \cdot in \cdot (2.5 \cdot in)^2}$$

$f_b = 16083\,psi < F_b = 30000\,psi$ O. K.

$\frac{F_b}{f_b} - 1 = 0.87$ margin of safety > 0 O. K.

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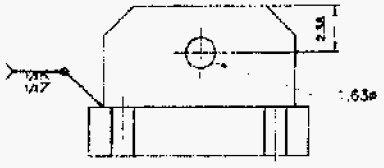
Client Fluor Hanford Inc. WO/Job No. 65400801.1217450 BL00
Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Megruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

Check Capacity of weld at proof load of 68,500 lbs



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

$L_{weld} := 2 \cdot 11.5 \cdot in + 2 \cdot 1.75 \cdot in$ $L_{weld} = 26.5\ in$

$Area_{weld} := 0.707 \cdot 0.50 \cdot in \cdot L_{weld}$ $Area_{weld} = 9.37\ in^2$

$Stress_{weld} := \frac{68500 \cdot lbf}{Area_{weld}}$ $Stress_{weld} = 7312\ psi$

Maximum tension stress from DAR page 3-3, Table 3.2.1-1 is 21600 psi for AISC allowables for test load

$Stress_{DAR} := 21600 \cdot psi$

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

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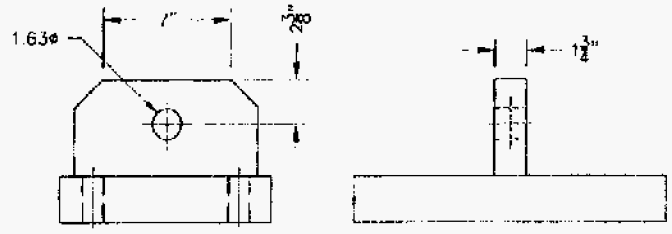
Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

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



Use ASTM A572, Grade 50 $F_{Y.A572} := 50 \cdot ksi$ $F_{U.A572} := 65 \cdot ksi$

Proof Load
$PL := 68500 \cdot lbf$

Web Thickness
$wt_{A7} := 1.75 \cdot in$

Dia Hole
$d_{A7} := 1.63 \cdot in$

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

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

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

$a_2 := \frac{1}{2} \cdot d_{A7}$ $a_2 = 0.81\ in$

$a_3 := 2 \cdot wt_{A7}$ $a_3 = 3.5\ in$

Or "a" should not exceed 4 times plate thickness

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

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

$P_{u.A7} := 2 \cdot a_{A7} \cdot wt_{A7} F_{U.A572}$ or $P_{u.A7} = 952.09\ kip$

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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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

$$P_{fail.1.A7} := \frac{P_{u.A7}}{5} \quad \text{or} \quad P_{fail.1.A7} = 190.42\,kip > PL = 68.5\,kip \text{ OK}$$

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. 6) the maximum allowed pin load is given by:

$$d_{pin.A7} := d_{A7} - 0.25 \cdot in \quad \text{or} \quad d_{pin.A7} = 1.38\,in$$

$$P_{fail.2.A7} := 0.9 \cdot F_{Y.A572} \cdot wt_{A7} \cdot d_{pin.A7} \quad \text{or} \quad P_{fail.2.A7} = 108.67\,kip > PL = 68.5\,kip \text{ OK}$$

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_y (as recommended by Ref. 5 and 6) the maximum allowed pin load is given by:

$$P_{fail.3.A7} := 2 \cdot \left(0.4 \cdot F_{Y.A572}\right) \cdot \left(2.375 \cdot in - \frac{d_{A7}}{2}\right) \cdot wt_{A7} \quad \text{or} \quad P_{fail.3.A7} = 109.2\,kip > PL = 68.5\,kip \text{ OK}$$

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 toward the edge (See Figure 10B 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_y, the allowable load is given by:

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

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 diameter.

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

Design a below the hook lifting device to Proof Load Weldment to 68,500 lbs and test load anchor group to 54,800 lbs.

Maximum Proof Load Test is 68,500 lbs when proof loading weldment. The weldment has a 1.63" diameter hole for attaching the lifting fixture. 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.

$P := 68.5 \cdot kip$ 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

$F_{Y.A325} := 81 \cdot ksi$

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

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

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

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

Try 1.5" diameter A325 bolts

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

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

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

2. Determine Side Plate Size

Use ASTM A36 material, allowable stress is 1/3 yield

$F_{Y.A36} := 36\cdot ksi$ $F_{U.A36} := 58\cdot ksi$

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

$w_{SP} := 4\cdot in$ $t_{SP} := 1.75\cdot in$

$$f_{LSP} := \frac{\frac{PL}{2}}{w_{SP}\cdot t_{SP}} \qquad f_{LSP} = 4.89\,ksi < \frac{1}{3}\cdot F_{Y.A36} = 12.0\,ksi \text{ OK}$$

Evaluation Based on Failure Modes Per Reference 6

Use ASTM A36 Steel

Proof Load $PL = 68.5\,kip$

Dia Hole $d_{SP} := 1.56\cdot in$ bolt size plus 1/16" Dia Pin (Bolt) $d_{pin} := 1.5\cdot in$

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

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

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

$a_{2a} := \frac{1}{2}\cdot d_{SP}$ $a_{2a} = 0.78\,in$

$a_{3a} := 2\cdot t_{SP}$ $a_{3a} = 3.5\,in$

Or "a" should not exceed 4 times plate thickness

$a_{4a} := 4\cdot t_{SP}$ $a_{4a} = 7\,in$

Use the actual distance from edge hole to edge lug $a_{SP} := a_{1a}$ $a_{SP} = 1.22\,in$

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$P_{u.SP} := 2 \cdot a_{SP} \cdot t_{SP} \cdot F_{U.A572}$ or $P_{u.SP} = 277.55\,kip$

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).

$P_{fail.1.SP} := \frac{P_{u.SP}}{5}$ or $P_{fail.1.SP} = 55.51\,kip > \frac{PL}{2} = 34.25\,kip$ 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_y (as recommended by Ref. 6) the maximum allowed pin load is given by:

$d_{pin.SP} := d_{pin} - 0.25 \cdot in$ or $d_{pin.SP} = 1.25\,in$

$P_{fail.2.SP} := 0.9 \cdot F_{Y.A36} \cdot t_{SP} \cdot d_{pin.SP}$ or $P_{fail.2.SP} = 70.87\,kip > \frac{PL}{2} = 34.25\,kip$ OK

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_y (as recommended by Ref. 5 and 6) the maximum allowed pin load is given by:

$P_{fail.3.SP} := 2 \cdot \left(0.4 \cdot F_{Y.A36}\right) \cdot \left(2.0 \cdot in - \frac{d_{SP}}{2}\right) \cdot t_{SP}$ or $P_{fail.3.SP} = 61.49\,kip > \frac{PL}{2} = 34.25\,kip$ 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 toward the edge (See Figure 10B 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_y, the allowable load is given by:

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

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
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Failure Mode 6:

This failure mode involves the out-of-plane buckling failure of the lug. Per 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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Project FFTF Project Checked Sept 2006 By J.W. Rich

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

Use ASTM A36 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 tensile stress on gross area

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

$f_{LLP} := \frac{PL}{w_{LP} \cdot t_{LP}}$ $f_{LLP} = 4.89\,ksi < \frac{1}{3} \cdot F_{Y.A36} = 12.0\,ksi$ **OK**

Evaluation Based on Failure Modes Per Reference 6

Use ASTM A36 Steel

Proof Load $PL = 68.5\,kip$

Dia Hole $d_{LP} := 2.37 \cdot in$ Dia Pin $d_{pin.LP} := 2.25 \cdot in$

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

$a_{1b} := \frac{w_{LP}}{2} - \frac{d_{LP}}{2}$ 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 dia 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 "a" should not exceed 4 times plate thickness

$a_{4b} := 4 \cdot t_{LP}$ $a_{4b} = 7\,in$

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Use the actual distance from edge hole to edge lug $a_{LP} := a_{1b}$ $a_{LP} = 2.81\,in$

$P_{u.LP} := 2 \cdot a_{LP} \cdot t_{LP} \cdot F_{U.A572}$ or $P_{u.LP} = 640.41\,kip$

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).

$P_{fail.1.LP} := \frac{P_{u.LP}}{5}$ or $P_{fail.1.LP} = 128.08\,kip$ > 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. 6) the maximum allowed pin load is given by:

$d_{pin.LP} := d_{pin.LP} - 0.25 \cdot in$ or $d_{pin.LP} = 2\,in$

$P_{fail.2.LP} := 0.9 \cdot F_{Y.A36} \cdot t_{LP} \cdot d_{pin.LP}$ or $P_{fail.2.LP} = 113.4\,kip$ > PL = 68.5 kip OK

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_y (as recommended by Ref. 5 and 6) the maximum allowed pin load is given by:

$$P_{fail.3.LP} := 2 \cdot (0.4 \cdot F_{Y.A36}) \cdot \left(3.0 \cdot in - \frac{d_{LP}}{2}\right) \cdot t_{LP}$$ or $P_{fail.3.LP} = 91.43\,kip$ > PL = 68.5 kip 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 toward the edge (See Figure 10B 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_y the allowable load is given by:

$$P_{fail.4.LP} := 1.67 \cdot \frac{F_{Y.A36}}{3} \cdot \left(3.0 \cdot in - \frac{d_{LP}}{2}\right)^2 \cdot \frac{t_{LP}}{d_{pin}}$$ or $P_{fail.4.LP} = 77.02\,kip$ > PL = 68.5 kip OK

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Subject Lifting Anchor Bolts Design for Disposable Solid Waste Cask Date Sept 2006 By W.J. Magruder
Project FFTF Project Checked Sept 2006 By J.W. Rich

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 than 0.5 inches and also greater than 0..25 times the hole diameter.

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Chastain, Steve A

From: Mccall, 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.

Dennis McCall, TRANS/TR-01
Fluor Transportation Safety Operations
Transportation Engineering
(509) 376-1651, dennis_l_mccall@rl.gov

From: Levinskas, David
Sent: Thursday, May 17, 2007 12:04 PM
To: Mccall, Dennis L
Subject: FW: HNF-FMP-06-30682-R0B

Dave Levinskas
Transportation Safety Operations
FH Waste Services
372-3855

From: Swenson, Douglas
Sent: Tuesday, May 15, 2007 3:07 PM
To: Levinskas, David
Subject: FW: HNF-FMP-06-30682-R0B

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 Alternate 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

APPENDIX F. CORROSION STUDY

DISPOSABLE SOLID WASTE CASK LINER

CORROSION EVALUATION

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

ACKNOWLEDGEMENTS

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

CONTENTS

ATTACHMENTS

FIGURES

TABLES

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.

- 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^3 of radioactive solid waste (Thielges 2006).[3] 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

[3] 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.

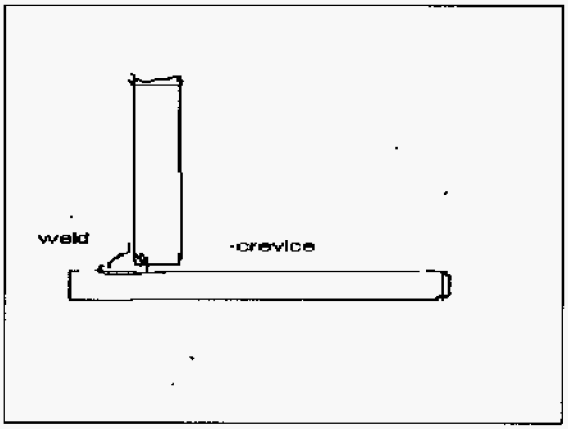

Figure 1. Schematic of Crevice (Exaggerated) and Weldment.

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.

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.

Table 1. April 2006 Cask Water Measurements.

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

3.0 EVALUATION

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).

$$4\,Fe + 3\,O_2 + 6\,H_2O \Rightarrow 4\,Fe(OH)_3$$

$Fe(OH)_3$, 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):

$$Fe \Rightarrow Fe^{++} + 2\,e^{-}$$

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

$$\tfrac{1}{2}\,O_2 + H_2O + 2\,e^{-} \Rightarrow 2\,OH^{-}$$

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

$$Fe + \tfrac{1}{2}\,O_2 + H_2O \Rightarrow 2\,Fe(OH)_2$$

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

$2\,Fe(OH)_2 + \tfrac{1}{2}\,O_2 + H_2O \Rightarrow 2\,Fe(OH)_3$, ferric hydroxide, or rust.

If the corroding system later dries out, the ferric hydroxide can break down to produce ferric oxide according to

$$2\,Fe(OH)_3 \Rightarrow Fe_2O_3 + 3\,H_2O$$

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.

Figure 2. Interior of Cask 4 before Cleaning.

Figure 3. Interior of Cask 4 after Cleaning.

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.

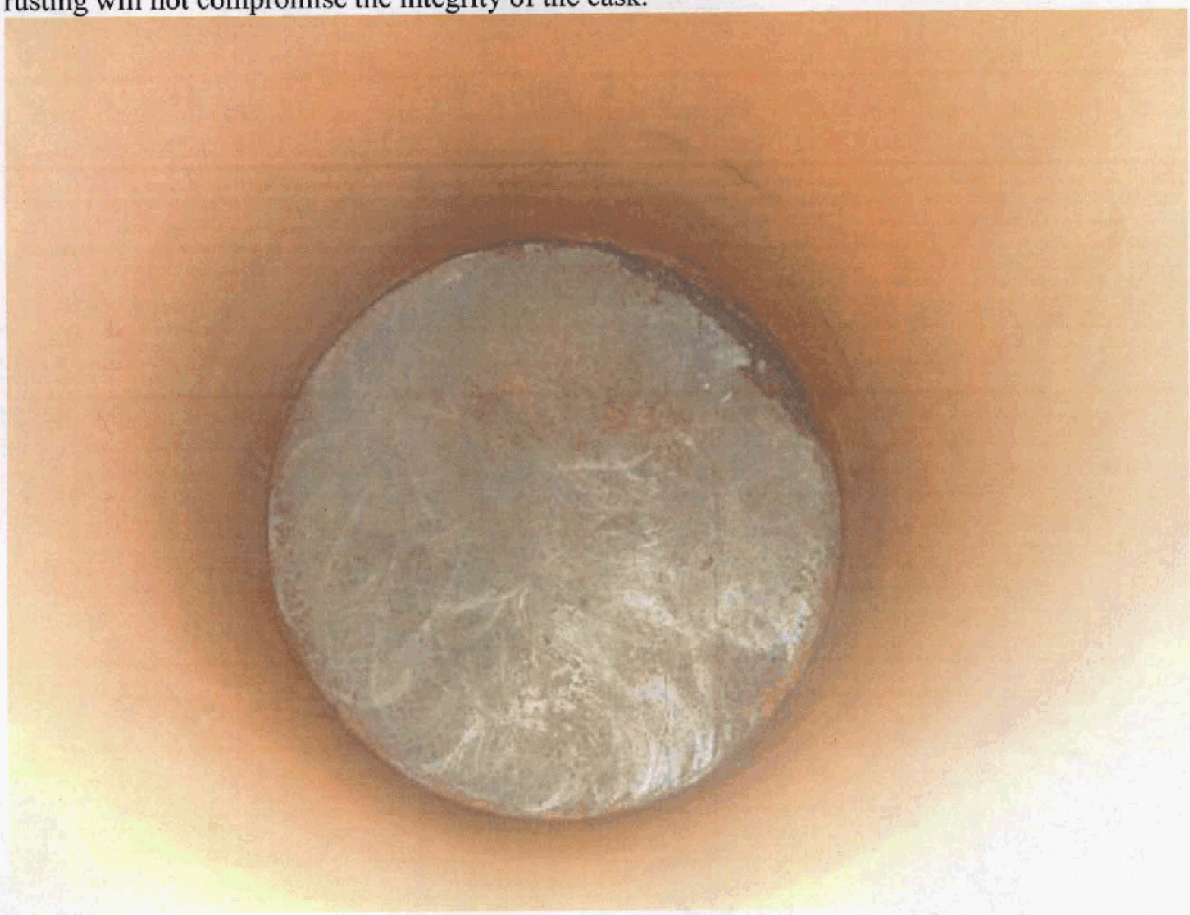

Figure 5. Interior of Cask 6 as Opened.

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

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.

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.

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

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

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.

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

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

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 μS/cm. Information obtained form the Internet (Lake Access 2006) states that conductivity of water from Lake Superior, a relatively pristine lake, is 97 μS/cm, and that of water from Lake Mead in Arizona/Nevada, is 850 μS/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 algae, 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 2.5×10^{-5} cm^2/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-to-winter 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 × 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.

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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ATTACHMENT F-A
CALCULATION OF OXYGEN SOLUBILITY IN WATER SATURATED WITH AIR

Solubility of a gas in water is defined according to

$$P = Hx$$

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 x 3.92 E-6 = 8.79 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°F is 6.51.

SOURCE

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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	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 * 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.

REVIEW CHECKLIST

Document Reviewed:
FFTF-31477 Appendix F
Disposable Solid Waste Cask Liner Corrosion Evaluation

Scope of Review:
Review the validity of the corrosion rate derived and the conclusions drawn.

Yes	No	NA		
◉	○	○	•	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
◉	○	○		Problem completely defined.
○	○	◉		Accident scenarios developed in a clear and logical manner.
◉	○	○		Necessary assumptions explicitly stated and supported.
○	○	◉		Computer codes and data files documented.
◉	○	○		Data used in calculations explicitly stated in document.
◉	○	○		Data checked for consistency with original source information as applicable.
◉	○	○		Mathematical derivation checked including dimensional consistency of results.
◉	○	○		Models appropriate and used within range of validity or use outside range of established validity justified.
◉	○	○		Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
○	○	◉		Software input correct and consistent with document reviewed.
○	○	◉		Software output consistent with input and with results reported in document reviewed.
◉	○	○		Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
○	○	◉		Safety margins consistent with good engineering practices.
◉	○	○		Conclusions consistent with analytical results and applicable limits.
◉	○	○		Results and conclusions address all points required in the problem statement.
○	○	◉		Format consistent with appropriate NRC Regulatory Guide or other standards.
○	○	◉	•	Review calculations, comments, and/or notes are attached.
◉	○	○		**Document approved.**

S. J. MARENAS — 5/09/07

Reviewer (Printed Name and Signature) — 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)

APPENDIX G. WASTE SAMPLING AND CHARACTERIZATION FACILITY ANALYSES

WSCF
ANALYTICAL RESULTS REPORT

for

Fast Flux Test Facility

Richland, WA

Attention: ME EBY/JIM RICH

Does not contain Official Use Only (OUO) information.
Wiley V. Witherspoon III FFTF 6/21/07

Analytical: William "Bill" Sanders III Bandstra

Client Services: John Trechter John Trechter

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

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

WSCF
ANALYTICAL RESULTS REPORT

Attention: ME EBY/JIM RICH **Group #:** 20060349

Sample #	Client ID		CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
Inorganic														
W060000848	DSWC#4	EBY/RICH	CONDUCT	Conductivity	SOLID	LA-519-401		802	uS/cm	1.00	0.49	05/01/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	PH	pH Soil and Waste Measurement	SOLID	LA-212-411		7.83	pH	1.00	0.010	05/01/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	16984-48-8	Fluoride (F) by IC	SOLID	LA-533-410	U	< 2.00	ug/g	50.00	2.0	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	16887-00-6	Chloride (Cl) by IC	SOLID	LA-533-410		17.9	ug/g	50.00	1.7	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	NO2-N	Nitrite (N) by IC	SOLID	LA-533-410	U	< 0.490	ug/g	50.00	0.49	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	24959-67-9	Bromide (Br) by IC	SOLID	LA-533-410	U	< 4.85	ug/g	50.00	4.8	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	NO3-N	Nitrate (N) by IC	SOLID	LA-533-410	U	< 0.900	ug/g	50.00	0.90	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	PO4-P	Phosphate (P) by IC	SOLID	LA-533-410	U	< 3.90	ug/g	50.00	3.9	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	14808-79-8	Sulfate (SO4) by IC	SOLID	LA-533-410		89.9	ug/g	50.00	6.5	04/25/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7429-90-5	Aluminum by ICP	SOLID	LA-505-411		869	ug/g	8.72e+002	24	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-36-0	Antimony by ICP	SOLID	LA-505-411	U	< 19.3	ug/g	8.72e+002	19	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-38-2	Arsenic by ICP	SOLID	LA-505-411	U	< 19.2	ug/g	8.72e+002	19	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-39-3	Barium by ICP	SOLID	LA-505-411		9.74	ug/g	8.72e+002	0.87	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-41-7	Beryllium by ICP	SOLID	LA-505-411	U	< 0.872	ug/g	8.72e+002	0.87	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-43-9	Cadmium by ICP	SOLID	LA-505-411	U	< 0.872	ug/g	8.72e+002	0.87	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-70-2	Calcium by ICP	SOLID	LA-505-411		8.43e+03	ug/g	8.72e+002	14	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-48-4	Cobalt by ICP	SOLID	LA-505-411		13.9	ug/g	8.72e+002	1.0	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-47-3	Chromium by ICP	SOLID	LA-505-411		61.5	ug/g	8.72e+002	2.8	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-50-8	Copper by ICP	SOLID	LA-505-411	C	84.9	ug/g	8.72e+002	2.9	05/03/06	04/18/06	04/19/06
W060000849	DSWC#4	EBY/RICH	7439-89-6	Iron by ICP	SOLID	LA-505-411		4.04e+05	ug/g	8.72e+003	1.8e+02	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7439-95-4	Magnesium by ICP	SOLID	LA-505-411		543	ug/g	8.72e+002	17	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7439-96-5	Manganese by ICP	SOLID	LA-505-411		2.07e+03	ug/g	8.72e+002	0.87	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-02-0	Nickel by ICP	SOLID	LA-505-411		121	ug/g	8.72e+002	1.2	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-09-7	Potassium by ICP	SOLID	LA-505-411	U	< 100	ug/g	8.72e+002	1.0e+02	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-22-4	Silver by ICP	SOLID	LA-505-411	U	< 1.57	ug/g	8.72e+002	1.6	05/03/06	04/18/06	04/19/06
W060000848	DSWC#4	EBY/RICH	7440-23-5	Sodium by ICP	SOLID	LA-505-411	U	< 173	ug/g	8.72e+002	1.7e+02	05/03/06	04/18/06	04/19/06

MDL = Minimum Detection Limit C - The Analyte was found in the Associated Blank. U - Analyzed for but not detected above limiting criteria.

RQ = Result Qualifier X - Other flags and notes described in the comments/narrative.

DF = Dilution Factor

* - Indicates results that have NOT been validated; + - Indicates more than six qualifier symbols

WSCF
ANALYTICAL RESULTS REPORT

Attention: ME EBY/JIM RICH **Group #:** 20060349

Sample #	Client ID		CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
W060000846	DSWC#4	EBY/RICH	7439-92-1	Lead by ICP	SOLID	LA-505-411		34.3	ug/g	8.72e+002	18	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7782-49-2	Selenium by ICP	SOLID	LA-505-411	U	< 15.7	ug/g	8.72e+002	16	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-28-0	Thallium by ICP	SOLID	LA-505-411	UX	< 17.4	ug/g	8.72e+002	17	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-32-6	Titanium by ICP	SOLID	LA-505-411		216	ug/g	8.72e+002	1.2	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-62-2	Vanadium by ICP	SOLID	LA-505-411		11.9	ug/g	8.72e+002	2.6	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-66-6	Zinc by ICP	SOLID	LA-505-411	X	151	ug/g	8.72e+002	2.6	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-21-3	Silicon by ICP	SOLID	LA-505-411	CX	23.7	ug/g	8.72e+002	16	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7439-93-2	Lithium by ICP	SOLID	LA-505-411	UX	< 0.872	ug/g	8.72e+002	0.87	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-42-8	Boron by ICP	SOLID	LA-505-411		182	ug/g	8.72e+002	23	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7723-14-0	Phosphorus by ICP	SOLID	LA-505-411		594	ug/g	8.72e+002	42	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7704-34-9	Sulfur by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	SCANDIUM	Scandium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-24-6	Strontium by ICP	SOLID	LA-505-411		8.18	ug/g	8.72e+002	1.1	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-65-5	Yttrium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-67-7	Zirconium by ICP	SOLID	LA-505-411		13.4	ug/g	8.72e+002	1.6	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7439-98-7	Molybdenum, ICP	SOLID	LA-505-411	C	17.3	ug/g	8.72e+002	3.5	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-31-5	Tin	SOLID	LA-505-411	U	< 14.0	ug/g	8.72e+002	14	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	13494-80-9	Tellurium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7553-56-2	Iodine by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-33-7	Tungsten, ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-57-5	Gold by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7439-97-6	Mercury by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-69-9	Bismuth by ICP	SOLID	LA-505-411		54.9	ug/g	8.72e+002	19	05/03/06	04/18/06	04/19/06
W060000846	DSWC#4	EBY/RICH	7440-61-1	Uranium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/03/06	04/18/06	04/19/06

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

DF = Dilution Factor

* - indicates results that have NOT been validated; + - indicates more than six qualifier symbols

Report W005/ver. 1.2
Fast Flux Test Facility

WSCF
ANALYTICAL COMMENT REPORT

Attention: ME EBY/JIM RICH **Group #:** 20060349

Sample #	Client ID	Lab Area	Test	Comment
		VALGROUP		IC-Anion - Phosphate, low recovery on matrix spikes probably due to matrix interference from presence of chloride. Sample result <MDL; no flag ICP-AES: High preparation blank results for the following elements: calcium, copper, nickel, silicon, thallium, and molybdenum; "C" flags if applicable. High antimony, selenium, zinc, and low silicon and lithium LCS recoveries: "X" flags if applicable. The following elements have sample results beyond effective spike range (spike results marked "NA"): aluminum, arsenic, barium, calcium, cobalt, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium, lead, titanium, zinc, vanadium, silicon, boron, phosphorus, strontium, zirconium, molybdenum, and bismuth. Low thallium spike recoveries; "X" flag.

Lab Areas: VALGROUP - Group Validation VALTEST - Test Validation TESTDATA - Test Data Entry
LOGSAMP - Login for Sample LOGTEST - Login for Tests

WSCF
TENTATIVELY IDENTIFIED PEAK REPORT

Attention: **Group #:** 20060349
Project Number :

Sample #	Client ID	Test Name	Peak Name	CAS#	RT	RQ	Result	Units

RQ = Result Qualifier

WSCF
METHOD REFERENCES REPORT

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 may reference an older version of the method. Also, a reference to a regulatory or industry method here does not necessarily indicate a verbatim 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 of WSCF analytical procedures and referenced regulatory or industry methods is available online at \\ap006\aspdocs\WSCF\Sample Mgmt\ProcedureMethodCrossReference.pdf. This document includes on-line links to full-text versions of the procedures and methods, where available.

Report Date: 4-may-2006
Report#: 20060348
Report W_006M/1

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: Anions by Ion Chromatography

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit		RQ
Lab ID: W060000848										
BATCH QC ASSOCIATED WITH SAMPLE										
DUP	Bromide (Br) by IC	24959-67-9	<4.65e0	n/a	RPD	04/25/06	0.000	20.000		U
DUP	Chloride (Cl) by IC	16887-00-6	1.59e+01	11.834	RPD	04/25/06	0.000	20.000		
DUP	Fluoride (F) by IC	16984-48-8	<2.00e0	n/a	RPD	04/25/06	0.000	20.000		U
DUP	Nitrite (N) by IC	NO2-N	<4.90e-1	n/a	RPD	04/25/06	0.000	20.000		U
DUP	Nitrate (N) by IC	NO3-N	<9.00e-1	n/a	RPD	04/25/06	0.000	20.000		U
DUP	Phosphate (P) by IC	PO4-P	<3.90e0	n/a	RPD	04/25/06	0.000	20.000		U
DUP	Sulfate (SO4) by IC	14808-79-8	9.69e+01	7.495	RPD	04/25/06	0.000	20.000		
MS	Bromide (Br) by IC	24959-67-9	1.87e+00	93.500	% Recov	04/25/06	75.000	125.000		
MS	Chloride (Cl) by IC	16887-00-6	9.18e-01	83.673	% Recov	04/25/06	75.000	125.000		
MS	Fluoride (F) by IC	16984-48-8	4.49e-01	89.800	% Recov	04/25/06	75.000	125.000		
MS	Nitrite (N) by IC	NO2-N	4.65e-01	93.373	% Recov	04/25/06	75.000	125.000		
MS	Nitrate (N) by IC	NO3-N	4.14e-01	94.091	% Recov	04/25/06	75.000	125.000		
MS	Phosphate (P) by IC	PO4-P	5.40e-01	56.133	% Recov	04/25/06	75.000	125.000	*	
MS	Sulfate (SO4) by IC	14808-79-8	1.98e+00	99.000	% Recov	04/25/06	75.000	125.000		
MSD	Bromide (Br) by IC	24959-67-9	1.84e+00	92.000	% Recov	04/25/06	75.000	125.000		
MSD	Chloride (Cl) by IC	16887-00-6	9.67e-01	88.673	% Recov	04/25/06	75.000	125.000		
MSD	Fluoride (F) by IC	16984-48-8	4.31e-01	86.200	% Recov	04/25/06	75.000	125.000		
MSD	Nitrite (N) by IC	NO2-N	4.46e-01	89.556	% Recov	04/25/06	75.000	125.000		
MSD	Nitrate (N) by IC	NO3-N	4.19e-01	95.227	% Recov	04/25/06	75.000	125.000		
MSD	Phosphate (P) by IC	PO4-P	6.01e-01	62.474	% Recov	04/25/06	75.000	125.000	*	
MSD	Sulfate (SO4) by IC	14808-79-8	2.30e+00	115.000	% Recov	04/25/06	75.000	125.000		
BATCH QC										
BLANK	Bromide (Br) by IC	24959-67-9	<9.30e-2	n/a	mg/L	04/25/06	0.000	300.000		U
BLANK	Bromide (Br) by IC	24959-67-9	<9.30e-2	n/a	mg/L	04/25/06	0.000	300.000		U
BLANK	Chloride (Cl) by IC	16887-00-6	<3.40e-2	n/a	mg/L	04/25/06	0.000	300.000		U

Report w13w5q#sv.6 p 1
4-may-2006 06:30:19

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: Anions by Ion Chromatography

SAF Number: NA
Sample Date:
Receive Date:

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
BLANK	Chloride (Cl) by IC	16887-00-6	<3.40e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Fluoride (F) by IC	16984-48-8	<4.00e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Fluoride (F) by IC	16984-48-8	<4.00e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Nitrite (N) by IC	NO2-N	<9.80e-3	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Nitrite (N) by IC	NO2-N	<9.80e-3	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Nitrate (N) by IC	NO3-N	<1.80e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Nitrate (N) by IC	NO3-N	<1.80e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Phosphate (P) by IC	PO4-P	<7.80e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Phosphate (P) by IC	PO4-P	<7.80e-2	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Sulfate (SO4) by IC	14808-79-8	<1.30e-1	n/a	mg/L	04/25/06	0.000	300.000	U
BLANK	Sulfate (SO4) by IC	14808-79-8	<1.30e-1	n/a	mg/L	04/25/06	0.000	300.000	U
LCS	Bromide (Br) by IC	24959-67-9	3.66e+02	91.500	% Recov	04/25/06	80.000	120.000	
LCS	Chloride (Cl) by IC	16887-00-6	2.02e+02	103.061	% Recov	04/25/06	80.000	120.000	
LCS	Fluoride (F) by IC	16984-48-8	9.50e+01	95.000	% Recov	04/25/06	80.000	120.000	
LCS	Nitrite (N) by IC	NO2-N	8.67e+01	97.088	% Recov	04/25/06	80.000	120.000	
LCS	Nitrate (N) by IC	NO3-N	8.35e+01	94.894	% Recov	04/25/06	80.000	120.000	
LCS	Phosphate (P) by IC	PO4-P	1.77e+02	91.948	% Recov	04/25/06	80.000	120.000	
LCS	Sulfate (SO4) by IC	14808-79-8	3.73e+02	93.250	% Recov	04/25/06	80.000	120.000	

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: pH Soil and Waste Measurement

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W060000848									
BATCH QC ASSOCIATED WITH SAMPLE									
DUP	pH Soil and Waste Measurement	PH	7.790	0.525	RPD	05/01/06	0.000	3.000	

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: Conductivity

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W060000848									
BATCH QC ASSOCIATED WITH SAMPLE									
DUP	Conductivity	CONDUCT	776.	3.295	RPD	05/01/06	0.000	20.000	
BATCH QC									
LCS	Conductivity	CONDUCT	131.7	101.308	%rec	05/01/06	90.000	110.000	

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W060000848									
BATCH QC ASSOCIATED WITH SAMPLE									
MS	Silver by ICP	7440-22-4	186	103.911	% Recov	05/03/06	75.000	125.000	
MS	Aluminum by ICP	7429-90-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Arsenic by ICP	7440-38-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Boron by ICP	7440-42-8	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Barium by ICP	7440-39-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Beryllium by ICP	7440-41-7	104	118.201	% Recov	05/03/06	75.000	125.000	
MS	Bismuth by ICP	7440-69-9	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Calcium by ICP	7440-70-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Cadmium by ICP	7440-43-9	186	103.911	% Recov	05/03/06	75.000	125.000	
MS	Cobalt by ICP	7440-48-4	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Chromium by ICP	7440-47-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Copper by ICP	7440-50-8	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Iron by ICP	7439-89-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Potassium by ICP	7440-09-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Lithium by ICP	7439-93-2	99.1	110.726	% Recov	05/03/06	70.000	130.000	
MS	Magnesium by ICP	7439-95-4	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Manganese by ICP	7439-96-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Molybdenum, ICP	7439-98-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Sodium by ICP	7440-23-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Nickel by ICP	7440-02-0	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Phosphorus by ICP	7723-14-0	NA	n/a	% Recov	05/03/06	70.000	130.000	
MS	Lead by ICP	7439-92-1	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Antimony by ICP	7440-36-0	176	98.324	% Recov	05/03/06	75.000	125.000	
MS	Selenium by ICP	7782-49-2	194	108.380	% Recov	05/03/06	75.000	125.000	
MS	Silicon by ICP	7440-21-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Tin	7440-31-5	173	96.648	% Recov	05/03/06	75.000	125.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
MS	Strontium by ICP	7440-24-6	NA	n/a	% Recov	05/03/06	70.000	130.000	
MS	Titanium by ICP	7440-32-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Thallium by ICP	7440-28-0	132	73.743	% Recov	05/03/06	75.000	125.000	*
MS	Vanadium by ICP	7440-62-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Zinc by ICP	7440-66-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MS	Zirconium by ICP	7440-67-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Silver by ICP	7440-22-4	193	94.148	% Recov	05/03/06	75.000	125.000	
MSD	Aluminum by ICP	7429-90-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Arsenic by ICP	7440-38-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Boron by ICP	7440-42-8	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Barium by ICP	7440-39-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Beryllium by ICP	7440-41-7	106	103.415	% Recov	05/03/06	75.000	125.000	
MSD	Bismuth by ICP	7440-69-9	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Calcium by ICP	7440-70-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Cadmium by ICP	7440-43-9	186	90.732	% Recov	05/03/06	75.000	125.000	
MSD	Cobalt by ICP	7440-48-4	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Chromium by ICP	7440-47-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Copper by ICP	7440-50-8	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Iron by ICP	7439-89-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Potassium by ICP	7440-09-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Lithium by ICP	7439-93-2	88.3	86.146	% Recov	05/03/06	75.000	125.000	
MSD	Magnesium by ICP	7439-95-4	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Manganese by ICP	7439-96-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Molybdenum, ICP	7439-98-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Sodium by ICP	7440-23-5	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Nickel by ICP	7440-02-0	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Phosphorus by ICP	7723-14-0	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Lead by ICP	7439-92-1	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Antimony by ICP	7440-36-0	194	94.634	% Recov	05/03/06	75.000	125.000	
MSD	Selenium by ICP	7782-49-2	219	106.829	% Recov	05/03/06	75.000	125.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/18/06
Receive Date:04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
MSD	Silicon by ICP	7440-21-3	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Tin	7440-31-5	172	83.902	% Recov	05/03/06	75.000	125.000	
MSD	Strontium by ICP	7440-24-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Titanium by ICP	7440-32-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Thallium by ICP	7440-28-0	100	48.780	% Recov	05/03/06	75.000	125.000	*
MSD	Vanadium by ICP	7440-62-2	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Zinc by ICP	7440-66-6	NA	n/a	% Recov	05/03/06	75.000	125.000	
MSD	Zirconium by ICP	7440-67-7	NA	n/a	% Recov	05/03/06	75.000	125.000	
SPK-RPD	Silver by ICP	7440-22-4	94.146	9.861	RPD	05/03/06	0.000	20.000	
SPK-RPD	Aluminum by ICP	7429-90-5		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Arsenic by ICP	7440-38-2		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Boron by ICP	7440-42-8		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Barium by ICP	7440-39-3		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Beryllium by ICP	7440-41-7	103.415	11.644	RPD	05/03/06	0.000	20.000	
SPK-RPD	Bismuth by ICP	7440-69-9		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Calcium by ICP	7440-70-2		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Cadmium by ICP	7440-43-9	90.732	13.542	RPD	05/03/06	0.000	20.000	
SPK-RPD	Cobalt by ICP	7440-48-4		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Chromium by ICP	7440-47-3		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Copper by ICP	7440-50-8		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Iron by ICP	7439-89-6		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Potassium by ICP	7440-09-7		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Lithium by ICP	7439-93-2	86.146	24.971	RPD	05/03/06	0.000	20.000	*
SPK-RPD	Magnesium by ICP	7439-95-4		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Manganese by ICP	7439-96-5		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Molybdenum, ICP	7439-98-7		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Sodium by ICP	7440-23-5		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Nickel by ICP	7440-02-0		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Phosphorus by ICP	7723-14-0		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Lead by ICP	7439-92-1		n/a	RPD	05/03/06	0.000	20.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/18/06
Receive Date: 04/19/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
SPK-RPD	Antimony by ICP	7440-36-0	94.634	3.825	RPD	05/03/06	0.000	20.000	
SPK-RPD	Selenium by ICP	7782-49-2	106.829	1.441	RPD	05/03/06	0.000	20.000	
SPK-RPD	Silicon by ICP	7440-21-3		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Tin	7440-31-5	83.902	14.119	RPD	05/03/06	0.000	20.000	
SPK-RPD	Strontium by ICP	7440-24-6		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Titanium by ICP	7440-32-6		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Thallium by ICP	7440-28-0	46.780	40.748	RPD	05/03/06	0.000	20.000	
SPK-RPD	Vanadium by ICP	7440-62-2		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Zinc by ICP	7440-66-6		n/a	RPD	05/03/06	0.000	20.000	
SPK-RPD	Zirconium by ICP	7440-67-7		n/a	RPD	05/03/06	0.000	20.000	
BATCH QC									
BLANK	Silver by ICP	7440-22-4	<1.8e-3	n/a	ug/L	05/03/06			U
BLANK	Aluminum by ICP	7429-90-5	<2.7e-2	n/a	ug/L	05/03/06			U
BLANK	Arsenic by ICP	7440-38-2	<2.2e-2	n/a	ug/L	05/03/06			U
BLANK	Boron by ICP	7440-42-8	<2.6e-2	n/a	ug/L	05/03/06			U
BLANK	Barium by ICP	7440-39-3	<1e-3	n/a	ug/L	05/03/06			U
BLANK	Beryllium by ICP	7440-41-7	<1e-3	n/a	ug/L	05/03/06			U
BLANK	Bismuth by ICP	7440-69-9	<2.2e-2	n/a	ug/L	05/03/06			U
BLANK	Calcium by ICP	7440-70-2	1.7e-2	0.017	ug/L	05/03/06			
BLANK	Cadmium by ICP	7440-43-9	<1e-3	n/a	ug/L	05/03/06			U
BLANK	Cobalt by ICP	7440-48-4	<1.2e-3	n/a	ug/L	05/03/06			U
BLANK	Chromium by ICP	7440-47-3	<3.7e-3	n/a	ug/L	05/03/06			U
BLANK	Copper by ICP	7440-50-8	1.8e-2	0.018	ug/L	05/03/06			
BLANK	Iron by ICP	7439-89-6	<2.1e-2	n/a	ug/L	05/03/06			U
BLANK	Potassium by ICP	7440-09-7	<0.115	n/a	ug/L	05/03/06			U
BLANK	Lithium by ICP	7439-93-2	<1e-3	n/a	ug/L	05/03/06			U
BLANK	Magnesium by ICP	7439-95-4	<1.9e-2	n/a	ug/L	05/03/06			U
BLANK	Manganese by ICP	7439-96-5	<1e-3	n/a	ug/L	05/03/06			U
BLANK	Molybdenum, ICP	7439-98-7	4e-3	0.004	ug/L	05/03/06			

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date:
Receive Date:

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
BLANK	Sodium by ICP	7440-23-5	<0.198	n/a	ug/L	05/03/06			U
BLANK	Nickel by ICP	7440-02-0	3.5e-3	0.004	ug/L	05/03/06			
BLANK	Phosphorus by ICP	7723 14-0	<4.8e-2	n/a	ug/L	05/03/06			U
BLANK	Lead by ICP	7439-92-1	<2.1e-2	n/a	ug/L	05/03/06			U
BLANK	Antimony by ICP	7440-36-0	<2.1e-2	n/a	ug/L	05/03/06			U
BLANK	Selenium by ICP	7782-49-2	<1.8e-2	n/a	ug/L	05/03/06			U
BLANK	Silicon by ICP	7440-21-3	0.112	0.112	ug/L	05/03/06			
BLANK	Tin	7440-31-5	<1.6e-2	n/a	ug/L	05/03/06			U
BLANK	Strontium by ICP	7440-24-6	<1.3e-3	n/a	ug/L	05/03/06			U
BLANK	Titanium by ICP	7440-32-6	<1.4e-3	n/a	ug/L	05/03/06			U
BLANK	Thallium by ICP	7440-28-0	4.8e-2	0.046	ug/L	05/03/06			
BLANK	Vanadium by ICP	7440-62-2	<3e-3	n/a	ug/L	05/03/06			U
BLANK	Zinc by ICP	7440-66-6	<3e-3	n/a	ug/L	05/03/06			U
BLANK	Zirconium by ICP	7440-67-7	<1.6e-3	n/a	ug/L	05/03/06			U
LCS	Silver by ICP	7440-22-4	142	109.231	% Recov	05/03/06	45.000	155.000	
LCS	Aluminum by ICP	7429 90 5	6271	99.225	% Recov	05/03/06	44.000	157.000	
LCS	Arsenic by ICP	7440-38-2	182	113.043	% Recov	05/03/06	79.000	121.000	
LCS	Boron by ICP	7440-42-8	108	110.883	% Recov	05/03/06	45.000	156.000	
LCS	Barium by ICP	7440-39 3	275	109.127	% Recov	05/03/06	80.000	120.000	
LCS	Beryllium by ICP	7440-41-7	109	115.466	% Recov	05/03/06	81.000	119.000	
LCS	Bismuth by ICP	7440-69-9	193	93.237	% Recov	05/03/06	80.000	120.000	
LCS	Calcium by ICP	7440-70-2	3648	109.880	% Recov	05/03/06	76.000	124.000	
LCS	Cadmium by ICP	7440-43-9	142	110.938	% Recov	05/03/06	80.000	120.000	
LCS	Cobalt by ICP	7440-48-4	37.7	107.102	% Recov	05/03/06	85.000	115.000	
LCS	Chromium by ICP	7440-47-3	75.1	108.058	% Recov	05/03/06	77.000	172.000	
LCS	Copper by ICP	7440-50-8	167	112.838	% Recov	05/03/06	80.000	120.000	
LCS	Iron by ICP	7439-89-6	16310	145.625	% Recov	05/03/06	47.000	152.000	
LCS	Potassium by ICP	7440-09-7	2001	104.219	% Recov	05/03/06	64.000	136.000	
LCS	Lithium by ICP	7439-93-2	3.48	58.389	% Recov	05/03/06	80.000	120.000	*
LCS	Magnesium by ICP	7439-95-4	2227	109.167	% Recov	05/03/06	71.000	129.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060349
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date:
Receive Date:

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
LCS	Manganese by ICP	7439-96-5	459	112.500	% Recov	05/03/06	76.000	124.000	
LCS	Molybdenum, ICP	7439-98-7	96.2	114.388	% Recov	05/03/06	78.000	121.000	
LCS	Sodium by ICP	7440-23-5	460	103.371	% Recov	05/03/06	51.000	149.000	
LCS	Nickel by ICP	7440-02-0	160	108.844	% Recov	05/03/06	74.000	121.000	
LCS	Phosphorus by ICP	7723-14-0	481	108.824	% Recov	05/03/06	76.000	123.000	
LCS	Lead by ICP	7439-92-1	168	118.310	% Recov	05/03/06	77.000	123.000	
LCS	Antimony by ICP	7440-36-0	160	262.726	% Recov	05/03/06	53.000	205.000	*
LCS	Selenium by ICP	7782-49-2	82.9	129.128	% Recov	05/03/06	74.000	126.000	*
LCS	Silicon by ICP	7440-21-3	245	33.608	% Recov	05/03/06	80.000	120.000	*
LCS	Tin	7440-31-5	67.6	110.820	% Recov	05/03/06	80.000	121.000	
LCS	Strontium by ICP	7440-24-6	94.2	112.143	% Recov	05/03/06	74.000	126.000	
LCS	Titanium by ICP	7440-32-6	330	106.452	% Recov	05/03/06	9.000	191.000	
LCS	Thallium by ICP	7440-28-0	95.2	118.333	% Recov	05/03/06	71.000	126.000	
LCS	Vanadium by ICP	7440-62-2	114	117.163	% Recov	05/03/06	70.000	129.000	
LCS	Zinc by ICP	7440-66-6	211	127.879	% Recov	05/03/06	77.000	123.000	*
LCS	Zirconium by ICP	7440-67-7	167	80.676	% Recov	05/03/06	80.000	120.000	

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

W13q Worklist/Batch/QC Report for Group# 20060349

WL#	S#	Batch	QC#	Tray Type	Sample#	Test
28503	2	28875	32709	BLANK		Anions by Ion Chromatography
28503	8	28875	32709	BLANK		Anions by Ion Chromatography
28503	3	28875	32709	LCS		Anions by Ion Chromatography
28503	5	28875	32709	DUP	W060000848	Anions by Ion Chromatography
28503	6	28875	32709	MS	W060000848	Anions by Ion Chromatography
28503	7	28875	32709	MSD	W060000848	Anions by Ion Chromatography
28503	4	28875	32709	SAMPLE	W060000848	Anions by Ion Chromatography
			32747	DUP	W060000848	pH Soil and Waste Measurement
			32747	SAMPLE	W060000848	pH Soil and Waste Measurement
			32749	LCS		Conductivity
			32749	DUP	W060000848	Conductivity
			32749	SAMPLE	W060000848	Conductivity
28532	1	28902	32769	BLANK		ICP - All possible metals
28532	2	28902	32769	LCS		ICP - All possible metals
28532	4	28902	32769	MS	W060000848	ICP - All possible metals
28532	5	28902	32769	MSD	W060000848	ICP - All possible metals
28532	3	28902	32769	SAMPLE	W060000848	ICP - All possible metals
28532	5	28902	32769	SPK-RPD	W060000848	ICP - All possible metals

WSCF
ANALYTICAL RESULTS REPORT

for

Fast Flux Test Facility

Richland, WA

Attention: M EBY/JW Rich

Analytical: Marlene Stauffer 5/11/06

Client Services: John Trecketer John Trecketer

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

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

Does Not Contain Official Use ONLY (OUO) Information
Vicky V. Witherspoon FFTF
6/21/07

WSCF
ANALYTICAL RESULTS REPORT

Attention: M EBY/JW Rich
Project: MISC: MISC

Group #: 20060391

Sample #	Client ID	CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
Inorganic													
W060000956	DSWC#8-1	CONDUCT	Conductivity	WATER	LA-519-401		2.16e+03	uS/cm	1.00	0.49	05/08/06	04/25/06	04/28/06
W060000956	DSWC#8-1	PH	pH Direct Measurement	WATER	LA-212-402		7.17	pH	1.00	0.010	05/08/06	04/25/06	04/28/06
W060000956	DSWC#8-1	16984-48-8	Fluoride (F) by IC	WATER	LA-533-410	U	< 0.800	mg/L	20.00	0.80	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	16887-00-6	Chloride (Cl) by IC	WATER	LA-533-410		7.17	mg/L	20.00	0.68	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	NO2-N	Nitrite (N) by IC	WATER	LA-533-410	U	< 0.196	mg/L	20.00	0.20	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	24959-67-9	Bromide (Br) by IC	WATER	LA-533-410	U	< 1.88	mg/L	20.00	1.9	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	NO3-N	Nitrate (N) by IC	WATER	LA-533-410	U	< 0.360	mg/L	20.00	0.36	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	PO4-P	Phosphate (P) by IC	WATER	LA-533-410	U	< 1.56	mg/L	20.00	1.6	04/28/06	04/25/06	04/28/06
W060000956	DSWC#8-1	14808-79-8	Sulfate (SO4) by IC	WATER	LA-533-410		1.33e+03	mg/L	5.01e+002	85	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	CONDUCT	Conductivity	WATER	LA-519-401		2.20e+03	uS/cm	1.00	0.49	05/08/06	04/25/06	04/28/06
W060000957	DSWC#8-2	PH	pH Direct Measurement	WATER	LA-212-402		7.12	pH	1.00	0.010	05/08/06	04/25/06	04/28/06
W060000957	DSWC#8-2	16984-48-8	Fluoride (F) by IC	WATER	LA-533-410	U	< 0.800	mg/L	20.00	0.80	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	16887-00-6	Chloride (Cl) by IC	WATER	LA-533-410		9.65	mg/L	20.00	0.68	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	NO2-N	Nitrite (N) by IC	WATER	LA-533-410	U	< 0.196	mg/L	20.00	0.20	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	24959-67-9	Bromide (Br) by IC	WATER	LA-533-410	U	< 1.88	mg/L	20.00	1.9	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	NO3-N	Nitrate (N) by IC	WATER	LA-533-410	U	< 0.360	mg/L	20.00	0.36	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	PO4-P	Phosphate (P) by IC	WATER	LA-533-410	U	< 1.56	mg/L	20.00	1.6	04/28/06	04/25/06	04/28/06
W060000957	DSWC#8-2	14808-79-8	Sulfate (SO4) by IC	WATER	LA-533-410		1.34e+03	mg/L	5.01e+002	85	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8-3	CONDUCT	Conductivity	WATER	LA-519-401		2.18e+03	uS/cm	1.00	0.49	05/08/06	04/25/06	04/28/06
W060000958	DSWC#8-3	PH	pH Direct Measurement	WATER	LA 212 402		7.14	pH	1.00	0.010	05/08/06	04/25/06	04/28/06
W060000958	DSWC#8-3	16984-48-8	Fluoride (F) by IC	WATER	LA-533-410	U	< 0.800	mg/L	20.00	0.80	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8-3	16887-00-6	Chloride (Cl) by IC	WATER	LA-533-410		7.58	mg/L	20.00	0.68	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8-3	NO2-N	Nitrite (N) by IC	WATER	LA-533-410	U	< 0.196	mg/L	20.00	0.20	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8-3	24959-67-9	Bromide (Br) by IC	WATER	LA-533-410	U	< 1.88	mg/L	20.00	1.9	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8-3	NO3 N	Nitrate (N) by IC	WATER	LA-533-410	U	< 0.360	mg/L	20.00	0.36	04/28/06	04/25/06	04/28/06
W060000958	DSWC#8 3	PO4-P	Phosphate (P) by IC	WATER	LA-533-410	U	< 1.56	mg/L	20.00	1.6	04/28/06	04/25/06	04/28/06

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

DF=Dilution Factor
* - Indicates results that have NOT been validated; + - Indicates more than six qualifier symbols

Report W005/ver. 1.2
Fast Flux Test Facility

WSCF
ANALYTICAL RESULTS REPORT

Attention: M EBY/JW Rich
Project: MISC: MISC
Group #: 20060391

Sample #	Client ID	CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
W060000958	DSWC#8-3	14808-79-8	Sulfate (SO4) by IC	WATER	LA-533-410		1.32e+03	mg/L	5.01e+002	65	04/28/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7429-90-5	Aluminum by ICP	SOLID	LA-505-411		7.48e+03	ug/g	1.01e+002	2.7	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-36-0	Antimony by ICP	SOLID	LA-505-411	U	< 2.13	ug/g	1.01e+002	2.1	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-38-2	Arsenic by ICP	SOLID	LA-505-411	U	< 2.23	ug/g	1.01e+002	2.2	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-39-3	Barium by ICP	SOLID	LA-505-411		1.07e+03	ug/g	1.01e+004	10	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-41-7	Beryllium by ICP	SOLID	LA-505-411		0.109	ug/g	1.01e+002	0.10	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-43-9	Cadmium by ICP	SOLID	LA-505-411	U	< 0.101	ug/g	1.01e+002	0.10	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-70-2	Calcium by ICP	SOLID	LA-505-411		3.83e+04	ug/g	1.01e+004	1.6e+02	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-48-4	Cobalt by ICP	SOLID	LA-505-411		16.8	ug/g	1.01e+002	0.12	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-47-3	Chromium by ICP	SOLID	LA-505-411	E	152	ug/g	1.01e+002	0.32	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-50-8	Copper by ICP	SOLID	LA-505-411		158	ug/g	1.01e+002	0.33	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7439-89-6	Iron by ICP	SOLID	LA-505-411		1.46e+05	ug/g	1.01e+004	2.1e+02	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7439-95-4	Magnesium by ICP	SOLID	LA-505-411		3.92e+03	ug/g	1.01e+002	1.9	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7439-96-5	Manganese by ICP	SOLID	LA-505-411		1.38e+03	ug/g	1.01e+004	10	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-02-0	Nickel by ICP	SOLID	LA-505-411		122	ug/g	1.01e+002	0.14	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-09-7	Potassium by ICP	SOLID	LA-505-411		405	ug/g	1.01e+002	12	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-22-4	Silver by ICP	SOLID	LA-505-411		0.341	ug/g	1.01e+002	0.18	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-23-5	Sodium by ICP	SOLID	LA-505-411		272	ug/g	1.01e+002	20	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7439-92-1	Lead by ICP	SOLID	LA-505-411		4.16	ug/g	1.01e+002	2.1	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7782-49-2	Selenium by ICP	SOLID	LA-505-411	U	< 1.82	ug/g	1.01e+002	1.8	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-28-0	Thallium by ICP	SOLID	LA-505-411	U	< 2.02	ug/g	1.01e+002	2.0	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-32-6	Titanium by ICP	SOLID	LA-505-411	E	575	ug/g	1.01e+004	14	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-62-2	Vanadium by ICP	SOLID	LA-505-411		30.2	ug/g	1.01e+002	0.30	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-66-6	Zinc by ICP	SOLID	LA-505-411		89.7	ug/g	1.01e+002	0.30	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-21-3	Silicon by ICP	SOLID	LA-505-411		283	ug/g	1.01e+002	1.7	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7439-93-2	Lithium by ICP	SOLID	LA-505-411		6.08	ug/g	1.01e+002	0.10	05/10/06	04/25/06	04/28/06
W060000959	DSWC#8-4	7440-42-8	Boron by ICP	SOLID	LA-505-411		51.3	ug/g	1.01e+002	2.8	05/10/06	04/25/06	04/28/06

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Report W005/ver. 1.2
Fast Flux Test Facility

WSCF
ANALYTICAL RESULTS REPORT

Attention: M EBY/JW Rich
Project: MISC: MISC
Group #: 20060391

Sample #	Client ID	CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
W060000958	DSWC#8-4	7723-14-0	Phosphorus by ICP	SOLID	LA-505-411		778	ug/g	1.01e+002	4.9	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7704-34-9	Sulfur by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	SCANDIUM	Scandium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-24-6	Strontium by ICP	SOLID	LA-505-411		149	ug/g	1.01e+002	0.13	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-65-5	Yttrium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-67-7	Zirconium by ICP	SOLID	LA-505-411		11.5	ug/g	1.01e+002	0.18	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7439-98-7	Molybdenum, ICP	SOLID	LA-505-411		30.0	ug/g	1.01e+002	0.40	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-31-5	Tin	SOLID	LA-505-411	U	< 1.62	ug/g	1.01e+002	1.6	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	13494-80-9	Tellurium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7553-56-2	Iodine by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-33-7	Tungsten, ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-57-5	Gold by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7439-97-6	Mercury by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-69-9	Bismuth by ICP	SOLID	LA-505-411	U	< 2.23	ug/g	1.01e+002	2.2	05/10/06	04/25/06	04/28/06
W060000958	DSWC#8-4	7440-61-1	Uranium by ICP	SOLID	LA-505-411		NA	ug/g	1.00	0.0	05/10/06	04/25/06	04/28/06

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Report W005/ver. 1.2
Fast Flux Test Facility

WSCF
ANALYTICAL COMMENT REPORT

Attention: M EBY/JW Rich
Project Number MISC

Group #: 20060391

Sample #	Client ID	Lab Area	Test	Comment
		VALGROUP		ICP-AES: High preparation blank results for phosphorus, silicon, bismuth, vanadium, copper, manganese, and potassium: "C" flags if applicable. High antimony and zinc and low zirconium LCS recoveries; no flags issued because other QC is acceptable. High titanium and low chromium spike duplicate (spike is acceptable but low) spike recoveries: "E" flag if applicable. Low silver and silicon and high sodium spike recoveries; no flags issued because all other QC is acceptable. Aluminum, barium, calcium, iron, magnesium, and manganese sample results beyond effective spike range (spike results marked "NA").

Lab Areas: VALGROUP - Group Validation
LOGSAMP - Login for Sample
VALTEST - Test Validation
LOGTEST - Login for Tests
TESTDATA - Test Data Entry

WSCF
TENTATIVELY IDENTIFIED PEAK REPORT

Attention:
Project Number :

Group #: 20060391

Sample #	Client ID	Test Name	Peak Name	CAS#	RT	RQ	Result	Units

RQ=Result Qualifier

WSCF
METHOD REFERENCES REPORT

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 may reference an older version of the method. Also, a reference to a regulatory or industry method here does not necessarily indicate a verbatim implementation of that method.

LA-212-402	Determination of pH Direct Measurement	
	EPA SW-846 9040B	pH ELECTROMETRIC MEASUREMENT
	EPA-600/4-79-020 150.1	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	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 of WSCF analytical procedures and referenced regulatory or industry methods is available online at \\ap006\aspdocs\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-may-2006
Report#: 20060391
Report W_005M/1

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: WATER
Test: Anions by Ion Chromatography

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W060000956									
BATCH QC ASSOCIATED WITH SAMPLE									
DUP	Bromide (Br) by IC	24959-67-9	<1.86e0	n/a	RPD	04/28/06	0.000	20.000	U
DUP	Chloride (Cl) by IC	16887-00-6	7.53e+00	4.898	RPD	04/28/06	0.000	20.000	
DUP	Fluoride (F) by IC	16984-48-8	<8.00e-1	n/a	RPD	04/28/06	0.000	20.000	U
DUP	Nitrite (N) by IC	NO2-N	<1.96e-1	n/a	RPD	04/28/06	0.000	20.000	U
DUP	Nitrate (N) by IC	NO3-N	<3.60e-1	n/a	RPD	04/28/06	0.000	20.000	U
DUP	Phosphate (P) by IC	PO4-P	<1.56e0	n/a	RPD	04/28/06	0.000	20.000	U
DUP	Sulfate (SO4) by IC	14808-79-8	1.34e+03	0.749	RPD	04/28/06	0.000	20.000	
MS	Bromide (Br) by IC	24959-67-9	1.82e+00	91.919	% Recov	04/28/06	75.000	125.000	
MS	Chloride (Cl) by IC	16887-00-6	1.01e+00	104.124	% Recov	04/28/06	75.000	125.000	
MS	Fluoride (F) by IC	16984-48-8	4.72e-01	95.354	% Recov	04/28/06	75.000	125.000	
MS	Nitrite (N) by IC	NO2-N	4.79e-01	97.160	% Recov	04/28/06	75.000	125.000	
MS	Nitrate (N) by IC	NO3-N	4.02e-01	92.414	% Recov	04/28/06	75.000	125.000	
MS	Phosphate (P) by IC	PO4-P	8.84e-01	92.760	% Recov	04/28/06	75.000	125.000	
MS	Sulfate (SO4) by IC	14808-79-8	2.23e+00	112.626	% Recov	04/28/06	75.000	125.000	
MSD	Bromide (Br) by IC	24959-67-9	1.79e+00	90.404	% Recov	04/28/06	75.000	125.000	
MSD	Chloride (Cl) by IC	16887-00-6	1.02e+00	106.155	% Recov	04/28/06	75.000	125.000	
MSD	Fluoride (F) by IC	16984-48-8	4.75e-01	95.960	% Recov	04/28/06	75.000	125.000	
MSD	Nitrite (N) by IC	NO2-N	4.73e-01	95.943	% Recov	04/28/06	75.000	125.000	
MSD	Nitrate (N) by IC	NO3-N	4.30e-01	98.851	% Recov	04/28/06	75.000	125.000	
MSD	Phosphate (P) by IC	PO4-P	8.09e-01	84.890	% Recov	04/28/06	75.000	125.000	
MSD	Sulfate (SO4) by IC	14808-79-8	2.16e+00	109.091	% Recov	04/28/06	75.000	125.000	
BATCH QC									
BLANK	Bromide (Br) by IC	24959-67-9	<9.30e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Bromide (Br) by IC	24959-67-9	<9.30e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Bromide (Br) by IC	24959-67-9	<9.30e-2	n/a	mg/L	04/28/06	0.000	300.000	U

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: WATER
Test: Anions by Ion Chromatography

SAF Number: NA
Sample Date:
Receive Date:

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
BLANK	Chloride (Cl) by IC	16887-00-6	<3.40e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Chloride (Cl) by IC	16887-00-6	<3.40e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Chloride (Cl) by IC	16887-00-6	<3.40e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Fluoride (F) by IC	16984-48-8	<4.00e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Fluoride (F) by IC	16984-48-8	<4.00e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Fluoride (F) by IC	16984-48-8	<4.00e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrite (N) by IC	NO2-N	<9.80e-3	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrite (N) by IC	NO2-N	<9.80e-3	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrite (N) by IC	NO2-N	<9.80e-3	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrate (N) by IC	NO3-N	<1.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrate (N) by IC	NO3-N	<1.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Nitrate (N) by IC	NO3-N	<1.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Phosphate (P) by IC	PO4-P	<7.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Phosphate (P) by IC	PO4-P	<7.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Phosphate (P) by IC	PO4-P	<7.80e-2	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Sulfate (SO4) by IC	14808-79-8	<1.30e-1	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Sulfate (SO4) by IC	14808-79-8	<1.30e-1	n/a	mg/L	04/28/06	0.000	300.000	U
BLANK	Sulfate (SO4) by IC	14808-79-8	<1.30e-1	n/a	mg/L	04/28/06	0.000	300.000	U
LCS	Bromide (Br) by IC	24959-67-9	3.56e+02	89.000	% Recov	04/28/06	80.000	120.000	
LCS	Bromide (Br) by IC	24959-67-9	4.04e+02	101.000	% Recov	04/28/06	80.000	120.000	
LCS	Chloride (Cl) by IC	16887-00-6	1.92e+02	97.959	% Recov	04/28/06	80.000	120.000	
LCS	Chloride (Cl) by IC	16887-00-6	2.03e+02	103.571	% Recov	04/28/06	80.000	120.000	
LCS	Fluoride (F) by IC	16984-48-8	9.13e+01	91.300	% Recov	04/28/06	80.000	120.000	
LCS	Fluoride (F) by IC	16984-48-8	1.04e+02	104.000	% Recov	04/28/06	80.000	120.000	
LCS	Nitrite (N) by IC	NO2-N	9.40e+01	94.378	% Recov	04/28/06	80.000	120.000	
LCS	Nitrite (N) by IC	NO2-N	9.76e+01	98.193	% Recov	04/28/06	80.000	120.000	
LCS	Nitrate (N) by IC	NO3-N	8.75e+01	89.645	% Recov	04/28/06	80.000	120.000	
LCS	Nitrate (N) by IC	NO3-N	9.16e+01	104.437	% Recov	04/28/06	80.000	120.000	
LCS	Phosphate (P) by IC	PO4-P	1.83e+02	95.085	% Recov	04/28/06	80.000	120.000	
LCS	Phosphate (P) by IC	PO4-P	2.03e+02	105.455	% Recov	04/28/06	80.000	120.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: WATER
Test: Anions by Ion Chromatography

SAF Number: NA
Sample Date:
Receive Date:

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
LCS	Sulfate (SO4) by IC	14808-79-8	3.81e+02	95.250	% Recov	04/28/06	80.000	120.000	
LCS	Sulfate (SO4) by IC	14808-79-8	3.99e+02	99.750	% Recov	04/28/06	80.000	120.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: WATER
Test: pH Direct Measurement

SAF Number: NA
Sample Date: 05/08/06
Receive Date: 05/08/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W06W000037									
BATCH QC ASSOCIATED WITH SAMPLE									
DUP	pH Direct Measurement	PH	6.310	0.537	RPD	05/08/06	0.000	20.000	
BATCH QC									
LCS	pH Direct Measurement	PH	7.967	0.996	Ratio	05/08/06	0.900	1.100	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: WATER
Test: Conductivity

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W060000956									
BATCH QC ASSOCIATED WITH SAMPLE									
DUP	Conductivity	CONDUCT	2.19	1.379	RPD	05/08/06	0.000	20.000	
BATCH QC									
LCS	Conductivity	CONDUCT	130.5	100.385	%rec	05/08/06	90.000	110.000	

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
Lab ID: W0600000959									
BATCH QC ASSOCIATED WITH SAMPLE									
MS	Silver by ICP	7440-22-4	165.859	83.866	% Recov	05/10/06	75.000	125.000	
MS	Aluminum by ICP	7429-90-5	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Arsenic by ICP	7440-38-2	198	100.000	% Recov	05/10/06	75.000	125.000	
MS	Boron by ICP	7440-42-8	186.7	94.293	% Recov	05/10/06	75.000	125.000	
MS	Barium by ICP	7440-39-3	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Beryllium by ICP	7440-41-7	93.391	94.334	% Recov	05/10/06	75.000	125.000	
MS	Bismuth by ICP	7440-69-9	167	84.343	% Recov	05/10/06	75.000	125.000	
MS	Calcium by ICP	7440-70-2	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Cadmium by ICP	7440-43-9	189	95.455	% Recov	05/10/06	75.000	125.000	
MS	Cobalt by ICP	7440-48-4	184.2	93.030	% Recov	05/10/06	75.000	125.000	
MS	Chromium by ICP	7440-47-3	150	75.758	% Recov	05/10/06	75.000	125.000	
MS	Copper by ICP	7440-50-8	193	97.475	% Recov	05/10/06	75.000	125.000	
MS	Iron by ICP	7439-89-6	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Potassium by ICP	7440-09-7	2018	101.818	% Recov	05/10/06	75.000	125.000	
MS	Lithium by ICP	7439-93-2	98.92	99.919	% Recov	05/10/06	70.000	130.000	
MS	Magnesium by ICP	7439-95-4	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Manganese by ICP	7439-96-5	NA	n/a	% Recov	05/10/06	75.000	125.000	
MS	Molybdenum, ICP	7439-98-7	178	89.899	% Recov	05/10/06	75.000	125.000	
MS	Sodium by ICP	7440-23-5	226	114.141	% Recov	05/10/06	75.000	125.000	
MS	Nickel by ICP	7440-02-0	198	100.000	% Recov	05/10/06	75.000	125.000	
MS	Phosphorus by ICP	7723-14-0	229	115.657	% Recov	05/10/06	70.000	130.000	
MS	Lead by ICP	7439-92-1	190.84	96.384	% Recov	05/10/06	75.000	125.000	
MS	Antimony by ICP	7440-36-0	175	88.384	% Recov	05/10/06	75.000	125.000	
MS	Selenium by ICP	7782-49-2	171	86.364	% Recov	05/10/06	75.000	125.000	
MS	Silicon by ICP	7440-21-3	159	80.303	% Recov	05/10/06	75.000	125.000	
MS	Tin	7440-31-5	174	87.879	% Recov	05/10/06	75.000	125.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
MS	Strontium by ICP	7440-24-6	76	76.768	% Recov	05/10/06	70.000	130.000	
MS	Titanium by ICP	7440-32-6	419	211.616	% Recov	05/10/06	75.000	125.000	*
MS	Thallium by ICP	7440-28-0	149	75.253	% Recov	05/10/06	75.000	125.000	
MS	Vanadium by ICP	7440-62-2	186.8	94.343	% Recov	05/10/06	75.000	125.000	
MS	Zinc by ICP	7440-66-6	184.3	93.081	% Recov	05/10/06	75.000	125.000	
MS	Zirconium by ICP	7440-67-7	199.5	100.758	% Recov	05/10/06	75.000	125.000	
MSD	Silver by ICP	7440-22-4	114.659	58.499	% Recov	05/10/06	75.000	125.000	*
MSD	Aluminum by ICP	7429-90-5	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Arsenic by ICP	7440-38-2	202	103.061	% Recov	05/10/06	75.000	125.000	
MSD	Boron by ICP	7440-42-8	186.7	95.255	% Recov	05/10/06	75.000	125.000	
MSD	Barium by ICP	7440-39-3	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Beryllium by ICP	7440-41-7	92.491	94.379	% Recov	05/10/06	75.000	125.000	
MSD	Bismuth by ICP	7440-69-9	168	85.714	% Recov	05/10/06	75.000	125.000	
MSD	Calcium by ICP	7440-70-2	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Cadmium by ICP	7440-43-9	189	96.429	% Recov	05/10/06	75.000	125.000	
MSD	Cobalt by ICP	7440-48-4	181.2	92.449	% Recov	05/10/06	75.000	125.000	
MSD	Chromium by ICP	7440-47-3	125	63.776	% Recov	05/10/06	75.000	125.000	*
MSD	Copper by ICP	7440-50-8	190	96.939	% Recov	05/10/06	75.000	125.000	
MSD	Iron by ICP	7439-89-6	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Potassium by ICP	7440-09-7	2005	102.296	% Recov	05/10/06	75.000	125.000	
MSD	Lithium by ICP	7439-93-2	96.92	98.898	% Recov	05/10/06	75.000	125.000	
MSD	Magnesium by ICP	7439-95-4	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Manganese by ICP	7439-96-5	NA	n/a	% Recov	05/10/06	75.000	125.000	
MSD	Molybdenum by ICP	7439-98-7	175	89.285	% Recov	05/10/06	75.000	125.000	
MSD	Sodium by ICP	7440-23-5	284	144.898	% Recov	05/10/06	75.000	125.000	*
MSD	Nickel by ICP	7440-02-0	188	95.918	% Recov	05/10/06	75.000	125.000	
MSD	Phosphorus by ICP	7723-14-0	199	101.531	% Recov	05/10/06	75.000	125.000	
MSD	Lead by ICP	7439-92-1	190.84	97.367	% Recov	05/10/06	75.000	125.000	
MSD	Antimony by ICP	7440-36-0	176	89.796	% Recov	05/10/06	75.000	125.000	
MSD	Selenium by ICP	7782-49-2	169	86.224	% Recov	05/10/06	75.000	125.000	

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
MSD	Silicon by ICP	7440-21-3	123	82.755	% Recov	05/10/06	75.000	125.000	*
MSD	Tin	7440-31-5	172	87.755	% Recov	05/10/06	75.000	125.000	
MSD	Strontium by ICP	7440-24-6	86	68.795	% Recov	05/10/06	75.000	125.000	
MSD	Titanium by ICP	7440-32-6	356	181.633	% Recov	05/10/06	75.000	125.000	*
MSD	Thallium by ICP	7440-28-0	149	76.020	% Recov	05/10/06	75.000	125.000	
MSD	Vanadium by ICP	7440-62-2	184.8	94.288	% Recov	05/10/06	75.000	125.000	
MSD	Zinc by ICP	7440-66-6	203.3	103.724	% Recov	05/10/06	75.000	125.000	
MSD	Zirconium by ICP	7440-67-7	196.5	100.255	% Recov	05/10/06	75.000	125.000	
SPK-RPD	Silver by ICP	7440-22-4	58.498	35.405	RPD	05/10/06	0.000	20.000	*
SPK-RPD	Aluminum by ICP	7429-90-5		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Arsenic by ICP	7440-38-2	103.081	3.015	RPD	05/10/06	0.000	20.000	
SPK-RPD	Boron by ICP	7440-42-8	95.255	1.015	RPD	05/10/06	0.000	20.000	
SPK-RPD	Barium by ICP	7440-39-3		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Beryllium by ICP	7440-41-7	94.379	0.048	RPD	05/10/06	0.000	20.000	
SPK-RPD	Bismuth by ICP	7440-69-9	85.714	1.612	RPD	05/10/06	0.000	20.000	
SPK-RPD	Calcium by ICP	7440-70-2		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Cadmium by ICP	7440-43-9	96.429	1.015	RPD	05/10/06	0.000	20.000	
SPK-RPD	Cobalt by ICP	7440-48-4	92.449	0.626	RPD	05/10/06	0.000	20.000	
SPK-RPD	Chromium by ICP	7440-47-3	63.776	17.174	RPD	05/10/06	0.000	20.000	
SPK-RPD	Copper by ICP	7440-50-8	96.939	0.551	RPD	05/10/06	0.000	20.000	
SPK-RPD	Iron by ICP	7439-89-6		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Potassium by ICP	7440-09-7	102.298	0.468	RPD	05/10/06	0.000	20.000	
SPK-RPD	Lithium by ICP	7439-93-2	98.898	1.027	RPD	05/10/06	0.000	20.000	
SPK-RPD	Magnesium by ICP	7439-95-4		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Manganese by ICP	7439-96-5		n/a	RPD	05/10/06	0.000	20.000	
SPK-RPD	Molybdenum, ICP	7439-98-7	89.286	0.894	RPD	05/10/06	0.000	20.000	
SPK-RPD	Sodium by ICP	7440-23-5	144.898	23.747	RPD	05/10/06	0.000	20.000	*
SPK-RPD	Nickel by ICP	7440-02-0	95.918	4.167	RPD	05/10/06	0.000	20.000	
SPK-RPD	Phosphorus by ICP	7723-14-0	101.531	13.008	RPD	05/10/06	0.000	20.000	
SPK-RPD	Lead by ICP	7439-92-1	97.367	1.015	RPD	05/10/06	0.000	20.000	

WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20060391
Matrix: SOLID
Test: ICP - All possible metals

SAF Number: NA
Sample Date: 04/25/06
Receive Date:04/28/06

QC Type	Analyte	CAS #	QC Found	QC Yield	Units	Analysis Date	Lower Limit	Upper Limit	RQ
SPK-RPD	Antimony by ICP	7440-36-0	88.796	1.585	RPD	05/10/06	0.000	20.000	
SPK-RPD	Selenium by ICP	7782-49-2	86.224	0.182	RPD	05/10/06	0.000	20.000	
SPK-RPD	Silicon by ICP	7440-21-3	62.755	24.533	RPD	05/10/06	0.000	20.000	
SPK-RPD	Tin	7440-31-5	87.755	0.141	RPD	05/10/06	0.000	20.000	
SPK-RPD	Strontium by ICP	7440-24-6	86.735	12.192	RPD	05/10/06	0.000	20.000	
SPK-RPD	Titanium by ICP	7440-32-6	181.633	15.249	RPD	05/10/06	0.000	20.000	
SPK-RPD	Thallium by ICP	7440-28-0	76.020	1.014	RPD	05/10/06	0.000	20.000	
SPK-RPD	Vanadium by ICP	7440-62-2	94.286	0.060	RPD	05/10/06	0.000	20.000	
SPK-RPD	Zinc by ICP	7440-66-6	103.724	10.816	RPD	05/10/06	0.000	20.000	
SPK-RPD	Zirconium by ICP	7440-67-7	100.255	0.500	RPD	05/10/06	0.000	20.000	

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W13q Worklist/Batch/QC Report for Group# 20060391

WL#	S#	Batch	QC#	Tray Type	Sample#	Test
28527	2	28898	32744	BLANK		Anions by Ion Chromatography
28527	9	28898	32744	BLANK		Anions by Ion Chromatography
28527	12	28898	32744	BLANK		Anions by Ion Chromatography
28527	3	28898	32744	LCS		Anions by Ion Chromatography
28527	10	28898	32744	LCS		Anions by Ion Chromatography
28527	5	28898	32744	DUP	W060000956	Anions by Ion Chromatography
28527	6	28898	32744	MS	W060000956	Anions by Ion Chromatography
28527	7	28898	32744	MSD	W060000956	Anions by Ion Chromatography
28527	4	28898	32744	SAMPLE	W060000956	Anions by Ion Chromatography
28527	8	28898	32744	SAMPLE	W060000957	Anions by Ion Chromatography
28527	11	28898	32744	SAMPLE	W060000958	Anions by Ion Chromatography
28588	4	28959	32801	LCS		pH Direct Measurement
28588	8	28959	32801	SAMPLE	W060000956	pH Direct Measurement
28588	9	28959	32801	SAMPLE	W060000957	pH Direct Measurement
28588	10	28959	32801	SAMPLE	W060000958	pH Direct Measurement
28588	6	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	32815	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