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December 13, 2002

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: USNRC Docket No. 72-1014
HI-STORM 100 Certificate of Compliance 1014

References:
1. Holtec Project 5014
2. Holtec Report to NRC Pursuant to 10 CFR 72.242(d), dated November 13, 2002

In Reference 2 report, we indicated that the final root cause evaluation for the recent MPC lid welding issue had not been completed at the time the report was submitted. The purpose of this letter is to inform the NRC that the root cause evaluation has now been completed and no changes to the information in the original report are necessary. In addition, in response to your request of December 10, 2002, we herewith enclose the subject root cause evaluation report for your information.

Sincerely,

Brian Gutherman P.E.
Licensing Manager

cc: Mr. S. O'Connor, USNRC (w/encl.)
Mr. C. Regan, USNRC (w/encl.)
HUG Licensing Subcommittee (w/o encl.)
NRC Correspondence Distribution (w/o encl.)

Document ID 5014476

NMSS01

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ROOT CAUSE EVALUATION REPORT

Root Cause Report #: E- 2002-12

Affected Project/Program: 1021 Applicable CAR #: 88

Problem Definition: Indications were discovered in the root pass of the MPC Lid to Shell weld (LTS) on MPC S/N #40 at Plant Hatch on September 18, 2002. The indications, which were discovered by the Liquid Penetrant (PT) process, are located in the toe of the partial penetration weld at the interface with the MPC Lid. The indications appear around the entire length of the weld. The indications have the appearance of porosity, and are distributed along the entire circumference of the root pass of the weld.

ROCAIB Board Members: The following individuals were appointed by the Vice President of Nuclear Projects.

Mark Soler- Chairman
Bernard Gilligan
Evan Rosenbaum

Data Collection and Scenario Reconstruction:

A ROCAIB meeting was held on October 24, 2002. All members of the ROCAIB attended. The time period between initial identification of the nonconforming condition and the initial root cause meeting was spent obtaining information necessary for a root cause investigation. The following actions occurred during the meeting:

1) The timeline of events from the initial indications to stopping of welding operations was summarized by Bernard Gilligan.

   Grinding was performed to remove the indications from the weld and adjacent lid base metal. Subsequent PT examinations confirmed the removal of all indications. However, similar indications in the same relative location reoccurred upon rewelding with the mechanized welding process (The welding process used for the LTS weld is a mechanized Gas Tungsten Arc Welding (GTAW) process with a hotwire option).

   After several unsuccessful attempts were made to repair the weld joint with the mechanized welding process without experiencing rejectable PT indications, a segment of weld was successfully repaired using the manual Flux Cored Arc Welding (FCAW) process.

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Manual welding using the FCAW process was performed to bring the LTS weld to a thickness of approximately 5/8" (requirement is ¾"). The 1st intermediate pass was successfully PT inspected after some grinding and re-welding. The 2nd intermediate pass was PT inspected with some rejectable indications. After removal of the indications, Shielded Metal Arc Welding (SMAW) of a cover pass was attempted around approximately ¼ of the MPC circumference. PT inspection of the SMAW pass revealed indications along the majority of the weld in the lid base material.

2) As the processes in (1) were occurring, Southern took various actions to determine the cause of the indications. These actions were summarized by Bernard Gilligan.

   a) This GTAW process used to weld the root pass has been used successfully on all MPCs welded to date, including one at Plant Hatch (S/N # 23) earlier in September 2002.

   b) After the initial root pass was made, parameters such as wire feed rate and amperage were varied to reduce heat input and weld dilution, but indications always reoccurred.

   c) With all welding techniques used, all indications were found to be at the interface between the weld and MPC lid. There were no rejectable indications found in the weld metal or at the interface between the weld and MPC shell.

   d) Since one of the major causes of porosity-like weld indications is known to be the result of contamination of the molten weld material during welding, Plant Hatch personnel, attempted to identify and isolate the potential causes of contamination. During the GTAW welding, the weld wire spool was changed, base material cleaned prior to rewelding and other potential sources of contamination identified. A coating material used to ease decontamination was evaluated by Plant Hatch personnel.

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The mechanized welding system performance was re-evaluated by performing welds on weld mock up coupons, using the actual welding parameters used on the LTS weld root pass. Welds were made without PT indications on the coupon. Also, strippable paint, which is used near the weld surface, was applied to the weld coupon. After curing, the paint was removed, and the coupon was cleaned; a portion with alcohol, a portion with PT cleaner, and a portion with decon solution. Subsequent welding of the coupon after this evolution yielded no indications, which implies that the weld indications are not the result of surface contaminants.

e) The welding process (GTAW) had been successfully used on the previous 33 MPCs loaded. Additionally, as stated above, weld mock up coupons on another material heat number which were welded subsequent to the identification of the indications did not show any indications. Therefore, the welding process was determined to be acceptable.

f) The grain size was evaluated on the lid. The grain structure of the subject lid forging was found to be coarser than 00 (ASTM E-112), while still meeting all ASME Code requirements for Section III, Subsection NB, Class 1. The other five MPC lids at Hatch were tested for their grain size. Attachment 2 (6 pages) provides the results of the tests. The serial number 25 MPC lid was found to have similar grain size. The other four lids were found to have grain sizes between 0.5-4.5. Test welds were performed on the serial number 25 lid with PT indications similar to that found on MPC serial number 40. Additional test welds were performed using low heat input GTAW and SMAW parameters and high heat input GTAW parameters. Samples were taken from the test welds and unwelded base metal on the serial number 25 lid for metallurgical examination. The results of the examination confirmed that the indications were liquation cracks of the form of hot cracking in the lid base material in all three test welds. The microfissures are very small and limited in length to something less than 400 microns (roughly the grain size). Many smaller crack lengths were also observed where partial grain diameters were fissured. Attachment 3 (6 pages) is a preliminary report from Marty Sims (welding engineer for plant Hatch) on grain sizes for lid #25. The report addresses how grain sizes can affect weldability.

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g) During the week of October 14th, Bernard Gilligan along with a UST&D welder, weld engineer and QC inspector went to Plant Hatch. Test welds were made to lid #25 using GTAW and FCAW. Indications were observed after welding. In addition, Holtec hired an independent Level III inspector to witness the performance of liquid penetrant examination on lid #40 by plant Hatch personnel. The examination was determined to be in compliance with the procedure and unacceptable indications were identified by the Level III inspector.

3) A discussion on hot cracking was provided. The following summary was extracted from the internet (Kobelco Welding).

Hot crack can be defined as cracking formed at high temperatures near the solidus of the metal, where the metal has coherence but is completely brittle. It can occur in weld metals and the heat affected zone. Almost all metals may, on any scale, suffer this defect.

The lack of ductility at high temperatures causing the brittle condition near the solidus is usually due to the formation of an intergranular liquid film of an impurity, notably sulfur and phosphorous in metal. Both these impurities combine with the matrix elements to form low- melting point (lower than that of the matrix) compounds, thereby reducing intergranular cohesion. The lack of cohesion between grain boundaries, in turn, initiates cracks aided by tensile stresses resulting from the contraction of the weld. Hot cracking is also known as " solidification cracking" which occurs in weld metals when molten weld metal freezes, and "liquation cracking", which occurs in the heat –affected zones of the mother metal and weld metal in solid, affected by the heat of the arc.

4) The ROCAIB reviewed a series of pictures provided by plant Hatch. Attachment 1 (13 pages) contains copies of the pictures. Pictures on lid #40 include indications prior to grinding of the surface and after some initial grinding. The pictures show a series of circular indications. After initial grinding, the indication is shown as a line. Indications produced from a test weld in lid #25 are also included in attachment 1. An arc strike purposely made on the lid was also found to produce indications.

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5) ASME Section IIA, SA-336 (Specification for Alloy Steel Forgings for Pressure and High Temperature Parts) was reviewed. Forgings were procured under this specification. The specification only identifies grain size criteria for high temperature (i.e. F304H) forgings in which large grain size is beneficial and desired. The forgings procured by Holtec were F304.

6) The ROCAIB evaluated whether the larger grain size would affect mechanical properties. Since the mechanical testing of forgings was performed using a prolongation as opposed to a separate test sample, the mechanical properties were determined with the grain size consistent with the rest of the forging.

7) The ROCAIB reviewed SMDR 622 (Attachment 4- 5 pages; Note: The ROCAIB identified that the UST&D NCR referenced the wrong Holtec purchase order- The ROCAIB confirmed that the discrepant material had been supplied by Gulfco. Since there was no affect on the SMDR disposition, no further action was taken by the ROCAIB) which was issued on 9/14/01. This SMDR addressed two lids which exhibited base metal indications after welding of the drain port shield block. After UST&D attempted several times without success to eliminate the indications through grinding and rewelding, the disposition was made to replace the lids. No further root cause or corrective actions were initiated based on the fact that UST&D was able to make an acceptable weld on all other lids. The SMDR checklist was reviewed by the ROCAIB. Questions addressing possible impact on previous product and the need for root cause evaluation were answered "not applicable" and "no" respectively. It was recently brought to the attention of Holtec that at least one other MPC lid (#25) had exhibited similar problems though UST&D was eventually able to make a weld with no base metal indications.

8) Test reports, NDE records and heat treat records for lid #25 (forging 5341V), lid #40 (forging 1322V) and the two lids rejected under SMDR 622 (forgings 5327V and 5333V) were reviewed. Chemistry and mechanical properties were found to be in compliance with ASME Section IIa, SA336-304 requirements. Attachment 5 (40 pages) includes copies of these documents.

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9) A review of the forging processes of Gulfco and Jorgensen was made. Jorgensen has supplied a number of MPC lid forgings to Holtec which have been welded at the sites without incident. Copies of Gulfco and Jogensen process documents are provided as Attachment 6 (10 pages). During the review it was noticed that the Gulfco heat requirements for forgings can go to 2300°F maximum while Jorgensen's process allows for 2200° F. Based on discussions with Gulfco and Jorgensen personnel during this investigation, it has become known that higher forging temperatures can cause increased grain size.

   Furthermore it was learned, that the most important parameter in the development of forging grain size is the amount of upsetting performed during the last forging cycle. Neither Gulfco nor Jorgensen controlled the amount of upsetting in the final forging step and, consequently, the grain size will vary from forging to forging.

10) Attachment 7 (6 pages) was discussed by the ROCAIB. This attachment is the results of Gulfco's investigation into the condition. The Gulfco letter states that the weldability issue is due to course grain size.

11) B. Gilligan summarized the corrective actions for S/N 40 that are documented under SMDR 929.

12) B. Gilligan stated that Holtec Information Bulletin (HIB) #9 had been issued. The HIB was distributed to all Holtec dry storage clients. A copy of the HIB is provided as Attachment 8 (3 pages). The following recommendation was provided in the HIB:

   For those clients currently in loading campaigns, Holtec recommends that test welds be applied to MPC lids prior to the commencement of loading. The welding process for the test welds should be the same as that planned for the MPC lid welding and should have similar heat input. Perform a liquid penetrant examination of the test welds using the same acceptance criteria as that for the lid welding. If the test weld exhibits indications at the toe of the weld, contact Holtec for assistance on additional testing to be performed. If the test weld passes liquid penetrant examination, the MPC lid is suitable for welding. Simply, remove the weld by grinding and perform liquid penetrant examination to confirm clean base metal prior to loading.

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Causal Factor Evaluation: The causal factor checklist was completed by the ROCAIB. The following causal factors were identified:

Written Communication: Holtec's purchase requisition did not address grain size (not required by ASME Subsection) and did not provide any weldability requirements.

Equipment Failure: Known problem not corrected. Previous welding problems with the drain shield block were either repaired or scrapped. There are two known scrapped lids (returned to vendor) and two that were repaired by UST&D after initial indications. No further action was taken regarding potential root causes since the condition was very infrequent and a number of lids had already been welded at the site. Further evaluation at the time of the initial incidents may have precluded the lid issue at Hatch.

Root Cause: The root cause was determined to be coarse grain size of the forging. A coarse grain size metal has less grain boundary and, therefore, the impurities, which are located at the grain boundary, are more concentrated in a coarse grain metal . These impurities combine with the matrix elements to form low- melting point (lower than that of the matrix) compounds, thereby reducing intergranular cohesion. The lack of cohesion between grain boundaries, in turn, initiates cracks aided by tensile stresses resulting from the contraction of the weld. Contributing causes were that Holtec did not clearly specify weldability requirements for the forging: the forging manufacturer did not control the forging process to limit grain size; and Holtec's vendor discrepancy programs (SMDRs/NCRs) failed to address the problem earlier when the opportunity arose.

- Programmatic or management policy breakdown? No
- Organization breakdown? No
- Inadequate procedures? No. However, grain sizes of forgings appear to vary based on several characteristics. Holtec's purchase requisition and specification did not impose grain size or weldability requirements on the forging. While this is not required by SA336, this information on the purchase requisition should prevent recurrence in the future.
- Inadequate training? No
- Process or operational breakdown? No
- Inadequate interface? No

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Extent of Conditions: Remaining lids at UST&D and any unwelded lids at the sites could have the same condition. Holtec has provided a recommended course of action for clients with lids awaiting welding. For lids at UST&D, PS-101 (Attachment 9 – 1 page) has been revised to require UST&D to perform a weldability evaluation. This same evaluation will apply for unwelded lids at Dresden and ANO.

Holtec is responsible for the welding of lids at Trojan. All lids at Trojan were manufactured by Jorgensen. There have been no weldability issues with forgings supplied by Jorgensen. Therefore, Holtec will perform grain size examinations on the first several lids which will be welded at Trojan. Based on the results of these examinations, Holtec's engineers will determine whether any further actions are necessary.

Corrective Actions and Actions to Prevent Recurrence:

1) Revise PS-107 (SA336-304 Purchase Specification) to include weldability requirements.
2) Perform weldability evaluation for lids at ANO, Dresden and UST&D in accordance with the requirements of PS-101.
3) Perform weldability evaluation of several lids at Trojan. Evaluate results to determine whether further action is necessary
4) Add weldability requirements to plate specification being used for the newly designed two piece lid which will replace the forging in future procurements. Also add weldability statement to all purchase specifications for dry cask NB components.
5) Provide lessons learned to UST&D and Holtec regarding insufficient corrective action during drain shield block welding issues.
6) Revise checklist questions on SMDR in order to provide additional direction for evaluating the potential impact of deviations and for determining whether an NCR should be issued.

Method for Evaluating Effectiveness of Corrective Actions:

1) Satisfactory results on future lid welding.

10CFR21 and 10CFR7.242 Reportability Evaluation:

The ROCAIB also evaluated the reportability of this issue under 10CFR21 and 1CFR72.242.

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A copy of the 10CFR21 evaluation in accordance with HQP 15.1 is provided as attachment 10 (5 pages) of this report. It was determined that this issue was not reportable under 10CFR21.This issue was determined to be reportable under 10 CFR 72.242(d). A copy of the letter issued to the NRC is provided as attachment 11 (6 pages) to this report.

ROOT CAUSE EVALUATION REPORT APPROVALS:

Chairman: 11/18/02
Mark Soler

ROCAIB Board Member: 11/18/02
Bernard Gilligan

ROCAIB Board Member: 11/18/2002
Evan Rosenbaum

QA Manager: 11/18/02
Mark Soler

Project/Program Manager: 11/18/02
Bernard Gilligan

Attachment 1

To: "'evan_rosenbaum@holtec.com'" <evan_rosenbaum@holtec.com>
Cc: "Bernard Gilligan (bernard_gilligan@holtec.com)"
<bernard_gilligan@holtec.com>
Subject: FW: Pictures

> -----Original Message-----
> From: Wade, Jim A.
> Sent: Thursday, September 19, 2002 9:17 AM
> To: McCallum, Thomas O.
> Subject:
>
> <<FW: PT indications on root pass,.....AFTER GRINDING. MPC S/N
> 40>> <<Lid dimensions>> <<FW: >>
Message-ID: <D34E5D478466D511A97D0002B3357EC0017F6179@gahnpex02.southernco.com>
From: "Goode, Glenn A." <gagoode@southernco.com>
To: "Sims, Marty B." <MBSIMS@southernco.com>
Cc: "Wade, Jim A." <JAWADE@southernco.com>, "Ponder, John T."
<jtponder@southernco.com>
Subject: FW: PT indications on root pass,.....AFTER GRINDING. MPC S
/N 40
Date: Thu, 19 Sep 2002 05:02:32 -0500
Importance: high
X-Priority: 1
MIME-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2652.33)
Content-Type: multipart/mixed;
boundary="----_=_NextPart_002_01C25FE9.4465AA8C"

FYI

> -----Original Message-----
> From: Hadden, John T.
> Sent: Thursday, September 19, 2002 5:18 AM
> To: Goode, Glenn A.
> Cc: McCall, J. V.; Clark, Robert S.
> Subject: PT indications on root pass,.....AFTER GRINDING. MPC
> S/N 40
> Importance: High
>
> <<MVC-010L.JPG>> <<MVC-011L.JPG>> <<MVC-007L.JPG>> <<MVC-008L.JPG>>
>
>
> Glenn,
>
> PT indications exist on approx 40% of weld surface after grinding of root

> pass. Depth of grind approximately 1/8 in all around on inside radius.
>
> Indications appear as rounded after about 3 minutes into developing
> time.....become joined at 7 to 10 minutes.

 MVC-010L1.jpg

 MVC-011L1.jpg

 MVC-007L.jpg

 MVC-008L1.jpg

Message-ID: <D34E5D478466D511A97D0002B3357EC0017F6178@gahnpex02.southernco.com>
From: "Goode, Glenn A." <gagoode@southernco.com>
To: "Wade, Jim A." <JAWADE@southernco.com>
Cc: "Chitty, Ken" <X2Chitty@southernco.com>, "Ponder, John T."
<jtponder@southernco.com>
Subject: Lid dimensions
Date: Thu, 19 Sep 2002 03:04:53 -0500
MIME-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2652.33)
Content-Type: text/plain

KC got these measurements:

S/N 025: 3/4
S/N 024: 3/4
S/N 041: 15/16
S/N 042: 15/16
S/N 090: 7/8

Message-ID: <D34E5D478466D511A97D0002B3357EC0017F6176@gahnpex02.southernco.com>
From: "Goode, Glenn A." <gagoode@southernco.com>
To: "Wade, Jim A." <JAWADE@southernco.com>, "Sims, Marty B."
<MBSIMS@southernco.com>, "Rayner, Larry M." <lmrayner@southernco.com>
Subject: FW:
Date: Thu, 19 Sep 2002 00:04:54 -0500
MIME-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2652.33)
Content-Type: multipart/mixed;
boundary="---_=_NextPart_002_01C25FE9.4465AA8C"

I asked John Hadden to take a picture of one of the cracks / indications

being chased. The person grinding out the weld was using some developer to help him identify where to grind - the developer has been on too long and the indication is a little faded. Still you can see some of the crack.

> -----Original Message-----
> From: Hadden, John T.
> Sent: Thursday, September 19, 2002 12:59 AM
> To: Goode, Glenn A.
> Subject:
>
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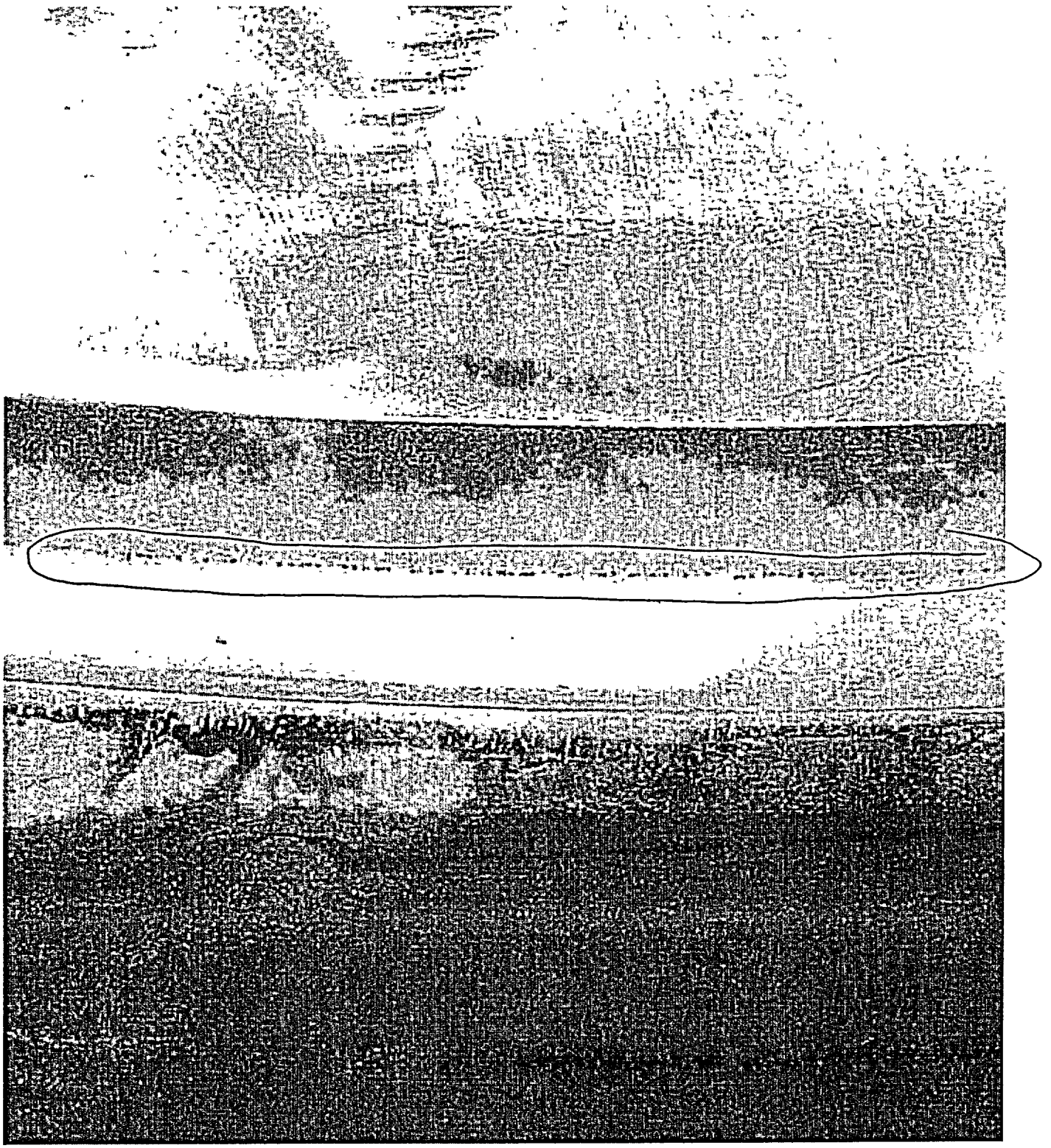
>
>
>

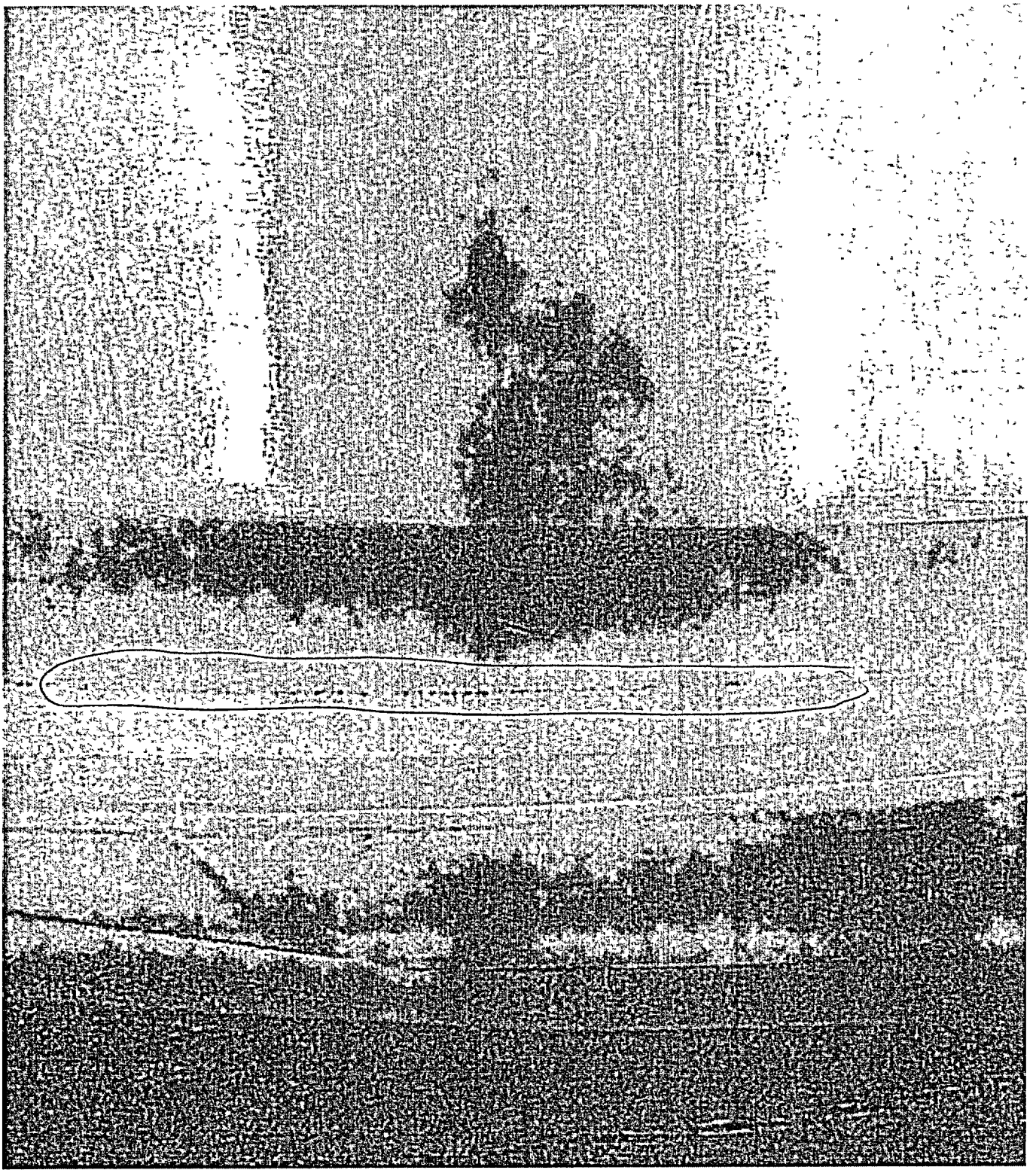
 MVC-001L2.jpg

 MVC-004L2.jpg

 MVC-006L2.jpg



Before Grading on #40



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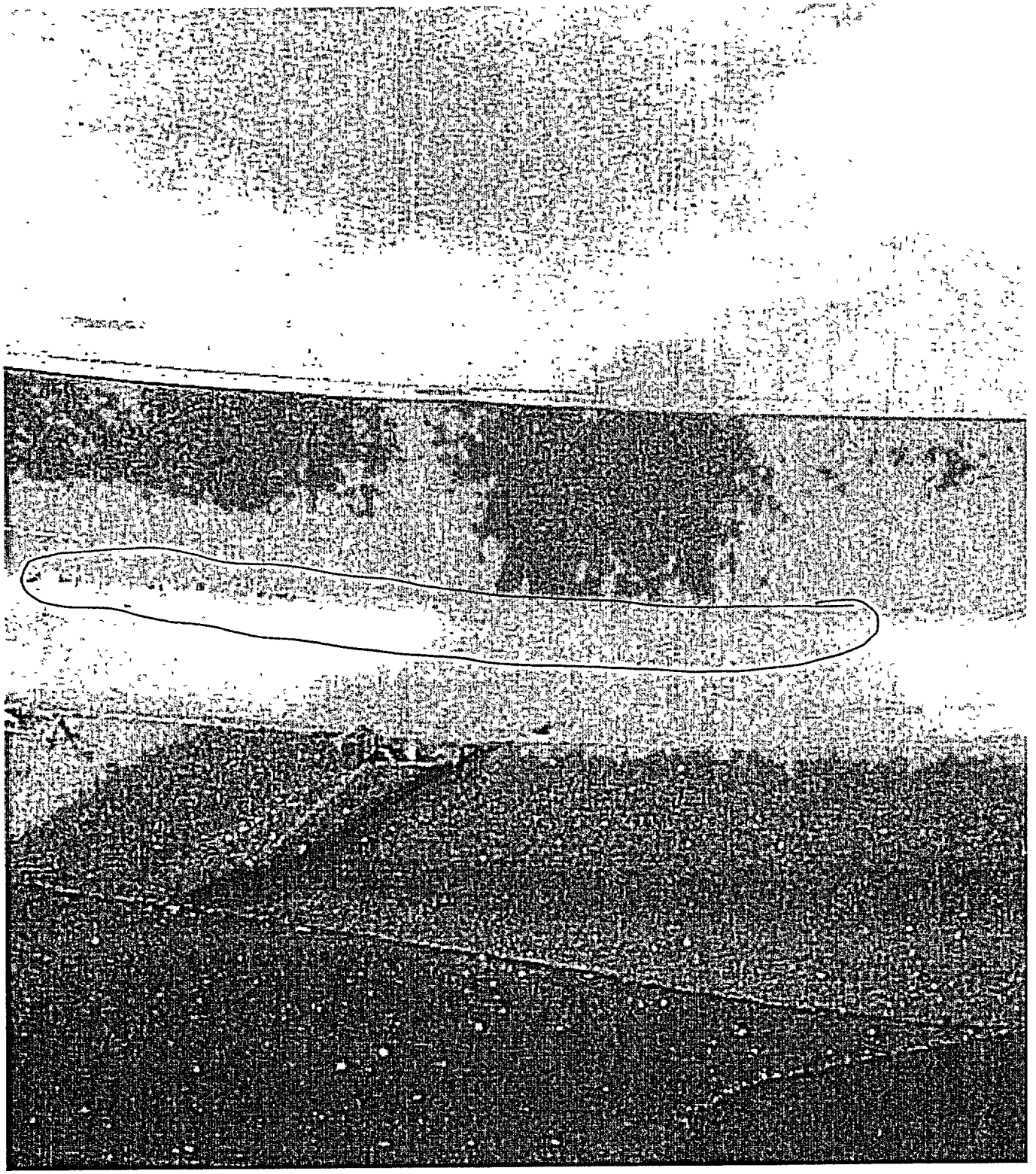

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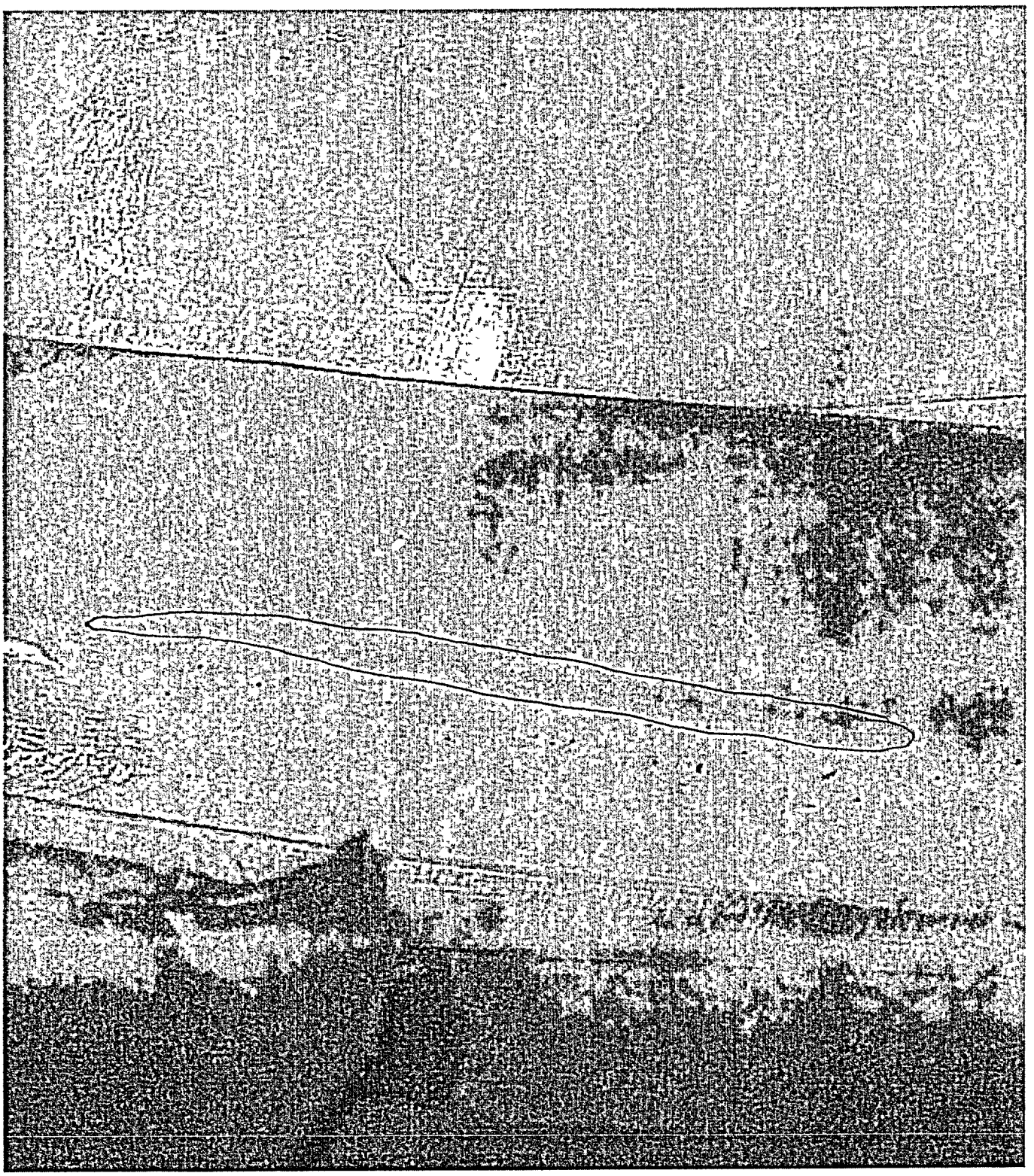
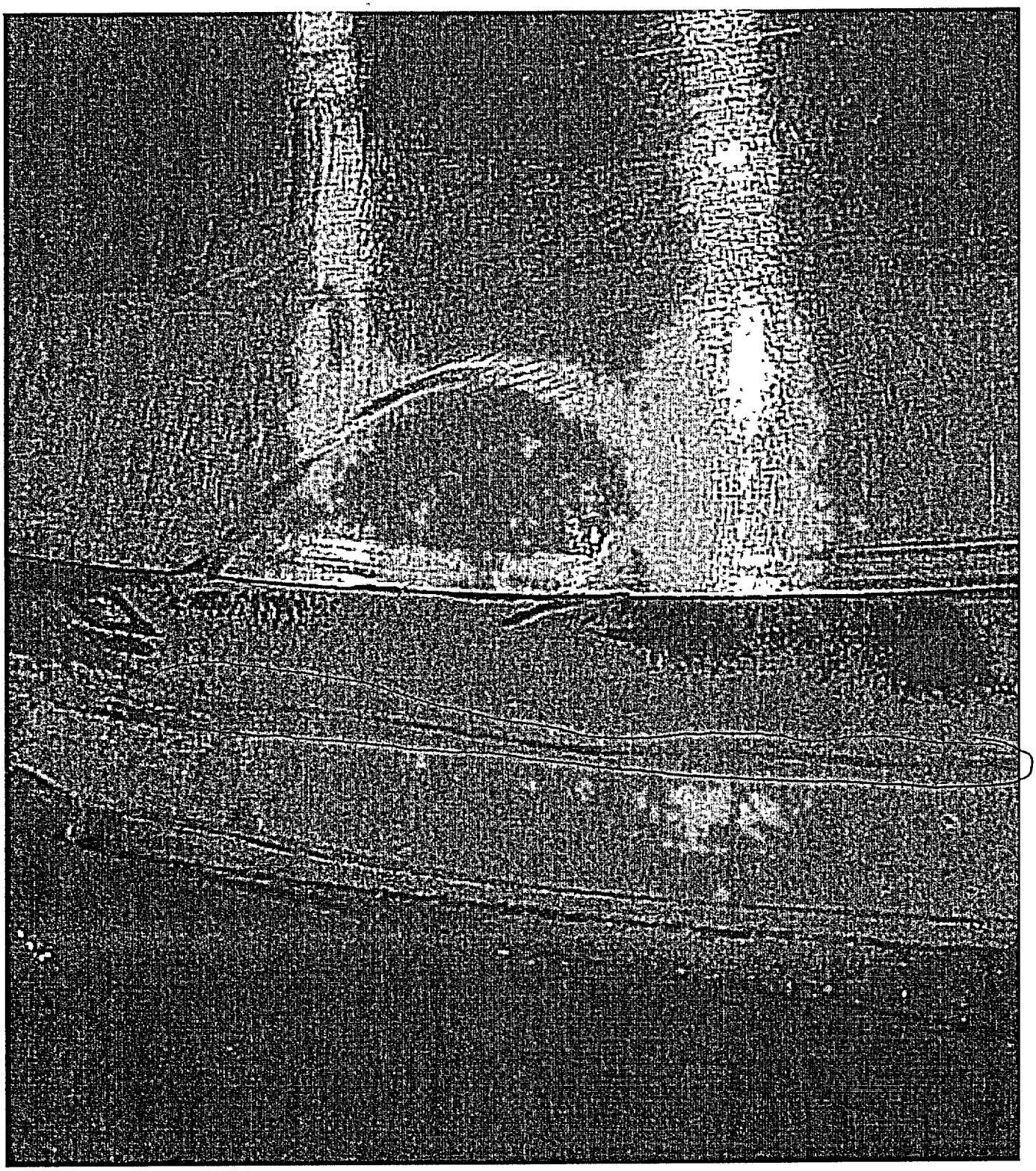
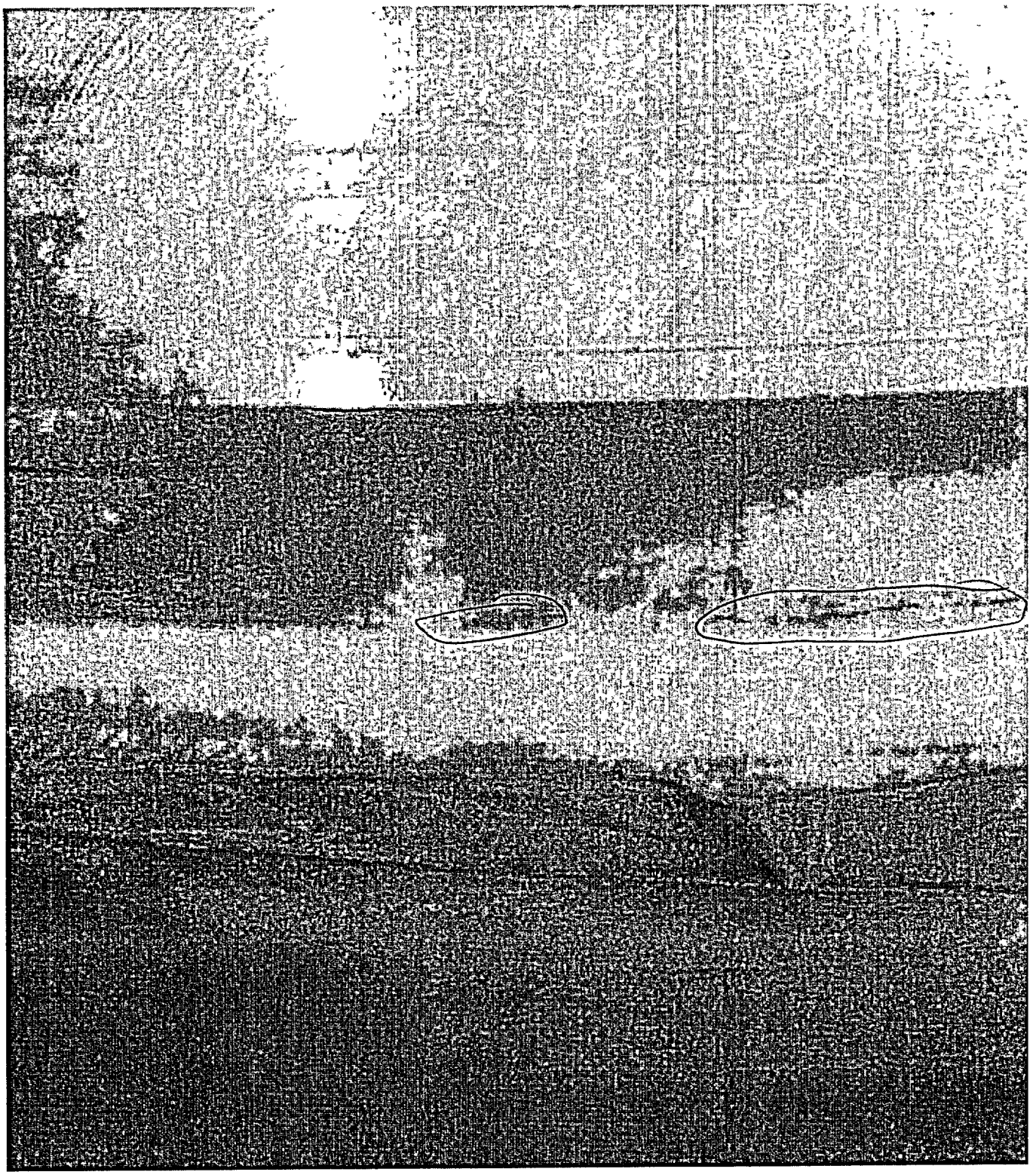


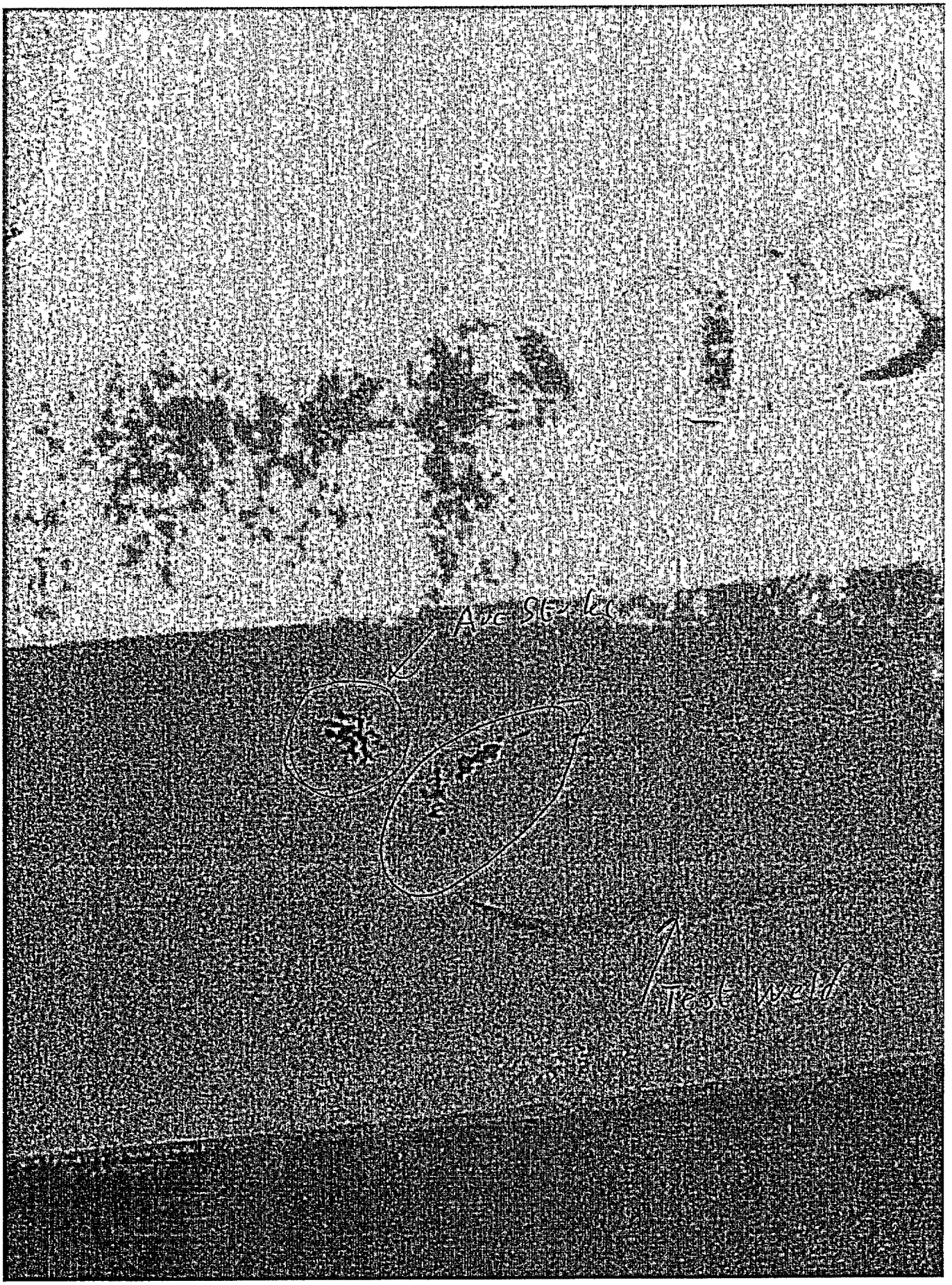
After grinding on #40

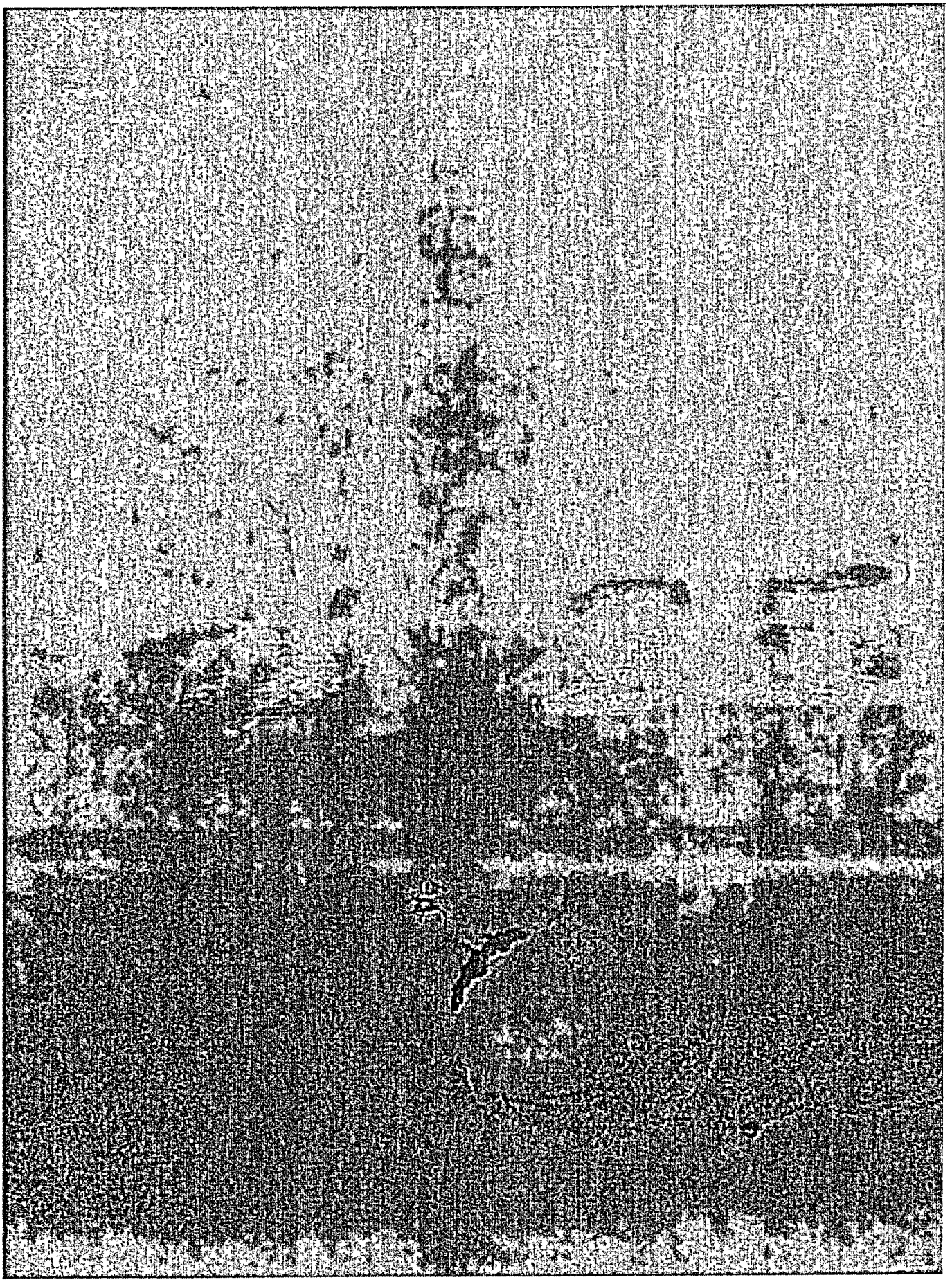


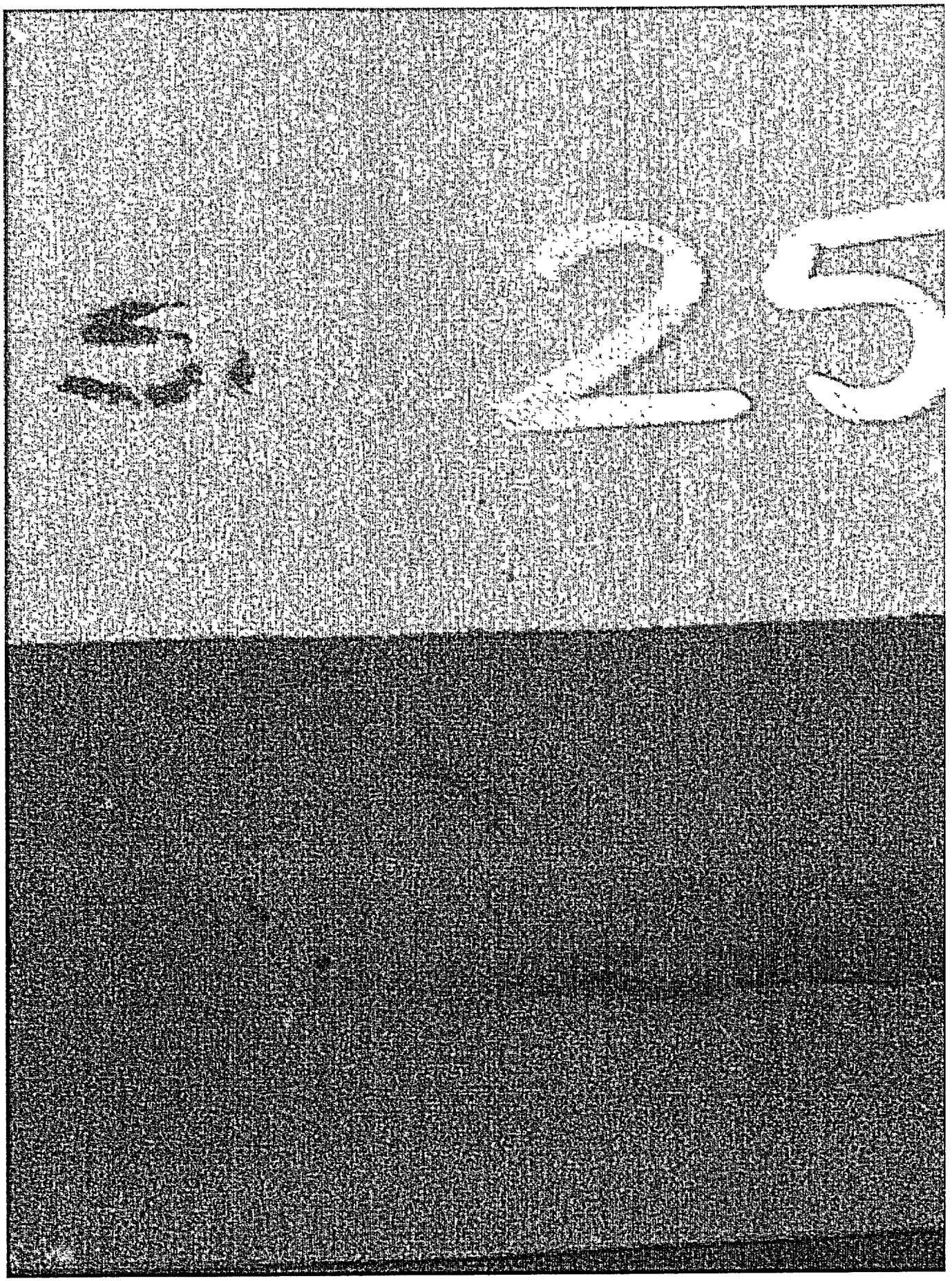
After grading on #40



After Grading on Ld #40


Arc Sense Loop
Test Weld





Attachment 2

Preliminary Replication Report
Of
MPC Cask

Prepared for:
Southern Nuclear Operating Company
Plant Hatch
Marty Sims
Jim Wade

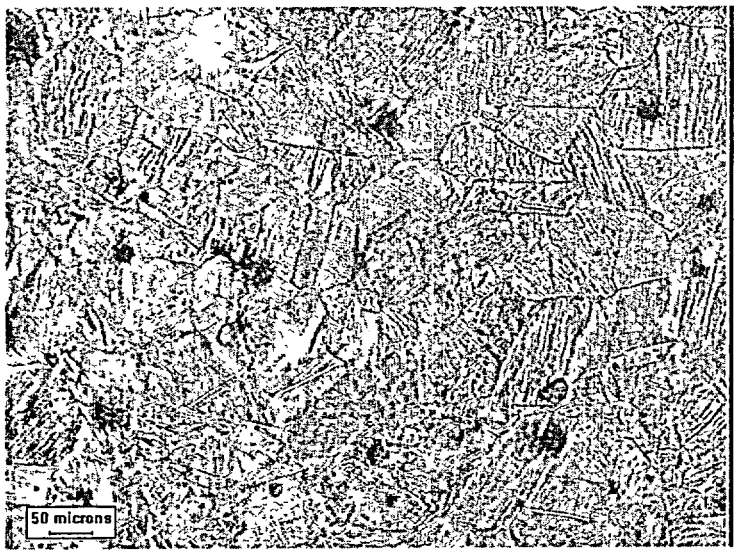
Prepared by:
Andy McGehee, P.E.
Manager - Materials Engineering

EPRI RRAC
1300 Harris Blvd
Charlotte, NC 28262
(704) 547-6126 P#
(704) 547-6109 F#
amcgehee@epri.com

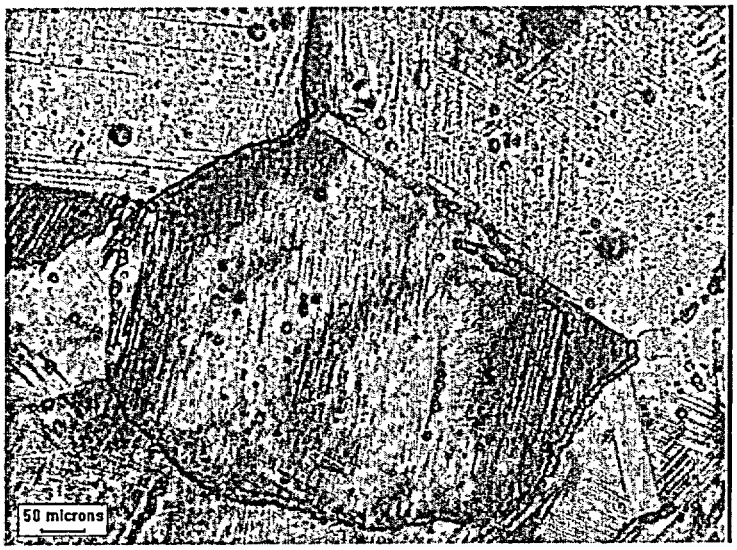
10/7/2002

RESULTS:

Grain size determinations were conducted according to ASTM E112 paragraph 10 Comparison Method. Grain size numbers with * indicates that a reduced magnification was employed in order to obtain micrographs suitable to yield comparisons to plate II designations.

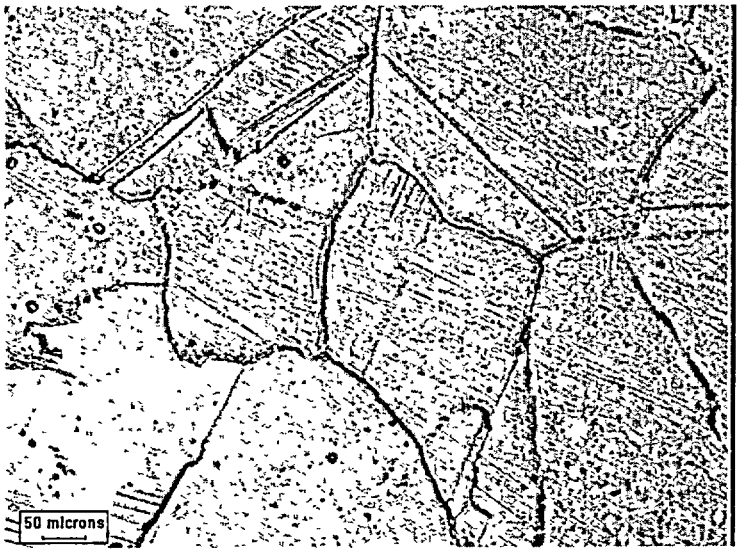


Lid # 24 – Top Surface @ 270°. Mag = 100x. Grain Size = 4.5

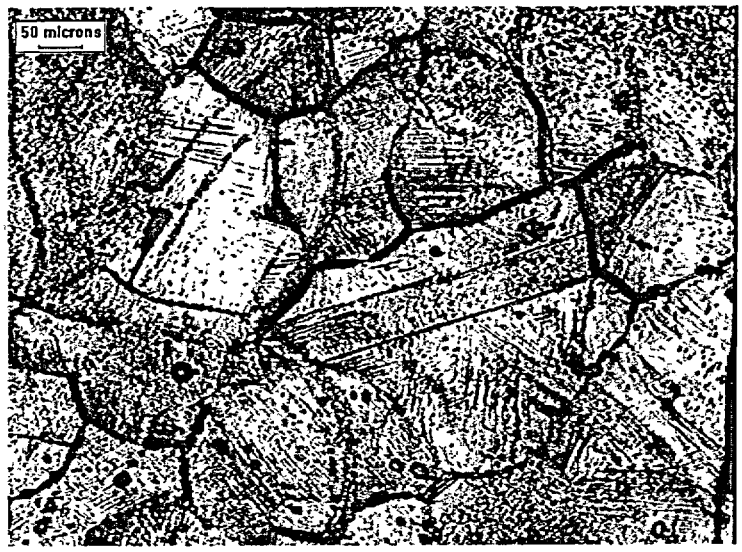


Lid# 25 – Top Surface @ 90° Mag = 100x. Grain Size = 00*

* = Grain Size determined by reducing the mag to 50X and application of correction factor per ASTM E112-96 paragraph 10.7



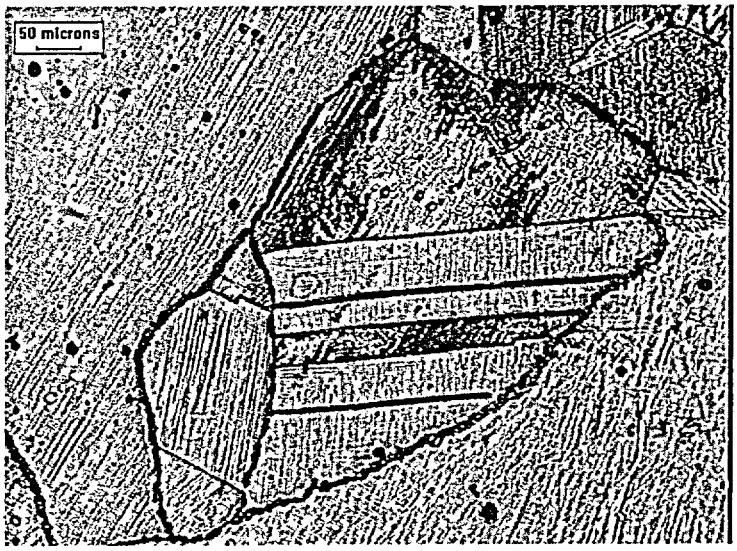
Lid# 40 – Test Weld Elbow @ 90°. Mag = 100X. Grain Size ≥ 00*



Lid# 42 – Top Surface @ 180°. Mag = 100X. Grain Size = 0.5 – 1.0

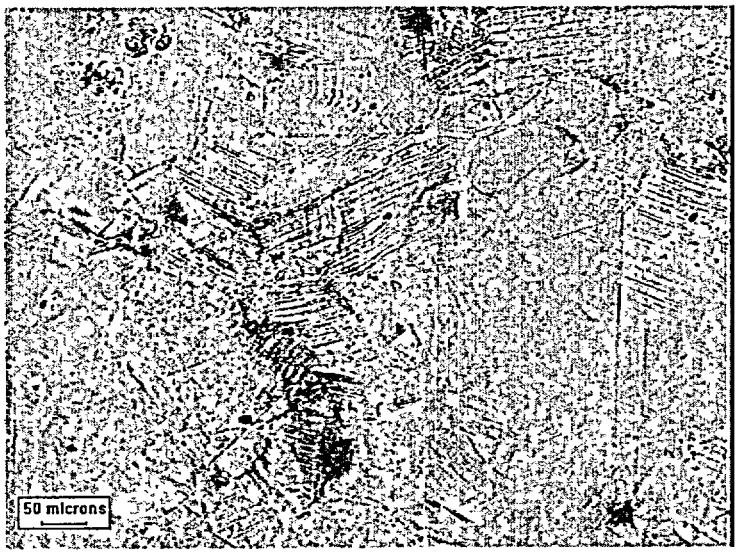
* = Grain Size determined by reducing the mag to 50X and application of correction factor per ASTM E112-96 paragraph 10.7

Lid# 41 – Top Surface @ 0°.Mag = 100X. Grain Size = 1

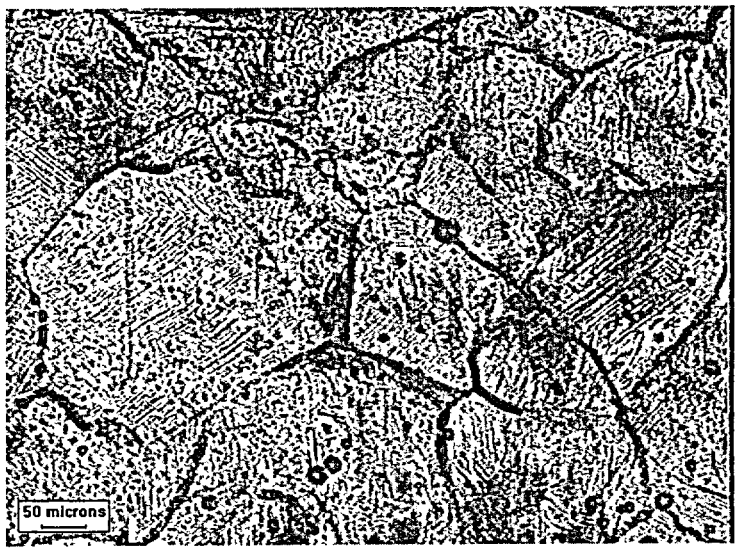


Lid# 25 – Bottom Surface @10° Near Drain Port. Mag = 100X. Grain Size = 00*

* = Grain Size determined by reducing the mag to 50X and application of correction factor per ASTM E112-96 paragraph 10.7



Lid# 90 – Top Surface @ 0°. Mag = 100X. Grain Size may be 3 – 4 but is not definite due to poor grain resolution in the replica.



Lid# 42 – Top Surface @ 180°. Mag = 100X. Grain Size = 0.5 – 1.0

Attachment 3

To: "'lharbison@ustdnuclear.com'" <lharbison@ustdnuclear.com>,
"Gilligan, Bernard (Holtec)" <bernard_gilligan@holtec.com>,
"'Moscardini, Bob (UST&D)'" <rmoscardini@ustdnuclear.com>,
"Rosenbaum, Evan" <evan_rosenbaum@holtec.com>, "Ponder, John T."
<jtponder@southernco.com>
Subject: FW: Cracking of the Spent Fuel Cask Lids

FYI. The reference below to MPC #24 should be #25. The pictures are impressive.
-----Original Message-----
From: Sims, Marty B.
Sent: Monday, October 07, 2002 1:20 PM
To: Baker, Ray D.; Branum, Jeff K.; McCallum, Thomas O.; Ponder, John T.
Cc: Mathews, Larry K.; Mullins, Rick E.; Dove, Mason W.; Evans, Patricia K. (Metallurgy); Bednash, John
Subject: FW: Cracking of the Spent Fuel Cask Lids

FYI - Structural Integrity's initial info on the boat sample results. A more detailed report will be provided later.
-----Original Message-----
From: Richard E. Smith [mailto:rsmith2@mindspring.com]
Sent: Monday, October 07, 2002 11:40 AM
To: Sims, Marty B.; Wade, Jim A.
Cc: Nancy Gerber; Andy McGehee; Tony Giannuzzi
Subject: Cracking of the Spent Fuel Cask Lids

Jim and Marty,

Please find attached a micro of the microstructure of the #24 lid material (micro 02206a.jpg). Note the micron scale. All three axes were examined and the structure was the same. A comparison of the grain size to the ASTM charts indicates a grain size greater than "00" which is very large andlikely is the key factor in the grain boundary composition subject to "micro fissuring" due to grain boundary liquation cracking. The PDF file is the grain size record from the Alstom Materials Lab showing the grain size .

The liquation cracks are theform of hot cracking we suspected and discussed at length at the site. The metallurgical examination basically verified the nature of the cracking. The microfissures arevery small and limited in length to something less than 400 microns (roughly the grain size). Many smaller crack lengths were also observed where partial grain diameters were fissured. I attached a photo of the grain size etched to show grain size without twins being visible. Also a representative 10x shot of the highest heat input GTAW weld is shown that demonstrates the fusion line cracking. A 100x photo of a crack is also shown.

It is obvious that the cracks are very small and I have thustermed them "microfissures" Thisphenomenon frequently is encountered with Inconel welds especially when deposited on ferritic materials. The likely culpert for the boundary liquation is the grain boundaryimpurities concentrated by the small grain boundary volumes associated with large grain size material. The large grain size was produced during forging due to improper forging controls. (we have two different grain sizes from the samemelt of material. Unfortunately a smaller grain size was not specified in the Holtec papers.

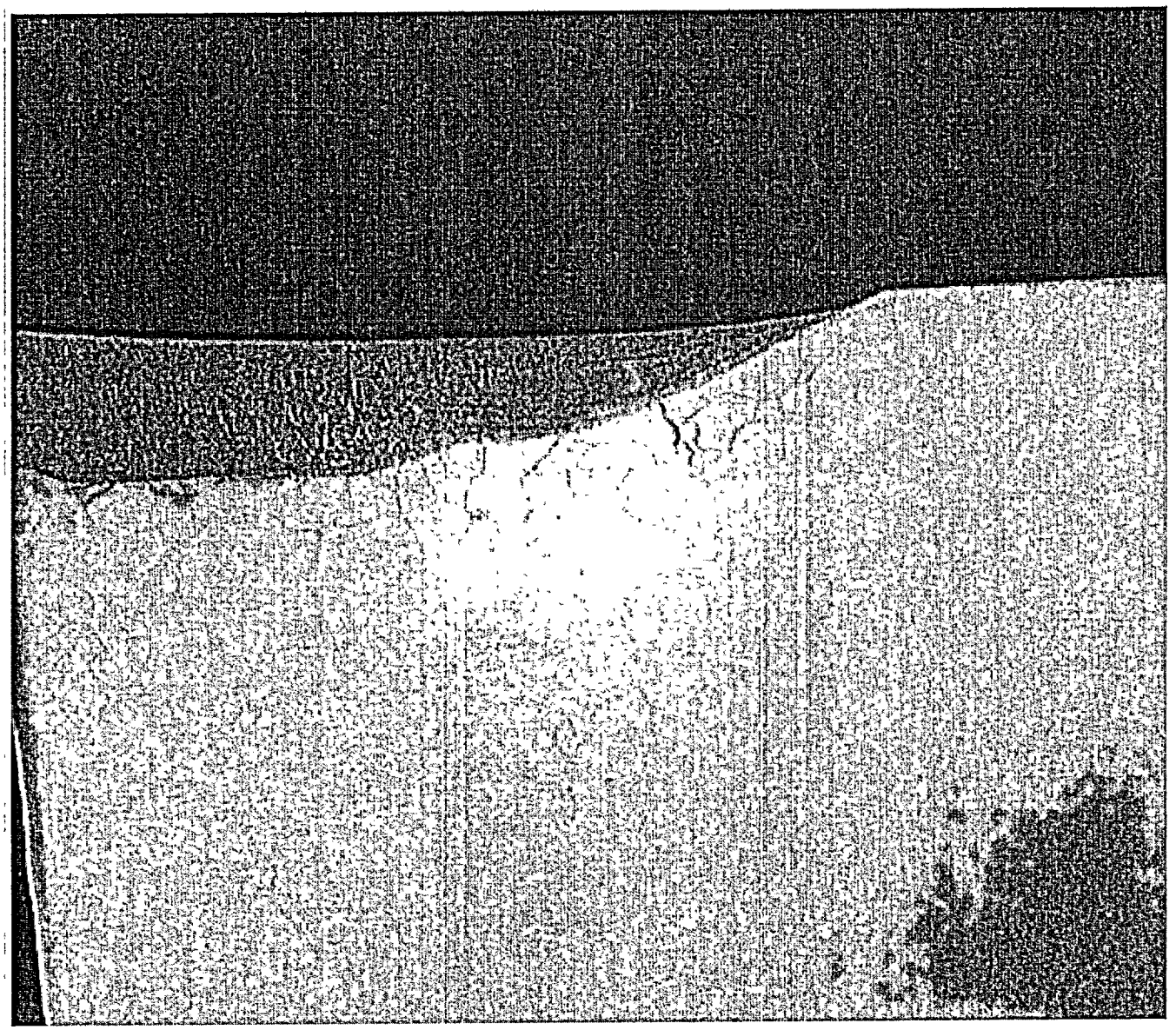
Fusion welding difficultieswith large grain sizes is nothing new. My discussions with Ted Ward indicated that he personally experienced the same problem with heavy section stainless steel materials encountered at least as early as the 1940s and 1950s for electric power generating station equipment and for the US Navy. He suggested that grain size 6 should be achievableusing proper forging controls. If the material reduction ratio were insufficient, a forging technique known as **"saddening"** could be used. It basically takes the disk shape and forges at 90 degrees to the original forging direction then flattens the disk again in a followon step. He gave me a name of an individual that works with the ASME Codes that is experienced with forging large stainless steel components.

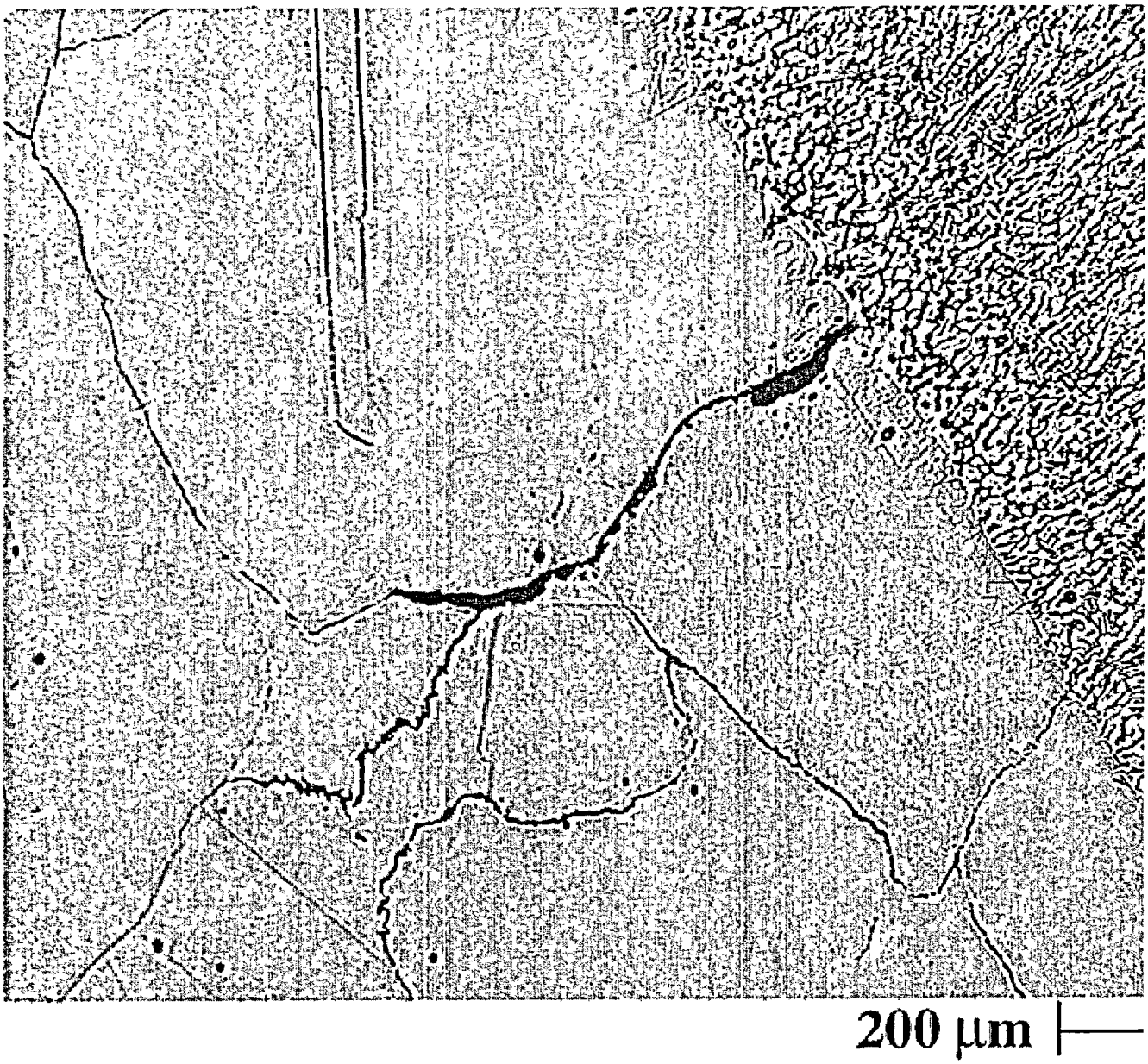
The microfissures are very small and show no indications forlinking to form larger defects. I am certain they can be shown to be insignificant in terms of fracture mechanics and strength considerations. This could be proved with some welded test samples of the material that demonstrate strength and ductility parameters. This then leads to the question of whether or not the remaining welds can be completed satisfactorily without undue rework. I think one could approach the task similarly to that apparently done at US Tool and Die where the visible cracks were eventually blended out. Since they are only about a grain diameter deep, several very small beads could be placed adjacent to the final bead and then blend the bead into the base material prior to final PT. By using thetiny beads at the edge,the number of fusion line microfissures will be minimizedand blended without too much trouble. Since microfissuring is not a new phenomenon and is relatively well understood, a strong case for completing and accepting the #40 lid could be made. Our previous concern (or at least mine) was that the degree of cracking adjacent to the fusion boundary was unknown and could be significant. I believe this was the proper assessment until the metallography was completed. The metallography shows the cracking to be limited to something less than 1000 microns (400 to 600 microns was the largest defect length seen). Also the density of the microfissures was small and became even lower as the heat input was reduced.

No chemistry forthe grain boundary segregates could be identified with the SEM EDS analysis. This indicates that the liquid layers are near monolayers. This is supported by the lack of precipitates seen in the boundaries. Typically the Boron carbonitrideswill be the problem, but we didnot see evidence for this. Boron isoften added to themelt to improve high temp strength and reduce the volume of matrial that has to be cropped prior to and during forging. This increases yield.It was also noted thatthe MnS particles are rounded and small that may indicate the use of rare earth additions to the melt. Of course Sulfur is another typical culprit. Again none of the grain boundaries examined with the SEM showed any indication of any of these low temperature melting materials.

The remaining lids show a much smaller grain size as evidenced by Andy's replication and in-place metallography. We will need to see the grain size he comes up with on those lids. They will be easier to weld but a grain size of about 6 is needed to completely avoid grain boundary liquation for normal ingot chemistries. The weld tests we gave them did not indicate any welding issues.

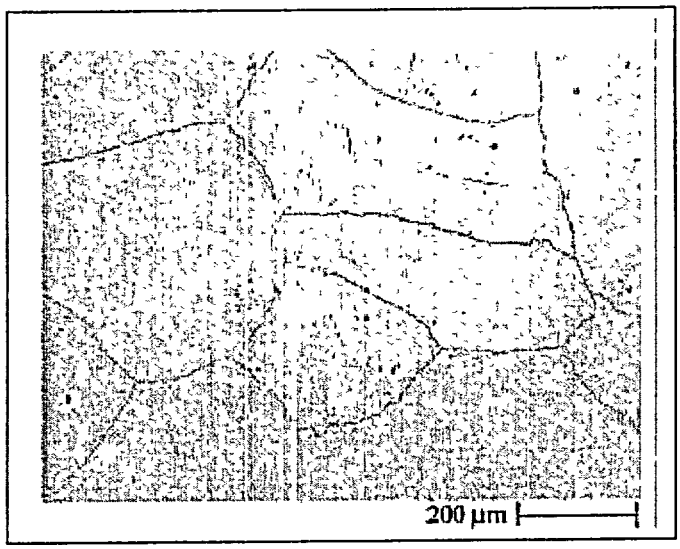
I just wanted to give you a brief upfront assessment before I can prepare the metallugical report on the boat samples. I have preserved all of the remaining pieces in a sealed box where the contents are photographed prior to sealing. Please forward this information to Jim Wade as I do not have his e-mail address.


2 mm


200 μm

ALSTOM

October 7, 2002



Richard Smith
Structural Integrity Associates
3315 Almaden Expressway
Suite 24
San Jose, CA 95118-1557

Subject: Evaluation of Grain Size

Richard:

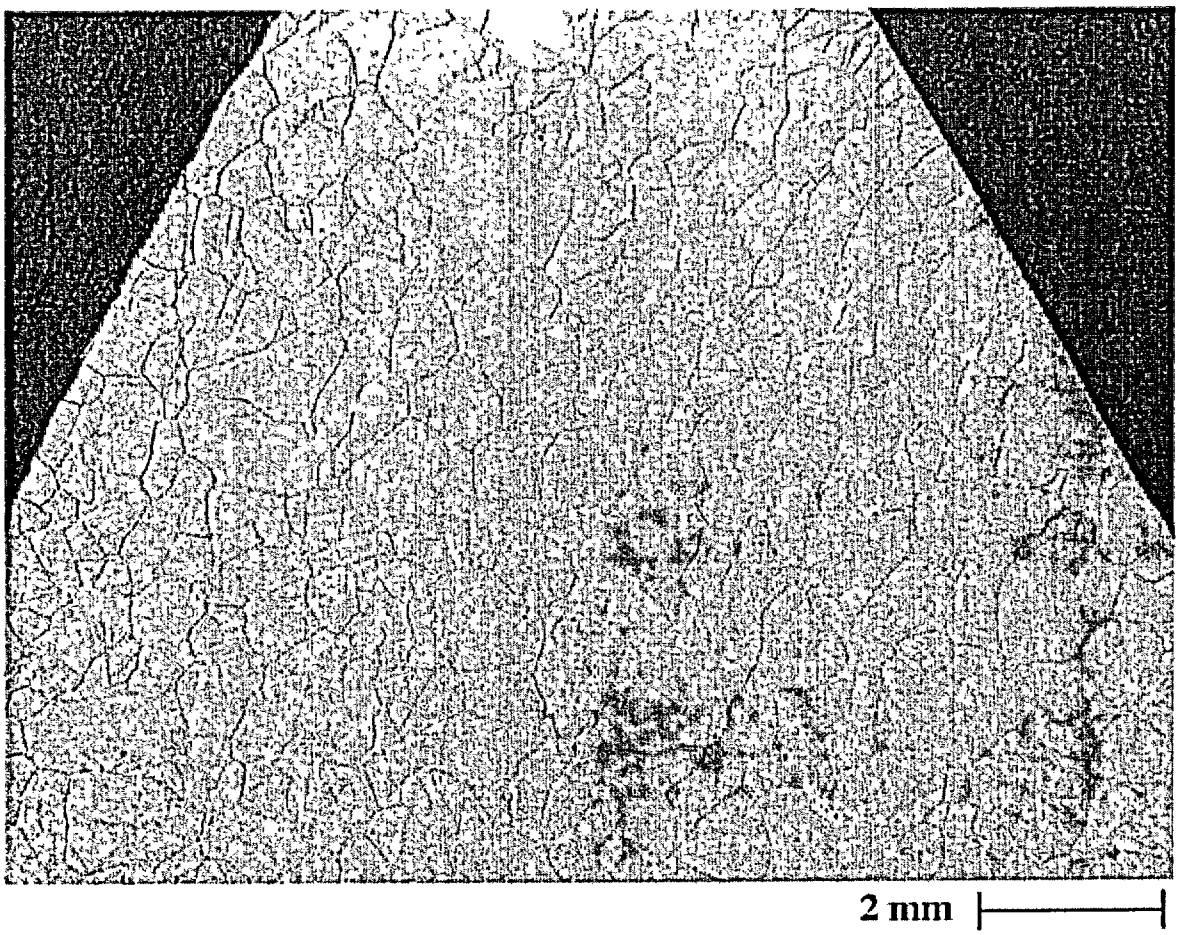
Based on ASTM designation E-112, grain size was determined to be courser than ASTM No. 00.
Please call if you have any questions or if we can be of any further assistance in this matter.

Bill Locke

Grain Size
LN-02J555
ASTM E-112
Date: 10/7/2002

ALSTOM Power, Inc.
Materials Technology Center
1119 Riverfront Parkway
Chattanooga, TN 37402

Telephone: 423-752-2940
Fax: 423-752-2792
Email: bill.locke@power.alstom.com


2 mm

Attachment 4

SUPPLIER MANUFACTURING DEVIATION REPORT (SMDR)[1]

Create DTF

SMDR Number: 622	Rev. No: 0	Unit Serial #: ,TBD,	Job: MPC-68 FABRICATION
Supersedes SMDR No. :		Holtec Project #: 1021	
Superseded by SMDR No. :		Applicable Vendor P.O #:	Holtec PM: HOLTEC

Deviation submitted by (Vendor) :	Vendor NCR/SMDR #: NCR 9925-303r1, 9925-333r1	Organization: UST&D	Recommended Resolution: REPLACE
		SMDR Issuance Date: 9/14/2001	
	Shop Non-Conformance Category: Material Defects		

Description of Deviation:

BASE METAL INDICATIONS EXIST ON TWO MPC LIDS, BOTH NEAR THE DRAIN PORT SHIELD BLOCK. FABRICATOR PROPOSES OBTAINING TWO REPLACEMENT LIDS FROM STOCK AND CONTINUING WITH FABRICATION. LIDS WITH BASE METAL INDICATIONS WILL BE DISPOSITIONED AT A LATER DATE.

Comments on Deviation :

FABRICATOR PROPOSED RESOLUTION IS ACCEPTED FINAL DISPOSITION OF THESE LIDS WILL BE PERFORMED UNDER A REVISION TO THIS SMDR

Identify affected documents :	*Identify attached descriptive material and documents :*
NONE	UST&D NCRs 9925-303r1 (2 pages) and 9925-333r1 (2 pages)

Proposed Resolution is (check one) : ☑ Accepted ☐ Rejected ☐ Conditionally Accepted

Filter by Deviaton

FOR HOLTEC USE ONLY Review Checklist: N:\PDOXWIN\WORKING\SMDR\

Holtec Approval to Proposed Resolution (Password Controlled Initials)

STRUCTURAL	THERMAL	FABRICATION	FIELD SERVICES	CRITICALITY	SHIELDING	LICENSING	PM
*	*	E Rosenbaum 9/14/2001	*	*	*	*	B.Gilligan 9/14/2001

For 10CFR 71 & 10CFR 72 Components Only

Is 10CFR72.48 applicable for this deviation and is the disposition "use as is or "repair"? If yes, go to 72.48 database : NO		If required, did the 72.48 Screening/Evaluation indicate that NRC approval is required? :	
Does this SMDR impact Part 71 CoC *(If yes then, this component can not be certified for transport without NRC approval)*: NO		72.48 Number :	72.48 # Database
Documentation modification required: NO	**Holtec Inspection Verification Req'd :** NO	**Documentation Required :** NO	***QA Approval*** (Sign & Date):
a. Send to Client : NO		b. If (a) is for Approval, has Client Approval been received :	
c. If Yes to (b), and Approval is verbal :	Date:	Client Name:	

Project Manager Confirmation: *(Client Approval Received)*

SMDR CLOSURE:		***Follow Up:***	

[1] *The distribution of the SMDR is controlled by the Project Manager.*

* *The Project Manager has determined that this SMDR does not require review by this discipline. A minimum of two project team members must participate in the evaluation of this document.*

Report of Non-Conformance:

Reference: PWRP 1401-21

Item: 14

Qty of Parts affected: 1

Product Location: D-Annex

Category: Customer - Raw matl supply (physical)

Party most likely responsible: Holtec and Jorgensen

Requirement Violated: QCP 9.6H

Inspection Report Attached: No

Description: Base metal indications are present in the MPC lid directly adjacent to weld #8 near the base of the drain shield block (item 12).

Attempts made to repair these indications repeatedly result in a reappearance of additional base metal indications in the lid just beyond the toe of weld #8.

Sign-off for Report of Non-Conformance Section:

fclester, 4/9/01 12:56:57 PM	Imported Data: Completed Section for Rev 0
jarlotti, 9/12/01 3:54:38 PM	Modified Section during creation of Rev 1

UST&D
U.S. Tool & Die, Inc.

NCR 9925-303 Rev 1

Project Management Review and Recommendation: ☐ Scrap ☐ Use As Is ☐ Rework ☒ Repair

Disposition Details (as required):

As UST&D is unable to repair the lid at this time, this NCR will be forwarded to Holtec recommending that this lid be replaced by a new lid machined from a stock forging received under Holtec PO #9042 NV.

Evaluation/repair of this lid will be performed at a later date.

Deviation Required: ☐ No ☒ Yes (describe): Need Holtec acceptance to replace

Document Changes: ☒ No ☐ Yes (describe):

Conditional Release: ☒ No ☐ Yes (describe):

Quality Assurance Review and Comments on Project Management Disposition:

NONE

10CFR21 Analysis: ☒ No ☐ Yes (describe):

NCR Disposition Acceptance (initial and date):

Proj Mgr: JCA 9/12/01	QA: [signature] 9.12.01	Eng Mgr: [signature] 9/12/01.	ANI:

Applicable Manager Review:

Action to prevent re-occurrence:

Training Required: ☐ No ☐ Yes (describe):

NCR Acknowledgement (initial and date):

Applicable Mgr:	Responsible Parties:

NCR Closure (initial and date):

Prod Completion:	QC Verification:	QA Closure:

UST&D
U.S. Tool & Die, Inc.

NCR 9925-333 Rev 1

Report of Non-Conformance:

Reference: PWRP 2301-7

Item: MPC lid assy

Qty of Parts affected: 1

Product Location: D-Annex

Category: Customer - Raw matl supply (physical)

Party most likely responsible: Holtec and Jorgensen

Requirement Violated: QCP 9.6H

Inspection Report Attached: No

Description: Base metal indications are present in the MPC lid directly adjacent to weld #8 near the base of the drain shield block (item 12).

Attempts made to repair these indications repeatedly result in a reappearance of additional base metal indications in the lid just beyond the toe of weld #8.

Sign-off for Report of Non-Conformance Section:

jmcclain, 7/20/01 9:22:13 PM	Completed Section for Rev 0
jarlotti, 9/12/01 4:07:52 PM	Modified Section during creation of Rev 1

UST&D
U.S. Tool & Die, Inc.

NCR 9925-333 Rev 1

Project Management Review and Recommendation: ☐ Scrap ☐ Use As Is ☐ Rework ☒ Repair

Disposition Details (as required):

As UST&D is unable to repair the lid at this time, this NCR will be forwarded to Holtec recommending that this lid be replaced by a new lid machined from a stock forging received under Holtec PO#9042NU.

Evaluation/repair of this lid will be performed at a later date.

Deviation Required: ☐ No ☒ Yes (describe): Need Holtec acceptance to replace

Document Changes: ☒ No ☐ Yes (describe):

Conditional Release: ☒ No ☐ Yes (describe):

Quality Assurance Review and Comments on Project Management Disposition:

NONE

10CFR21 Analysis: ☒ No ☐ Yes (describe):

NCR Disposition Acceptance (initial and date):

Proj Mgr: SCA 9/12/01	QA: [signature] 9-12-01	Eng Mgr: [signature] 9/12/01	ANI:

Applicable Manager Review:

Action to prevent re-occurrence:

Training Required: ☐ No ☐ Yes (describe):

NCR Acknowledgement (initial and date):

Applicable Mgr:	Responsible Parties:

NCR Closure (initial and date):

Prod Completion:	QC Verification:	QA Closure:

07-07-00 (R)

5327V

Attachment 5

NO PCS	
1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 66.250 OD X 10.000 LG PT# MPC-68 F ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO Q.A. MANUAL ~~REV 0/1 DATED 3/23/95~~ 01-11-00; Rev dated 5-11-00

BFT: 1.97

WK CD:FIHMPTZG(TZG)MNT

MACH BY GULFCO DUE DATE

MATERIAL REQUIRED 28B

PCS.	WEIGHT	STEEL
1	12964	GC304L

STEEL INSTRUCTIONS
(2.0) HT# 2F815
BI# 011107
F/O'S 5326V & 5327V
MUST BE CUT FROM
SAME BILLET
U.S. MATL. ONLY

FORGING INSTRUCTIONS

69-1/4 OD

11-1/4 LG

H/T SOLUTION ANNEAL

BY:GULFCO

TEST. REMOVE PROLONGATION
UT/WI 1003-01 ADD.1
REV 0 - LP/METCO-N-
PT-004 REV 4 W/ADD.3
REV 0 DATED 12/01/97
TT. CORROSION TEST
ASTM A262 PRACTICE E
USE CK. ANAL. FROM
F/O 5326V

HEAT NO

CUT		
FRG		
HT1		
HT2		
MCH1		
MCH2		
MCH3		
TEST		
SHIP		

SHIPPING - MARKING

TO:
BY:
DEST:TURTLE CREEK, PA.
MCH: 12003 /SHP: 9766
SA.REMOVE PROL..R/M.
UT,LP THEN UST & D
KEYSTONE COMMONS
200 BRADDOCK AVE.
TURTLE CK, PA.15145
DO NOT SHIP W/O CUST
APPRL.OF DOC.-SHIP
ON PALLETS & SHRINK
WRAP/COVERED TRAILER
MK: TAG: INK OR PAINT:
HT#. ASME SA336F304A
DIMENSIONS &
PO# 1021 NA

RMK:
10CFR50 APP.B
10CFR21 APPLIES
NO WELD REPAIR
STATEMENT ON MTR.

JOB# .

10 CFR 50 App B
10 CFR 21 APPLIES

NUCLEAR

05-24-00

07/15

/O: 5327V
UST: HOLTEC INTERNAT
O: 1021 NA
O: 11171- 2
ESC: D06620100
UE: 07/15/*0

QFT: 1.97
BFT: 1.97

HT WEIGHT: 12003
MCH CST: 33.33

FORG PR	19013.00	MCH PR	2000.00
FRT. PR	586.00	H/T PR	601.00
TEST PR	200.00	OTH PR	50.00
OTH PR	50.00	OTH PR	.00

TOTAL SALE PRICE 22,500.00

GULF COAST MACHINE & SUPPLY CO.

ILF COAST MACHINE & SUPPLY CO.

GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD - P.O. BOX 26002
BEAUMONT, TEXAS 77720-6002 - (409) 842-1311

#2

MATERIAL TEST REPORT

RENCE NUMBER	DATE	CUSTOMER P/O NUMBER		SOLD TO
81272	08/18/00	1021 NA		HOLTEC INTERNATIONAL

QUAN. ORD.	QUAN. SHIP	FO #	DESCRIPTION	HEAT NUMBER / BHN / TO	HEAT TREAT CYCLE
1	1	53271	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21 U.S. MATL. ONLY. 66.250 OD X 10.000 LG PT# MPC-68 F ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO QA MAN/01-11-00;REV.DATED 5-11-00	2F815	AUST. AT 1900 DEG. F 06.0 HOURS WATER QUENCH
			MELT PRACTICE: EF AOD NO WELD REPAIR PERFORMED ON THIS ORDER BILLET # 011107		
			CORROSION TEST PER ASTM A262 PRACTICE E: SATISFACTORY SENSITIZED AT 1250 DEG. F. FOR 1.0 HR 10 CFR 21 APPLIES 10 CFR 50 APPENDIX B APPLIES		
			UT PER ASME SA 388 PROCEDURE: WI 1003-01 ADD. 1, REV-0 LP PER SE 165 PROCEDURE: NPT-004 REV-4 W/ADD. 3 REV-0		
			THIS CERTIFIES COMPLIANCE TO 10 CFR 21, 10 CFR 50 APPENDIX B, ASME SECT. II, 1995 ED. W/96 & 97 ADD. ASME SECT. III, SUB. NB 1995 ED W/96 & 97 ADD. GULFCO QUALITY MANUAL DATED 1/11/2000 REV-DATED 05/11/00 AS APPROVED BY HOLTEC,		
			PS-107 REV-2, HOLTEC P.O. 1021 NA AND THE MATERIAL SPEC		

CHEMICAL ANALYSIS

HEAT NUMBER	STEEL MILL	C	MN	PHOS	SUL	SI	NI	CR	MOLY	CU	V	CB	TYPE ANALYSIS
2F815	JORGENSEN	.018 .02	1.54 1.52	.021 .027	.004 .004	.55 .58	9.66 9.55	18.4 18.4	.09	.04	<.01	.079	SM CK

TYPE ANALYSIS / STEEL MILL/SM. CHECK/CK

MECHANICAL PROPERTIES

.505 DIA. TEST SPECIMEN

TYPE — BILLET HEAT ACCEPT-B, PRODUCTION PROLONGATION-P, REPRESENTATIVE TEST BLOCK R

TENSILE LB PER SQ. IN.	.2% YIELD LBS/SQ. IN.	ELONGATION IN 2 INS.	REDUCTION IN AREA %	TYPE TEST	CHARPY IMPACT TEST: TYPE SAMPLE	°F	IMPACT TEST VALUES FT./LBS.	AVG.	TYP
78,000	37,000	62	69	P					

HOLTEC PK Q.A. APPROVED

UST & D REVIEW/APPROVAL
SCW 8/24/00
QUALITY ASSURANCE

M 1/1 2

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE _____

Elva Cille 8/18/00
Q.A. REPRESENTATIVE

Gulfco
GULF COAST MACHINE & SUPPLY COMPANY • GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD • P.O. BOX 25002 BEAUMONT, TEXAS 77720 (409) 842-1311

REPORT OF ULTRASONIC INSPECTION

Date of Test: 08/18/00 Page 1 of 1 Report Number: UT - G72

CUSTOMER & P.O. NUMBER	HOLTEC INTERNAT 1021 NA	GULFCO M/O NO.:	11171-002
SPECIFICATION NUMBER:	ASME SA-388	WITNESSED BY:	
PROCEDURE NUMBER:	WI 1003-01ADD.1REV.0	SCOPE OF INSPECTION:	100%
TYPE & MODEL NUMBER OF INSTRUMENT:	USN 50 S.N. 604473	TYPE OF COUPLANT:	ULTRAGEL II
LONGITUDINAL FREQUENCY:	1 mHz	SIZE OF TRANSDUCER: 1"	TYPE OF TRANSDUCER: GAMMA S/N 001PKR
SHEAR FREQUENCY:		SIZE OF TRANSDUCER:	TYPE OF TRANSDUCER:
REFERENCE LEVEL:	LONG. 45DB	SCAN LEVEL:	LONG. 51DB
SHEAR WAVE WEDGE MEDIUM & SIZE:		ESTIMATED RMS SURFACE:	250

ITEM NO.	GULFCO F.O. #	NUMBER OF PCS.	DESCRIPTION	REPORT OF INSPECTION
02	5327V	1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 66.250 OD X 10.000 LG PT# MPC-68 F. ROUGH MACHINE TO FINISH SOLUTION ANNHEAL GULFCO QA MAN/01-11-00;REV.DATED 5-11-00	ALL PIECES SHOWN ON THIS REPORT WERE INSPECTED AND FOUND TO BE ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

HOLTEC PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

Scal 8/24/00
QUALITY ASSURANCE

PERSONNEL PERFORMING UT EXAMINATIONS ARE QUALIFIED TO SNT-TC-1A.

Jerrica Gaubas 8-18-00
QUALITY CONTROL

Scal 8/21/00 R. Gumma-Hall II
TECHNICIAN LEVEL

COPY RAYMOND STEELEY m 11/2 II

Gulfco

GULF COAST MACHINE & SUPPLY COMPANY | GENERAL OFFICES & PLANT – @ I-10 East & SMITH ROAD |
P. O. BOX 26002 | BEAU MONT, TEXAS 77720-6002 | WORK PH# (409)842-1311 | FAX PH# (409)842-4621

LIQUID PENETRANT EXAMINATION REPORT

CUSTOMER: HOLTEC INTERNATIONAL P.O. #: 1021 NA DATE : 081800

SPECIFICATION: SE-165 GULFCO M/O #: 11171-002

PROCEDURE: N-PT-004 REV. 4 ADD.3 REV.0 SCOPE of EXAM: 100% SURFACE

SIZE: 66.250"OD X 10"LG F/O #: 5327V HEAT #: 2F815 QUANTITY: 1

TEST PARAMETERS

LIQUID PENETRANT USED
A-FLUORESCENT: ____ B-VISIBLE: YES

VENDOR: BRENT

	PENETRANT	REMOVER / EMULSIFIER	DEVELOPER
TYPE:	P6R	WATER	NQ-1
BATCH:	8273D		9264A
TIME:	15MIN.		15MIN.

LIGHT SOURCE
MANUFACTURER: _____ DATE CALIBRATED: _____

INTENSITY @ 15": _____ micron W/cm^2 MODEL: _____

TEST RESULTS

DISPOSTION OF PARTS: ALL FORGINGS SHOWN ON REPORT WERE INSPECTED AND FOUND TO BE: ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

HOLTEC PK QA APPROVED

NOTE: _____

LIQUID PENETRANT EXAMINATION PERFORMED BY METCO

JODY HANCOCK LEVEL II

UST & D
REVIEW/APPROVAL

8/24/00
QUALITY ASSURANCE

mill 2

GULFCO

Test Date	06/23/2000
Forge Order #	5327V
Lab #	D58
Diameter	0.505
Mat'l	GC304L
Wall:	10
Type	P
Heat Number	2F815
Customer	HOLTEC
Spec.	SA 336 F304

		Tensile Loc/Ornt	SURFACE/LG
Tensile Strength	78,000	*% Elongation*	62
Yield Strength	37,000	*Reduction of Area*	69
		CVN Loc/Ortn	
CVN Temp		*CVN'S*	
		%SH	
Bhn		*L.E.*	

Ht Treat	SA-PQ@1900/6 HR
Ht Treat 1	
Ht Treat 2	
Ht Treat 3	
Notes	
Notes1	
Notes2	
Notes3	

POSTED JUN 2 3 2000

Status: ***PASSED***

6.27.00

Bodycote MATERIALS TESTING
METAL TECHNOLOGY

Bodycote Omnitest Inc., Omni Laboratory, 4302 Dayco Street, Houston, Texas, 77092
Tel: 7139398690, Fax: 7139390249

ACCREDITED CERTIFICATE 1283 01

Test Certificate

GULF COAST MACHINE & SUPPLY CO
P.O. BOX 26002
BEAUMONT, TX

77720-6002

Attn: PATRICK REID

REF No 0004796 : Issue 1
Ord No PO: QA062300a

Date Tested 06/24/00
Date Reported 07/10/00

Item - SA336-F304L TEST SAMPLE
HT# 2F815 BILLET# 011107 F/O# 5327V

Specification - A262-E

Chemical Analysis - OES,Combustion

	C [%]	Mn [%]	P [%]	S [%]	Si [%]	Ni [%]	Cr [%]	Mo [%]	Cu [%]	Al [%]	V [%]	Comments
01:	.02	1.52	.027	.004	.58	9.55	18.44	.09	.14	<.01	.04	Nil
	Nb [%]	Ti [%]	N2 [%]									Comments
01:	<.01	<.01	.079									Nil

Corrosion Test - ASTM A 262-Pr E

	Position	Details	Comments
02:ICC Copper Sulphate	N/A	N/A	See Below

Item 02: TEST PERIOD: 24 HRS IN BOILING SOLUTION.
SAMPLE BENT THROUGH 180 DEG OVER A DIAMETER OF 1/4".
THE BENT SAMPLE WAS EXAMINED UNDER LOW MAGNIFICATION AND SHOWED NO SIGNS OF INTERGRANULAR ATTACK.
EVALUATION : THIS MATERIAL IS ACCEPTABLE IN ACORDANCE WITH ASTM A262 PRACTICE E.
SAMPLE WAS SENSITIZED AT 1250 DEG F FOR 1 HOUR PRIOR TO TESTING

Certificate Comments

10 CFR-21 APPLIES

Bodycote MATERIALS TESTING
METAL TECHNOLOGY
Bodycote Omnitest Inc.

ACCREDITED
CERTIFICATE
1283.01

Test Certificate

GULF COAST MACHINE & SUPPLY CO REF No 0004796 : Issue 1

SA336-F304L TEST SAMPLE
HT# 2F815 BILLET# 011107 F/O# 5327V

Approved By J. Blevins

J. Blevins
For and on authority of
Bodycote Omnitest Inc.

M/O 11171- 2 CUST. HOLTEC INTERNAT P/O 1021 NA *MS*

NR PCS*

NO. 5327V

1 * ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 66.250 OD X 10.000 LG PT# MPC-68 F ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO Q.A. MANUAL REV 0/1 DATED 3/23/95

060100*

SOZ 28 IN ITEMS 2/17

DL

HT NO. 2F815
WC: FIHMPTZG(TZG)MNT

MATERIAL REQUIRED		
PCS	WGT	STEEL
1	12964	GC304L

FORGING INSTRUCTIONS

69-1/4 OD

11-1/4 LG

TEST:
REMOVE PROLONGATION
UT/WI 1003-01 ADD.1
REV 0 - LP/METCO-N-PT-004 REV 4 W/ADD.3
REV 0 DATED 12/01/97
TT, CORROSION TEST
ASTM A262 PRACTICE E
USE CK. ANAL. FROM
F/O 5326V

TO:
BY:
FOB:TURTLE CREEK, PA.
MCH: 12003# / HT: 12003#

SA,REMOVE PROL.,R/M,
UT,LP THEN UST & D
KEYSTONE COMMONS
200 BRADDOCK AVE.
TURTLE CK, PA.15145
DO NOT SHIP W/O CUST
APPRL.OF DOC.-SHIP
ON PALLETS & SHRINK

NR

NR 7/25 00
NR 6-16-00

USE BHN FROM FO

H/T REQ: SOLUTION ANNEAL

								BHN	PCS
STP FURNACE								MIN	MAX
STP	TYPE	TEMP	HOLD	COOL	ACT TEMP	HOLD	LOG NO	BHN	DATE	WGT
1	SLA	1900°	5.75	W	1900	6	~~59791~~		6-14-00	12,003 #1
2	SLA	1900°	6	W	1900	6	59739 / 60009		7-21-00	12,003 #2

1/82/97 *2/74/88*

0619*0 Q

FM 0905-02 *6/16/00* *7/25/00*

REV. DATE 02-07-2000

FURNACE LOAD HEAT TREATING LOG

HT—GC—1A

DATE: 7-21-00

FURNACE LOAD NO: 60009 FURNACE NO: 2

START H.T.	DATE	7-24-00	TIME FURNACE ON	6:25 (a.m.) p.m.	SHIFT (1) 2 3
FINISH H.T.	DATE	7-24-00	TIME FURNACE OFF	5:30 a.m. (p.m.)	SHIFT 1 (2) 3

LEADERMAN IN: ES	TEMPERATURE TO BE SET: 1900°	TIME AT TEMPERATURE: 6.0 hrs
LEADERMAN OUT: WB	TEMPERATURE ACTUAL SET: 1900°	ACTUAL FURNACE TIME: 11.0 hrs

NORMALIZE		STRESS RELIEVE		TEMPER		OTHER	
ANNEAL		WATER QUENCH		POLYMER QUENCH		S/A	X

Forge Order	RH	Pcs.	Wgt Ea	Load By	Unload By
53271	NR	1	12,003	WB	WB

Forge Order	RH	Pcs	Wgt Ea.	Load By	Unload By

HEAT TREAT INSTRUCTIONS: Bring temp up to 1900° held 6.0 hours
Water Cool

LOG 24742 2/74/88

(1) LOAD OK WB WGT 12,003 #

REV. DATE 12-20-99

FM-0905-04

S/O 11171- 8/17 CUST HOLTEC INTERNAT P/O 1021 NA

07-07-00

5333V DL

NO PCS	
1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO Q.A. MANUAL ~~REV 0/1 DATED 3/23/95~~ 01-11-00; Rev Dated 5-11-01

BFT: 2.01

WK CD:FIHMPTZG(TZG)MNT

MACH BY. GULFCO DUE DATE.

MATERIAL REQUIRED 28B

PCS	WEIGHT	STEEL
1	13246	GC304L

STEEL INSTRUCTIONS
(2.0) HT# 31442
BI# 023508
F/O'S 5332V, 5333V & 5334V MUST BE CUT FROM SAME BILLET.
U.S. MATL. ONLY

FORGING INSTRUCTIONS

70 OD

11-1/4 LG

H/T SOLUTION ANNEAL

BY:GULFCO

TEST REMOVE PROLONGATION
UT/WI 1003-01 ADD.1
REV 0 - LP/METCO-N-PT-004 REV 4 W/ADD.3
REV 0 DATED 12/01/97
TT, CORROSION TEST
ASTM A262 PRACTICE E
USE CK. ANALYSIS
FROM F/O 5332V

HEAT NO

CUT		
FRG		
HT1		
HT2		
MCH1		
MCH2		
MCH3		
TEST		
SHIP		

SHIPPING - MARKING

TO:
BY:
DEST:TURTLE CREEK, PA.
MCH: 12265 /SHP: 10063
SA,REMOVE PROL.,R/M,
UT,LP THEN UST & D
KEYSTONE COMMONS
200 BRADDOCK AVE.
TURTLE CK, PA.15145
DO NOT SHIP W/O CUST
APPRL.OF DOC.-SHIP
ON PALLETS & SHRINK
WRAP/COVERED TRAILER
MK: TAG: INK OR PAINT:
HT#, ASME SA336F304A
DIMENSIONS &
PO# 1021 NA

RMK:
10CFR50 APP.B
10CFR21 APPLIES
NO WELD REPAIR
STATEMENT ON MTR.

JOB# .

10 CFR 50 APP B
10 CFR 21 APPLIES
NUCLEAR
05-24-00

07/15

): 5333V
T: HOLTEC INTERNAT
1021 NA
11171- 8
C: D06720100
: 07/15/*0

QFT: 2.01
BFT: 2.01
HT WEIGHT: 12265
MCH CST: 33.33

FORG PR	18982.00	MCH PR	2000.00
FRT. PR	604.00	H/T PR	614.00
TEST PR	200.00	OTH PR	50.00
OTH PR	50.00	OTH PR	.00

TOTAL SALE PRICE 22,500.00

COAST MACHINE & SUPPLY CO.

GULF COAST MACHINE & SUPPLY CO.

GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD - P.O. BOX 26002
BEAUMONT, TEXAS 77720-6002 - (409) 842-1311

#1

MATERIAL TEST REPORT

RENCE NUMBER	DATE	CUSTOMER P/O NUMBER		SOLD TO
81273	08/18/00	1021 NA		HOLTEC INTERNATIONAL

	QUAN. ORD. / QUAN. SHIP / FO #	DESCRIPTION	HEAT NUMBER / BHN / TO	HEAT TREAT CYCLE
B	1 / 1 / 5333V	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO QA MAN/01-11-00;REV.DATED 5-11-00	31442	AUST. AT 1900 DEG. F 06.0 HOURS POLYMER QUENCH
		MELT PRACTICE: EAF AOD NO WELD REPAIR PERFORMED ON THIS ORDER BILLET # 023508		
		CORROSION TEST PER ASTM A262 PRACTICE E: SATISFACTORY SENSITIZED AT 1250 DEG. F. FOR 1.0 HR 10 CFR 21 APPLIES 10 CFR 50 APPENDIX B APPLIES		
		UT PER ASME SA 388 PROCEDURE: WI 1003-01 ADD. 1, REV-0 LT PER SE 165 PROCEDURE: NPT - 004 REV-4 W/ADD 3, REV-0		
		THIS CERTIFIES COMPLIANCE TO 10 CFR 21, 10 CFR 50 APPENDIX B, ASME SECT. II, 1995 ED. W/96 & 97 ADD. ASME SECT. III, SUB. NB 1995 ED W/96 & 97 ADD. GULFCO QUALITY MANUAL DATED 1/11/2000 REV-DATED 05/11/00 AS APPROVED BY HOLTEC,		
		PS-107 REV-2, HOLTEC P.O. 1021 NA AND THE MATERIAL SPEC		

CHEMICAL ANALYSIS

HEAT NUMBER	STEEL MILL	C	MN	PHOS	SUL	SI	NI	CR	MOLY	CU	V	CB	TYPE ANALYS
31442	ELECTRALL	.016 .022	1.76 1.83	.030 .032	.022 .024	.48 .52	8.28 8.47	18.5 18.4	.39 .43	.44 .47	.079	.014	SI CI

TYPE ANALYSIS / STEEL MILL/SM CHECK-CK

MECHANICAL PROPERTIES

.505 DIA. TEST SPECIMEN

TYPE — BILLET HEAT ACCEPT-B, PRODUCTION PROLONGATION-P, REPRESENTATIVE TEST BLOCK-R

TENSILE LB PER SQ. IN.	.2% YIELD LBS/SQ. IN.	ELONGATION IN 2 INS.	REDUCTION IN AREA %	TYPE TEST	CHARPY IMPACT TEST: TYPE SAMPLE	°F	IMPACT TEST VALUES FT./LBS.			AVG.	TYI
78,200	37,700	62	64	P							

HOLTEC PK Q.A. APPROVED

UST & D REVIEW/APPROVAL
SCW 8/24/00
QUALITY ASSURANCE

M1/09

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE

Elva Cole 8/18/00

GULF COAST MACHINE & SUPPLY COMPANY • GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD • P.O. BOX 26002 BEAUMONT, TEXAS 77720 (409) 842-1311

REPORT OF ULTRASONIC INSPECTION

ate of Test: 08/18/00 Page 1 of 1 Report Number: UT - G78

CUSTOMER & P.O. NUMBER	HOLTEC INTERNAT 1021 NA	GULFCO M/O NO.:	11171-008
SPECIFICATION NUMBER:	ASME SA-388	WITNESSED BY:	
PROCEDURE NUMBER:	WI 1003-01ADD.1REV.0	SCOPE OF INSPECTION:	100%
TYPE & MODEL NUMBER OF INSTRUMENT:	USN 50 S.N. 604473	TYPE OF COUPLANT:	ULTRAGEL II
LONGITUDINAL FREQUENCY:	1 mHz	SIZE OF TRANSDUCER:	1"
		TYPE OF TRANSDUCER:	GAMMA S/N 00JPKB
SHEAR FREQUENCY:		SIZE OF TRANSDUCER:	
		TYPE OF TRANSDUCER:	
REFERENCE LEVEL:	LONG. 45DB	SCAN LEVEL:	LONG. 51DB
SHEAR WAVE WEDGE MEDIUM & SIZE:		ESTIMATED RMS SURFACE:	250

ITEM NO.	GULFCO F.O.#	NUMBER OF PCS.	DESCRIPTION	REPORT OF INSPECTION
08	5333V	1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO QA MAN/01-11-00;REV.DATED 5-11-00	ALL PIECES SHOWN ON THIS REPORT WERE INSPECTED AND FOUND TO BE ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

HOLTEC PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

SCW 8/24/00

QUALITY ASSURANCE

PERSONNEL PERFORMING UT EXAMINATIONS ARE QUALIFIED TO SNT-TC-1A.

Virginia Grubbs 8-18-00

QUALITY CONTROL

SCW 8/24/00

Raymond Steeley 1-07

TECHNICIAN LEVEL

COPY RAYMOND STEELEY M1809 II

Gulfco

GULF COAST MACHINE & SUPPLY COMPANY | GENERAL OFFICES & PLANT – @ I-10 East & SMITH ROAD |
P. O. BOX 26002 | BEAUMONT, TEXAS 77720-6002 | WORK PH# (409)842-1311 | FAX PH# (409)842-1621

LIQUID PENETRANT EXAMINATION REPORT

CUSTOMER: HOLTEC INTERNATIONAL P.O. #: 1021 NA DATE: 081800

SPECIFICATION: SE-165 GULFCO M/O #: 11171-008

PROCEDURE: N-PT-004 REV. 4 ADD.3 REV.0 SCOPE of EXAM: 100% SURFACE

SIZE: 67.250"OD X 10"LG F/O #: 5333V HEAT #: 31442 QUANTITY: 1

TEST PARAMETERS

LIQUID PENETRANT USED
A-FLUORESCENT: ____ B-VISIBLE: YES
VENDOR: BRENT

	PENETRANT	REMOVER / EMULSIFIER	DEVELOPER
TYPE:	P6R	WATER	NQ-1
BATCH:	8273D		9264A
TIME:	15MIN.		15MIN.

LIGHT SOURCE
MANUFACTURER: _____ DATE CALIBRATED: _____
INTENSITY @ 15": _____ micron W/cm^2 MODEL: _____

TEST RESULTS

DISPOSTION OF PARTS: ALL FORGINGS SHOWN ON REPORT WERE INSPECTED AND FOUND TO BE: ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

NOTE: _____

HOLTEC PK QA APPROVED

UST & D
REVIEW/APPROVAL

SCW 8/24/00
QUALITY ASSURANCE

LIQUID PENETRANT EXAMINATION PERFORMED BY METCO

JODY HANCOCK LEVEL II

M1109

GULFCO

Test Date	07/05/2000
Forge Order #	5333V
Lab #	D64
Diameter	0.504
Mat'l	GC304L
Wall:	10
Type	P
Heat Number	31442
Customer	HOLTEC
Spec.	SA 336 F304

		Tensile Loc/Ornt	SURFACE/LG
Tensile Strength	78,200	*% Elongation*	62
Yield Strength	37,700	*Reduction of Area*	64
		CVN Loc/Ortn	
CVN Temp		*CVN'S*	
		%SH	
Bhn		*L.E.*	

Ht Treat	SA-PQ@1900/6 HR
Ht Treat 1	
Ht Treat 2	
Ht Treat 3	
Notes	
Notes1	
Notes2	
Notes3	

POSTED JUL 0 5 2000

Status: ***PASSED***

FM 1004-01

7.5.00

Accu Test Labs
ISO 9002
P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/13/00
REPORT NO: 131846.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071000b
MATERIAL : SA336 F304L SOL. ANNEALED & WQ TEST SAMPLE
HEAT/ID NO. : 31442 F/O#5333V- BILLET#023508

CORROSION PER A262 METHOD E

LENGTH: 2.993"

WIDTH: 0.667"

THICKNESS: 0.255"

WEIGHT BEFORE TEST: 64.1693

WEIGHT AFTER TEST: 64.1413

EVALUATION: THIS MATERIAL IS ACCEPTABLE IN ACCORDANCE WITH ASTM A262 PRACTICE E.

SENSITIZING HEAT TREATMENT AT 1,250°F FOR 1 HOUR

Respectfully submitted,

BY:

CORRECTED COPY

Accu Test Labs
ISO 9002
P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/13/00
REPORT NO: 131846.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071000b
MATERIAL : SA336 F304L SOL. ANNEALED & WQ TEST SAMPLE
HEAT/ID NO. : 31442 F/O#5333V BILLET#023508

10CFR21 APPLIES

Respectfully submitted,

BY:

COPIED COPY

Accu Test Labs

ISO 9002

P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/22/00
REPORT NO: 132102.1
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA072100d BILLET#023508
MATERIAL : SA336-F304 TEST PC
HEAT/ID NO. : 31442 F/O#5333V

Respectfully submitted,

BY:

CORRECTED

Accu Test Labs

ISO 9002

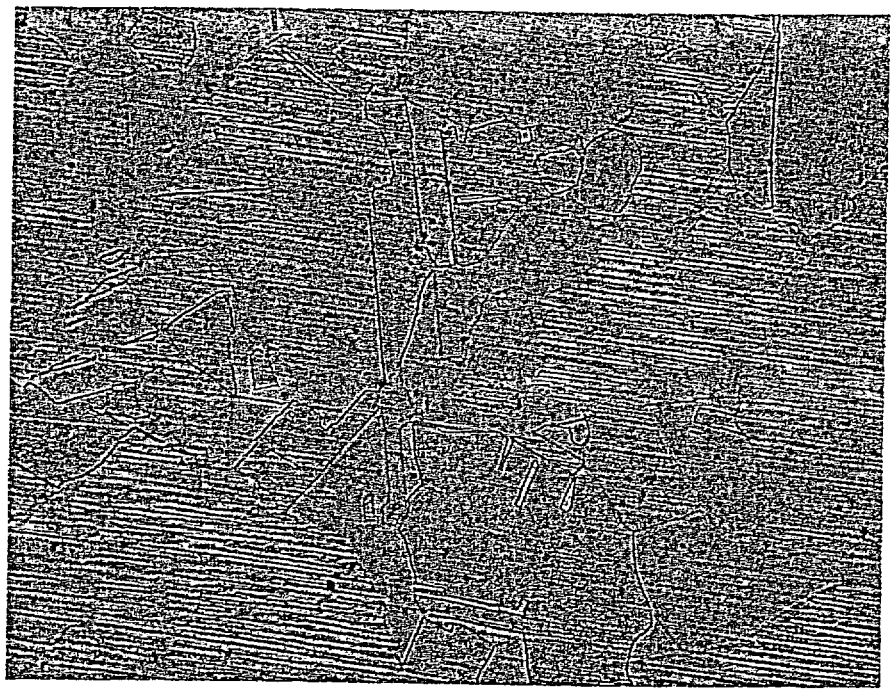
P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/22/00
REPORT NO: 132102.1
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA072100d BILLET#023508
MATERIAL : SA336-F304 TEST PC
HEAT/ID NO. : 31442 F/O#5333V

GRAIN SIZE DETERMINATION PER ASTM E112
GRAIN SIZE:2.0 PHOTO:100X ETCHANT:10% OXALIC ACID



Respectfully submitted,

BY:

CORRECTED COPY

Accu Test Labs
ISO 9002
P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/18/00
REPORT NO: 132102.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071400b BILLET#023508
MATERIAL : SA336-F304 TEST PC
HEAT/ID NO. : 31442 F/O#5333V

CHEMICAL ANALYSIS

1. C:0.022 MN:1.83 P:0.032 S:0.024 SI:0.52 CR:18.39 MO:0.43
NI:8.47 CU:0.47 CO:0.15 NB:0.014 V:0.079 AL:0.005 TI:0.009
N:.0866

Chemical results are reported in percent by weight.

10CFR21 APPLIES

Respectfully submitted,

BY:

M/O 11171- 8 CUST. HOLTEC INTERNAT P/O 1021 NA

NR PCS			
1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL	SOZ	NO. 5333V
060200	GULFCO O.A. MANUAL REV 0/1 DATED 3/23/95	28 IN ITEMS 8/17	HT NO. 31442 WC: FIHMPTZG(TZG)MI

MATERIAL REQUIRED		FORGING INSTRUCTIONS	TO:
PCS	WGT / STEEL		BY:
1	13246 / GC304L	70 OD	FOB:TURTLE CREEK, PA.
			MCH: 12265# / HT: 12265#
TEST: REMOVE PROLONGATION UT/WI 1003-01 ADD.1 REV 0 - LP/METCO-N-PT-004 REV 4 W/ADD.3 REV 0 DATED 12/01/97 TT, CORROSION TEST ASTM A262 PRACTICE E USE CK. ANALYSIS FROM F/O 5332V		11-1/4 LG	SA,REMOVE PROL.,R/M, UT,LP THEN UST & D KEYSTONE COMMONS 200 BRADDOCK AVE. TURTLE CK, PA.15145 DO NOT SHIP W/O CUST APPRL.OF DOC.-SHIP ON PALLETS & SHRINK

H/T REQ: SOLUTION ANNEAL — USE BHN FROM FO PIRO-20

STP FURNACE							BHN	PCS
STP	TYPE	TEMP	HOLD	COOL	ACT TEMP	HOLD	LOG NO	BHN MIN / MAX	DATE	WGT
1.	SL-A	1900°	5.15	WD	1900	6	59757		6-12-00	12,265#

0619*0 Q

1/81°/100°

c/20°

FURNACE LOAD HEAT TREATING LOG

HT—GC—1A

FURNACE LOAD NO: 59757 DATE: 6-17-00 FURNACE NO: #1

START H.T.	DATE	6-19-00	TIME FURNACE ON	6-15	(a.m) p.m.	SHIFT (1) 2 3
FINISH H.T.	DATE	6-19-00	TIME FURNACE OFF	7:00	a.m. (p.m.)	SHIFT 1 (2) 3

LEADERMAN IN	ES	TEMPERATURE TO BE SET	1900	TIME AT TEMPERATURE	6 HRS
LEADERMAN OUT	GR	TEMPERATURE ACTUAL SET	1900°	ACTUAL FURNACE TIME	12.7 HRS

NORMALIZE		STRESS RELIEVE		TEMPER		OTHER	
ANNEAL		WATER QUENCH		POLYMER QUENCH		SC-A	/

Forge Order	RH	Pcs.	Wgt Ea	Load By	Unload By
5333V		1	12265	GR	RA.

Forge Order	RH	Pcs.	Wgt Ea.	Load By	Unload By

HEAT TREAT INSTRUCTIONS: Raise temp to 1900° and hold 6 HRS
Polymer
810°/100°
LOG 19671
1 PC
LOAD OK GR

WGT 12,265

CUST HOLTEC INTERNAT P/O 1021 NA

07-07-00

5341V D1

#25

NO PCS.	
1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO Q.A. MANUAL ~~REV 0/1 DATED 3/23/95~~ 01-11-00; Rev dated 5-11-02

BFT: 2.01

WK CD:FIHMPTZG(TZG)MNTA

MACH BY: GULFCO DUE DATE

MATERIAL REQUIRED 28B

PCS.	WEIGHT	STEEL
1	13246	GC304L

STEEL INSTRUCTIONS.
(2.0) STEEL ON ORDER

~~F/O S 5341V & 5342V MUST BE CUT FROM SAME BILLET.~~
U.S. MATL. ONLY

FORGING INSTRUCTIONS

70 OD

11-1/4 LG

HT SOLUTION ANNEAL

BY:GULFCO

TEST. REMOVE PROLONGATION
UT/WI 1003-01 ADD.1
REV 0 - LP/METCO-N-
PT-004 REV 4 W/ADD.3
REV 0 DATED 12/01/97
TT. CORROSION TEST
ASTM A262 PRACTICE E
~~USE~~ CK. ANALYSIS ~~FROM F/O 5341V~~ from plate orig.
Mark w/HTH. Ht # + P/O
Ck Ana for 5342V

HEAT NO.

CUT		
FRG		
HT1		
HT2		
MCH1		
MCH2		
MCH3		
~~TEST~~		
~~HIP~~		

SHIPPING - MARKING

TO:
BY:
DEST:TURTLE CREEK, PA.
MCH: 12265 /SHP: 10063
SA,REMOVE PROL..R/M,
UT,LP THEN UST & D
KEYSTONE COMMONS
200 BRADDOCK AVE.
TURTLE CK, PA.15145
DO NOT SHIP W/O CUST
APPRL.OF DOC.-SHIP
ON PALLETS & SHRINK
WRAP/COVERED TRAILER
MK: TAG: INK OR PAINT:
HT#, ASME SA336F304A
DIMENSIONS &
PO# 1021 NA

RMK:
10CFR50 APP.B
10CFR21 APPLIES
NO WELD REPAIR
STATEMENT ON MTR.

JOB#

10 CFR 50 APP B
10 CFR 21 APPLIES

NUCLEAR

05-26-00

07/15

D: 5341V
ST: HOLTEC INTERNAT
1021 NA
11171- 16
C: D06720100
: 07/15/*0

QFT: 2.01
BFT: 2.01
HT WEIGHT: 12265
MCH CST: 33.33

FORG PR	18982.00	MCH PR	2000.00
FRT. PR	604.00	H/T PR	614.00
TEST PR	200.00	OTH PR	50.00
OTH PR	50.00	OTH PR	.00

TOTAL SALE PRICE 22,500.00

COAST MACHINE & SUPPLY CO.
1-02

GULF COAST MACHINE & SUPPLY CO. BEAUMONT, TEXAS (713) 842-[illegible]

MATERIAL TEST REPORT

REFERENCE NUMBER	SALE DATE	CUSTOMER P.O. NUMBER		SOLD TO
81271	08/18/00	1021 NA		HOLTEC INTERNATIONAL

QUAN ORD	QUAN SHIP	F.O. NO.	DESCRIPTION	HEAT NUMBER	HEAT TREAT CYCLE
6	1	5341V	ASME SA-336 F304 PS 107 REV 2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP B 10CFR 21, U.S. MATL ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO QA MAN/01-11-00 REV DATED 5-11-00	1P119	AUST AT 1900 DEG F 06.0 HOURS WATER QUENCH
			MELT PRACTICE EF AOD NO WELD REPAIR PERFORMED ON THIS ORDER BILLET # 039801		
			CORROSION TEST PER ASTM A262 PRACTICE E: SATISFACTORY SENSITIZED AT 1250 DEG F FOR 1.0 HR 10 CFR 21 APPLIES 10 CFR 50 APPENDIX 50 APPLIES		
			UT PER ASME SA 388 PROCEDURE: WI 1003-01 ADD 1 REV-0 LP PER SE 165 PROCEDURE: NPT-004 REV-4 W/ADD-3 REV-0		
			THIS CERTIFIES COMPLIANCE TO 10 CFR 21, 10 CFR 50 APPENDIX B, ASME SECT. II, 1995 ED. W/96 & 97 ADD. ASME SECT. III, SUB. NB 1995 ED W/96 & 97 ADD. GULFCO QUALITY MANUAL DATED 01/11/2000 REV. DATED 05/11/00 AS APPROVED BY HOLTEC		
			PS-107 REV-2, HOLTEC P.O. 1021 NA AND THE MATERIAL SPEC		

CHEMICAL ANALYSIS

HEAT NUMBER	STEEL MILL	C	MN	PHOS	SULF	SI	N	CR	MO/Y	CU	NI	CB	V/N/A
1P119	JORGENSEN	.025 .028	1.52 1.51	.021 .024	.002 .009	.47 .51	9.86 9.82	18.8 18.6	.55	.29	.68	.024	

MECHANICAL PROPERTIES

SPECIMEN	TENSILE LB PER SQ IN	0.2% YIELD PT LBS/SQ IN	ELONGATION % IN 2 INS	REDUCTION IN AREA %	TYPE TEST	CHARPY IMPACT TEST TYPE SAMP	CHARPY IMPACT TEST VALUES FT-LBS	LAT EXP MILS	% SHEAR AVG
	76,500	36,800	62	72	P				

HOLTEC 12-28-99 PK Q.A. APPROVED

UST & D REVIEW/APPROVAL
SCW 8/24/00
QUALITY ASSURANCE

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS COMPANY.

STEEL MADE IN U.S.A.

Allan Cole 8/18/00
Q.A. REPRESENTATIVE

Gulfco
GULF COAST MACHINE & SUPPLY COMPANY • GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD • P.O. BOX 26002 BEAUMONT, TEXAS 77720 (409) 842-1311

REPORT OF ULTRASONIC INSPECTION

Date of Test: 08/18/00 Page 1 of 1 Report Number: UT - H64

CUSTOMER & P.O. NUMBER	HOLTEC INTERNAT 1021 NA	GULFCO M/O NO.:	11171-016
SPECIFICATION NUMBER:	ASME SA-388	WITNESSED BY:	
PROCEDURE NUMBER:	WI 1003-01ADD. 1REV. 0	SCOPE OF INSPECTION:	100%
TYPE & MODEL NUMBER OF INSTRUMENT:	USN 50 S.N. 604473	TYPE OF COUPLANT:	ULTRAGEL II
LONGITUDINAL FREQUENCY:	1 mHz	SIZE OF TRANSDUCER:	1"
TYPE OF TRANSDUCER:	GAMMA S/N 00JPKR		
SHEAR FREQUENCY:		SIZE OF TRANSDUCER:	
TYPE OF TRANSDUCER:			
REFERENCE LEVEL:	LONG. 45DB	SCAN LEVEL:	LONG. 51DB
SHEAR WAVE WEDGE MEDIUM & SIZE:		ESTIMATED RMS SURFACE	250

ITEM NO.	GULFCO F.O.#	NUMBER OF PCS.	DESCRIPTION	REPORT OF INSPECTION
16	5341V	1	ASME SA-336 F304 P5 107 REV. 2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP. B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO QA MAN/01-11-00;REV. DATED 5-11-00	ALL PIECES SHOWN ON THIS REPORT WERE INSPECTED AND FOUND TO BE ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

HOLTEC 12-28-01 PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

Scw 8/24/00

QUALITY ASSURANCE

PERSONNEL PERFORMING UT EXAMINATIONS ARE QUALIFIED TO SNT-TC-1A.

Scw 8/24/00

Virginia Gleason 8-18-00

QUALITY CONTROL

Raymond Steeley Jr. 8/18/00

TECHNICIAN LEVEL

COPY RAYMOND STEELEY M1108 II

Gulfco

GULF COAST MACHINE & SUPPLY COMPANY | GENERAL OFFICES & PLANT – @ I-10 East & SMITH ROAD |
P. O. BOX 26002 | BEAUMONT, TEXAS 77720-6002 | WORK PH# (409)842-1311 | FAX PH# (409)842-4621

LIQUID PENETRANT EXAMINATION REPORT

CUSTOMER: HOLTEC INTERNATIONAL P.O. #: 1021 NA DATE: 081800

SPECIFICATION: SE-165 GULFCO M/O #: 11171-016

PROCEDURE: N-PT-004 REV. 4 ADD.3 REV.0 SCOPE of EXAM: 100% SURFACE

SIZE: 66.250"OD X 10"LG F/O #: 5341V HEAT #: 1P119 QUANTITY: 1

TEST PARAMETERS

LIQUID PENETRANT USED
A-FLUORESCENT: ____ B-VISIBLE: YES

VENDOR: BRENT

	PENETRANT	REMOVER / EMULSIFIER	DEVELOPER
TYPE:	P6R	WATER	NQ-1
BATCH:	8273D		9264A
TIME:	15MIN.		15MIN.

LIGHT SOURCE
MANUFACTURER: _____ DATE CALIBRATED: _____

INTENSITY @ 15": _____ micron W/cm^2 MODEL: _____

TEST RESULTS

DISPOSTION OF PARTS: ALL FORGINGS SHOWN ON REPORT WERE INSPECTED AND FOUND TO BE: ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

NOTE: _____

HOLTEC 12-26-01 PK Q.A. APPROVED

LIQUID PENETRANT EXAMINATION PERFORMED BY METCO

Jody Hancock
JODY HANCOCK LEVEL II

UST & D
REVIEW/APPROVAL

SW 8/24/00
QUALITY ASSURANCE

M1108

GULFCO

Test Date	07/13/2000
Forge Order #	5341V
Lab #	E33
Diameter	0.505
Mat'l	SS304L
Wall:	.10
Type	P
Heat Number	1P119
Customer	HOLTEC
Spec.	SA 336 F304

		Tensile Loc/Ornt	SURFACE/LG
Tensile Strength	76,500	*% Elongation*	62
Yield Strength	36,800	*Reduction of Area*	72
		CVN Loc/Ortn	
CVN Temp		*CVN'S*	
		%SH	
Bhn		*L.E.*	

Ht Treat	SA-WQ@1900/6 HR
Ht Treat 1	
Ht Treat 2	
Ht Treat 3	
Notes	
Notes1	
Notes2	
Notes3	

POSTED JUL 13 2000

Status: ***PASSED***

7-13-00

Accu Test Labs

ISO 9002

P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/14/00
REPORT NO: 131988.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071200b
MATERIAL : SA336-F304L SOL. ANNEALED & WQ TEST SAMPLE
HEAT/ID NO. : 1P119 BILLET#039801 F/O#5341V

CHEMICAL ANALYSIS

1. C:0.028 MN:1.51 P:0.024 S:0.009 SI:0.51 CR:18.63 MO:0.55
NI:9.82 CU:0.29 CO:0.027 NB:0.024 V:0.68 AL:<.005 TI:<.002
N:.0875

Chemical results are reported in percent by weight.

10CFR21 APPLIES

Respectfully submitted,

BY:

Accu Test Labs

ISO 9002

P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/18/00
REPORT NO: 131987.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071200b
MATERIAL : SA336-F304L SOL. ANNEALED & WQ TEST SAMPLE
HEAT/ID NO. : 1P119 BILLET#039801 F/O#5341V

10CFR21 APPLIES

Respectfully submitted,

BY:

Accu Test Labs
ISO 9002
P.O. Box 802404 ◆ Houston, TX 77280-2404 ◆ Telephone (713) 460-3655 ◆ FAX (713) 460-3695

DATE : 07/18/00
REPORT NO: 131987.0
CUST ACCT: 3194

GULF COAST MACHINE AND SUPPLY CO.
P. O. BOX 26002
BEAUMONT, TX 77720-6002

P.O. NO. : QA071200b
MATERIAL : SA336-F304L SOL. ANNEALED & WQ TEST SAMPLE
HEAT/ID NO. : 1P119 BILLET#039801 F/O#5341V

CORROSION PER A262 METHOD E

LENGTH: 3.008"

WIDTH: 0.850"

THICKNESS: 0.254"

WEIGHT BEFORE TEST: 81.7986

WEIGHT AFTER TEST: 81.7924

EVALUATION: THIS MATERIAL IS ACCEPTABLE IN ACCORDANCE WITH ASTM A262 PRACTICE E.

SENSITIZING HEAT TREATMENT AT 1,250°F FOR 1 HOUR

Respectfully submitted,

BY: Alan Hughes

M/O. 11171- 16 CUST. HOLTEC INTERNAT P/O 1021 NA

NR PCS				
1	ASME SA-336 F304 PS 107 REV.2 ASME SECT. III SUB NB 1995 W/96 & 97 ADD. 10CFR50 APP.B 10CFR 21, U.S. MATL. ONLY 67.250 OD X 10.000 LG PT# MPC-68 ROUGH MACHINE TO FINISH SOLUTION ANNNEAL GULFCO Q.A. MANUAL REV 0/1 DATED 3/23/95	SOZ	NO. 5341V	D
062000		28 IN ITEMS 16/17	HT NO. 1P119 WC: FIHMPTZG(TZG)MN	

MATERIAL REQUIRED		FORGING INSTRUCTIONS	TO: BY: FOB:TURTLE CREEK, PA. MCH: 12265# / HT: 12265#
PCS	WGT / STEEL		
1	13246 / GC304L	70 OD	SA,REMOVE PROL.,R/M, UT,LP THEN UST & D KEYSTONE COMMONS 200 BRADDOCK AVE. TURTLE CK, PA.15145 DO NOT SHIP W/O CUST APPRL.OF DOC.-SHIP ON PALLETS & SHRINK
TEST: REMOVE PROL.UT/ WI1003-01 ADD.1 REV0 LP/METCO-N-PT-004 REV 4 W/ADD.3 REV 0 DATED 12/01/97 TT, CORROSION TEST ASTM A262 PRAC E-CK ANAL.FROM PROL.MK W/ HT#,PT#& FO# CK ANAL FOR 5342V		11-1/4 LG	PR 7-5-00

H/T REQ: SOLUTION ANNEAL — USE BHN FROM FO _____

STP FURNACE								BHN MIN	BHN MAX	PCS
STP	TYPE	TEMP	HOLD	COOL	ACT TEMP	HOLD	LOG NO	BHN	DATE	WGT
1	SLA	1900°	5.75	W	1900	6	59845		6-30-00	12265#2

484/108

0707*0 Q.

FM 0905-02 7/5

REV. DATE 02-07-2000

FURNACE LOAD HEAT TREATING LOG

HT—GC—1A

DATE: 6·30·00

FURNACE LOAD NO: 59845 FURNACE NO: 2

START H.T.	DATE	6·30·00	TIME FURNACE ON	10:05	(a.m) p.m.	SHIFT (1) 2 3
FINISH H.T.	DATE	6-30-00	TIME FURNACE OFF	5:30	a.m (p.m)	SHIFT 1 (2) 3

LEADERMAN IN: RAY	TEMPERATURE TO BE SET: 1900°F	TIME AT TEMPERATURE: 6 hrs
LEADERMAN OUT: Am	TEMPERATURE ACTUAL SET: 1900	ACTUAL FURNACE TIME: 7:4hrs

NORMALIZE		STRESS RELIEVE		TEMPER		OTHER	
ANNEAL		WATER QUENCH		POLYMER QUENCH		5L-A	X

Forge Order	RH	Pcs	Wgt Ea.	Load By	Unload By
5341V		1	12,265	RB	Am

Forge Order	RH	Pcs.	Wgt Ea.	Load By	Unload By

HEAT TREAT INSTRUCTIONS: Temp went to 1900 held 6 hrs ~~Quenched~~. water cooled.

LOG 30642

1 PCS

LOAD OK Ray ✓ 84/108 WGT 12,265

REV DATE 12-20-99

P/O 5043LH

1322V

#40

PCS	
1	ASME SA336 F304 PER PS-107 REV.2 ASME SECT.III SUBX. NB1995 ED.96 & 97 ADD. 10CFR50 APP B 10CFR21 US MATL. ONLY 67.250 OD X 10.000 LG SOLUTION ANNEAL GULFCO QUALITY MANUAL REV.0/1 DATED 3/23/95, R/M TO FINISH PT# MPC-68

BFT: ~~2.770~~ 1.99 (TZ)

WK CD:FIHMPTZGMNT(X)A

MACH BY: GULFCO DUE DATE.

MATERIAL REQUIRED 28B

PCS	WEIGHT	STEEL
1	~~15027~~ 13152	GC304L

STEEL INSTRUCTIONS

(2.0) US MATL.ONLY
STEEL ON ORDER
Check analyses already done on F/O 1321V

FORGING INSTRUCTIONS

69-3/4
~~71~~ OD

11-1/4 LG

H/T. SOLUTION ANNEAL

BY:GULFCO

TEST. REMOVE PROLONGATION
UT/GCM-UT-388-01
REV ~~85-WITNESS-BY CUSTOMER~~.
LP/METCO-N-PT-004
REV 4 W/ADD.3 REV. 10
DATED ~~9-29-99~~ 12-1-97
~~WITNESS-BY CUSTOMER.~~
TT, CORROSION TEST
ASTM A262 PRACTICE E
Use results from F/O 1321V for check analyses

HEAT NO

CUT		
FRG		
HT1		
HT2		
MCH1		
MCH2		
MCH3		
TEST		
SHIP		

SHIPPING - MARKING

TO:
BY:
DEST:TURTLE CREEK, PA.
MCH: ~~12610~~ /SHP: 10053
12/17 SA,REMOVE PROL.,RM,
UT&LP-SHIP ON PALLET
DO NOT SHIP W/O
CUST. APPROVAL ON
DOCUMENTS. SHRINK
WRAP ON COVERED
TRAILER,THEN UST&D
KEYSTONE COMMONS, TURTLE CREEK, PA. 15145
200 BRADDOCK AVE.
MK: INK OR PAINT: HT#,
Asme SA336 F304 (DIMENS.)
PO# 5043LH ~~PER ASME CODE & PS-107~~
Gulfco

RMK:
10CFR50 APP.B
10CFR21 APPLIES
NO WELD REPAIR
STATEMENT ON MTR.

JOB# .

10 CFR 50 APP B
10 CFR 21 APPLIES

NUCLEAR
12-17-99

06/15

P/O: 1322V
VEST: HOLTEC INTERNAT
#: 5043LH
#: 99514- 8
ESC: D06720100
DUE: 06/15/*0

QFT: ~~2.770~~ 1.99
BFT: ~~2.770~~

HT WEIGHT: 12177 ~~12618~~

MCH CST: ~~21.15~~ 20.55

FORG PR	~~17397~~ 17459.00	MCH PR	~~1269~~ 1233.00
FRT. PR	603.00	H/T PR	~~631~~ 609.00
TEST PR	48.00	OTH PR	~~50~~ 48.00
OTH PR	~~50~~.00	OTH PR	.00

TOTAL SALE PRICE 20,000.00

GULF COAST MACHINE & SUPPLY CO.

MATERIAL TEST REPORT

REFERENCE NUMBER	DATE	CUSTOMER P/O NUMBER		SOLD TO
0570	07/21/00	5043LH		HOLTEC INTERNATIONAL

	QUAN ORD	QUAN SHIP	F.O.#	DESCRIPTION	HEAT NUMBER	BHN	HEAT TREAT CYCLE
8	1	1	13221	ASME SA336 F304 PER PS-107 REV.2 ASME SECT.III SUB. NB1995 ED.96 & 97 ADD. 10CFR50 APP B 10CFR21 US MATL. ONLY 67.250 OD X .10.000 LG. SOLUTION ANNEAL GULFCO QUALITY MANUAL REV.0/1 DATED 3/23/95, R/M TO FINISH PT# MPC-68	2F830	TO	AUST. AT 1900 DEG. F 06.0 HOURS WATER QUENCH
				MELT PRACTICE: EF AOD BILLET # 013403 NO WELD REPAIR PERFORMED ON THIS ORDER		TO	
				CORROSION TEST PER ASTM A262 PRACTICE E: SATISFACTORY - SENSITIZED @ 1250 DEG.F. FOR 1.0 HR. 10 CFR 21 APPLIES 10 CFR 50 APPENDIX B APPLIES		TO	
				UT PER ASME SA388, PROCEDURE GCM-UT-388-01 REV-5 LP PER N-PT-004 REV-4, ADD. 3, REV-0 DATED 12/1/97 PROCEDURE: SE-165		TO	
				WITNESS WAIVED PER CUSTOMER, 02/24/00 THIS CERTIFIES COMPLIANCE TO 10 CFR 21, 10 CFR 50 APPENDIX B, ASME SECT. II, 1995 ED W/96 & 97 ADDENDA, ASME SECT. III, SUB. NB 1995 ED. W/96 & 97 ADDENDA		TO	
				GULFCO QUALITY MANUAL REV-0, (ISSUE 1) DATED 03/95 AS APPROVED BY HOLTEC INTL. 3/27/99, HOLTEC P.O. 5043LH AND THE MATERIAL SPEC.		TO	

CHEMICAL ANALYSIS

HEAT NUMBER	STEEL MILL	C %	MN %	PHOS %	SULF %	SI %	NI %	CR %	MOLY %	CU %	V %	CB %	NITROGEN ANALYSIS CHECK OK
2F830	JORGENSEN	.017 .02	1.57 1.57	.022 .028	.011 .010	.54 .57	9.71 9.68	18.4 18.3	.40	.27	.05	<.01	

MECHANICAL PROPERTIES

.505 DIA. TEST SPECIMEN													
TENSILE LB PER SQ IN	0.2% YIELD LBS/SQ IN	ELONGATION IN 2 INS	REDUCTION IN AREA %	TYPE TEST	CHARPY IMPACT TEST TYPE SAMPLE	SIZE	IMPACT TEST VALUES FT LBS					BILLET HEAT ACCEPTED PRODUCTION PROLONGATION REPRESENTATIVE TEST BLOCK	
75,800	35,000	62	71	P									

HOLTEC 5-23-00 PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

Sab 8/17/00

QUALITY ASSURANCE

M 11-00

I HEREBY CERTIFY THIS REPORT TO BE TRUE AND CORRECT ACCORDING TO RECORDS IN THE POSSESSION OF THIS COMPANY

STEEL MADE IN U.S.A.

Olivia Cole 7/24/00

Q. A. REPRESENTATIVE

Gulfco
GULF COAST MACHINE & SUPPLY COMPANY • GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD • P.O. BOX 26002 BEAUMONT, TEXAS 77720 (409) 842-1311

REPORT OF ULTRASONIC INSPECTION

Date of Test: 07/20/00 Page 1 of 1 Report Number: UT - F56

CUSTOMER & P.O. NUMBER:	HOLTEC INTERNAT 5043LH	GULFCO M/O NO.:	99514-008
SPECIFICATION NUMBER:	GCM-UT-388-01 REV 5	WITNESSED BY:	
PROCEDURE NUMBER:	WI 1003-01 ADD1 REV0	SCOPE OF INSPECTION:	100%
TYPE & MODEL NUMBER OF INSTRUMENT:	USN52 S/N 620146	TYPE OF COUPLANT:	ULTRAGEL II
LONGITUDINAL FREQUENCY:	1 mHz	SIZE OF TRANSDUCER:	1"
TYPE OF TRANSDUCER:	GAMMA S/N 00DWKB		
SHEAR FREQUENCY:		SIZE OF TRANSDUCER:	
TYPE OF TRANSDUCER:			
REFERENCE LEVEL:	LONG. 57DB	SCAN LEVEL:	LONG. 63DB
SHEAR WAVE WEDGE MEDIUM & SIZE:		ESTIMATED RMS SURFACE:	250

ITEM NO.	GULFCO F.O.#	NUMBER OF PCS.	DESCRIPTION	REPORT OF INSPECTION
08	1322Y	1	ASME SA336 F304 PER PS-107 REV.2 ASME SECT. III SUB. NB1995 ED.96 & 97 ADD. 10CFR50 APP B 10CFR21 US MATL. ONLY 67.250 OD X 10.000 LG. SOLUTION ANNEAL GULFCO QUALITY MANUAL REV.0/1 DATED 3/23/95, R/M TO FINISH PT# MPC-68 REPORT OF ULTRASONIC INSPECTION PERFORMED BY METCO	ALL PIECES SHOWN ON THIS REPORT WERE INSPECTED AND FOUND TO BE ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

HOLTEC 5-23-02 PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

SCD 8/17/00

QUALITY ASSURANCE

PERSONNEL PERFORMING UT EXAMINATIONS ARE QUALIFIED TO SNT-TC-1A.

[signature] 7-20-00
QUALITY CONTROL

[signature] 7-20-00
TECHNICIAN GERALD MESSER II LEVEL

COPY

M1100

Gulfco

GULF COAST MACHINE & SUPPLY COMPANY | GENERAL OFFICES & PLANT – @ I-10 East & SMITH ROAD |
P. O. BOX 26002 | BEAU MONT, TEXAS 77720-6002 | WORK PH# (409)842-1311 | FAX PH# (409)842-4621

LIQUID PENETRANT EXAMINATION REPORT

CUSTOMER: HOLTEC INTERNATIONAL P.O. #: 5043LH DATE : 072000

SPECIFICATION: SE-165 GULFCO M/O #: 99514-008

PROCEDURE: N-PT-0004 REV 4 ADD.3 REV. 0 SCOPE of EXAM: 100% SURFACE

SIZE: 67.250"OD X 10"LG F/O #: 1322V HEAT #: 2F830 QUANTITY: 1

TEST PARAMETERS

LIQUID PENETRANT USED

A-FLUORESCENT: ____ B-VISIBLE: YES

VENDOR: BRENT

	PENETRANT	REMOVER / EMULSIFIER	DEVELOPER
TYPE:	P6R	9PR50	NQ-1
BATCH:	8273D	9223C	9264A
TIME:	15MIN.	10MIN.	15MIN.

LIGHT SOURCE

MANUFACTURER: _____ DATE CALIBRATED: _____

INTENSITY @ 15": _____ micron W/cm^2 MODEL: _____

TEST RESULTS

DISPOSTION OF PARTS: ALL FORGINGS SHOWN ON REPORT WERE INSPECTED AND FOUND TO BE: ACCEPTABLE IN ACCORDANCE WITH THE SPECIFICATION OR PROCEDURE SHOWN ABOVE.

NOTE: _____

LIQUID PENETRANT EXAMINATION PERFORMED BY METCO

Gerald Messer LII

GERALD MESSER LEVEL II

HOLTEC 5-23-02 PK Q.A. APPROVED

UST & D REVIEW/APPROVAL

SCW 8/17/00

QUALITY ASSURANCE

M1100

GULFCO

Test Date	05/26/2000
Forge Order #	1322V
Lab #	C30
Diameter	0.503
Mat'l	GC304L
Wall:	10
Type	P
Heat Number	2F830
Customer	HOLTEC
Spec.	SA 336 F304

		Tensile Loc/Ornt	SURFACE/TG
Tensile Strength	75,800	*% Elongation*	62
Yield Strength	35,000	*Reduction of Area*	71
		CVN Loc/Ortn	
CVN Temp		*CVN'S*	
		%SH	
Bhn		*L.E.*	

Ht Treat	SA-WQ@1900/6 HR
Ht Treat 1	
Ht Treat 2	
Ht Treat 3	
Notes	
Notes1	
Notes2	
Notes3	

POSTED MAY 2 6 2000

Status: ***PASSED***

P/R 5-26-00

Bodycote MATERIALS TESTING
METAL TECHNOLOGY

Bodycote Omnitest Inc., Omni Laboratory, 4302 Dayco Street, Houston, Texas, 77092
Tel. 7139398690, Fax: 7139390249

ACCREDITED CERTIFICATE 1283.01

Test Certificate

GULF COAST MACHINE & SUPPLY CO
P.O. BOX 26002
BEAUMONT, TX

77720-6002

Attn: PATRICK REID

REF No 0004040 : Issue 1
Ord No PO: QA052500a

Date Tested 06/01/00
Date Reported 06/01/00

Item - SA336-F304L TEST SAMPLE
H/N:2F830 BILLET:013403 F/O:1322V

Specification - Not Applicable

Chemical Analysis - OES,Combustion

	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cr [%]	Mo [%]	Ni [%]	Al [%]	B [%]	Cu [%]	Comments
01:	.02	.57	1.57	.028	.010	18.32	.40	9.68	<.01	.002	.27	Nil
	Nb [%]	Sn [%]	Ti [%]	V [%]	N [%]							Comments
01:	<.01	<.01	<.01	.05	.075							Nil

Certificate Comments

10 CFR-21 APPLIES
NITROGEN ANALYSIS PERFORMED @ BODYCOTE METAL ANALYSIS.

Approved By J. Blevins

J. Blevins
For and on authority of
Bodycote Omnitest Inc.

Bodycote MATERIALS TESTING
METAL TECHNOLOGY

Bodycote Omnitest Inc., Omni Laboratory, 4302 Dayco Street, Houston, Texas, 77092
Tel: 7139398690, Fax: 7139390249

ACCREDITED CERTIFICATE 1283.01

Test Certificate

GULF COAST MACHINE & SUPPLY CO
P.O. BOX 26002
BEAUMONT, TX

77720-6002

Attn: PATRICK REID

REF No 0004122 : Issue 1
Ord No PO: QA053000a

Date Tested 06/06/00
Date Reported 06/07/00

Item - SA336-F304L TEST SAMPLE
H/N:2F830 BILLET:013403 F/O:1321V

Specification - ASTM A262-E

Chemical Analysis - OES,Combustion

	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cr [%]	Mo [%]	Ni [%]	Al [%]	B [%]	Cu [%]	Comments
01:	.017	.57	1.56	.027	.009	18.45	.40	9.45	<.01	.002	.27	Nil
	Nb [%]	Sn [%]	Ti [%]	V [%]	N [%]							Comments
01:	<.01	<.01	<.01	.05	.081							Nil

Corrosion Test - ASTM A 262-PrE

	Position	Details	Comments
02:ICC Oxalic acid	N/A	N/A	See Below

Item 02: TEST PERIOD: 24 HRS IN BOILING SOLUTION.
SAMPLE BENT THROUGH 180 DEG OVER A DIAMETER OF 1/4".
THE BENT SAMPLE WAS EXAMINED UNDER LOW MAGNIFICATION AND SHOWED NO SIGNS OF INTERGRANULAR ATTACK.
EVALUATION : THIS MATERIAL IS ACCEPTABLE IN ACORDANCE WITH ASTM A262 PRACTICE E.
SAMPLE WAS SENSITIZED AT 1250 DEG F FOR 1 HOUR PRIOR TO TESTING

Certificate Comments

10 CFR-21 APPLIES

COST: HOLTEC INTERNAT P/O 5043LH

NR PCS			
1	ASME SA336 F304 PER PS-107 REV.2 ASME SECT.III SUB. NB1995 ED.96 & 97 ADD. 10CFR50 APP B 10CFR21 US MATL. ONLY 67.250 OD X 10.000 LG SOLUTION ANNEAL GULFCO QUALITY MANUAL REV.0/1 DATED 3/23/95, R/M TO FINISH PT# MPC-68	SOZ 28 IN ITEMS 8/8	NO. 1322V DL HT NO. 2F830 WC: FIHMPTZG(TZG)MNT
042600			

MATERIAL REQUIRED			FORGING INSTRUCTIONS	TO: UST & D
PCS	WGT	STEEL		BY:
1	13152	GC304L	69-3/4 OD	FOB:TURTLE CREEK, PA.
				MCH: 12177# / HT: 12177#
TEST: REMOVE PROLONGATION UT/GCM-UT-388-01 REV 5 -LP/METCO-N-PT -004 REV 4 W/ADD. 3 REV 0 DATED 12-1-97			11-1/4 LG	SA,REMOVE PROL.,RM, UT&LP-SHIP ON PALLET DO NOT SHIP W/O CUST. APPROVAL ON DOCUMENTS. SHRINK WRAP ON COVERED TRAILER,THEN UST&D KEYSTONE COMMONS
TT,CORROSION TEST ASTM A262 E CK.ANAL.ALREADY DONE ON F/O 1321V				

H/T REQ: SOLUTION ANNEAL — USE BHN FROM FO PIES-2-00

STP	STP FURNACE TYPE	TEMP	HOLD	COOL	ACT TEMP	HOLD	LOG NO	BHN	BHN MIN	BHN MAX	DATE	PCS WGT
1.	SL-A	1900°	6	W	1900	6	59401					7633

0517*0 Q

7/10/97°

FM 0905-02 REV. DATE 02-07-2000

5/8

FURNACE LOAD HEAT TREATING LOG

HT—GC—1A

DATE: 5-1-00

FURNACE LOAD NO: 59401

FURNACE NO: 2

START H.T.	DATE	5-1-00	TIME FURNACE ON	2:35 a.m. p.m.	SHIFT 1 (2) 3
FINISH H.T.	DATE	5-2-00	TIME FURNACE OFF	1:10 (a.m.) p.m.	SHIFT 1 2 (3)

LEADERMAN IN: WB	TEMPERATURE TO BE SET: 1900	TIME AT TEMPERATURE: 6 HRS
LEADERMAN OUT: GR	TEMPERATURE ACTUAL SET: 1900	ACTUAL FURNACE TIME: 10.5 HRS

NORMALIZE		STRESS RELIEVE		TEMPER		OTHER	
ANNEAL		WATER QUENCH		POLYMER QUENCH		SA	X

Forge Order	RH	Pcs.	Wgt Ea.	Load By	Unload By
43780		1	60	BL	GR
43770		3	714		
44690		2	473		
45320		4	817		
13220		1	1217	BL	

Forge Order	RH	Pcs.	Wgt Ea.	Load By	Unload By

HEAT TREAT INSTRUCTIONS: Raised temp to 1900° and held 6 HRS
Air & Water Cool
740/970°
LOG 01542
11 PCS
Load OK BL
WGT 18,593 ~~4,633~~

REV DATE 12-20-99

FM-0905-04

Attachment C

General Outline of Processing Steps for SA336 F304 Forged Discs
Jorgensen Forge Corporation

1. Melt and pour ingots using Electric furnace-AOD process to chemical analysis required:

Carbon	0.08 % max.
Manganese	2.00 % max.
Phosphorus	0.045% max.
Sulfur	0.030% max.
Silicon	1.00 % max.
Chromium	18.0-20.0 %
Nickel	8.0-11.0 %

2. Cool to below 1000F.

3. Heat for initial forging to billet 2200F max., hold until uniform. Maintain temperature control with furnace temperature charts. Provide furnace charts if required by customer specification .

4. Forge billet ~30" diameter.

5. Cool to below 1000F

6. Condition billet.

7. Cut into individual billets of appropriate weight to make part.

8. Heat to 2200 F max. Hold until uniform. Maintain temperature control using furnace temperature charts. Provide charts if required by customer specification.

9. Forge to finish size.

10. Cool to below 1000F.

11. Solution treat at 1900-1950F. Maintain temperature control with both contact thermocouples and furnace temperature charts. Provide charts if required by customer specification. Cool in liquid media to below 500F.

12. Remove test material and perform required mechanical and chemical tests. Tensile tests performed to ASME SA370. Intergranular corrosion tests to ASME SA262 Practice E when specified.

13. Rough machine to ordered configuration.

14. Perform required non-destructive examination. Ultrasonic inspection to be done in accordance with ASME Code, Section III, Subsection NB, 1995 Edition with 1996 and 1997 addenda, Article NB-2540. Liquid penetrant inspection in accordance with Article NB-2546.

15. Finish machine to applicable Holtec or US Tool and Die drawing when applicable.

General Outline of Processing Steps for SA336 T304 Forged Discs
Jorgensen Forge Corporation

16. Dimensional inspection to ordered geometry.

17. Certified test reports shall include the following:
- Certification to SA336-F304.
- Certification to ASME Code Section II, and ASME Code, Section III, Subsection NB, 1995 Edition with 1996 and 1997 addenda.
Certification to 10CFR71 Part H, 10CFR72 Subpart G, 10CFR21, and QA manual revision used.
- Actual chemical and physical test reports for heat number per the requirements for ASME Section II and ASME Section III, Subsection NB, and Holtec specification PS-107.
- Results of required NDE.
- No weld/weld repair statement.

10/2002 rhs

Notes;

1. No grain size measurements were required by Holtec specification PS-107.

2, ASTM E112 does allow for reporting of average grain size for austenic grades.

FORGING TEMPERATURE AND PREHEAT OF FORGING MATERIAL

1. **PURPOSE/SCOPE** This instruction covers normal heating and cooling practice of ingot and billet materials forged at GULFCO. It is recognized that due to production and customer requirements for delivery some modifications to this practice may take place. The consequences of any modification is the responsibility of the department authorizing the modification.

   Note: Materials not covered in this specification should be brought to the attention of the Quality Assurance department before forging.

   Note: For the purpose of determining heating and cooling conditions GULFCO (GC) grades that do not have the prefix GC and those that do, are considered identical. i.e. GC120 and 120 are the same thing.

2. **REFERENCES:** Supplier Literature

3. **DEFINITIONS:** Ingot "AS CAST" material that has not been worked by forging or rolling

   Billet Ingot that has been worked by forging or rolling.

   Forging Temperature is the maximum temperature the material is heated to, i.e. furnace operating temperature.

4. **HOLD TIMES AT FORGING TEMPERATURE:**

   Minimum hold times for all grades (round or square) up to 34" shall be 30 minutes per inch of thickness at forging temperature. For material (round or square) 34" and larger minimum hold time shall be 45 minutes per inch. When the material has a cut length less than the diameter, and the part will be loaded vertical in the furnace, then the lesser dimension may be used in the hold time calculation.

5. **INSTRUCTION:** The following preheat, forging and cooling requirements apply to each listed material as indicated. Notes indicated in parentheses are listed on page eight (8) of the specification.

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
1010-1035	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC1040	NONE (5)	2350 DEG.F. MAX.	AIR COOL
1045	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC120	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC130	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC38	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC42	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC42 MOD	NONE (5)	2350 DEG.F. MAX.	AIR COOL
GC50	NONE (5)	2350 DEG.F. MAX.	AIR COOL
A707	NONE (5)	2350 DEG.F. MAX.	AIR COOL
A707L5	NONE (5)	2350 DEG.F. MAX.	AIR COOL
A707 GR 1	NONE (5)	2350 DEG.F. MAX	AIR COOL
GC4130 INGOT		2300 DEG.F. MAX.	AIR COOL (6)
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GC4130 BILLET	NONE (5)		
GC4140 INGOT		2300 DEG.F.MAX.	AIR COOL (6)
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GC4140 BILLET	NONE (5)		
GC4145 INGOT	YES (1)	2300 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
GC4145 BILLET			
24" AND LESS	NONE (5)		
OVER 24"	YES (1)		

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
4145M INGOT	YES (1)	2300 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
4145M BILLET			
20" AND LESS	NONE (5)		
OVER 20"	YES (1)		
4150	YES (1)	2300 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
4320 INGOT		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GC4320 BILLET	NONE (5)		
4330 INGOT	YES (1)	2300 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
GC4330 BILLET			
14" AND LESS	NONE (5)		
OVER 14"	YES (1)		
GC4340 INGOT	YES (1)	2300 DEG.F.MAX	SECTIONS 10" AND OVER AIR COOL TO 400-600 DEG.F. THEN HEAT TO 1200 DEG.F. FOR 1HR/IN OF THICKNESS. ALL OTHERS BURY IN SAND UNTIL TIME FOR HEAT TREAT
GC4340 BILLET			
24" AND LESS	NONE (5)		
OVER 24"	YES (1)		
GC8620 INGOT		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GC8620 BILLET	NONE (5)		
GC9310 BILLET		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GCCrNiM INGOT		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NO (5)		
30" AND OVER	YES (1)		
GCCrNiM BILLET	NO (5)		

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
GC202 INGOT		2300 DEG.F.MAX.	AIR COOL (6)
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GC202 BILLET	NONE (5)	2300 DEG.F.MAX.	AIR COOL (6)
508CL3 INGOT		2300 DEG.F.MAX	AIR COOL (6)
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
508CL3 BILLET	NONE (5)		
GCLF3 INGOT		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GCLF3 BILLET	NONE (5)		
52100	YES (1)	2100 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
6150	YES (1)	2100 DEG.F.MAX.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
8617M	NO (5)	2350 DEG.F.MAX.	AIR COOL
8630 INGOT		2300 DEG.F.MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
8630 BILLET	NONE (5)		
F1 INGOT		2350 DEG.F. MAX	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
F1 BILLET	NONE (5)		
GCF11 INGOT		2350 DEG.F. MAX.	AIR COOL
LESS THAN 30"	NONE (5)		
30" AND OVER	YES (1)		
GCF11 BILLET	NONE (5)		

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
GCF22 INGOT LESS THAN 30" 30" AND OVER GCF22 BILLET	 NONE (5) YES (1) NONE (5)	2350 DEG.F. MAX.	AIR COOL
GCF5 INGOT/BILLET	YES (1)	2200-1700 DEG.F.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
F9 BILLET	YES (1)	2200-1700 DEG.F.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
F91 BILLET	YES (1)	2200-1700 DEG.F.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
17-4PH BILLET	NONE (4)	2200-1800 Deg.F.	AIR COOL TO BLACK THEN SAND COOL
15-5PH BILLET	NONE (4)	2200-1800 Deg.F.	AIR COOL TO BLACK THEN SAND COOL
GC304 INGOT/BILLET	NONE (2)	2300-1700 Deg.F. (3)	AIR COOL OR FASTER
304N INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER
GC304L INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER
310 INGOT/BILLET	NONE (2)	2200-1800 DEG.F. (3)	AIR COOL OR FASTER
GC316 INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER
GC316L INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
317L INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER
321 INGOT/BILLET	NONE (2)	2300-1700 DEG.F. (3)	AIR COOL OR FASTER
321H INGOT/BILLET	NONE (2)	2250-1700 DEG.F. (3)	AIR COOL OR FASTER
347 INGOT/BILLET	NONE (2)	2250-1700 DEG.F. (3)	AIR COOL OR FASTER
405 INGOT/BILLET	YES (1)	1900-2050 DEG. F. (3)	AIR COOL
409 INGOT/BILLET	YES (1)	2150-1700 DEG.F. (3)	AIR COOL
GC410 BILLET	YES (1)	2200-1700 DEG.F.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
420M BILLET	YES (1)	2200-1800 DEG.F.	TRANSFER TO 1300 TO 1350 DEG.F.FURNACE HOLD 1 HOUR PER INCH OF THICKNESS THEN AIR COOL
F6NM	YES (1)	2200-1700 DEG.F.	BURY IN SAND UNTIL TIME FOR HEAT TREAT
F51	NONE (5)	2200-1700 DEG.F (3)	FAN OR WATER QUENCH
A255	NONE (5)	2200-1700 DEG.F. (3)	FAN OR WATER QUENCH
NI200	NONE (2)	2250 DEG.F. (3)	AIR COOL OR FASTER
MON400	NONE (2)	2150-1200 DEG.F. (3)	AIR COOL OR FASTER
INC600	NONE (2)	2250-1900 DEG.F.(3)	AIR COOL OR FASTER
INC617	NONE (2)	2200-1850 DEG.F.(3)	AIR COOL OR FASTER

MATERIAL	PREHEAT	FORGING TEMPERATURE	COOLING REQUIREMENTS
INC625	NONE (2)	2150-1850 DEG.F.(3)	AIR COOL OR FASTER
INC690	NONE (2)	2250-1850 DEG.F. (3)	AIR COOL OR FASTER
INC718	NONE (2)	2150-1850 DEG.F. (3)	AIR COOL OR FASTER
INC800	NONE (2)	2200-1900 DEG.F. (3)	AIR COOL OR FASTER
INC800H	NONE (2)	2200-1900 DEG.F. (3)	AIR COOL OR FASTER
IN800HT	NONE (2)	2200-1900 DEG.F. (3)	AIR COOL OR FASTER
INC825	NONE (2)	2150-1900 DEG.F. (3)	AIR COOL OR FASTER
C276	NONE (2)	2250-1750 DEG.F. (3)	AIR COOL OR FASTER
G3	NONE (2)	2150-1700 DEG.F. (3)	AIR COOL OR FASTER
AL6XN	NONE (5)	2150-1800 DEG.F. (3)	AIR COOL OR FASTER
926MO	**NONE (5)**	**2150-1800 DEG.F. (3)**	**AIR COOL OR FASTER**
20CB3	NONE (2)	2250-1800 DEG.F. (3)	AIR COOL OR FASTER
GC1513	NONE (5)	2350 DEG.F.MAX.	AIR COOL
CARP	NONE (5)	2350 DEG.F.MAX.	AIR COOL
VNT	NONE (5)	2350 DEG.F.MAX.	AIR COOL
D2	YES (1)	2000-1700 DEG.F	BURY IN SAND
S7	YES (1)	2050-1700 DEG.F.	BURY IN SAND
HY100	YES (1)	2150-1700 DEG.F.	AIR COOL
NIT60	YES (7)	2150-1700 DEG.F.	AIR COOL

TABLE NOTES:

(1) LOAD IN FURNACE OPERATING AT 1400 - 1500 DEG.F. HOLD 30 MINUTES PER INCH, THEN RAISE TEMPERATURE 100 DEG.F. PER HOUR TO FORGING TEMPERATURE
(2) LOAD IN FURNACE OPERATING AT FORGING TEMPERATURE PREHEAT NOT REQUIRED
(3) INDICATES STAINLESS AND NICKEL BASED GRADES THAT SHOULD NOT BE SOAKED ANY LONGER THAN NECESSARY
(4) CHARGE IN FURNACE OPERATING NO HIGHER THAN 1400 DEG.F. INCREASE FURNACE TO FORGING TEMPERATURE.
(5) FURNACE MUST BE OPERATING AT OR BELOW 1750 Deg.F. AT TIME OF LOADING. DO NOT LOAD IN FURNACE OPERATING AT FORGING TEMPERATURE.
(6) FORGINGS WITH CUT WEIGHT OVER 25,000 POUNDS MUST BE FURNACE COOLED OR BURIED IN SAND TO COOL.
(7) LOAD IN FURNACE BELOW1500 Deg. F, RAISE TO 2000 DEG. F AND EQUALIZE, RAISE TO 2150 Deg. F AND EQUALIZE.

3. DOCUMENTATION:

Preheat Instruction Record FM 0909-03

Attachment 7

Gulfco

GULF COAST MACHINE & SUPPLY COMPANY • GENERAL OFFICES & PLANT INTERSTATE 10 AT SMITH ROAD • P.O. BOX 26002 BEAUMONT, TEXAS 77720-6002 (409) 842-1311

October 23, 2002

TO: Mr. Mike Johnson
Holtec International
555 Lincoln Drive West
Marlton, New jersey 08053

FR: David LeBlanc
Gulfco

RE: Resolution of claim on SA336 F 304 Stainless Steel Disc.

Dear Sir:

We are now in possession of all related information on the disc forgings returned to Gulfco. Gulfco took the following steps.

1. Chemical analysis to verify chemistry of the material.
2. Observation of the welding of the parts by a Holtec representative.
3. Examination of the base material by an independent group (RJ Lee Group Inc.). See attached report.

Based on the information we have compiled it has been determined that the root cause of the welding problems with this material is the result of course grained material. Grain is a direct result of the forging of the material and is related to the forging temperature. The higher the forging temperature the greater the chance of having large grain growth.

The referenced specification of this order SA 336 F 304 and the requirements of the associated purchase order have no requirements with regards to grain size. If such a requirement had been submitted Gulfco would have to either:

1. Developed a forging procedure to insure a grain size within the requirements specified by the order.

or

2. Declined the order if Gulfco felt that the required grain size was unattainable.

As I stated in our conversation acceptance of any claim would be based on the underlying cause of the welding problem. Based on the above information and the attached report, Gulfco feels these forgings met all requirements of both SA 336 F 304 and the Holtec purchase order. Therefore your claim has been rejected.

If you require any additional information please feel free to contact me.

Regards,

David LeBlanc
Sales Manager

RJ LeeGroup, Inc.

TOMMY
NICKAY
DAVID

350 Hochberg Road
Monroeville, PA 15146
Tel: (724) 325-1776
Fax: (724) 733-1799

The Materials Characterization Specialists

October 22, 2002

Mr. Jim Mazzoli
Gulf Coast Machine & Supply Co.
PO Box 26002
Beaumont, TX 77720-6002

RE: Optical Examination of LP Indications in Sample HT #2F815
RJ Lee Group Project No. MAH210298
Gulf Coast PO #QA093002a

Dear Mr. Mazzoli:

Pursuant to your request, optical microscopy (OM) was conducted on liquid penetrant indications on a welded 304 sample identified by you as HT #2815. Our investigation shows that cracking is occurring in the parent metal and are intergranular. The base metal is course grained (ASTM 00) with some chromium carbides decorating the grain boundaries. The details of our analysis follow.

Initially two metallographic cross sections that included the weld were made from the sample sent by you. Figure 1 contains photomicrographs at the weld/base metal interfacing showing the cracks to be intergranular and confined to the base metal. Figure 2 shows a crack that appears to be following small precipitates (chromium carbides) along the grain boundary. Figure 3 is a photomicrograph of the base metal away from the weld. The grain size in this sample is approximately ASTM 00.

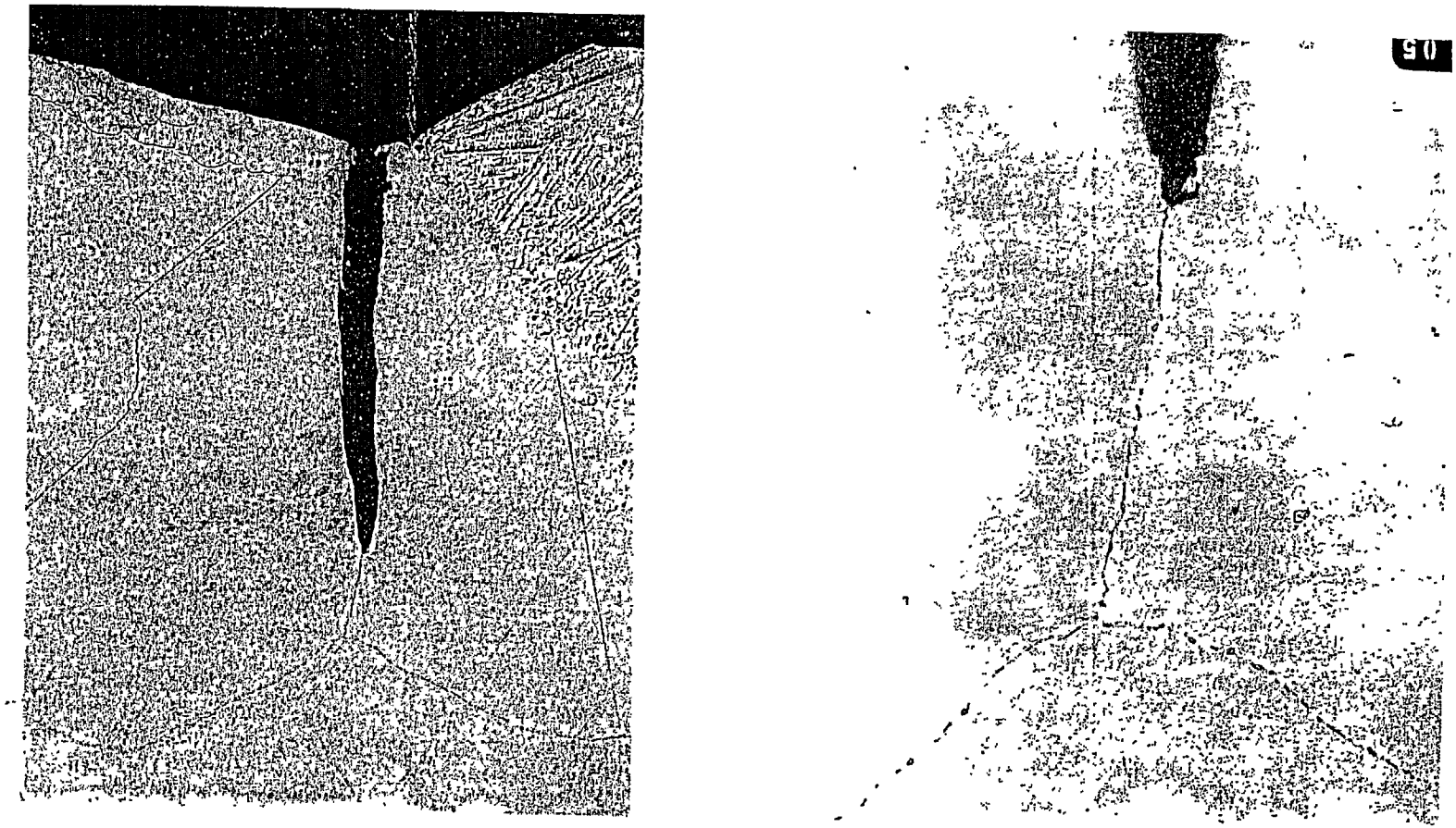
These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. No responsibility or liability is assumed for the manner in which the results are used or interpreted. The samples associated with this project are enclosed with this correspondence.

Should you have any questions or feel that I may be of further assistance, please do not hesitate to contact me.

Sincerely,

J. E. Stulga
Manager, Materials Characterization

Enclosures

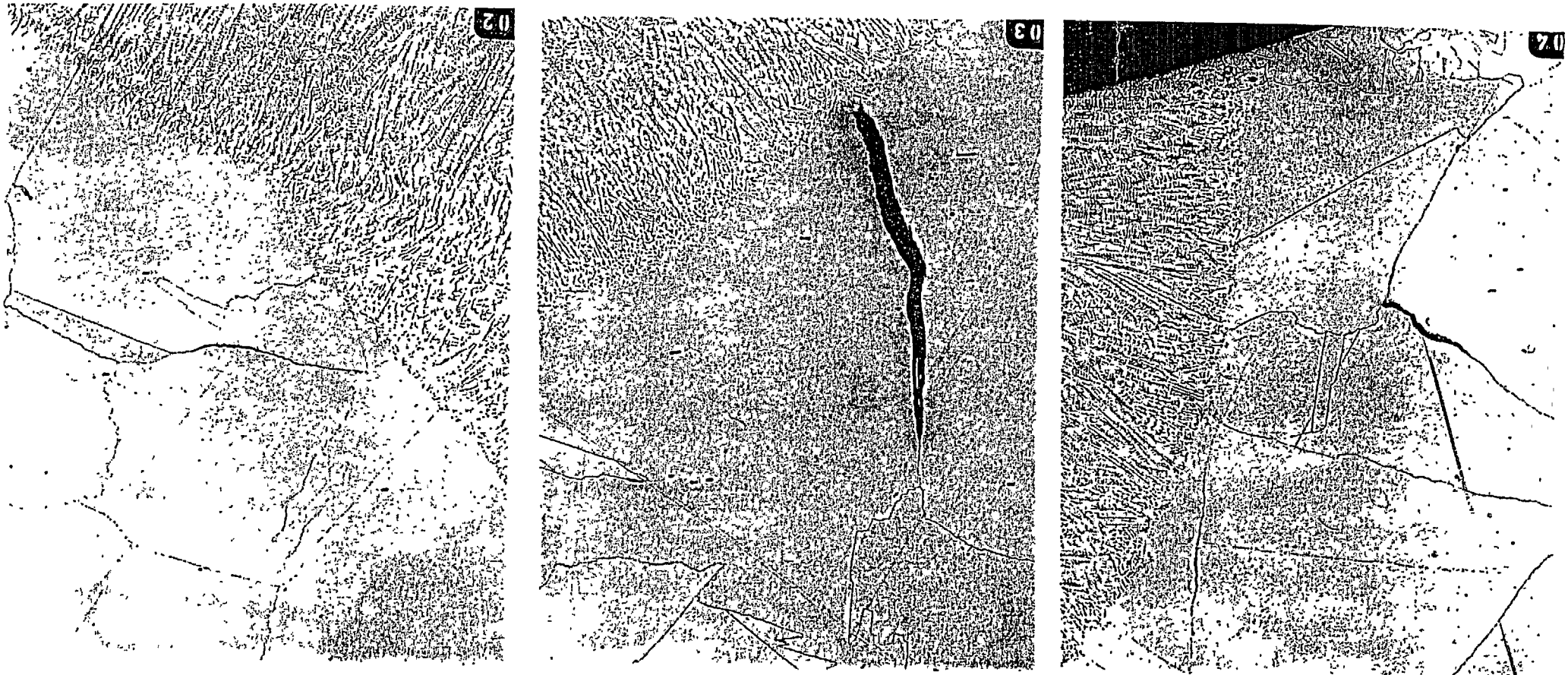


A. 100x

B. 500x

Figure 2. Photomicrographs of cracks in Gulf Coast Sample 2F815.
etchant: acetic/nitric acid/HCl/glycerol

Gulf Coast Machine & Supply Co.
RJ Lee Group Project No. MAH210298



A B C

Figure 1. Photomicrographs of cracks in Gulf Coast Sample 2F815.
Magnification: 100x etchant: acetic/nitric acid/HCl/glycerol

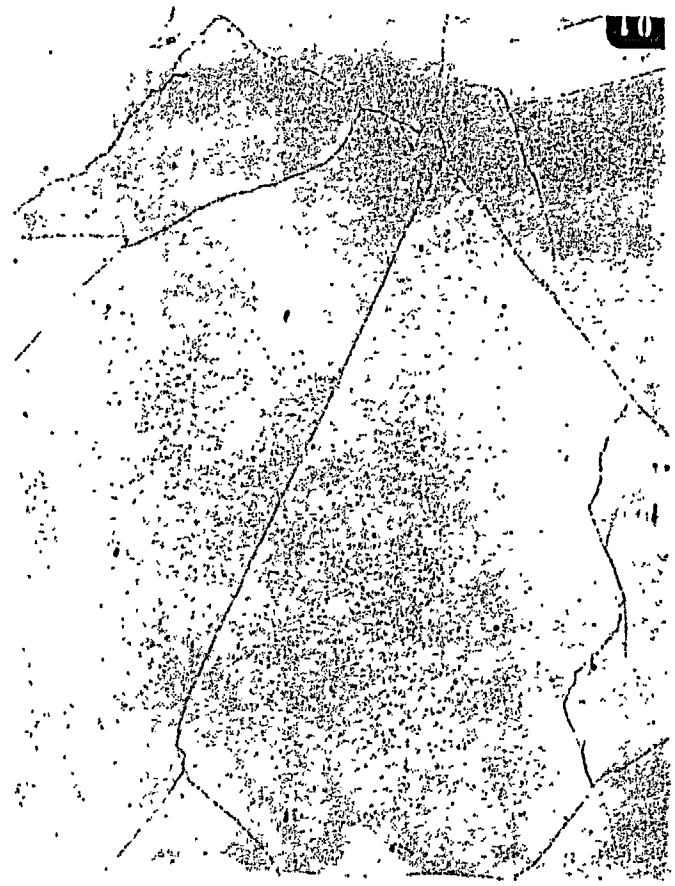


Figure 3. Photomicrograph of base metal away from the weld.
Magnification: 100x etchant: oxalic acid

*HOLTEC INFORMATION BULLETIN (HIB)** Attachment 8

Parsing the present to protect the future

CoC Holder:	Holtec International	Ref. Nuclear Plant:	Plant Hatch	HIB No. (sequential):	9
System Name:	MPC	Reference Document(s):	DWG 1402, detail "D"	Preparer (Rev. 0):	M. McNamara
Holtec Program No.:	1021	Period of Occurrence (m/y):	9/18/02	Preparer (Rev. 1):	B. Gilligan
Affected Component(s):	MPC Lid	Ancillary No. (If applicable):	N/A	Preparer (Rev. 2):	

Title of the Event: Indications in Lid-to-Shell Weld Root Pass

PROBLEM BACKGROUND & EVENT DESCRIPTION

Event Category (Use Legend Below): H

This Holtec Information Bulletin describes the anomalous behavior of a stainless lid forging, that had met all ASME Code Section III Class 1 requirements, during the lid-to-shell welding operation at Plant Hatch. This event is significant to cask users who are presently engaged in MPC welding activities.

Indications were discovered in the root pass of the MPC Lid to Shell weld (LTS) on MPC S/N #40 at Plant Hatch on September 18, 2002. The indications, which were discovered by the Liquid Penetrant (PT) process, were located in the toe of the ¾" partial penetration weld at the interface with the MPC Lid. The indications had the appearance of porosity, and were distributed along the entire circumference of the root pass of the weld.

The LTS weld is a ¾" effective throat partial penetration groove weld that connects the 10" thick lid to the ½" thick shell. This weld is subject to multiple PT exams as the weld joint is completed (i.e., root, 1st intermediate, 2nd intermediate, and final). The MPC lid is a forged material, type SA-336 F304, subjected to Ultrasonic and Liquid Penetrant examinations as required by ASME Code, Section III, subsection NB.

Grinding was performed to remove the indications from the weld and adjacent lid base metal. Subsequent PT examinations confirmed the removal of all indications. However, similar indications in the same relative location reoccurred upon rewelding with the mechanized welding process. Parameters such as wire feed rate and amperage were varied to reduce heat input and weld dilution, but indications always reoccurred.

The welding process used for the LTS weld is a mechanized Gas Tungsten Arc Welding (GTAW) process with a hotwire option. This process has been used successfully on all MPCs welded to date, including one at Plant Hatch (S/N # 23) earlier in September 2002.

After several unsuccessful attempts were made to repair the weld joint with the mechanized welding process without experiencing rejectable PT indications, a segment of weld was successfully repaired using the manual Flux Cored Arc Welding (FCAW) process.

MPC recirculation cooling was completed and a new time-to-boil timeclock was established. Manual welding using the FCAW process was performed to bring the LTS weld to a thickness of approximately 5/8" (requirement is ¾"). The 1st intermediate pass was successfully PT inspected after some grinding and re-welding. The 2nd intermediate pass was PT inspected with some rejectable indications. After removal of the indications, Shielded Metal Arc Welding (SMAW) of a cover pass was attempted around approximately ¼ of the MPC circumference. PT inspection of the SMAW pass revealed indications along the majority of the weld in the lid base material. With all welding techniques used, all indications were found to be at the interface between the weld and MPC lid. There were no rejectable indications found at the interface between the weld and MPC shell. Low heat input welding processes were unsuccessful in producing welds that meet ASME III PT acceptance criteria for lid serial number 40.

Hatch has decided to remove the existing MPC lid and replace it with a lid that has been verified to be weldable with the GTAW process. Holtec is providing the replacement lid and the necessary equipment to perform the replacement.

Legend: **H: Holtec system related; P: Peer system related; G: Industry generic.**

* Form revised August 20, 2002.

PROBABLE CAUSE

Cause Category (Use Legend Below): 3 (Describe Below)

Since one of the major causes of porosity-like weld indications is known to be the result of contamination of the molten weld material during welding, Plant Hatch personnel, attempted to identify and isolate the potential causes of contamination. The weld wire spool was changed, base material cleaned prior to rewelding and other potential sources of contamination identified. A coating material used to ease decontamination was evaluated by Plant Hatch personnel.

The mechanized welding system performance was re-evaluated by performing welds on weld mock up coupons, using the actual welding parameters used on the LTS weld root pass. Welds were made without PT indications on the coupon. Also, strippable paint, which is used near the weld surface, was applied to the weld coupon. After curing, the paint was removed, and the coupon was cleaned; a portion with alcohol, a portion with PT cleaner, and a portion with decon solution. Subsequent welding of the coupon after this evolution yielded no indications, which implies that the weld indications are not the result of surface contaminants.

The welding process had been successfully used on the previous 33 MPCs loaded. The welding parameters were adjusted and weld wire replaced without any changes in severity of the PT indications. The investigative work determined that a contaminant was not the cause. All indications occurred at the MPC lid side of the weld. Therefore, additional investigation of the MPC lid forging was performed.

The grain structure of the subject lid forging was found to be coarser than 00 (ASTM E-112), while still meeting all ASME Code requirements for Section III, Subsection NB, Class 1. The other five MPC lids at Hatch were tested for their grain size. The serial number 25 MPC lid was found to have similar grain size. Test welds were performed on the serial number 25 lid with PT indications similar to that found on MPC serial number 40. Additional test welds were performed using low heat input GTAW and SMAW parameters and high heat input GTAW parameters. Samples were taken from the test welds and unwelded base metal on the serial number 25 lid for metallurgical examination. The results of the examination confirmed that the indications were liquation cracks of the form of hot cracking in the lid base material in all three test welds. The microfissures are very small and limited in length to something less than 400 microns (roughly the grain size). Many smaller crack lengths were also observed where partial grain diameters were fissured.

There have been two other lids that were susceptible to similar indications during fabrication. Although these lids had passed all of the required mechanical property tests and NDE required for compliance with ASME Code, Section III, Subsection NB, they were rejected during fabrication at UST&D. The heat number of the rejected lids has been determined to be different than the heat number of the lid in question. Further, lids from the same heat number as those rejected have been successfully welded without indications. Two of these lids were previously installed at Hatch - one on MPC S/N 12 in 2001 and one on MPC S/N 23 in 2002.

The probable cause of the indications (liquation hot cracking) is the combination of large grain structure, quantity of impurities (which are concentrated on the limited grain boundary), the heat input of the welding process, and the geometry of the weld.

Further investigation is being made into the forging process of these lids to determine any changes that may be required to eliminate this condition, such as grain size limits, forging process changes or other appropriate measures.

Legend: (1) Weakness in Mechanical Design (inappropriate or unachievable tolerances, drafting error, etc.); (2) Unsuitable analysis (erroneous input data, inappropriate analysis methodology, or defect in the computer code utilized); (3) Improper material selection (poor weldability, machinability, lamination concerns, etc.); (4) Inadequacy in the client's ISFSI operation procedure; (5) Inadequacy in a procedure provided by Holtec; (6) Administrative deficiency (such as failure to transmit information to the Client); (7) Human Error; (8) Manufacturing Deficiency; (9) Unassigned; (10) Other.

Date of Issue: 9/23/02 *LESSONS LEARNED*

(Describe Planned Activities to Implement the Lessons Learned)

The potential variability in the lid forging material properties does not have a negative impact on the material performance nor is it cause for violation of the ASME Code, Section III , Subsection NB requirements, as demonstrated by successful material testing including ultrasonic and liquid penetrant inspection. The potential variability of forging material of this type can, however affect weldability with the welding processes normally used for making the closure welds.

If a significant amount of indications are found adjacent to the MPC lid during the LTS welding, switch to a lower heat input welding process and apply the weld so as to minimize the heat input and increase the width-to-depth ratio of the weld metal.

Holtec will evaluate the welding process parameters and provide cautionary advisories for future automated welding procedures to the HUG membership.

For those clients currently in loading campaigns, Holtec recommends that test welds be applied to MPC lids prior to the commencement of loading. The welding process for the test welds should be the same as that planned for the MPC lid welding and should have similar heat input. Perform a liquid penetrant examination of the test welds using the same acceptance criteria as that for the lid welding. If the test weld exhibits indications at the toe of the weld, contact Holtec for assistance on additional testing to be performed. If the test weld passes liquid penetrant examination, the MPC lid is suitable for welding. Simply, remove the weld by grinding and perform liquid penetrant examination to confirm clean base metal prior to loading.

AUXILIARY CONSIDERATIONS &COMMENTS

Holtec has entered this condition into its corrective action program and will complete a detailed root cause investigation. The corrective action will determine the extent of the condition, the corrective action (if any) to be performed on equipment already delivered, and the corrective actions to prevent recurrence. The HUG Fabrication Committee will participate in the development of the root cause investigation plan.

Holtec will re-evaluate the forging material for continued use a lid material. As most are aware, Holtec has already processed a change to allow the MPC lid to be optionally fabricated from two pieces, which would allow the use of plate stock (SA240-304) in lieu of a forging.

The Holtec Information Bulletin (HIB) is used by the company to document relevant industry events pertaining to dry storage deployment at nuclear plants and to disseminate the knowledge gleaned from such events to the Holtec Users' Group (HUG) membership, the company's personnel, and affected suppliers. The HIB also serves as the vehicle for the company, if applicable, to notify Part 72 licensees of immediate and/or interim corrective actions to be taken in response to an event as required by the company's QA program. While the great majority of the events catalogued in the HIB focus on our system, Holtec may include industry events involving other suppliers' systems where the lesson learned can be beneficially applied in Holtec's dry storage program. HIBs are prepared by the Spent Fuel Division of Holtec International as part of company's self-improvement program. The company expects Holtec's clients and suppliers to take timely, appropriate action pursuant to this bulletin in their dry storage programs. This bulletin is subject to internal reviews to ensure accuracy and clarity, and, as such, may be used in the corrective action process, if applicable, under the company's QA program. A HIB is prepared, internally reviewed, and issued expeditiously after an event is determined by the company to be significant to the continued success of Holtec's dry storage program. HUG members are encouraged to contact Holtec's Manufacturing Program Manager to suggest events that merit a HIB. Revised versions of the HIB may be distributed as the analysis and evaluation of the event proceeds. This form is stored in g:\generic\HIB\ directory.

Date of Issue: Draft date9/20/2002.
Rev. 0 date 9/23/2002.
Rev. 1 date 10/8/2002.

Attachment 9

7.2.6 MPC Lid Forging Weldability Inspection

a) All MPC lid forgings shall be subjected to the following weldability test. If this test is not performed by the material supplier as annotated in its material documentation, this test shall be performed by UST&D. The results of this weldability test shall be included in the MPC documentation package.

1. Perform a metalographic examination (ASTM E-112) of the forging to determine its grain size. Examinations are to be taken on the top surface of the lid adjacent to the MPC lid-to-shell weld prep at two locations (separated by approximately 180 degrees). If both grain size values are 1 or greater (i.e., grain size of 1 or finer), the forging is acceptable and no further testing is required. If either grain size is less than 1 (i.e., grain size larger than 1), perform test welds in accordance with 2 below.
2. Apply two test welds (TIG – approximately 200 amps), each approximately 5" long radially orientated, on top of the MPC lid near the MPC lid-to-shell weld prep on the outer diameter of the MPC lid. Test welds are to be located approximately 180 degrees apart. Perform a PT examination of the test welds and heat affected zone (minimum of ½" beyond toe of weld) using the acceptance criteria of NB-5352. If the two test welds pass the PT examination (arc strike and arc liftoff should be discounted), the forging is acceptable. If there are unacceptable indications, report the results to Holtec via a NCR.

8.0 QUALITY ASSURANCE

8.1 General Requirements

a) Material procurement, fabrication, inspection and testing shall be performed under a quality assurance program that meets the applicable requirements of 10CFR71, Subpart H and 10CFR72, Subpart G except as provided for in this specification.

b) The requirements and responsibilities identified in 10CFR21 are applicable. The fabricator shall immediately notify the designer in writing of any deviation which falls under the reporting requirements of 10CFR21.

Attachment 10

10CFR21 DEVIATION AND NONCOMPLIANCE EVALUATION

BRIEFLY SUMMARIZE THE DEVIATION OR NONCONFORMING ITEM*:

Holtec International fabricated and certified MPC-68 Serial Numbers 40 and 25 to SNC for use in the HI-STORM 100 dry spent fuel storage system at the Plant Hatch Independent Spent Fuel Storage Installation (ISFSI). Subsequent to fuel loading in MPC-68 Serial Number 40, welding was performed on the MPC lid-to-shell joint in accordance with the normal welding procedures used for other MPCs. Unacceptable liquid penetrant (PT) indications were found on the root weld layer and repaired. Additional weld layers were made and additional unacceptable PT indications were found. While continued grinding and welding could have been performed until the full weld depth was completed, SNC, with Holtec's concurrence, decided to remove the lid and replace it with a new lid. The MPC lid for MPC-68 Serial Number 25 was found to have similar welding difficulties when test welds were applied.

DATE OF DISCOVERY:

Difficulties with MPC-68 Serial Number 40 lid welding were first encountered on September 18, 2002. The decision was made to replace the MPC-68 Serial Number 40 lid in question on October 16, 2002. The latter date is used as the date of discovery.

SOURCE DOCUMENT FOR DEVIATION OR NONCOMPLIANCE (E.G., AUDIT REPORT, QPVF, NCR, CAR, ETC.):

QPVF# 217 and CAR# 88 document the deviation.

* Include part make/model or similar identifier, as applicable.

NAME AND ADDRESS OF ENTITY RESPONSIBLE FOR THE DEVIATION OR NONCOMPLIANCE:

Manufacturer: Gulf Coast Machine and Supply Company (Gulfco)
Interstate 10 West at Smith Rd
6817 Industrial Rd.
Beaumont, TX, 77720-6002
Phone: 1-800-842-3032

Forging Nos. 1322V – MPC-68 Serial Number 40
5341V – MPC-68 Serial Number 25

I. Determination of 10 CFR 21 Applicability

Is the affected component hardware or the design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services associated with the component hardware a basic component (see Definition 2.1).

YES ___X___ NO _____

BASIS:

The MPC lid is a basic component of the MPC-68 licensed under 10CFR71 and 10CFR72. 10CFR21 is invoked by both, 10CFR71 and 10CFR72. The MPC lid (Item 8, Holtec Drawing 1402) is defined in the HI-STORM FSAR and HI-STAR FSAR (Table 2.2.6) and SAR (Table 1.3.3) as Important to Safety Category A. The basis for the MPC lid being classified as Category A is that this part is defined as part of the confinement boundary. During transport, the MPC lid is part of the helium retention boundary.

If the response is "NO", then 10 CFR 21 is not applicable to this deviation or noncompliance. The preparer and reviewer must sign this exhibit and obtain a QA concurrence signature. No further action is required.

II. Description of Deviation or Noncompliance

Provide a detailed description of the deviation or noncompliance as it relates to the basic component's ability to perform its safety function (see Definition 2.7).

The sole deviation or noncompliance of the subject MPC lids is their inability to be welded. This lack of weldability is the result of the large grain structure of these forgings. The large grain size does not have a detrimental effect on the mechanical or chemical properties of the forging.

The subject MPC lids passed all chemistry tests, mechanical tests, and NDE (ultrasonic and liquid penetrant) requirements of the ASME Code for a Section III, Subsection NB, Class 1, forging. The test coupons were taken directly from the as-forged component. The component is forged with a protrusion that is removed after forging to be used as the test coupons. Therefore, the test results were based on the large grain size material.

The MPC lid performs the following important-to-safety functions:

1. Confinement – The MPC lid is an integral component of the MPC confinement boundary providing the top closure of the MPC enclosure vessel and a base for most of the confinement boundary welds applied in the field (MPC lid-to-shell, MPC lid-to-cover plate, and MPC lid-to-closure ring). Structural analyses are performed to demonstrate that the MPC lid meets or exceeds the AMSE Code Section III, Subsection NB acceptance criteria for all loading conditions. These structural analyses confirm that the MPC lid can perform its confinement function. As the subject forgings meet the mechanical and NDE requirements of the ASME Code, the lids will continue to adequately perform their confinement function. The welds applied to the lid are performed using welders and weld procedures qualified in accordance with the ASME Code. The confinement welds applied in the field are subjected to multiple liquid penetrant (PT) examinations. The PT's confirm the integrity of the applied weld. In addition, the weld indications on the subject lids were characterized as microfissures, very small and limited in length to something less than 400 microns (roughly the grain size). Many smaller indication lengths were also observed where partial grain diameters were fissured. The length of these indications are well below the 3/8" depth full-circumference crack assumed in Position Paper DS-213 and, therefore, the applied weld would meet the technical requirements of the FSARs. Additionally, the field welds must pass the PT acceptance criteria of the AMSE Code at the FSAR specified intervals, which ensure that it is not possible to have an indication greater than that assumed in Position Paper DS-213.
2. Structural Member – Lifting of the loaded MPC is facilitated by four threaded holes in the MPC lid, which has been qualified by evaluating the loading condition against the AMSE Code Section III, Subsection NB acceptance criteria. As the subject forgings meet the mechanical and NDE requirements of the ASME Code, the lids will continue to adequately perform their structural function.
3. Shielding – The MPC lid has a total thickness of 10 inches, which provides a significant amount of shielding. As the subject forgings meet the chemistry and NDE (i.e., UT)

requirements of the ASME Code, the lids will continue to adequately perform their shielding function.

4. Thermal – The MPC lid material and thickness is accounted for in the thermal analyses which evaluates the decay heat load transport from the spent nuclear fuel to the ambient environment. As the subject forgings meet the chemistry and NDE (i.e., UT) requirements of the ASME Code, the lids will continue to act as analyzed in the thermal analyses.
5. Criticality – The MPC lid material and thickness is accounted for in the criticality analyses as the MPC lid acts as a reflector. As the subject forgings meet the chemistry and NDE (i.e., UT) requirements of the ASME Code, the lids will continue to act as analyzed in the criticality analyses.

In conclusion, the subject MPC lids passed all chemistry tests, mechanical tests, and NDE (ultrasonic and liquid penetrant) requirements of the ASME Code for a Section III, Subsection NB, forging. These tests and inspections confirm that the lids were capable of performing their safety functions.

III. Determination of 10 CFR 21 Reportability

Is the deviation or noncompliance described in Item II above a defect or failure to comply potentially involving a substantial safety hazard per 10 CFR 21 (see Definition 2.6). Pay particular attention to Definition 2.14 for Substantial Safety Hazard.

NOTE: For those occasions where it is indeterminate whether a defect or noncompliance constituting a substantial safety hazard exists, consult with the QA Manager; Licensing Manager, Vice President, Nuclear Projects; or other Holtec senior management. If, after discussion with Holtec management, the issue is still indeterminate and no further evaluation can be performed in a timely manner, check "YES" and report the issue to the NRC. Describe the issue as a "potential" defect or failure to comply potentially involving a substantial safety hazard in the basis below.

YES _____ NO __X__

BASIS:

The condition of the large grain size in the forgings and the inability to weld to the lid are not defects or failures that involve a substantial safety hazard. There is NOT a major reduction in the degree of protection to the public health and safety, because the subject lids were capable of performing their safety functions.

IV. Conclusion

The deviation/noncompliance **IS NOT** reportable under 10 CFR 21

B. GILLIGAN 11/7/02
Preparer Signature/Date

11/8/2002
Reviewer Signature/Date

QA Manager Concurrence Signature/Date

Attachment 1

HOLTEC INTERNATIONAL

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November 13, 2002

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: USNRC Docket No. 72-1014
HI-STORM 100 Certificate of Compliance 1014
Report Pursuant to 10 CFR 72.242(d)

References:
1. Holtec Project 5014
2. Holtec Corrective Action Report No. 88

In September of this year, Southern Nuclear Operating Company (SNC) was experiencing difficulty achieving acceptable liquid penetrant (PT) examination results on a Holtec HI-STORM 100 System Multi-Purpose Canister (MPC) lid-to-shell (LTS) weld at Plant Hatch. Based on the circumstances of this issue, we hereby submit this report pursuant to 10 CFR 72.242(d) pertaining to a fabrication deficiency affecting MPC lid material that was manufactured by a Holtec vendor and certified for use under a 10 CFR 72 general license.

ABSTRACT

Holtec International fabricated and certified MPC-68 Serial Numbers 40 and 25 to SNC for use in the HI-STORM 100 dry spent fuel storage system at the Plant Hatch Independent Spent Fuel Storage Installation (ISFSI). The MPC functions as the confinement boundary in the HI-STORM 100 dry storage system. Subsequent to fuel loading in MPC-68 Serial Number 40, welding was performed on the MPC LTS joint in accordance with the normal welding procedures used for other MPCs. Unacceptable liquid penetrant (PT) indications were found on the root weld layer and repaired. Additional weld layers were made and additional unacceptable PT indications were found. While continued grinding and welding could potentially have been performed until the full weld depth was completed, SNC, with Holtec's concurrence, decided to remove the lid and replace it with a new lid. As part of an extent-of-condition evaluation, the lid for MPC-68 Serial Number 25, also at Plant Hatch but not yet loaded with fuel, was found to have similar welding difficulties when test welds were applied. Therefore, the lid supplied for MPC Serial Number 25 will not be installed on an MPC.

NARRATIVE DESCRIPTION

Description of Deficiency

The stainless steel lid forging for MPC-68 Serial Number 40 was fabricated by a supplier to Holtec (Gulf Coast Machine and Supply Company) and Holtec's MPC fabricator (UST&D) performed final machining on the lid per the design drawings. Holtec International certified and delivered MPC-68 Serial Number 40, including the lid, to SNC for use in the HI-STORM 100 dry spent fuel storage system at the Plant Hatch ISFSI. Subsequent to fuel loading, welding of the ¾-inch (min.) partial penetration groove weld that joins the MPC lid to the MPC shell commenced. Similar LTS welding has been successfully performed using the same mechanized weld process (Gas Tungsten Arc

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Welding - GTAW - with hot wire option) on eight previous MPCs currently in service at Plant Hatch's ISFSI and over 20 additional MPCs at other nuclear plants.

The HI-STORM 100 CoC (72-1014) requires, for the MPC LTS weld, a liquid penetrant (PT) examination of the root and final weld layers, and each approximately 3/8 inch of intermediate weld depth. The PT examination of the LTS weld root layer of MPC-68 Serial Number 40 revealed surface indications that were deemed rejectable by the NDE inspector using the ASME Code acceptance criteria of NB-5350. These indications were located in the toe of the weld at the interface with the MPC lid. The indications had the appearance of porosity and were distributed along the entire length of the weld around the circumference of MPC lid. There were no rejectable indications found at the interface between the LTS weld and the MPC shell.

These indications were ground out and re-welded using the mechanized welding process. Subsequent PT examinations of the root layer once more revealed unacceptable indications in essentially the same locations. After several unsuccessful attempts were made to repair the root weld using the mechanized welding process with different weld parameters (e.g., wire feed rate, amperage) and consumables, a segment of the root weld was successfully repaired using a manual Flux Core Arc Welding (FCAW) process.

Manual welding using the FCAW process was performed to bring the LTS weld up to a thickness of approximately 5/8 inch. The first intermediate PT inspection was successful after a minor amount of grinding and re-welding. A second intermediate PT inspection revealed some rejectable indications. After removal of these indications, a Shielded Metal Arc Welding (SMAW) process was used for a cover pass, which resulted in indications along the majority of the weld in the lid base metal material. While continued grinding and welding could potentially have been performed until an acceptable full weld was completed, the decision was made to replace the lid on MPC-68 Serial Number 40 with a new lid.

During the investigation as to the cause of the welding difficulties on MPC-68 Serial Number 40, test welds were performed on the lid for MPC-68 Serial Number 25, also delivered to Plant Hatch but not yet placed in service. These test welds revealed rejectable indications similar to those experienced on the MPC-68 Serial Number 40 lid. Multiple welding processes with varying welding parameters were applied to the MPC-68 Serial Number 25 lid with results similar to MPC-68 Serial Number 40. It was decided that the MPC-68 Serial Number 25 lid would also be replaced.

Date and Approximate Time of Discovery

Difficulties with MPC-68 Serial Number 40 lid welding were first encountered on September 18, 2002. The decision was made to replace the MPC-68 Serial Number 40 lid on October 16, 2002. The latter date was used as the starting date for the 30-day reportability "clock."

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Cause of Deficiency

The root cause analysis has not been finalized at the time of this report. However, from the causal evaluation work completed to date (which included third party input from metallurgical consultants), weld wire material contamination and inappropriate weld technique have been ruled out. The apparent cause of the weld indications is large grain size combined with residual elemental impurities concentrated in the grain boundaries of the MPC lid base metal. The average grain size of the subject lid forging was found to be coarser than 00 (per ASTM E-112), while still meeting all ASME Code requirements for Section III, Subsection NB, Class 1 material, including chemical and mechanical properties.

The MPC-68 Serial Number 25 lid was found to have similar grain size as the MPC-68 Serial Number 40 lid. Test welds were performed on the Serial Number 25 lid using low heat input GTAW and SMAW parameters and high heat input GTAW parameters. Samples were taken from the test welds and unwelded lid base metal for metallurgical examination. The results of the examination confirmed that the indications were liquation cracks of the form of "hot cracking" in the lid base metal heat affected zone in all three test welds. The micro-fissures were very small and limited in length to 400 microns (roughly the grain size). Many smaller crack lengths were also observed where partial grain diameters were fissured.

"Hot cracking" can be defined as grain boundary cracking formed at high temperatures near the solidus of the metal, where the metal has coherence but has low strength and ductility. It can occur in either the weld metal or the heat-affected zone of the base metal. Almost all metals may, on any scale, suffer this defect. The lack of ductility at high temperatures, which causes the cracking condition near the solidus, is usually due to the formation of an intergranular liquid film of an impurity (typically sulfur and/or phosphorous) in the metal. Both of these impurities combine with the matrix elements to form low-melting point (lower than that of the matrix) compounds, thereby reducing intergranular cohesion at high temperatures. The lack of cohesion between grain boundaries, in turn, initiates cracks aided by tensile stresses resulting from the contraction of the weld. Hot cracking occurs in two forms. It is known as "solidification cracking" when it occurs in the weld metal as the molten weld metal freezes and "liquation cracking" when it occurs in the heat-affected zones of the base metal or previously solidified weld metal as the solid metal cools. The cracks in these lids were determined to be the liquation cracking type.

Impurities are typically located at the grain boundaries. Metals with a very large grain size have less grain boundary area than metals with a very fine grain size. Consequently, the impurities are more concentrated in metals with large grain size. Therefore, metals with large grain sizes are more susceptible to liquation cracking.

Failure Mode, Mechanism, and Effect

There was no failure of a component important to safety and, therefore, no effect on safe ISFSI operations at Plant Hatch. The unacceptable weld indications were discovered during the normal inspection process conducted at the time of LTS welding on MPC-68 Serial Number 40. Therefore,

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the MPC-68 Serial Number 40 was never placed into service with the subject lid. Similarly, the large grain size and corresponding lack of weldability on MPC-68 Serial Number 25 was discovered prior to the commencement of fuel loading activities.

Systems or Secondary Functions Affected

None

Method of Discovery

This deficiency was discovered through the normal weld inspection process for MPC LTS welding.

Manufacturer and Model Number of Deficient Component

Manufacturer: Gulf Coast Machine and Supply Company (Gulfco)
Interstate 10 West at Smith Rd
6817 Industrial Rd.
Beaumont, TX, 77720-6002
Phone: 1-800-842-3032

Forging Nos. 1322V – MPC-68 Serial Number 40
5341V – MPC-68 Serial Number 25

Model and Serial Number of the Affected Spent Fuel Storage Cask

HI-STORM 100 System, MPC-68 Serial Number 40.
HI-STORM 100 System, MPC-68 Serial Number 25.

ASSESSMENT OF SAFETY CONSEQUENCES

There are no safety consequences because the affected lids were replaced before the storage systems were placed in service. The subject MPC lids passed all chemistry tests, mechanical tests, and NDE (ultrasonic and liquid penetrant) requirements of the ASME Code for a Section III, Subsection NB, forging. The mechanical test coupons were taken directly from the as-forged component. The components were forged with protrusions that were removed after forging to be used as the test coupons. Therefore, had the lid been welded into place with all rejectable indications removed by weld repair, these lids would have satisfactorily performed their safety function.

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CORRECTIVE ACTIONS AND ACTIONS TO PREVENT RECURRENCE

1. The MPC-68 Serial Number 40 lid was replaced with another lid, which was successfully welded. The MPC-68 Serial Number 25 lid is also being replaced.

2. Lids on MPCs already in service are unaffected based on the acceptable results of welding and associated PT inspections on those LTS welds prior to placing the MPC into service.

3. Holtec issued a Holtec Information Bulletin (HIB) and discussed this issue on the Holtec Users Group weekly fabrication committee conference call to ensure all users were informed. One other licensee (Energy Northwest (EN)) was involved in an active dry cask loading campaigns at the time the deficiency was discovered. Holtec immediately recommended to EN that they perform weld tests on all lids not in service prior to their use. This was communicated to EN verbally and in writing via the HIB.

4. Three other MPC lids delivered to SNC at Plant Hatch were tested for their grain size and weldability via the application of test welds, which were inspected using the same criteria as the MPC LTS weld. The other three lids at Plant Hatch were found to have grain sizes between 0.5 and 4.5, passed the weldability tests, and were deemed acceptable for use.

5. MPC lids already delivered to other clients will be tested for their grain size. Lids found to have unacceptable grain size will be subjected to weldability tests to ascertain their acceptability. Any lid forging that has large grain size and fails the weldability tests will be replaced.

6. All remaining undelivered lids at the UST&D shop are being evaluated for grain size. For those with unacceptable grain size, test welding will be performed on the lids to determine their status. Any lid forging that has large grain size and fails the weldability tests will be replaced.

7. All forged lid material historically has been required to meet the chemical, mechanical, and NDE requirements of ASME Section II for ASME III Class 1 service. The low-temperature service condition for the stainless steel forgings did not require additional restrictions on grain size to be established in the procurement specification. However, to prevent recurrence, all future MPC forged lid material procurement documents will include an appropriate limit for grain size in the material in addition to the ASME Section II chemical, mechanical, and NDE requirements.

PREVIOUS SIMILAR DEFICIENCIES

None.

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Sincerely,

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Document ID 5014470