FINAL EXAMINATION OF IDMS CORROSION COUPONS (U)

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and
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September 16, 1993

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Savannah River Technology Center

September 16, 1993

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SUBJECT DESCRIBERS
IDMS
Corrosion
Coupon
Evaluation
DWPf
T-Area
Retention: Lifetime
WSRC-TR-93-461

FINAL EXAMINATION OF IDMS CORROSION COUPONS (U)

Summary

The metallurgical examination of corrosion coupons removed from the Integrated DWPf Melter System (IDMS) was performed as part of the IDMS Materials Evaluation Program. The findings and conclusions of the evaluation program are as follows:

- 1) No corrosive attack or abnormal wear was observed on coupons in the IDMS Feed Preparation System, including Hastelloy C-276. Exposure represents approximately 4 months (1/3 of the anticipated annual throughput) of DWPf operation. An internal inspection of the IDMS Slurry Receipt Adjustment Tank/Slurry Mix Evaporator (SRAT/SME) and Melter Feed Tank is necessary to fully assess any abrasive damage.

2) All coupons in the Quencher Inlet region of the Off-Gas System exhibited localized corrosion. Exposure was continuous, representing four years of DWPF operation. Alloys 690 and Al1corr, which are used in DWPF Off-Gas System, experienced significant corrosive attack, but not sufficient to affect operating life. Alloys C-22 and 625 exhibited superior corrosion resistance and must be considered for the next generation Quencher.

3) Pitting was observed in the austenitic stainless steel coupons in the Off-Gas Condenser vapor inlet and the HEME inlet locations downstream of the Quencher. The IDMS units are of stainless steel construction and inspection for possible damage is recommended. Similar DWPF components are fabricated from Hastelloy C-276 and are not subject to corrosion in this environment.

4) Corrosion coupons from the Melter have not yet been removed for metallurgical examination. These examinations should be performed at the earliest possible time.

Background

Materials Technology Section (MTS) was requested by Defense Waste Processing Technology (DWPT) to examine corrosion coupons removed from the IDMS as part of the IDMS Materials Evaluation Program¹. This program was established to confirm the performance of Defense Waste Processing Facility (DWPF) reference materials of construction and other to evaluate alternate materials. Generally, the alternate materials are more highly alloyed, and therefore, expected to be more corrosion resistant. The various materials exposed during this study are listed in Table 1.

The IDMS consists of two major portions, the Feed Preparation System and the Melter/Off-Gas System. In addition to the current evaluation, an initial characterization^{2,3} and an interim visual inspection⁴ of the corrosion coupons were conducted as part of the IDMS Materials Evaluation Program. Coupons selected for this study were placed throughout the IDMS and consisted of standard flat and U-bend specimens. Some of the coupons were welded with matching filler metal and are designated with a "W" in the coupon identification number. In order to evaluate the effects of crevice corrosion, crevice washers were used on most specimens. In addition, coupons were inspected for evidence of general corrosion, pitting, stress corrosion cracking, and abrasive wear.

Removal of all corrosion racks except those from the melter and melter stack was performed in April, 1993. The following list contains the locations of the thirteen corrosion racks which were evaluated as part of this study (Figure 1):

Feed Preparation System

- 1a) Slurry Receipt Adjustment Tank and Slurry Mix Evaporator (SRAT/SME) - Vapor Space,
- 1b) SRAT/SME - Liquid/Vapor Zone,
- 2) SRAT/SME Condenser - Vapor Inlet,
- 3) Mercury Water Wash Tank (MWWT) - Vapor Space,
- 4a) Melter Feed Tank - Vapor Space,
- 4b) Melter Feed Tank - Liquid/Vapor Zone,

Melter/Off-Gas System

- 5) Quencher - Inlet,
- 6) Quencher - Outlet,
- 7a) Off-Gas Condensate Tank (OGCT) - Vapor Space,
- 7b) Off-Gas Condensate Tank - Liquid Zone,
- 8) Off-Gas Condenser - Vapor Inlet,
- 9) Off-Gas Condenser - Drain,
- 10) Steam Atomized Scrubber (SAS) - Drain Line,
- 11) High Efficiency Mist Eliminator (HEME) - Inlet,
- 12) HEME - Outlet, and
- 13) High Efficiency Particulate Air (HEPA) Filter - Inlet.

Operating History

The Feed Preparation System and the Melter System have been exposed to a total of 20 batches of sludge and frit since the system was started in April, 1989. Sixteen of the batches were processed prior to the interim visual inspection in January, 1992. Sludge for the 16 tests contained reference levels of all materials, including halides and sulfates. Nominal compositions of several of the sludge-slurry feed simulants are presented in Table 2. Mercury, noble metals, selenium (Se) and tellurium (Te) were added to several of the batches. The following lists the sludge-slurry types used for the various test runs processed in IDMS between 1989 and 1992:

- Coupled Feed Runs⁵ 1, 2, and 3:
 - Batch 1 type sludge was used for all three runs.
- Mercury Runs⁶ 1, 2, and 3:
 - Batch 1 type sludge with approximately 1.2% mercury, was used for all three runs.
- Blend Runs⁷ 1 and 2:
 - Blend type sludge was used in both runs with Se, Te and noble metals all at reference levels together with mercury at approximately 1.6%.

- Blend Run⁸ 3:
 - Blend type sludge with no mercury additions.
- H Modified (HM) Run 1:
 - HM type sludge with no mercury.
- HM Runs 2 and 3:
 - HM type sludge with Se, Te and noble metals all at reference levels. Sludge for these runs contained no mercury.
- Purex Runs 1 and 2:
 - Purex type sludge with Se, Te and noble metals all at HM sludge (or high heat Purex) reference levels. Sludge for these runs contained no mercury.
- Hanford Runs⁹ 1 and 2:
 - Hanford type sludge which contained noble metals at reference levels and no mercury.

For mercury runs 1, 2, and 3, the concentration of $\text{Hg}(\text{NO}_3)_2$ in the SRAT/SME condenser condensate was up to 11,000 mg/liter. The mercury in the melter feed ranged from 6 to 37 mg/liter. The concentration of mercury compounds in the melter off-gas condensate was up to 15 mg/liter. Analyses indicated that mercury existed primarily as HgO or HgCl_2 while lower concentrations of metallic Hg and Hg_2Cl_2 were present⁶. These concentrations are consistent with those anticipated in DWPF.

After the interim visual inspection was conducted in January, 1992, four additional runs were completed, three of which were fed to the melter. All of these runs were processed using the nitric acid flow sheet. Two of the runs were with hydroxylamine nitrate (HAN) type Precipitate Hydrolysis Aqueous (PHA) and two were with simulated Late Wash PHA. Noble metals were at HM sludge concentrations and mercury was nominally 3.2 wt% on a dry (solids only) basis. The sludges used for the four runs were one HM type and three Purex types.

The IDMS has been in operation for approximately 4 years during which a total of 20 batches of sludge have been processed as described above. In comparison, DWPF anticipates processing approximately 70 batches of sludge per year, approximately 75% of full operating capacity, without a significant amount of idle time. During the 4 years there has been much idle time in which sludge was not being prepared and fed to the melter. However, while the Feed Preparation System was down, the melter was maintained at operating temperature (vapor space temperature

800°C) and contained a full charge, approximately 6 ft³, of molten glass from the previous batch. Most of the corrosive species, which would normally have been entrained in the vitrified glass, were volatilized and exited the melter through the Off-Gas System. This may represent a slightly more corrosive environment.

Observations And Test Results

As part of this investigation all coupons were photographed before and after cleaning. Cleaning was performed in accordance with ASTM G1¹⁰. In most cases the use of a soft brush with light pressure and mild soap mixed with domestic water was sufficient to remove any deposits. Coupons requiring additional cleaning to remove deposits or elemental mercury were immersed for several minutes in a 5% nitric acid solution at room temperature.

Coupon evaluation included visual and microscopical examinations, dye penetrant testing and weight change measurements. Destructive metallography was performed on only those coupons that showed evidence of significant corrosive attack or wear. Visual and microscopic examinations of the coupons included inspection of the areas beneath the crevice washers, in the fusion and heat affected zones of the welds and in the parent metal including the edges of the coupons. Dye penetrant tests were performed and documented by Site Services Quality/Quality Control (SSQ/QC)^{11,12}. These tests were performed to identify any surface flaws, including stress corrosion cracks, which may have resulted from exposure to the different IDMS process environments. All observations and test results will be presented in this document on a rack by rack basis. Data was recorded in Lab Notebook WSRC-NB-93-30.

SRAT/SME (Vapor Space And Liquid/Vapor Zone)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Coupons were covered with hard brownish deposits from the slurry. The deposit was packed tightly between the coupons. Elemental mercury was observed on all coupons (Figures 2 and 3). The coupons were difficult to clean with mild soap and water and therefore required additional cleaning in dilute nitric acid.

Visual And Microscopic Examination After Cleaning: Slight brown stains remained on some samples. Grinding marks from the initial fabrication were still clearly visible on all samples. No general or crevice corrosion or pitting attack was evident on any of the coupons (Figure 4).

Weight And Dimensions: No significant weight or dimensional change was observed for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And Scanning Electron Microscope (SEM):
Examinations were not necessary.

SRAT/SME Condenser (Vapor Inlet)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Coupons were coated with a thin brown layer. This layer was adherent and required extra pressure during the cleaning with mild soap and water. No elemental mercury was observed on these specimens (Figure 5).

Visual And Microscopic Examination After Cleaning: A thin dark brown deposit remained after cleaning. Grinding marks from the initial fabrication were still clearly visible on all samples. No pitting attack, general or crevice corrosion was evident on any of the specimens (Figure 6).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Mercury Water Wash Tank (Vapor Space)

Coupon Rack And Washer Material: Type 304L / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Coupons were coated with a dark brown, almost black, deposit. Elemental mercury was evident on all coupons. A tar-like substance was observed on portions of these coupons (Figure 7).

Visual And Microscopic Examination After Cleaning: Removal of the black tarry substance and the elemental mercury required additional cleaning in dilute nitric acid. Grinding marks from the initial fabrication were still clearly visible on all samples. The coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 8).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Melter Feed Tank (Vapor Space And Liquid/Vapor Zone)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: A brittle light brown coating was evident on coupons from both locations. The deposits were packed tightly between all the specimens. Coupons in the vapor region were not coated as heavily as those in the liquid/vapor region. The deposits did not appear to contain any elemental mercury (Figures 9 and 10).

Visual And Microscopic Examination After Cleaning: Coupons cleaned up well in mild soap and water. A very thin light brown stain remained on coupons from the liquid/vapor zone. Grinding marks from the initial fabrication were still clearly visible on all samples. Coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 11).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Quencher (Inlet)

Coupon Rack And Washer Material: Hastelloy C-276 / Flat ceramic washers on all coupons.

Visual Examination Before Cleaning: Quencher inlet coupons were covered with a thick porous black soot-like material (Figure 12). This layer was easily removed with a soft brush but the metal surfaces remained discolored (blackened).

Visual And Microscopic Examination After Cleaning: An adherent thin black layer was visible on all the coupons from this rack even after cleaning using a soft brush with soap and water (Figure 13). The layer remained even after vigorous scrubbing

with a stiff bristle brush. Since these coupons may be examined in more detail in the future, further cleaning was not performed. Crevice corrosion, pitting and end-grain attack were evident on a number of these coupons, as indicated in Table 5. Photographs showing end-grain attack and general surface condition are shown in Figures 14 - 19. Pit depths, lengths and widths of representative pits are presented in Table 6.

Weight And Dimensions: All coupons experienced some weight loss; however, dimensional changes were not significant (see Table 3 and 4). The apparent inconsistency in the results is due to the highly localized nature of the attack.

Dye Penetrant Tests: Indeterminate due to the amount of pitting on the samples.

Metallography And SEM: Photomicrographs and SEM images of the Inconel 690 and Allcorr samples are shown in Figures 20 and 21. Pitting and end-grain attack are shown.

Quencher (Outlet)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Coupons were coated with a very thin black glassy substance. Both grinding marks from the initial fabrication and identification marks could be seen under the coating (Figure 22).

Visual And Microscopic Examination After Cleaning: A thin black coating remained on several of the coupons. Coupons did not exhibit any signs of general or crevice corrosion or pitting attack. End-grain attack was not observed on any coupon (Figure 23).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Off-Gas Condensate Tank (Vapor Space And Liquid Zone)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: These coupons were removed from the rack before they were documented. However, photographs of the coupons were taken before they were cleaned and are presented in Figures 24 and 25. A dark brown or black deposit was observed on coupons from both vapor and liquid regions.

Visual And Microscopic Examination After Cleaning: Deposits were completely removed by cleaning with mild soap and water. Grinding marks from the initial fabrication were still clearly visible on all samples. Coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 26).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Off-Gas Condenser (Vapor Inlet)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on standard coupons, and flat Teflon washers on U-bend specimens.

Visual Examination Before Cleaning: Only small localized staining of these coupons was noted. The stains were light brown in color. Grinding marks from the initial fabrication were still clearly visible all samples (Figure 27).

Visual And Microscopic Examination After Cleaning: All stains were removed during cleaning with soap and water (Figure 28). Some pitting attack was observed under the flat washer on the 317LW (1) U-bend specimen. The pitting was not extensive and did not affect regions away from the washer (Figure 29). Other specimens on this rack did not show any signs of general, crevice or pitting corrosion.

Weight And Dimensions: Weight loss on the 317LW (1) U-bend specimen was not significant since the pitting was limited to only a small area under the washers. No significant weight or dimensional change was noted in any of the other coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: The extent of the pitting on the 317LW (1) U-bend specimen is shown in Figure 29a. Photomicrographs of the pitted region are shown in Figure 29b. No cracking was

observed inside the pits. Pit depths, lengths (longest dimension) and widths (shortest dimension) of representative pits are presented in Table 7.

Off-Gas Condenser (Drain)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on standard coupons, and flat Teflon non-crevice washers on U-bend specimens.

Visual Examination Before Cleaning: Only small localized staining of these coupons was noted. The stains were light brown in color (Figure 30).

Visual And Microscopic Examination After Cleaning: Stains were removed with mild soap and water. Grinding marks from the initial fabrication were still clearly visible all samples. The coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 31).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Steam Atomized Scrubber (Drain)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Coupons exhibited a light brown uniform coating. However, grinding marks from the initial fabrication were still clearly visible all samples (Figure 32).

Visual And Microscopic Examination After Cleaning: All deposits were removed by cleaning with soap and water. No evidence of general or crevice corrosion was observed on any of the coupons (Figure 33).

Weight And Dimensions: No significant weight or dimensional change was observed for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

HEME (Inlet)

Coupon Rack And Washer Material: Hastelloy C-276 / Teflon crevice washers on standard coupons, and flat Teflon non-crevice washers on U-bend specimens.

Visual Examination Before Cleaning: Small localized reddish brown stains were visible on all the coupons. Grinding marks from the initial fabrication were still clearly visible on all samples (Figure 34).

Visual And Microscopic Examination After Cleaning: All stains were removed with soap and water (Figure 35). Pitting was observed under the flat washers on the 304LW (1) and 316LW (2) U-bend specimens, with pitting attack more severe on the 304 coupon (Figure 36). No pits were seen in the region outside the washers on either of these coupons. Pitting was more extensive on these coupons than on the 317LW coupon from the Off-Gas Condenser. Other coupons on this rack did not exhibit any signs of general or crevice corrosion or pitting attack.

Weight And Dimensions: Weight measurements of the 316LW (2) and 304LW (1) U-bend specimens showed some weight loss due to the pitting in the washer region. No significant weight or dimensional changes were noted for any of the other coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: No SCC was observed at the base of the pits in either of the coupons. Pit depths, lengths and widths of representative pits are presented in Table 8.

HEME (Outlet)

Coupon Rack And Washer Material: Type 316L / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: Only localized staining of these coupons was noted. Stains were reddish brown in color (Figure 37).

Visual And Microscopic Examination After Cleaning: Stains were removed with mild soap and water. The coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 38).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

HEPA (Inlet)

Coupon Rack And Washer Material: Type 316L / Teflon crevice washers on all coupons.

Visual Examination Before Cleaning: A light haze was observed in several small areas on these coupons. Grinding marks from the initial fabrication were still clearly visible on all samples (Figure 39).

Visual And Microscopic Examination After Cleaning: Haze was almost completely removed from all coupons. These coupons did not exhibit any signs of general or crevice corrosion or pitting attack (Figure 40).

Weight And Dimensions: No significant weight or dimensional change was noted for any of the coupons (see Table 3 and 4).

Dye Penetrant Tests: No indication of any surface flaws was noted.

Metallography And SEM: Examinations were not necessary.

Discussion

Coupons from the Feed Preparation System, including the SRAT/SME, SRAT/SME Condenser, MWWT and the MFT, exhibited no evidence of any form of corrosion or abnormal wear. However, coupons from the SRAT/SME and the MFT were heavily coated with solidified sludge/frit. This thick coating may act as a barrier to protect these coupons from both corrosive attack and abrasive wear. Abnormal wear of full scale equipment at TNX, i.e., agitator blades and coil supports, was observed previously^{13,14}. Thus, a thorough internal inspection of the SRAT/SME vessel should be performed immediately.

To prevent the accumulation of sludge/frit on the coupons from the SRAT/SME and the MFT, the coupons should be spaced further apart. In addition, these racks should be cleaned prior to processing each new batch of sludge/frit.

Coupons from the Melter Off-Gas System, in particular the Quencher Inlet, experienced various types of localized and general corrosive attack. Although the IDMS is run on an intermittent (batch) basis, the Melter and the Off-Gas System are operated continuously. Therefore, the Quencher Inlet coupons have experienced approximately four years of exposure. Table 5 summarizes the various types of corrosion and the relative degree of attack observed on each of the coupons from the Quencher Inlet. In addition, the materials in the table are ranked based on performance, with pitting and crevice corrosion given the most weight, respectively. Localized attack was observed on the Inconel 690 and Teledyne-Allvac Allcorr coupons. This is significant since these materials are currently used in the DWPF Off-Gas System, including the Off-Gas Film Cooler and Quencher. The environment in this region of the system is severe, containing such corrosive species as Cl, F, sulfur and SO₂ with temperatures in excess of 350°C¹⁵.

Based on the results of this study, Hastelloy C-22 and Inconel 625 possess superior corrosion resistance to the environment in the inlet region of the Quencher. Although Inconel 690 and Teledyne-Allvac Allcorr did not perform as well as Hastelloy C-22 and Inconel 625, these alloys should meet the design life requirements in DWPF. Design life for the DWPF Melter is between 2 and 5 years while jumpers, including the one containing the Quencher, are designed for up to 5 years of service life.

A visual examination of the IDMS Off-Gas Film Cooler and Quencher, which are fabricated from Inconel 690 and Hastelloy C-276 respectively, is recommended since additional information concerning the performance of these alloys under actual operating environments would be beneficial. This information is pertinent to DWPF since the DWPF Off-Gas Film Cooler and the replacement Quenchers are fabricated from Inconel 690 and Hastelloy C-276, respectively.

The only other coupons from the Melter Off-Gas System that showed any signs of localized or general corrosive attack were from the Off-Gas Condenser Vapor Inlet and the HEME Inlet. Pitting was observed on the 317L stainless steel coupon from the Off-Gas Condenser and on the 304L and 316L stainless steel coupons from the HEME Inlet. In each case these were the least corrosion resistant material on the corrosion racks. Hastelloy C-276, the material of construction for these components in DWPF, suffered no degradation. Therefore, under conditions expected in the DWPF Off-Gas Condenser and HEME, Hastelloy C-276 is expected to perform satisfactorily. However, because the IDMS components are fabricated from 304L stainless steel, periodic inspections should be performed.

Corrosion coupons exposed in the melter, including the melter vapor and spray zones, were not examined at this time. They are attached to the melter thermowell and could not be removed due to an unknown

obstruction. Important material performance data would be acquired from evaluation of the various coupons exposed in this region, therefore, they should be removed and examined as soon as possible.

Findings and Conclusions

The findings presented in this investigation lead to the following conclusions:

- 1) No corrosive attack or abnormal wear was observed on any of the coupons from the Feed Preparation System in IDMS. Hastelloy C-276, the DWPF reference material of construction for the Feed Preparation System process vessels, should perform satisfactorily in DWPF. However, internal inspections of the IDMS SRAT/SME and MFT are still necessary to fully assess the abrasive behavior of the sludge/frit slurry.
- 2) Teledyne-Allvac Allcorr and Inconel 690 showed evidence of localized corrosive attack in the IDMS Quencher Inlet region. However, the degradation was not severe and would not be expected to result in a component failure in DWPF within the design life of the system. Further inspection of IDMS Off-Gas components, i.e., Film Cooler and Quencher, are necessary to fully assess the corrosion behavior of the Inconel 690 and Hastelloy C-276.
- 3) Hastelloy C-22 and Inconel 625 exhibited superior resistance to localized corrosion compared to that of Inconel 690 and Allcorr in the Quencher Inlet region of the Melter Off-Gas System. Consideration needs to be given to using these alloys for the next generation Quencher.
- 4) The pitting of the austenitic stainless steels (304L, 316L and 317L) from the Off-Gas Condenser Vapor Inlet and the HEME Inlet is a concern in IDMS only. Corrosive attack of these regions in DWPF is not expected because DWPF components are fabricated from the more corrosion resistant Hastelloy C-276.

Recommendations

The following are recommendations based on the results of this investigation:

- 1) Internal inspections of the IDMS SRAT/SME and MFT are required to fully assess the abrasive behavior of the sludge/frit slurry. Replacement coupons installed in the SRAT/SME and in the MFT should be spaced further apart to avoid accumulation of sludge. Furthermore, it is suggested that these coupon racks be cleaned prior to processing each new batch of sludge.

- 2) The IDMS Off-Gas Film Cooler and Quencher should be visually at the earliest opportunity inspected for signs of localized corrosion.
- 3) The IDMS Off-Gas Condenser Vapor Inlet and the HEME Inlet should be visually inspected for indications of crevice and pitting corrosion.
- 4) The coupons exposed in the melter vapor space and spray zone should be removed as soon as possible for metallurgical evaluation.

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TABLE 1
Material Compositions

Manufacturer	Material	Ni	Cr	Fe	W	Co	Mo	Mn	Si	P	S	C	Other
J&L Speciality	304L	8.83	18.23	69.79		0.10	0.24	1.79	0.61	0.030	0.018	0.026	N 0.086, Cu 0.250
Allegheny-Ludlum	316L	10.12	16.22	68.80		0.10	2.12	1.70	0.60	0.033	0.001	0.020	N 0.040, Cu 0.250
Eastern Stainless	317L	14.00	18.29	61.75		0.20	3.13	1.63	0.59	0.026	0.011	0.017	N 0.072, Cu 0.280
Allegheny-Ludlum	AL6XN	23.92	20.67	47.80			6.32	0.46	0.30	0.028	0.001	0.026	N 0.230, Cu 0.250
Haynes	G-3	44.11	22.46	19.84	0.80	1.77	7.49	0.77	0.49	0.019	0.002	0.005	Cu 1.880, Cb+Ta 0.360
Duraloy Blaw-Knox	Mo-Re 2*	48.45	32.08		15.72			0.36	0.49	0.011	0.007	0.190	Al 0.610
Duraloy Blaw-Knox (Cast)	50/50 (I657)*	50.26	47.06					0.15	0.36	0.020	0.002	0.010	Cb+Ta 1.690
INCO	671*	53.92	45.50	0.13				0.02	0.09		0.003	0.050	Ti 0.290
Haynes	C-22	56.00	22.00	3.00	3.00	2.50	13.00	0.50	0.08			0.010	V 0.350
INCO	72*	56.17	43.46	0.31				0.01	0.04			0.010	Cu 0.010, Ti 0.610
Haynes	C-276	57.26	15.54	5.77	3.80	1.33	15.63	0.45	0.03	0.015	0.002	0.003	V 0.170
Teledyne-Allvac	Allcorr	57.99	30.93	0.11		0.01	9.97	0.01	0.02	0.005	0.001	0.030	Al 0.230, B 0.002, Zr 0.010, V 0.010, Cb+Ta 0.420, Ti 0.240
INCO	690*	59.40	29.10	10.48				0.42	0.30		0.003	0.010	Ti 0.290
INCO	625*	60.66	21.86	4.49			8.77	0.05	0.07	0.006	0.001		Cb+Ta 3.570, Ti 0.260
Duriron (Cast)	CW-7M	61.52	18.79	1.09			17.51	0.59	0.48	0.007	0.005	0.010	
INCO	MA758*	67.00	30.00	1.00								0.050	Al 0.300, Ti 0.500, Y2O3 0.600
Haynes	556*	22.07	21.44	31.45	2.43	17.32	3.05	1.01	0.40	0.007	0.002	0.100	Al 0.150, La 0.018, B 0.690, Zr 0.010
Haynes	8727*	42.49	28.76	2.31	0.10	24.35	0.05	0.38	1.50	0.005	0.001	0.057	
Haynes	188*	22.55	21.64	1.84	14.36	37.97	0.20	0.95	0.35	0.017	0.001	0.120	
Haynes	25	9.84	20.25	2.25	15.15	50.39	0.34	1.45	0.21	0.005	0.002	0.110	
Duraloy Blaw-Knox	Mo-Re 5*	0.25	28.46	16.00		53.41		0.87	0.84	0.020	0.030	0.120	
Stellite (Cast)	6	3.00	30.00	3.00	5.00	54.10	1.50	1.00	1.50			0.900	
Haynes	150*	1.37	22.42	18.94		56.01	0.05	0.71	0.39	0.011	0.002	0.100	
Stellite (Wrought)	6B	2.25	30.02	1.74	4.13	57.45	0.97	1.68	0.65	0.013	0.001	1.100	
Stellite	6BLC*	2.73	30.35	0.10	3.98	60.35	0.10	1.70	0.58	0.011	0.004	0.100	

* Alloy sample placed in the IDMS Melter

Manufacturer	Material	Al2O3	SiO2	MgO	Na2O	CaO	Fe2O3	Cr2O3	K2O
Bolt Technical Ceramics	Alumina	99.70	0.11	0.22	0.008	0.005	0.060	0.007	0.00

TABLE 2

Nominal Cation And Anion
 Concentration In Sludge-Slurry Feed Simulants (wt%, dry)

<u>Component</u>	<u>Blend (Nd)</u>	<u>Batch 1</u>	<u>H Modified</u>	<u>Purex</u>
<u>Cation</u>				
Al	5.82	6.56	9.90	4.00
Ba	0.224	0.163	0.133	0.269
Ca	1.89	2.16	1.35	2.19
Cr	0.220	0.179	0.155	0.253
Cu	0.110	0.105	0.0445	0.132
Fe	20.6	22.8	14.0	24.2
K	0.298	0.248	0.130	0.258
Mg	0.183	0.156	0.213	0.134
Mn	4.97	4.68	4.89	4.72
Na	5.56	5.68	5.97	6.47
Nd	0.433	0.249	1.04	0.0982
Ni	1.98	1.54	0.856	2.58
Os	0.0081	0.0046	0.0195	0.0020
Pb	0.255	0.278	0.156	0.312
Si	2.98	1.44	4.60	1.04
Sr	0.101	0.060	0.250	0.020
Zn	0.173	0.185	0.0357	0.248
Zr	2.17	0.768	1.41	2.57
<u>Anion</u>				
SO ₄	0.650	0.665	0.494	0.735
PO ₄	0.126	0.092	0.0855	0.147
CO ₃	2.26	2.92	1.15	2.88
NO ₃	0.490	0.504	0.381	0.535
Cl	0.650	0.980	0.298	0.848
F	0.115	0.124	0.121	0.113
I	0.132	0.0184	0.000	0.0206
NO ₂	7.71	7.33	8.32	7.20
Soluble OH	0.634	0.738	0.654	1.46
<u>Organic Carbon</u>	<0.05	<0.05	<0.05	<0.05
<u>Solids Conc.</u>				
Total Solids	15.4	15.4	15.4	15.4
Ins Solids	13.00	12.96	12.93	12.78
<u>Volume (gal)</u>	5000	5000	5000	5000

TABLE 3
Final Dimensions Of IDMS Coupons

IDMS Rack Location	Coupon Location	Material Type	Coupon No.	Length (in)	Width (in)	Hole Dia. (in)	Thickness (in)
SRAT/SME	V	HC22W	1	2.005	0.750	0.391	0.115
SRAT/SME	V	HC276W	1	1.990	0.765	0.391	0.110
SRAT/SME	V	6B	3	1.503	0.755	0.372	0.131
SRAT/SME	V	ST6	1	1.609	0.859	0.370	0.233
SRAT/SME	V	HA25W (s)	2	1.005	0.755	0.390	0.117
SRAT/SME	V	CW7MW	1	2.006	0.766	0.396	0.095
SRAT/SME	V	ALUMINA	1	1.976	0.743	0.368	0.159
SRAT/SME	L/V	HC22W	2	2.002	0.758	0.389	0.116
SRAT/SME	L/V	HC276W	2	1.999	0.770	0.389	0.108
SRAT/SME	L/V	6B	4	1.503	0.755	0.370	0.130
SRAT/SME	L/V	ST6	2	1.608	0.865	0.370	0.219
SRAT/SME	L/V	HA25W (s)	1	1.010	0.751	0.389	0.119
SRAT/SME	L/V	CW7MW	2	2.019	0.745	0.390	0.098
SRAT/SME	L/V	ALUMINA	2	1.978	0.743	0.380	0.159
SRAT/SME Condenser		HG3W (U)	1	3.180	0.752	0.389	0.125
SRAT/SME Condenser		316LW (U)	1	3.175	0.750	0.389	0.112
SRAT/SME Condenser		AL6XNW (U)	1	3.180	0.756	0.383	0.115
SRAT/SME Condenser		317LW (U)	1	3.125	0.757	0.389	0.095
SRAT/SME Condenser		HC22W	3	2.011	0.759	0.391	0.115
SRAT/SME Condenser		HC276W	3	1.993	0.767	0.388	0.111
MWWT		316LW	7	2.000	0.753	0.374	0.115
MWWT		304LW	10	1.991	0.756	0.375	0.104
MWWT		AL6X-NW	5	2.001	0.761	0.388	0.108
MWWT		HC-276W	17	2.014	0.767	0.387	0.110
MWWT		6B	2	1.504	0.755	0.369	0.133
Melter Feed Tank	V	HC22W	5	1.999	0.758	0.389	0.119
Melter Feed Tank	V	HC276W	5	2.020	0.768	0.390	0.111
Melter Feed Tank	V	6B	2	1.504	0.758	0.367	0.132
Melter Feed Tank	V	ST6	5	1.590	0.755	0.368	0.253
Melter Feed Tank	V	HA25W (s)	3	1.006	0.755	0.388	0.121
Melter Feed Tank	V	CW7MW	4	2.018	0.768	0.393	0.118
Melter Feed Tank	V	ALUMINA	3	1.978	0.757	0.367	0.152
Melter Feed Tank	L/V	HC22W	4	2.002	0.754	0.390	0.121
Melter Feed Tank	L/V	HC276W	6	1.991	0.765	0.389	0.112
Melter Feed Tank	L/V	6B	1	1.502	0.755	0.370	0.132
Melter Feed Tank	L/V	ST6	4	1.591	0.841	0.368	0.233
Melter Feed Tank	L/V	HA25W (s)	4	1.007	0.759	0.387	0.114
Melter Feed Tank	L/V	CW7MW	3	2.009	0.763	0.392	0.108
Melter Feed Tank	L/V	ALUMINA	4	1.965	0.745	0.376	0.155
Quencher	Inlet	ALLCORRW (s)	1	1.014	0.763	0.389	0.074
Quencher	Inlet	HC276W (s)	1	1.002	0.771	0.387	0.111
Quencher	Inlet	8727 (s)	1	1.006	0.749	0.374	0.085
Quencher	Inlet	HC22W (s)	6	2.000	0.756	0.388	0.119
Quencher	Inlet	I671 (s)	1	1.030	0.750	0.375	0.120
Quencher	Inlet	I690W (s)	1	1.003	0.750	0.387	0.119
Quencher	Inlet	HA556 (s)	1	1.006	0.758	0.390	0.118
Quencher	Inlet	6BLC (s)	1	1.034	0.744	0.370	0.085
Quencher	Inlet	I625W (s)	1	1.009	0.765	0.389	0.115
Quencher	Inlet	CW7MW (s)	1	0.997	0.760	0.390	0.117

V = Vapor Zone
L = Liquid Zone
L/V = Liquid/Vapor Zone

W = Welded Coupon
(U) = U-Bend Specimen
(s) = Small Flat Coupon

TABLE 3 (Cont.)

Final Dimensions of IDMS Coupons

IDMS Rack Location	Coupon Location	Material Type	Coupon No.	Length (in)	Width (in)	Hole Dia. (in)	Thickness (in)
Quencher	Outlet	ALLCORRW	1	1.999	0.767	0.389	0.095
Quencher	Outlet	ALLCORRW	2	1.992	0.765	0.389	0.089
Quencher	Outlet	HC276W	7	1.979	0.764	0.389	0.111
Quencher	Outlet	HC276W	8	1.998	0.760	0.389	0.111
Quencher	Outlet	HC22W	7	2.000	0.755	0.389	0.117
Quencher	Outlet	HC22W	8	2.000	0.755	0.392	0.117
Quencher	Outlet	I625W	1	2.007	0.748	0.390	0.117
Quencher	Outlet	I625W	2	2.019	0.769	0.389	0.116
Quencher	Outlet	CW7MW	5	2.013	0.768	0.393	0.113
Quencher	Outlet	CW7MW	6	2.016	0.768	0.394	0.102
SAS		ST6	6	1.647	0.804	0.370	0.230
SAS		ALLCORRW	3	1.997	0.767	0.389	0.098
SAS		6B	7	1.502	0.756	0.370	0.131
SAS		HC22W	14	2.000	0.758	0.391	0.115
SAS		HC276W	13	1.996	0.764	0.390	0.113
Off-Gas Condenser	Inlet	HC276W	9	2.002	0.769	0.390	0.109
Off-Gas Condenser	Inlet	317LW (U)	2	3.125	0.759	0.382	0.094
Off-Gas Condenser	Inlet	HC22W	9	1.980	0.759	0.390	0.118
Off-Gas Condenser	Inlet	AL6XNW (U)	2	3.175	0.755	0.391	0.115
Off-Gas Condenser	Drain	HC276W	10	1.999	0.760	0.389	0.110
Off-Gas Condenser	Drain	317LW (U)	3	3.125	0.763	0.390	0.091
Off-Gas Condenser	Drain	HC22W	10	1.999	0.760	0.391	0.121
Off-Gas Condenser	Drain	AL6XNW (U)	3	3.165	0.756	0.389	0.117
OGCT	V	HC22W	13	1.999	0.759	0.389	0.115
OGCT	V	HC276W	11	1.998	0.766	0.390	0.108
OGCT	V	CW7MW	7	2.006	0.768	0.392	0.098
OGCT	V	ST6	7	1.602	0.834	0.369	0.230
OGCT	V	HA25W (s)	5	0.999	0.756	0.389	0.122
OGCT	V	6B	6	1.497	0.754	0.371	0.132
OGCT	L	HC22W	12	1.992	0.753	0.388	0.118
OGCT	L	HC276W	12	1.999	0.759	0.390	0.112
OGCT	L	CW7MW	8	2.014	0.762	0.397	0.099
OGCT	L	ST6	8	1.620	0.838	0.368	0.220
OGCT	L	HA25W	6	1.993	0.768	0.386	0.122
OGCT	L	6B	5	1.502	0.753	0.370	0.131
HEME	Inlet	AL6XNW	4	1.997	0.760	0.390	0.111
HEME	Inlet	HC276W	14	2.000	0.766	0.389	0.111
HEME	Inlet	316LW (U)	2	3.240	0.756	0.389	0.109
HEME	Inlet	304LW (U)	1	3.175	0.762	0.390	0.113
HEME	Outlet	317LW	1	2.008	0.762	0.389	0.105
HEME	Outlet	AL6XNW	2	2.004	0.767	0.390	0.113
HEME	Outlet	316LW	8	1.998	0.745	0.375	0.112
HEME	Outlet	304LW	9	1.995	0.755	0.375	0.111
HEPA	Inlet	317LW	2	2.006	0.760	0.391	0.106
HEPA	Inlet	AL6XNW	3	2.002	0.761	0.389	0.109
HEPA	Inlet	316LW	3	1.996	0.770	0.387	0.098
HEPA	Inlet	304LW	3	1.997	0.769	0.390	0.092

V = Vapor Zone
L = Liquid Zone
L/V = Liquid/Vapor Zone

W = Welded Coupon
(U) = U-Bend Specimen
(s) = Small Flat Coupon

TABLE 4

Final Weights And Weight Change Calculation For IDMS Coupons

IDMS Rack Location	Coupon Location	Material Type	Coupon No.	Initial Weight* (g)	Final Weight (g)	Weight Change (g)
SRAT/SME	V	HC22W	1	22.1693	22.1717	0.0024
SRAT/SME	V	HC276W	1	22.0781	22.0795	0.0014
SRAT/SME	V	6B	3	18.1085	18.1069	-0.0016
SRAT/SME	V	ST6	1	40.3343	40.3303	-0.0040
SRAT/SME	V	HA25W (s)	2	11.1865	11.1868	0.0003
SRAT/SME	V	CW7MW	1	18.4065	18.4044	-0.0021
SRAT/SME	V	ALUMINA	1	13.3970	13.3962	-0.0008
SRAT/SME	L/V	HC22W	2	22.8065	22.8062	-0.0003
SRAT/SME	L/V	HC276W	2	22.0029	22.0028	-0.0001
SRAT/SME	L/V	6B	4	18.2035	18.2020	-0.0015
SRAT/SME	L/V	ST6	2	38.5938	38.5812	-0.0126
SRAT/SME	L/V	HA25W (s)	1	11.2009	11.2011	0.0002
SRAT/SME	L/V	CW7MW	2	19.4842	19.4817	-0.0025
SRAT/SME	L/V	ALUMINA	2	13.3328	13.3346	0.0018
SRAT/SME Condenser		HG3W (U)	1	32.0015	32.0192	0.0177
SRAT/SME Condenser		316LW (U)	1	28.6703	28.6883	0.0180
SRAT/SME Condenser		AL6XNW (U)	1	30.4406	30.4521	0.0115
SRAT/SME Condenser		317LW (U)	1	24.4498	24.4628	0.0130
SRAT/SME Condenser		HC22W	3	23.0813	23.0861	0.0048
SRAT/SME Condenser		HC276W	3	22.1704	22.1697	-0.0007
MWWT		316LW	7	20.1692	20.1685	-0.0007
MWWT		304LW	10	19.4694	19.4685	-0.0009
MWWT		AL6X-NW	5	20.4082	20.4087	0.0005
MWWT		HC-276W	17	22.3438	22.3440	0.0002
MWWT		6B	2	18.5337	18.5336	-0.0001
Melter Feed Tank	V	HC22W	5	22.5704	22.5718	0.0014
Melter Feed Tank	V	HC276W	5	21.6912	21.6925	0.0013
Melter Feed Tank	V	6B	2	18.2622	18.2627	0.0005
Melter Feed Tank	V	ST6	5	37.1386	37.1413	0.0027
Melter Feed Tank	V	HA25W (s)	3	11.3039	11.3047	0.0008
Melter Feed Tank	V	CW7MW	4	22.7386	22.7395	0.0009
Melter Feed Tank	V	ALUMINA	3	13.0519	13.0510	-0.0009
Melter Feed Tank	L/V	HC22W	4	22.7645	22.7681	0.0036
Melter Feed Tank	L/V	HC276W	6	21.6486	21.6528	0.0042
Melter Feed Tank	L/V	6B	1	18.2145	18.2144	-0.0001
Melter Feed Tank	L/V	ST6	4	38.5446	38.5484	0.0038
Melter Feed Tank	L/V	HA25W (s)	4	10.6580	10.6590	0.0010
Melter Feed Tank	L/V	CW7MW	3	20.1882	20.1910	0.0028
Melter Feed Tank	L/V	ALUMINA	4	13.0477	13.0534	0.0057
Quencher	Inlet	HA556 (s)	1	9.8420	9.8142	-0.0278
Quencher	Inlet	I625W (s)	1	9.8718	9.8381	-0.0337
Quencher	Inlet	CW7MW (s)	1	9.7851	9.7410	-0.0441
Quencher	Inlet	HC22W (s)	6	22.5802	22.3109	-0.2693
Quencher	Inlet	I671 (s)	1	9.9768	9.8179	-0.1589
Quencher	Inlet	I690W (s)	1	9.4146	9.2497	-0.1649
Quencher	Inlet	ALLCORRW (s)	1	6.3369	6.2233	-0.1136
Quencher	Inlet	HC276W (s)	1	9.6959	9.5026	-0.1933
Quencher	Inlet	6BLC (s)	1	7.5153	7.3413	-0.1740
Quencher	Inlet	8727 (s)	1	7.0436	6.8187	-0.2249

* See Reference 2

V = Vapor Zone
 L = Liquid Zone
 L/V = Liquid/Vapor Zone

W = Welded Coupon
 (U) = U-Bend Specimen
 (s) = Small Flat Coupon

TABLE 4 (Cont.)

Final Weights And Weight Change Calculation For IDMS Coupons

IDMS Rack Location	Coupon Location	Material Type	Coupon No.	Initial Weight* (g)	Final Weight (g)	Weight Change (g)
Quencher	Outlet	ALLCORRW	1	17.4982	17.5019	0.0037
Quencher	Outlet	ALLCORRW	2	15.7689	15.7718	0.0029
Quencher	Outlet	HC276W	7	21.5529	21.5482	-0.0047
Quencher	Outlet	HC276W	8	21.4353	21.4303	-0.0050
Quencher	Outlet	HC22W	7	21.5448	21.5975	0.0527
Quencher	Outlet	HC22W	8	22.1526	22.1556	0.0030
Quencher	Outlet	I625W	1	20.9760	20.9793	0.0033
Quencher	Outlet	I625W	2	21.6140	21.6179	0.0039
Quencher	Outlet	CW7MW	5	21.4257	21.4186	-0.0071
Quencher	Outlet	CW7MW	6	19.1589	19.1467	-0.0122
OGCT	V	HC22W	13	22.0451	22.0470	0.0019
OGCT	V	HC276W	11	21.1929	21.1917	-0.0012
OGCT	V	CW7MW	7	18.0509	18.0449	-0.0060
OGCT	V	ST6	7	37.6655	37.6682	0.0027
OGCT	V	HA25W (s)	5	No Initial Data	11.1645	No Initial Data
OGCT	V	6B	6	18.0946	18.0906	-0.0040
OGCT	L	HC22W	12	21.7607	21.7627	0.0020
OGCT	L	HC276W	12	21.3489	21.3496	0.0007
OGCT	L	CW7MW	8	17.9248	17.9223	-0.0025
OGCT	L	ST6	8	37.3585	37.3593	0.0008
OGCT	L	HA25W	6	No Initial Data	25.0116	No Initial Data
OGCT	L	6B	5	18.0749	18.0765	0.0016
Off-Gas Condenser	Inlet	HC276W	9	21.6785	21.6776	-0.0009
Off-Gas Condenser	Inlet	317LW (U)	2	24.0720	24.0659	-0.0061
Off-Gas Condenser	Inlet	HC22W	9	22.4036	22.4050	0.0014
Off-Gas Condenser	Inlet	AL6XNW (U)	2	30.2956	30.2965	0.0009
Off-Gas Condenser	Drain	HC276W	10	21.7680	21.7696	0.0016
Off-Gas Condenser	Drain	317LW (U)	3	23.2278	23.2285	0.0007
Off-Gas Condenser	Drain	HC22W	10	22.7220	22.7240	0.0020
Off-Gas Condenser	Drain	AL6XNW (U)	3	30.6502	30.6520	0.0018
SAS		ST6	6	38.0081	38.0099	0.0018
SAS		ALLCORRW	3	17.8572	17.8586	0.0014
SAS		6B	7	18.1119	18.1121	0.0002
SAS		HC22W	14	21.7792	21.7808	0.0016
SAS		HC276W	13	21.8224	21.8230	0.0006
HEME	Inlet	AL6XNW	4	30.9693*	19.3848	Initial Data Incorrect
HEME	Inlet	HC276W	14	22.0572	22.0559	-0.0013
HEME	Inlet	316LW (U)	2	28.6703	28.6616	-0.0087
HEME	Inlet	304LW (U)	1	28.9064	28.8586	-0.0478
HEME	Outlet	317LW	1	18.3992	18.3998	0.0006
HEME	Outlet	AL6XNW	2	20.3229	20.3248	0.0019
HEME	Outlet	316LW	8	19.2118	19.2061	-0.0057
HEME	Outlet	304LW	9	19.5396	19.5309	-0.0087
HEPA	Inlet	317LW	2	18.7209	18.7222	0.0013
HEPA	Inlet	AL6XNW	3	19.6882	19.6901	0.0019
HEPA	Inlet	316LW	3	18.9071	18.9063	-0.0008
HEPA	Inlet	304LW	3	16.2592	16.2592	0.0000

* See Reference 2

V = Vapor Zone
L = Liquid Zone
L/V = Liquid/Vapor Zone

W = Welded Coupon
(U) = U-Bend Specimen
(s) = Small Flat Coupon

TABLE 5

Results Of Examination Of Quencher Inlet Corrosion Coupons

Corrosion Coupon	Machining Marks	End Grain Attack	Pitting Corrosion	Crevice Corrosion	General Non-Uniform	Weight Loss (%)
Hastelloy C-22	Gone Outside Washer, Present under washer	1	1	2	3	1.19
Inconel 625	Still visible under and outside washer	1	2	1	2	0.34
Duriron CW7M	Still visible under and outside washer	1	2	1	1	0.45
Hastelloy C-276**	Present under washer Gone outside washer	2	2	1	4	1.99
Haynes 8727	Marks are still somewhat visible. Material is hard so marks were not very deep originally.	2	2	1	3	3.19
Inconel 671	Gone outside washer Present under washer	4	3	1	1	1.59
Inconel 690 ***	Most are gone	4	3	1	3	1.75
Haynes 556	Slightly visible under washer	1	3	3	2	0.28
Teledyne-Allyvac Alcorr*	Slightly visible under washer Gone outside washer	3	3	3	2	1.79
Stellite 6BLC	Slightly visible under washer Most gone outside washer	1	4	4	4	2.32

* Material of construction for DWPF primary Quencher.

** Material of construction for DWPF backup Quencher and IDMS Quencher.

*** Material of construction for DWPF and IDMS Off-Gas Film Cooler.

Note - Material relative rankings from 1 to 4 with:

- 1 - No indications
- 2 - Minor attack
- 3 - Moderate attack
- 4 - Definite attack but satisfactory

TABLE 6

Pit Dimensions Of Quencher Inlet Corrosion Coupons

Alloy	Coupon ID	Pit Depth (in)	Length (in)	Width (in)
Teledyne-Allvac Allcorr	ALLCORRW (1)	0.0026 0.0022	0.0190 0.0182	0.0215 0.0200
Hastelloy C-276	HC276W (1)	0.0012 0.0023	0.0137 0.0116	0.0113 0.0194
Hastelloy C-22	HC22W (6)	0.0010 0.0017	0.0046 0.0050	0.0100 0.0062
Inconel 690	I690W (1)	0.0012 0.0040	0.0101 0.0076	0.0305 0.0339
Inconel 671	I671 (1)	0.0014 0.0027	0.0126 0.0177	0.0116 0.0150
Inconel 625	I625W (1)	0.0011 0.0033	0.0365 0.0084	0.0398 0.0388
Haynes 556	HA556 (1)	0.0028 0.0076	0.1287 0.0961	0.0671 0.1911
Haynes 8727	8727 (1)	0.0013 0.0025	0.0074 0.0157	0.0085 0.0185
Stellite 6BLC	6BLC (1)	0.0022 0.0036	0.0602 0.0138	0.3127 0.0321
Duriron CW7M	CW7MW (1)	0.0024 0.0025	0.0081 0.0124	0.0087 0.0122

TABLE 7

**Pit Dimensions On 317LW (1) U-Bend Specimen From
 Off Gas Condenser Vapor Inlet**

Pit Depth (in)	Length (in)	Width (in)
0.0017	0.2176	0.0435
0.0020	0.0857	0.0580
0.0046	0.1363	0.0845

TABLE 8

**Pit Dimensions On 316LW (2) and 304LW (1) U-Bend Specimens From
 HEME Inlet**

304LW (1)			316LW (2)		
Pit Depth (in)	Length (in)	Width (in)	Pit Depth (in)	Length (in)	Width (in)
0.0122	0.1265	0.0354	0.0058	0.0652	0.0478
0.0029	0.1997	0.1010	0.0022	0.1865	0.0820

FIGURE 1

Schematic Of IDMS Showing Locations Of Corrosion Coupons And The Materials Of Construction Of The Various Process Vessels

■ - Corrosion Rack Location

FIGURE 2

SRAT/SME Vapor Space Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 3

SRAT/SME Liquid/Vapor Zone Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 4
SRAT/SME Vapor And Liquid/Vapor Zone Corrosion Coupons
Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

SRAT/SME
(Vapor Space)

(1/2)

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SRAT/SME
(Liquid/Vapor Zone)

(2/2)

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FIGURE 5

SRAT/SME Condenser Vapor Inlet Corrosion Coupon Rack

**Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack**

FIGURE 6

SRAT/SME Condenser Vapor Inlet Corrosion Coupons

**Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)**

**HG3W
(1)**

**HC22W
(3)**

**HC-276W
(3)**

**317LW
(1)**

**AL6X-NW
(1)**

**316LW
(1)**

**SRAT
Condenser**

(1/1)

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FIGURE 7

Mercury Water Wash Tank Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 8

Mercury Water Wash Tank Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURE 9

Melter Feed Tank Vapor Space Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

VAPOR
(TOP)

LIQUID/VAPOR
(BOTTOM)

Corrosion Rack - C-276
Teflon Device Washers

FIGURE 10

Melter Feed Tank Liquid/Vapor Zone Corrosion Coupon Rack
Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

Corrosion Rack - C-276
Teflon Grevice Washers

FIGURE 11

Melter Feed Tank Vapor Space And Liquid/Vapor Zone Corrosion Coupons
 Photograph Following Cleaning With Soap And Water
 (Negative No. EE52535-A)

Melter Feed Tank
 (Liquid/Vapor Zone)

(2/2)

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MATERIALS TECHNOLOGY SECTION

FIGURE 12

Quencher Inlet Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 13

Quencher Inlet Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

Quencher
(Inlet)

(1/1)

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FIGURE 14

Quencher Inlet Corrosion Coupons

Photograph Showing End-Grain Attack (Mag. ~ 4X)
(Negative No. EE22529-A)

FIGURES 15a & b

Quencher Inlet Corrosion Coupons

(Mag. 4X)

Figure 15a. Photograph
Hastelloy C-22 coupon. Slight
crevice attack is evident.
(Negative No. EE22529-A).

(Mag. 4X)

Figure 15b. Photograph of
Inconel 625 coupon showing
slight pitting attack.
(Negative No. EE22529-A).

FIGURES 16a & b

Quencher Inlet Corrosion Coupons

(Mag. 4X)

Figure 16a. Photograph of Teledyne-Allyvac Allicorr coupon showing pitting and crevice attack. (Negative No. EE22529-A).

(Mag. 4X)

Figure 16b. Photograph of Inconel 690 coupon showing pitting attack. (Negative No. EE22529-A).

FIGURES 17a & b

Quencher Inlet Corrosion Coupons

(Mag. 4X)

Figure 17a. Photograph Duriron CW7M coupon showing some pitting outside ceramic washer. (Negative No. EE22529-A).

(Mag. 4X)

Figure 17b. Photograph of Hastelloy C-276 coupon showing mainly general corrosive attack. (Negative No. EE22529-A).

FIGURES 18a & b

Quencher Inlet Corrosion Coupons

(Mag. 4X)

Figure 18a. Photograph of Haynes 556 coupon showing pitting and crevice attack. (Negative No. EE22529-A).

(Mag. 4X)

Figure 18b. Photograph of Inconel 671 showing pitting generally outside washer region. (Negative No. EE22529-A).

FIGURES 19a & b

Quencher Inlet Corrosion Coupons

(Mag. 4X)

Figure 19a. Photograph of Haynes 8727 coupon showing some pitting and general non-uniform corrosion. (Negative No. EE22529-A).

(Mag. 4X)

Figure 19b. Photograph of Stellite 6BLC coupon showing severe pitting outside and underneath washer. (Negative No. EE22529-A).

FIGURES 20a & b

Quencher Inlet Inconel 690 Corrosion Coupon

(Mag. 40X)

Figure 20a. Photomicrograph exhibiting localized corrosion of Inconel 690 coupon. End-grain attack is shown on left edge (Etch 5% Nital, 6 Volts). (Negative No. EE52599-A).

(Mag. 100X)

Figure 20a. SEM image showing severe end-grain attack of Inconel 690 coupon. (Negative No. EE22544-A).

FIGURES 21a & b

Quencher Inlet Teledyne-Allvac Allcorr Corrosion Coupon

(Mag. 40X)

Figure 21a. Photomicrograph showing pitting corrosion of Allcorr coupon (Etch 5% Nital, 6 Volts). (Negative No. EE52598-A).

(Mag. 100X)

Figure 21b. SEM image showing end of Allcorr coupon. (Negative No. EE22544-A).

FIGURE 22

Quencher Outlet Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 23

Quencher Outlet Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURE 24

Off-Gas Condensate Tank Vapor Space Corrosion Coupons
Photograph Prior To Cleaning* (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

* Rack had to be reinstalled immediately after coupons were removed so photographs of the coupons on the rack were not taken.

FIGURE 25

Off-Gas Condensate Tank Liquid Zone Corrosion Coupons
Photograph Prior To Cleaning* (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

* Rack had to be reinstalled immediately after coupons were removed so photographs of the coupons on the rack were not taken.

FIGURE 26

Off-Gas Condensate Tank Corrosion Coupons
 Vapor Space And Liquid Zone
 Photograph Following Cleaning With Soap And Water
 (Negative No. EE52535-A)

CW7MW
(7)

HC22W
(12)

HC-276W
(11)

ST6
(6)

SB
(5)

HA25W
(5)

OGCT (Vapor Space)

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CW7MW
(7)

HC22W
(12)

HC-276W
(11)

ST6
(6)

SB
(5)

HA25W
(5)

OGCT (Liquid Zone)

(2/2)

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MATERIALS TECHNOLOGY SECTION

FIGURE 27

Off-Gas Condenser Vapor Inlet Corrosion Coupon Rack*

**Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack**

* Photograph is mislabeled should be Off-Gas Condenser Vapor Inlet

FIGURE 28

Off-Gas Condenser Vapor Inlet Corrosion Coupons

**Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)**

FIGURE 29a And b
Off-Gas Condenser Vapor Inlet

(Mag. 4X)

Figure 29a. Photograph of U-bend corrosion coupon 317LW (1) showing pitting attack under Teflon washer. Pits were not observed in any other region. (Negative No. EE52531-A).

(Mag. 50X)

Figure 29b. Photomicrograph of pit from U-bend corrosion coupon 317LW (1). No SCC was observed. (Negative No. EE22532-A).

FIGURE 30

Off-Gas Condenser Drain Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 31

Off-Gas Condenser Drain Corrosion Coupons
Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURE 32

Steam Atomized Scrubber Drain Line Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 33

Steam Atomized Scrubber Drain Line Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURE 34

HEME Inlet Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 35

HEME Inlet Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURES 36a & b

HEME Inlet

(Mag. 4X)

Figure 36a. Photograph of U-bend corrosion coupon 304LW (1) from HEME Inlet showing pitting attack under Teflon washer. Pits were not observed in any other region. (Negative No. EE52531-A).

(Mag. 4X)

Figure 36b. Photograph of U-bend corrosion coupon 316LW (1) from HEME Inlet showing pitting attack under Teflon washer. Pits were not observed in any other region. (Negative No. EE52530-A).

FIGURE 37

HEME Outlet Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 38

HEME Outlet Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

FIGURE 39

HEPA Inlet Corrosion Coupon Rack

Photograph Prior To Cleaning (Negative No. EE52534-A) and
Schematic Showing Location Of Coupons On Rack

FIGURE 40

HEPA Inlet Corrosion Coupons

Photograph Following Cleaning With Soap And Water
(Negative No. EE52535-A)

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