U.S. Department of Energy
[redacted]
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

APR 1 6 2007

07-WTP-094

Mr. C. M. Albert, Project Manager
Bechtel National, Inc.
2435 Stevens Center Place
Richland, Washington 99354

Dear Mr. Albert:

CONTRACT NO. DE-AC27-01RV14136 – TRANSMITTAL OF THE U.S. DEPARTMENT OF ENERGY, OFFICE OF RIVER PROTECTION (ORP) DESIGN ASSESSMENT REPORT NUMBER D-06-DESIGN-031: REVIEW BECHTEL NATIONAL, INC. (BNI) GLASS FORMER STORAGE FACILITY (GFSF)

ORP conducted an assessment of BNI's GFSF Design to evaluate: 1) the adequacy of the GFSF equipment within the Balance of Facility, High-Level Waste, and Low-Activity Waste Facilities; and 2) whether all safety structures, systems, and components are incorporated within the GFSF design. The Design Assessment Team evaluated BNI's GFSF design with an understanding that the design has not been finalized. The results of this assessment are identified in section 4.0, *Results,* of the GFSF Report (Attachment 1). The GFSF plan by which the assessment was performed is also attached (Attachment 2). ORP did not identify any Findings or Observations. However, ORP identified nine assessment follow-up items (AFI) which are described throughout section 4.0, *Results,* and section 7.0, *Recommendations, Assessment Follow-up Items (AFI), Observations, or Findings,* of the GFSF Report.

Additional action, by BNI, as a result of this assessment is not required. ORP will re-evaluate the AFIs once BNI's GFSF design matures.

If you have any questions, please contact me, or your staff may call Robert W. Griffith, Acting Director, WTP Project Engineering Division, (509) 372-2821.

Sincerely,

John R. Eschenberg, Project Manager
Waste Treatment and Immobilization Plant Project

WTP:MAR

Attachments: (2)

cc w/attachs:
D. Burks, BNI
W. Clements, BNI
W. S. Elkins, BNI
G. Shell, BNI
BNI Correspondence

DESIGN OVERSIGHT REPORT

REVIEW
BECHTEL NATIONAL, INC.
GLASS FORMER STORAGE FACILITY (GFSF)

MARCH 2007

DESIGN OVERSIGHT: D-06-DESIGN-031

Team Lead:

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EXECUTIVE SUMMARY

The objectives of this assessment were to evaluate (1) the adequacy of the Glass Former Storage Facility (GFSF) receipt, storage, transport and blending equipment design within the Balance of Facilities, High-Level Waste and Low-Activity Waste facilities, and (2) whether all safety structures, systems, and components (SSC) are incorporated within the GFSF design. Bechtel National, Inc. (BNI) personnel stated that the GFSF design is currently 80% complete. In 2004, BNI awarded a contract to Dynamic Air, Inc. (DA) for the design and supply of the GFSF equipment. DA is a designer and supplier of bulk storage equipment.

This Assessment Report is an evaluation of the GFSF design in relation to contract requirements. In addition, the adequacy of the GFSF design was evaluated with respect to designs and reports of leading industry bulk solid storage equipment designers. Jenike and Johanson, Inc. (J&J) is one of the leading specialists in the field of bulk solid storage engineering in the United States. The J&J reports are a forensic analysis of previous bulk solid storage equipment failures. These reports identified common bulk solid storage equipment design problems, construction issues, system effectiveness, and safety of bulk solid storage systems. Additionally, in 2001 J&J completed material property flow testing on the WTP glass former chemicals (GFC), which BNI is utilizing to design the GFSF equipment. The J&J reports that the team reviewed are listed in Section 8.0 of this report.

The Design Assessment Team (Team) determined that the most effective way to design the GFSF equipment is to first understand the GFC material properties and how GFCs flow through equipment. The J&J reports listed that the number one cause of bulk solid storage equipment failures resulted from designers designing equipment without a thorough understanding of material properties and material flow properties. The Team verified that BNI started the GFSF design by first testing the GFCs to gain an understanding of the GFC material properties and GFC flow properties. BNI's GFC test requirements and test results are documented in BNI documents such as 24590-CM-POA-MH00-00001-12-00002, *GFSF Specification*, 24590-CM-POA-MH00-00001-03-00001 *Pilot Test Procedure*, and 24590-CM-POA-MH00-00001-12-00002, *Pilot Test*. BNI utilized full-scale test equipment to test the 13 WTP GFCs and is utilizing the resulting test data to design the GFSF equipment. The Team verified that BNI is utilizing the GFC test results to design GFSF equipment through spot-checking BNI's GFSF equipment design calculations.

The Team did not identify any findings, observations, or recommendations. However, the Team identified nine Assessment Follow-up Items (AFI), which are listed in Section 7.0 and discussed throughout Sections 4.0. These AFIs identify the U.S. Department of Energy's future evaluation of the equipment design, electrical design, software development, equipment testing, maintenance plans, and inspection plans once the GFSF design matures.

TABLE OF CONTENTS

ACRONYMS

AFI	Assessment Follow-up Item
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CETL	Clemson Environmental Technology Laboratory
DA	Dynamic Air, Inc.
DOE	U.S. Department of Energy
EFRT	External Flowsheet Review Team
GF	glass former
GFC	glass former chemicals
GFSF	Glass Former Storage Facility
HLW	High-Level Waste
HP	High Precision
ISARD	Integrated Sample and Analysis Requirements
ISM	Integrated Safety Management
ITS	important-to-safety
J&J	Jenike and Johanson, Inc.
LAW	Low-Activity Waste
LOI	line of inquiry
MCC	Motor Control Center
MFPV	Melter Feed Prep Vessel
ORP	Office of River Protection
PSAR	Preliminary Safety Analysis Report
QA	quality assurance
QC	quality control
SSC	structures, systems, and components
Team	Design Assessment Team
UPS	uninterruptible power supply
WTP	Waste Treatment and Immobilization Plant

1.0 INTRODUCTION

The U.S. Department of Energy (DOE), Office of River Protection's (ORP) mission is to retrieve and treat Hanford Site tank waste and close the tank farms to protect the Columbia River. In order to complete one major component of this mission, ORP awarded Bechtel National Inc. (BNI) a contract for the design, construction, and commissioning of the Waste Treatment and Immobilization Plant (WTP) Project at the Hanford Site in Richland, Washington. In order to meet the requirement of the WTP contract, DE-AC27-01RV14136, to support the continuous vitrification process, BNI is constructing the Balance of Facilities (BOF). BOF consists of various utilities and service facilities such as the Glass Former Storage Facility (GFSF). This facility will handle large quantities of dry glass forming chemicals (GFC) used in the vitrification facilities to make borosilicate glass.

2.0 BACKGROUND

BNI stated that the GFSF design is approximately 80% complete. Throughout this report, the acronym GFSF refers to the BOF glass former (GF) equipment, Low-Activity Waste (LAW) GF equipment and High-Level Waste (HLW) GF equipment. In 2004, BNI awarded a contract to Dynamic Air Inc. (DA) to design and supply the GFSF equipment, electrical, instrumentation and control system, as well as the small GFC blend facility. According to DA's schedule (24590-CM-POA-MH00-00001-02-00001), the design and fabrication of the GFSF equipment is scheduled to be completed by mid 2007.

The BOF GFSF equipment is comprised of GFC receiving equipment, storage silos, weigh hoppers, blend silos, and transport equipment used to transfer the GFCs. The GFCs are transported from the BOF material receipt area (GFSF foundation-pad) to the GF mixers located within the LAW and HLW vitrification buildings. The LAW GF equipment consists of two mixers, and two inert-fill hoppers. Equipment within HLW consists of two mixers. In addition, a small blend building will be constructed on the GFSF equipment foundation-pad. To the east of the GFSF equipment foundation-pad, a GFSF electrical/control building will also be constructed.
The objectives of this assessment were to evaluate the GFSF design related to the following areas: (1) the functional and operational adequacy of the design, (2) how the design met WTP contract requirements, (3) whether all GFSF safety structures, systems and components (SSC) were incorporated into the design, and (4) whether the results of all BNI GFSF design reviews were incorporated in the design. These objectives are also defined within Section 1.3 of the GFSF Design Assessment Plan, (Attachment 2).

3.0 OBJECTIVES, SCOPE AND APPROACH

3.1 Objectives

The objectives of this assessment were to evaluate the GFSF design related to the following areas: (1) the functional and operational adequacy of the design, and if the design met WTP contract requirements, (2) whether all GFSF SSCs were incorporated into the design, and (3) whether the results of all BNI GFSF design reviews were incorporated in the design. These objectives are also defined within Section 1.3 of the GFSF Design Assessment Plan, (Attachment 2).

3.2 Scope

The scope of the GFSF Design Assessment included an evaluation of BNI's GFSF equipment design within BOF, LAW, and HLW. This assessment did not include an evaluation of the GFSF's ability to meet WTP extended throughput requirements.

The Design Assessment Team (Team) evaluated both BNI and subcontractor GFSF design documentation such as GFSF drawings, specifications, calculations, test results, datasheets, and design change requests. The Team also evaluated BNI's GFSF Model in relation to how well this model simulates GFSF operations.

3.3 Approach

The approach for assessing the adequacy of the GFSF design was based on evaluating the facility's ability to provide correct GFC batches to the HLW and LAW Facilities. There are no specific WTP contract requirements regarding the design and construction of the GFSF other then general statements for the delivery and transport of GFC materials to support the vitrification process. The Design Assessment Team reviewed high-level documents such as the WTP Contract, Basis of Design, Operations Requirements Document, Safety Requirements Document, and Preliminary Safety Analysis Report (PSAR) to obtain a broad understanding of the GFSF requirements. In order to perform a detailed assessment of the Contractor's GFSF design, the Assessment Team evaluated lower-level documents such as BNI's GFSF engineering specifications, calculations, equipment datasheets, and vendor documents. The Design Assessment Team also developed lines of inquiry (LOI) and met with BNI Engineering personnel during the investigation phase of the GFSF/GF assessment.

In addition, the adequacy of the Contractor's design was evaluated in relation to lessons learned reports from leading industry bulk solid storage equipment designers and operators. Jenike and Johanson Inc. (J&J) is a leading specialist regarding bulk solid storage engineering in the United States. J&J completed forensic analysis reports describing common bulk solid storage design problems that led to equipment failures during operations. These reports identified sound bulk solid storage design and construction practices, system effectiveness, and safe bulk solid storage practices. In 2001, J&J completed material property flow testing on WTP glass former chemicals (GFC), which BNI is utilizing to design the GFSF equipment. The J&J reports that the team reviewed are identified in Section 8.0 of this report.

4.0 RESULTS

The Design Assessment Team evaluated the GFSF design (BOF GF design, HLW GF design, LAW GF design, electrical/instrumentation and control (I&C) design, along with safety requirements. The functional capability of the GFSF ensuring GFC delivery to the vitrification buildings is dependent on the following: (1) adequacy of the design specifications outlining the civil, structural, mechanical, electrical, and I&C equipment requirements; (2) successful contract execution implemented by BNI and subcontractors; as well as (3) operational and maintenance procedures. The following sections are a summary of the Assessment Team's evaluation of the GFSF design.

4.1 Glass Former Storage Facility (GFSF) located in Balance of Facilities (BOF)

BOF GF equipment is the core of the GFSF design, enabling the transfer of blended GFCs to the vitrification facilities. The GFC consist of silica, zinc oxide, ferric oxide, zircon sand, lithium carbonate, sodium carbonate, boric acid, aluminum silicate, titanium dioxide, magnesium silicate, calcium silicate, borax, and sucrose. The following is a brief description of the BOF GF equipment:

a. Truck Unloading area (bulk dry materials are pneumatically unloaded into 13 GF storage silos)
b. Thirteen GF storage silos (GFC are pneumatically transferred from silos into weigh hoppers)
c. Five Weight Hoppers (after each GFC is weighed, they are gravity fed to the transporters)
d. Five Transporters (GFCs are pneumatically transferred to blending silos)
e. One Blend Building containing
    - Two Blending Silos (one LAW and one HLW; GFCs are gravity fed to transporters)
    - Two Transporters (blended GFCs are pneumatically transferred to LAW or HLW mixers)
f. One Reject Hopper (GFCs can be sent to reject hopper if GFC batch is not correct)
g. One Trim Hopper (used only to transport glass chemical trim to HLW)
h. One Electrical Motor Control Center (MCC) Building
i. Support Equipment:
    - Three air compressors (supplying 372 acfm at 100 psi; two operate with one spare)
    - One air dryer (removes moisture from the air before entering in the GFSF system)

Three of the J&J reports the Assessment Team reviewed, *Silo Failures – Why do They Happen, Load Development and Structural Consideration,* as well as *Silo Failures – Case Histories and Lessons Learned*, describe technical deficiencies during design, construction, and operations that led to failure of bulk solid storage equipment. Section 4.1.1 of this report describes some of these technical deficiencies, and how BNI is designing and constructing GFSF equipment to avoid these deficiencies. Section 4.1.4 is an assessment of the BOF GFSF safety and contract requirements.

4.1.1 Evaluation of BNI's GFSF Design Considering Some Common Deficiencies/Failures Described in the J&J Reports

1. **Avoiding Design Deficiencies and Inadequate Material Flow Knowledge:** The most common design deficiency, within the bulk solid storage industry, is designing equipment without clearly understanding the flow properties of the materials being stored/used. One design shortcut described was when engineers designed equipment utilizing flow property data from previous or similar materials versus physically testing the materials to be stored/used. Consequently, the use of inadequate test data led to material flow issues such as material ratholing, arching/ bridging, within bulk storage equipment. Inadequate material flow, over time, can lead to equipment failure during operations. According to the J&J reports reviewed, understanding flow properties of the materials being stored is paramount before engineers start designing equipment.

   The Team agrees with BNI's decision to start the GFSF design by having DA complete material flow tests, utilizing samples of the 13 GFCs that will be stored/used at WTP. These test results are documented within BNI document 24590-CM-POA-MH00-00001-12-00002, *Pilot Test*, dated July 14, 2005. The tests were conducted by the subcontractor Dynamic Air (DA) located in St. Paul, Minnesota. The objective of the pilot test was to obtain property flow information relative to how the GFCs flowed within DA's full-scale equipment. In addition, the GFC property flow information will be utilized to design the GFSF equipment. The following paragraph (a.) contains a synopsis of DA's GFC property flow tests; paragraph (b.) contains the Assessment Teams evaluation of the pilot test.

a. BNI's Material Flow Test: The pilot test consisted of the following: (1) GFC feeder tests, (2) GFC pneumatic conveying tests, (3) air blending tests, and (4) mixing tests:

- GFC Feeder Tests were completed to document the material feed rates, feed times, air consumption, pressure requirements, and gravity flow rates for each of the GFCs from the silos through feeders to the hoppers. Initially, all of the GFCs were tested using a 4-inch High Precision (HP) Dyna Slide in automatic and manual mode. (See Dyna Slide picture below; Dyna Slides are used to convey GFCs from silos to hoppers.)

  A Dyna Slide was tested in manual mode to determine the maximum and minimum GFC feed rates. In addition, the Dyna Slide was tested in automatic feed control to determine whether the Dyna Slide feeder could accurately feed GFCs within (+/-) 0.5% of the target weight.

  The Dyna Slide tests indicated that a 4-inch HP Dyna Slide can be used satisfactorily for all but four of the 13 GFC materials. These four GFCs will require the following equipment:

  Accu-Flo Screw Feeder Series 495 (pictured at right): (S*crew feeders are required for the following GFCs versus the Dyna-Slides in order to maintain a consistent GFC material flow*.)

  – Titanium Dioxide and 6-inch screw feeder is required.
  – Ferric Oxide a 6-inch screw feeder is required.
  – Zinc Oxide, a 9-inch screw feeder is required.

  Larger Dyna Slide:
  – Magnesium Silicate, a 6-inch HP Dyna Slide is required.

- GFC Pneumatic Conveying Test: Tests were conducted for each of the 13 GFC materials to optimize efficiency, reliability, and overall quality of the material conveying process. Full-scale test equipment was utilized consisting of a storage hopper with Vibra-jet aerators, gravity fill chute, 10 cubic-foot transporter, and 100 feet of 3-inch conveying line. Several conveying tests were performed to determine the optimum system settings for each GFC. The detailed results of this testing are as shown in Table 3.1 of the Pilot Test Report (24590-CM-POA-MH00-00001-12-00002).

- Hopper Air Blend Testing: DA conducted blend tests for the LAW A44 and HLW 98/96 GFSF recipes utilizing full-scale test equipment. The blend test equipment consisted of a blend hopper fitted with a 12 port Blendcon Air Blender and a catch drum for discharging the GFC material. The information obtained from these recipe blend tests demonstrated the following:

  – Using 12 Port Blendcon Air Blenders at the bottom of the cone section of the hoppers will adequately blend each GFSF recipe within 20 to 30 pulses. The picture to the right, taken from DA's website, shows the 12 Port Blendcon Air Blenders that will be used in the GFSF hoppers.

  – The LAW A44 recipe blend test resulted in a mixing index of 0.979; the HLW 98-96 recipe blend test resulted in a mixing index of 0.950.

  – In addition, an independent laboratory (third-party test laboratory) analyzed the blended material and confirmed that both the LAW A44 and HLW 98-96 recipes were effectively blended.

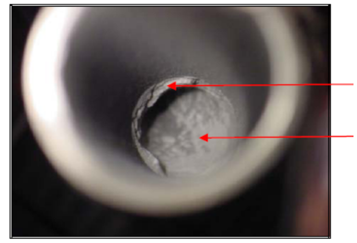
  – The blend effectiveness results are shown in Table 4.4 of DA's Pilot Test Report. These results also meet the requirements listed in paragraph 3.1.2.9 of BNI's GFSF specification, 24590- BOF-3PS-G000-T0007.

  LAW and HLW Mixer Effectiveness and Mixer Dust Mitigation: DA tested how well the GFC batches, which included LAW and HLW simulated recipes, were mixed within DA's Bella mixers. The bullets below describe the (1) mixing effectiveness results of the GFC batches, and (2) tests that were independently conducted to develop strategies to mitigate air borne fines (dust) during delivery of the GFC batches to the Melter Feed Prep Vessel (MFPV).

  – MIXING EFFECTIVENESS: During the pilot test, DA demonstrated a mix effectiveness index of 0.959 for the HLW 98-96 recipe and a mix effectiveness index of 0.973 for the LAW A44 recipe. These mixing indices are within the Good (0.90 - 0.94) to Excellent (>96) range as specified in BNI's GFSF specification, 24590-BOF-3PS-G000-T0007, Section 2.3.1. In addition, these mix effectiveness indices are higher then BNI's specified minimum mixing index of 0.85 or better before discharging GFC batches to the MFPV.

  – DUST MITIGATION: Prior to DA's pilot test, BNI and DOE jointly conducted independent pilot and bench tests to test the GFC delivery system. A pilot test was assembled at the Clemson Environmental Technology Laboratory (CETL) under the direction of the Savannah River National Laboratory. Representative GFC blends were utilized to determine the behavior of the dry chemicals when transported through a chute and discharged into the enclosed head space of an agitated tank. The need for dust mitigation was discovered when air was injected into the system at the point where GFCs were added to the chute. Injecting air was effective in reducing

GFCs from clumping within the chute; however, an accumulation of air borne fines (dust) was seen within the chute between the mixer and tank (tank-simulated WTP's MFPV). The photo at right illustrates the GFC air borne fines (dust) accumulation within the test chute during the CETL tests.



This dust accumulation led to additional CETL tests to mitigate the chute dust buildup. These additional tests showed that adding water (a wetting agent) to the LAW and HLW GFC mix recipes would effectively mitigated dust accumulations. An upper limit of water that could be added to the mixers was set at 10% (by weight).

DA utilized the CETL test information as bounding conditions along with BNI's GFSF Specification during DA's LAW and HLW mixer effectiveness testing. The last bullet in paragraph (b.) below describes the Assessment Team's evaluation of DA's mixing effectiveness within the LAW and HLW mixers.

b. <u>The Design Assessments Teams Evaluation of the Pilot Test</u>: The Team agrees with BNI's decision to physically test the 13 GFC flow properties before starting to design the GFSF equipment. Testing the GFC flow properties, before starting equipment design, is also consistent with the J&J reports that the Team reviewed. The pilot test results have given DA vital information regarding: (1) GFC material properties, as well as (2) an understanding of how the 13 GFCs will behave and flow through silos, bins, hoppers, feeders, and other handling equipment. The Assessment Team concurs with the following BNI design decisions implemented as a result of information obtained during the GFC material pilot test.

- <u>GFC Silos and Hoppers</u>: Vibra-Jet bin/cone aerators (Series 683, Model K) will be positioned around the silos cone sections. These Vibra-Jets will be used to direct compressed air in timed pulses (generally less than every .5 seconds) to coincide with the start of silo discharge. The use of Vibra-Jets will reduce the coefficient of friction that exists between the cone wall and the GFC material, aiding in a continuous discharge of stored GFC material.

- <u>Pneumatic Conveying GFC Material</u>: The pilot test demonstrated that air boosters spaced every 10 feet along the pneumatic lines were adequate for all GFCs except zinc oxide and magnesium silicate. These two GFCs required a 5-foot booster spacing. DA is designing an air booster spacing very 5 feet along all of the individual GFC pneumatic conveying pipelines.

- <u>GFC Feeders</u>: The results of the pilot test regarding GFC feeders demonstrated that a 4-inch HP Series Dyna-Slide will be used for all of the GFCs except for magnesium silicate, titanium dioxide, zinc oxide, and ferric oxide. See paragraph (a), above, for additional information.

- <u>Air Blended Batches</u>: Blend equipment tested with the LAW A44 recipe results in a mixing index of 0.979; the HLW 98-96 recipe blend test resulted in a mixing index of 0.950. The GFSF blend equipment being designed will achieve a slightly higher mixing index then the minimum mixing index specified in Section 3.1.2.9 of the GFSF Specification, 24590-BOF-3PS-G000-T00007. The minimum mixing index specified in the GFSF specification is 0.90

- LAW and HLW Mixer (Mixing Index): The minimum mixing index specified in BNI's GFSF Specification will be exceeded by adding 4% water to the LAW A44 recipe and adding 5% water to the HLW 98-96 recipe. Section 3.2.6.4 of the GFSF Specification identifies a mixing index of 0.85 for the LAW and HLW mixers before discharging to the melter feed preparation vessels (MFPV). The specific mixing indices are listed under the bullet above "LAW and HLW Mixer Effectiveness." The bullets below are the Assessment Team's evaluation of the LAW and HLW mixer test that were performed during the pilot test.

  - GFC MIXER AND RECIPE LAW 44: Testing confirmed that a 4% liquid addition by weight will be added to effectively mitigate airborne dust. However, as water was added, a GFC buildup was found on the paddles and corners of the mixer. The design of the Bella 10,000-XN mixers has been modified to minimize these buildup areas by adding nylon-coated agitator paddles, and reducing the total flat surface area on the interior of the mixer.

  - GFC MIXER AND RECIPE HLW 98-96: Testing confirmed that a 5% liquid addition by weight will be added to effectively mitigate airborne dust. However, as water was added, a GFC buildup was found on the paddles and corners of the mixer. As more water was added, the GFCs adhered to the inside of the mixer and lumps started to form. The lumps ranged from 1/8 inch to approximately 1/2 inch in diameter, and were soft and easily broken when squeezed.

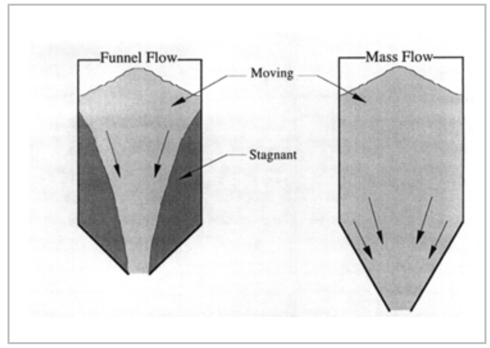
    The design of the Bella 6,000-XN mixers is being modified to minimize the GFC buildup areas by adding nylon-coated agitator paddles and reducing the total flat surface area on the interior of the mixer. Also, to break up the lumps, another pin mill operation to the post-mix cycle is being added.

  - ADDITIONAL MELTER TEST: After experiencing the lumps in recipe HLW 98-96 (described above), BNI tested an additional LAW recipe (LAW B96). LAW B96 was chosen for this additional test because it included lithium carbonate and sodium carbonate, both of which were not included in LAW A44, but are present in HLW 98-96. By conducting this test, BNI verified that the LAW B96 recipe with a 4% water addition would not form GFC lumps within the mixer. As in the test for LAW A44, the 4% liquid addition to LAW B96 was very effective at mitigating air borne dust. Although the test results indicated that the GFC recipe LAW B96 would not form lumps, the Bella 10,000-XN LAW mixers will be fitted with rnounting plates for easy installation of a pin mill system that will break up lumps if lumps do occur during WTP operations.

All testing was completed in a controlled environment. During WTP operations, the blending and transport functions, aside from the mixer functions, will be conducted outside. Even though the test environment was not the same as what is expected during WTP operations, the Team agrees that the testing provided valuable information about GFC material properties and flow properties in order to effectively design/construct an adequate GFSF system.

2. **Common Material Flow Problems**: Even if designers understand the flow properties of material being stored/used, common flow problems such as ratholing, arching, and bridging can occur. The Assessment Team discovered that BNI included the following design features to decrease the probability of flow problems within the GFSF equipment.

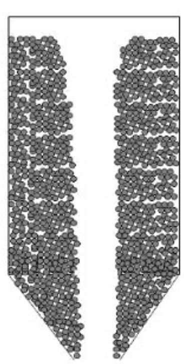
   a. "First in First Out (FIFO)": The ideal discharge mode is one where, at steady state, all material flows without obstruction, and material that enters the silos/equipment first will be the first to exit the silos/equipment. This flow pattern is called FIFO. The GFSF equipment has been designed with the FIFO concept. FIFO is also known as "Mass Flow" (see diagram to the right). Funnel flow occurs when the equipment is not sufficiently steep and smooth to force material to flow/slide along the interior walls. The Assessment Team found that BNI has adequately designed the GFSF silos and equipment in relation to material flow properties, structural materials, coatings, as well as equipment angles and geometries, to ensure an adequate flow/FIFO operation. Silos are constructed of A-36 carbon steel with a cone section angled to promote FIFO material flow. The GFSF equipment is sufficiently designed to avoid the following material flow problems:

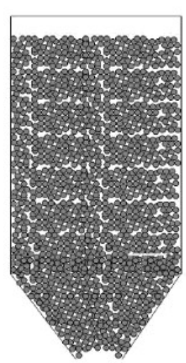


   - Ratholing and Arching/Bridging (the Ratholing and Arching diagrams below are from the www.chemicalprocessing.com website)

     – RATHOLING: Occurs when a stable, nearly vertical flow channel empties from within the silos/equipment and the surrounding material remains stagnant.

     – ARCHING/BRIDGING: Occurs at the outlet of bulk handling equipment because this is where the bin cross-section is narrowest. The minimum outlet size in bulk storage equipment that can overcome arching is directly related to the GF materials cohesive strength.


RATHOLING


ARCHING

b. Design Oversight Teams Assessment of the GFSF Design and Avoiding GFC Flow Problems: The GFC's susceptibility to ratholing or arching is primarily related to the material cohesiveness, while the GFC flow pattern is dependent upon internal friction and equipment friction. According to the J&J reports, the FIFO design provides optimal conditions to prevent ratholing or arching/bridging, optimal discharge rate, and the optimal conditions for laminar flow in vessel discharge, gravity chutes, or other GFC equipment. The Team agreed that BNI's pilot test identified the GFCs flow properties related to cohesive properties, wall friction properties, and the material compressibility/permeability. According to the J&J reports, identifying these properties and using these property values to design the GFSF equipment is paramount in order to design an adequate system. The Team conducted a sample evaluation of the GFSF equipment calculations and verified that DA utilized the GFC flow property test results to develop the geometric design of the GFSF equipment.

3. **Structural Design**: BNI's GFSF Structural Load Path Component List, No. 24590-CM-POA-MH00-00001-07-00007, Rev. 00A, defines structural load path as "Any component whose purpose is to support, restrain or hold down a piece of GFSF equipment, instrument, platform, walkway or pipe." Bulk storage equipment experiences both static and dynamic loads which can co-exist on the GFSF equipment due to the GFC materials being stored, discharged, and recharged. Structural design of the GFSF equipment requires knowledge of material flow, and the distribution of pressures and stresses will affect the equipment. The information below lists some common structural design and bulk solid material flow issues that can affect the structural integrity of the GFSF equipment. Also, listed below is the Team's evaluation of how BNI is designing the GFSF equipment to avoid the common flow or structural issues:

   a. Thermal Ratcheting: Thermal ratcheting is a phenomenon affecting the silo walls of outdoor metal silos. The silo walls expand during the daytime, causing the stored material level to lower. At night, when temperatures are cooler, the silo walls contract, which causes increased tensile stresses on silo walls as the stored material tries to return to its original level (see Table 1, LOI No. 10). Below is the Team's assessment of how BNI is designing the WTP silos to avoid thermal ratcheting:

      - The Team spoke with a J&J structural engineer in January 2007; he stated that thermal ratcheting can lead to silo failures both in welded and bolted silos. However, bolted silos are more prone to thermal ratcheting due to the increased tensile stresses (hoop stress) at the bolted joints.

      - Both J&J and DA stated that thermal ratcheting is more of a concern in larger diameter silos. Larger diameter silos are designed with the tension in the shell plates due to hoop stress as the controlling factor. Smaller diameter silos are designed with compression stresses as the controlling factor versus hoop stresses.

      - After evaluating J&J's information and DA's silo design, the Team determined that thermal ratcheting has been effectively mitigated due to the following:

         - BOLTED SILOS: Thermal ratcheting can occur in bolted silos due to slippage between the bolt and silo wall if tensile stresses are high enough from expansion and contraction of the walls. The only WTP silo that is bolted is the Silica silo, measuring 78 feet high and 14 feet in diameter. The remaining 12 silos are welded.

The Assessment Team determined that the Silica silo is adequately designed to avoid thermal ratcheting due to the type of bolted connection and weld detail at the bolted connection. [*BNI's Silica Silo drawing* 24590-CM-POA-MH00-00001-08-00110, Rev. 00B *illustrates the Silica silo's bolt – weld (fillet weld all around) detail.*]

- WELDED SILOS: Thermal ratcheting is less likely to occur in welded silos because the stress in the welds is relieved during each expansion and contraction cycle. Also, any stresses that do occur are spread out over the entire shell rather than localized at the shell to bolt connection.
- GFSF SILO CALCULATIONS: The largest silo at WTP, in diameter, is 14 feet and the tallest silo is 78 feet. The controlling stresses in all of the GFSF silos are compression stresses in the shell due to overturning moments from either wind or seismic loadings versus hoop stresses.

- The Borax and Sucrose silos and hoppers are insulated to minimize the effects of direct sun, considering the heat-sensitive material handling characteristics of these bulk solids. The insulation will also aid in avoiding thermal ratcheting.

b. <u>Self-induced Equipment Vibration</u> (caused within silos and equipment due to material flow problems). Vibration (high or low types of cyclic vibration) can cause transient dynamic responses on the GF silos and equipment due to different dynamic load scenarios. These different dynamic load scenarios can be caused from eccentric loading and discharging, ratholing, and bridging/arching. Vibration can damage equipment walls, weigh cells, and other delicate instrumentation, as well as lead to silo/equipment structural failures. Below is the Team's assessment of how BNI is designing the WTP GFSF equipment to avoid self-induced vibration.

- BNI is designing the GFSF equipment geometry in relation to GFC material flow properties. The GFC flow properties were obtained during the pilot testing, which demonstrated how the GFCs will behave within the GFSF equipment. The GFC material testing also revealed the GFC cohesive properties, wall friction properties, and compressibility and permeability values. These property values are also being used to decide which equipment materials to use and whether coatings or linings are needed, such as the following:

  - GFSF silos and hoppers are being designed with a smooth interior to alleviate GFC material flow issues. By choosing steel silo material and specifying a smooth interior surface, this will lessen friction and buildup of GFCs between the material and equipment walls.

  - The LAW and HLW mixers are being designed with nylon-coated agitator paddles and a reduced total flat surface area on the interior of the mixer in an effort to reduce friction and aid in optimal material flow.

  - GFSF silos hoppers and mixers are concentrically loaded and discharged to lesson the possibility of adverse vibration responses.

- BNI is approving all submittals before construction begins and planning on conducting a quality control (QC)/quality assurance (QA) visit to the vendor to assure a quality product.

- GFSF Vibra-Jet Cone/Bin Aerators cycle on and off when material is being discharged from silos. The Vibra-Jets will cycle on and off in zones to facilitate concentric discharge.

  – A single Vibra-Jet will be utilized for a continuous dry air (-40°F Dew Point) blanket, which promotes positive air flow up through the material and out through dust filter vents. (see Table 1, LOI No. 09)

c. Bending of Circular Walls: This can be caused by eccentrically loading and discharging GFCs from equipment. BNI silo calculations No. 24590-CM-POA-MH00-00001-13-00001 through 00008 and hopper calculation No. 24590-CM-POA-MH00-00001-13-00038 include a factor for eccentric loading. Also, Vibra Jets will prevent formation of eccentric flow channel while discharging.

- Bending Moment: The BNI has minimized bending moments resulting from non-uniform GFC loading or discharging by loading and discharging the silos at the geometric (concentric) center (see Table 1, LOI No.08).

- Lateral Pressures and Hoop Stresses: These stresses can occur on silo walls due to moisture migration between stagnant areas of GFCs. As stated in Table 1, LOI No. 11, the silos will not experience GFC moisture migration since dry air will flow from the bottom to the top of the silos by way of a single Vibra-Jet.

4. **Construction**: During construction, activities, poor workmanship, and uneven settlement are common problems leading to the following deficiencies. The Assessment Team discovered that BNI through their QA/QC program frequently conducts vendor shop visits and verifies contract compliance in the field. In addition, BNI holds weekly subcontractor meetings to discuss progress of design and fabrication efforts. DOE attends these meetings and verifies the meetings are beneficial in facilitating resolution of design/fabrication efforts. DA will begin fabrication after they receive BNI approval of all submittals, which will aid in reducing poor construction issues.

a. Uneven Settlement: This can occur by inadequate compaction, using wrong materials, or not using adequate reinforcement. The Design Assessment Team evaluated this portion of the design, because if uneven settlement occurred this would cause the GFSF equipment to fail; i.e., structural failure of the silos. If a silo fell, due to their size and resultant high center of gravity, this could cause a hazard to surrounding workers, as well as disrupt WTP operations until the silo was replaced. The Silica silo is the largest silo; dimensions with support are 78’-4” high and 14’-0” nominal diameter with a center of gravity at 51’-6 15/16” above ground level.

- BNI designed and constructed the GFSF foundation. The Assessment Team discovered that BNI designed the foundation after receiving all equipment calculations from DA and general arrangement details. However, the Team was not able to assess the foundation design in relation to whether the design included the optional GFSF equipment. Assessment Follow-up Item (AFI) **D-06-Design-031-AFI-01** identifies further evaluation of the GFSF foundation design.

b. Welding: The pressure vessels and all of the silos except for the Silica silo will be welded. The Team discovered that contractors/subcontractors are required to submit welding procedures and plans according to the American Welding Society (AWS) D1.1, *Structural Welding Code - Steel,* and American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*. Both of these codes are specified in BNI's GFSF specification. However, the codes do not require contractors/subcontractors to submit individual welder certifications unless the contract specifically requires that welder certifications be submitted. The GFSF equipment that requires welding are the two 3.750 gallon air compressors, one 750 cfm air dryer, three 75-horse power air compressors, and 12 of the 13 silos. The Team reviewed the subcontractor's available welding procedures and found the procedures to be acceptable. Since not all of the welding procedures have been submitted and the equipment is in the beginning stages of design/construction, the Team identified AFI **D-06-DESIGN-031-AFI-02** to re-evaluate vendor welding procedures and the progress of welded construction. The following bullets outline the GFSF welding design that will be re-evaluated:

- Imperial, Inc. (silo vendor): Fabrication of the silos started the end of January 2007. BNI's QC and QA inspectors stated that their first periodic visit to Imperial's shop, January 2007, was completed, and that they did not find any unsatisfactory welds or construction. This bullet identifies a re-evaluation of BNI's QA inspection at Imperial to review the vendor's general welding progress, and to perform a visual inspection of welder certification per welded equipment.

  - If the silo interiors are not constructed or welded properly, ratholing or arching could occur, causing material flow problems that can result in self-induced vibration of the silo walls. According to the J&J reports that the Team reviewed, silo self-induced vibration has led to structural failure within the bulk storage equipment industry.

- GFSF Welding: The WTP Contract, BNI, and subcontractors do not require that the contracted welders submit welder certifications for approval. Welder certifications state information such as the welders name, length of training, as well as type and position of weld that the welder is certified to perform. BNI personnel stated that BNI conducts vendor site inspections to examine in process construction/fabrication. AFI **D-06-DESIGN-031-AFI-02** also identifies the review of BNI's site inspection documentation for welded GFSF equipment.

5. **Maintenance and Adequate Inspection**: Three types of important maintenance are preventive maintenance, periodic inspection, and repair. BNI has not developed GFSF equipment maintenance, testing, and inspection procedures. The future evaluation of maintenance, testing, and inspection plans/requirements by DOE is identified by AFI **D-06-DESIGN-031-AFI-03**.

4.1.2 BNI Designed BOF Buildings Integral to the GFSF

1. BNI's GFSF Specification, 24590-BOF-3PS-T0007, lists two small buildings that are integral to GFSF operations: (1) a small GFC blend structure that houses two blend silos, weigh hoppers, and transporters located on the GFSF equipment foundation-pad; and (2) a GFSF electrical MCC

building located directly to the east of the GFSF foundation-pad. The GFSF MCC houses associated lighting, heating, ventilation and air conditioning (HVAC) equipment, 480V MCC, uninterruptible power supply (UPS), control system panels, lighting panels, building service panel, and all associated transformers and instrumentation.

Since both of these buildings are in the beginning stages of design, AFI **D-06-Design-031-AFI-04** identifies further evaluation of the GFC blend building and GFSF MCC building.

4.1.3 BNI's GFSF Simulation Model

1. The GFSF simulation model was completed by the Lanner Group utilizing WITNESS 2004 (Release 1.0) software. The Assessment Team evaluated this model and discovered that it can be used to evaluate the GFSF system's throughput capacity, reliability, availability, maintainability, and inspectability of all equipment and components that make up the GFSF.

    a. Currently not all of the GFC transfer lines can be simulated from the silos to the GFSF blend silos. Simulation model requirements are specified within BNI's GFSF Specification 24590-BOF-3PS-G000-T0007, Section 3.4, "Performance Requirements," as well as Sections 3.16 and 3.16.1, "GFSF Simulation Model" One of the model requirements is to simulate transport of all 13 GFCs from the GF silos to the LAW and HLW blend silos. Currently the GFSF model simulates all 13 GFCs being transferred to the LAW blend silo, and only 9 of the 13 GFCs transferred to the HLW blend silo.

        - BNI approved this specification change through a Supplier Deviation Disposition Request, 24590-WTP-SDDR-M-06-00345. The 4 GFCs that are not currently included in the simulation model are magnesium silicate, titanium dioxide, zirconium silicate, and ferric oxide. BNI will include these four GFCs within the model simulation at a later date. Since the simulated transfers of these four GFCs are not currently included in the GFSF model, AFI **D-06-Design-031-AFI-05** identifies the re-evaluation of the GFSF model to verify the transfer simulation of all 13 GFCs to the HLW blend silo.

    b. In addition, the Assessment Team discovered that the GFSF simulation model can be incorporated into the WTP process model since the GFSF model was developed utilizing WITNESS software.

4.1.4 GFSF BOF Safety Requirements:

1. **Safety Requirements/Safety Meetings:** No SSCs have been credited with prevention or mitigation of an accident in another WTP facility. Currently, no SSCs have been identified as important-to-safety (ITS). However, BNI is still scheduling Integrated Safety Management (ISM) meetings in relation to:

    a. BNI is conducting ongoing ISM meetings regarding sucrose hazards within LAW, and how to control these hazards; the hazards, identified by BNI, are as follows:

        - When sugar is added to the melter, it reduces nitrates and nitrite in the waste to ammonia. Ammonia with nitrite, nitric acid, and water vapor can form ammonium nitrate through gas or liquid phase reactions. The ammonium nitrate can in turn load the high-efficiency particulate air (HEPA) filters in the LAW Offgas Treatment System and lead to plugging and melter pressurization, producing a toxic offgas (NO_x) release.

- Sucrose evolves gases including hydrogen, carbon monoxide, ammonia, and hydrocarbons that would be flammable hazards in the offgas system.
- The thermolytic evolution of hydrogen in the LAW and HLW MFPV could explode and cause a loss of confinement and associated release of radionuclides.
- BNI will hold ISM meetings regarding the solenoid valve that regulates the air supply to the Sucrose Silo's butterfly valve and whether the solenoid valve needs to be ITS. The butterfly valve regulates the amount of sucrose that is delivered to LAW and HLW.

The further evaluation of ISMS meeting results related to the GFSF design of ITS and non-ITS equipment within the BOF, HLW, and LAW facilities, is identified by AFI **D-06-DESIGN-031-AFI-06**.

2. **GFSF Potential for Sucrose Explosion**: The Assessment Team observed that BNI has reduced the potential for sugar explosions by the following: (a) Very few fines will be generated due to the very low transfer velocities of the Dense Phase Conveying System. (b) Additional screening and analysis was performed on the LAW A44 recipe. Blended and conveyed sample analysis was performed to determine if the recipe was explosive. The results are documented in BNI's Sucrose Explosion Report, No. 24590-CM-POA-MH00-00001/Fike Corporation Laboratory Report No. SCRN10633735. This report identified that LAW A44 is not explosive.

3. **GFC Sucrose Silo and Potential Explosion**: DA's Sucrose Silo design has explosion-proof side panel-vents. There are two of these panels on the Sucrose Silo (each panel is 39-inches by 47-inches). BNI will conduct meetings to determine whether DA's Sucrose Silo design will adequately protect WTP workers if a sucrose explosion occurs. The Sucrose Silo design and explosion potential will be re-evaluated as part of AFI, **D-06-DESIGN-031-AFI-06** identified under Section 4.1.4 (1.a) of this report.

4. **GFSF Chemical Hazards**: Individual GFC chemical hazards are identified in BNI document 24590-WTP-ESH-01-001, *Determination of Extremely Hazards Substance*s, and in the BOF PSAR. The Assessment Team observed that the BOF PSAR Table 3A-10, "Matrix of Possible Interactions of Material in the GFSF," did not show two of the possible GFC hazards identified in the 24590-WTP-ESH-01-001 document. These chemical hazards are (a) borax which reacts with sodium carbonate to produce heat and (b) borax which reacts with zinc oxide to produce water soluble toxic products. During this assessment, both of these reactions were added to the PSAR through safety evaluation 24590-WTP-SE-ENS-06-0223 (See Table 1, LOI no. 22). Also, there are no hazard changes as a result of these added reactions.

   The Assessment Team concluded that the GFC chemical interactions identified within the BOF PSAR will not cause adverse heat generation, soluble toxic products, and/or pressurization effect based on the following:

   a. The Team concludes after analyzing BNI document, 24590-WTP-RPT-ESH-01-001, *Determination of Extremely Hazardous Substances* that the chemicals once in the hopper will not be in large enough quantities to cause the chemical reactions listed in Table 3A-10.

b. The receiving and offloading equipment will minimize the potential for cross contamination of GFCs during transport to their specified storage silo through administrative controls. In addition, the design will have a visual indication at the receiving station/silo that is electronically linked to the GFSF control room panel lights to prevent an operator from making an incorrect silo selection.

c. The Borax and Sucrose Silos are insulated to minimize the effects of direct sun, considering the heat/temperature-sensitive material (i.e., prevention of material degradation) identified in BNI document SCT-M0SRLE60-00-175-01, *Characterization of HLW and LAW Glass Formers*.

d. The principal reaction would be an acid plus carbonate reaction, which generates carbon dioxide and some heat. The blending silos are well-ventilated by design because they receive/discharge large volumes of bulk material, and are vented under all operating conditions. The majority of each glass former mixture is inert to these reactions; such as silicates or oxides. These inert materials would adsorb heat and limit any temperature increase.

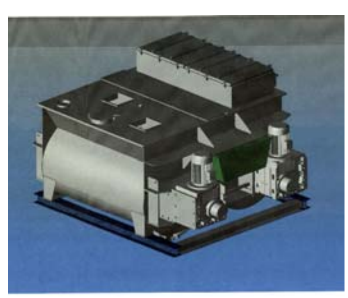
e. Many of the reactions can occur or increase under moist conditions; the GFSF materials are kept dry to facilitate material flow.

5. **GFSF Industrial Safety**: The Assessment Team concurs that the design of the mechanical equipment, walkways, platforms, handrails, access structures, stair cases, doorways, manholes, and access doors, will be designed to meet Occupational Safety and Health Administration (OSHA) safety regulation, as defined in 29 *Code of Federal Regulations* (CFR) Part 1910. In addition to 29 CFR 1910, 29 CFR Part 1910.1200(g), "Hazards Communication Standard," and 29 CFR Part 1910.145, "Specification for accident protection signs and tags," are listed as design requirement in BNI GFSF Specification, Section 2.2.1.

   In section 3.3.3.16 of the BOF PSAR, BNI states that GFSF chemical exposure during normal operations will be controlled to recognized standards through full regulatory conforming design and operating procedures. A chemical hygiene plan will address how to deal with spills and other off-normal incidents. Both the operating procedures and chemical hygiene plan will be prepared in the future to support operations. AFI **D-06-DESIGN-031-AFI-07** identifies DOE's future evaluation of the chemical hygiene plan and operating procedures.

4.2 GFSF LAW and GF HLW Equipment

The Assessment Team evaluated the following BNI, Westinghouse Savannah River Company (WSRC), and J&J reports in relation to the GFC hoppers and mixers:



a. 24590-CM-0POA-MH00-00001-06-00003, *Bella Mixer Dust Mitigation*
b. 24590-101-TSA-10000-0004-148-00001, Mixer Tests at Philadelphia Mixer.
c. WSRC-TR-2003-00209, Evaluation of Wetting Agents to Mitigate Dusting of Glass Forming Chemicals during Delivery to the Melter Feed Preparation Vessel
d. J&J report, Solve Solids Flow Problems in Bins, Hoppers and Feeders

e. J&J report, Fine Powder Flow Phenomena in Bins Hopper
f. J&J report, *Understanding and Eliminating Particle Segregation Problems*

This evaluation is discussed further in the paragraphs below. Also, see section 8.0 for a complete list of documents reviewed by the Team.

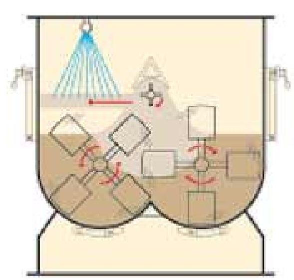
4.2.1 GFSF LAW and HLW Equipment Summary

LAW and HLW equipment consist of two GFSF mixers along with associated piping/valving in each facility. If required, the HLW trim hopper and transporter (located in BOF) can be utilized to transfer individual GFCs to the HLW mixer in order to adjust the glass former recipe to meet regulatory requirements. In addition, the LAW facility will have two inert fill hoppers. These inert fill hoppers will be designed in accordance with the WTP Contract, Specification 2 "Immobilized Low-Activity Waste Product". The inert fill hoppers will be used to fill the void space within the LAW containers. The follow statement is in the WTP Contract, Specification 2 (2.2.2.5) "Void Space":

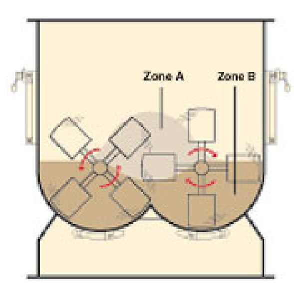
- "The void space in the container is designed not to exceed 10 percent of the total internal volume at the time of filling, excluding void space internal to the glass form (e.g. small bubbles in the glass). After cooling, if necessary the container shall be filled with suitable inert dry filler (silica) such that the void space meets the requirements of Dangerous Waste Regulation WAC 173-303-665(12); i.e. the container shall be at least ninety (90) percent full when placed in the landfill."

The GFCs are blended and transported from BOF through a dense-phase pneumatic conveying system to the GF LAW and HLW mixers. The blended GFCs within the LAW and HLW mixers are then fed to the MFPVs. The LAW GFC mixer is a Bella 10,000-XN mixer and the HLW GFC mixer is a Bella 6,000-XN Mixer. The photo above is an example of the Bella XN mixers. The Assessment Team concluded that the following BNI design features will avoid some of the common mixer deficiencies listed within the J&J reports and BNI Research and Technology work.

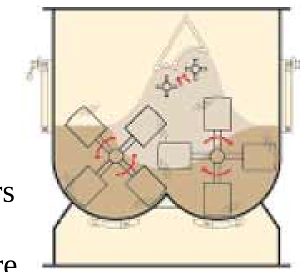
1. **Homogeneous Mix within Mixer**: BNI's full-scale pilot test completed by DA (24590-CM-POA-MH00-00001-12-00002) confirmed that a homogenous mix could be obtained through utilizing a GFC 6,000-XN Bella mixer for LAW and a GFC 10,000-XN Bella mixer for HLW. These mixers (diagrammatic sketch shown to the right) consist of twin drums that have two counter rotating agitators. The mixer paddles are angled to provide a full sweep of the entire drum. GFSF mixers will have the following design features to facilitate homogeneous mixing.



   a. Mixer Weightless Zone: As GFC batches move between Zone A and Zone B (shown in sketch to the right), the rotational motion effectively lifts the ingredients to an almost weightless state (shown as Zone A) allowing the GFCs to move freely regardless of particle size and density. The resultant zone interaction aids in homogeneity and becomes highly efficient as every particle moves rapidly and homogenously.

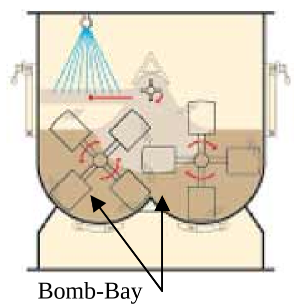


b. Pin Mill System: A pin mill system was added to the LAW and HLW mixers to introduce high shear into the GFC batch during mixing for breaking soft lumps and agglomerates that may be present. The pin mill system (shown in the gray area of the sketch to the right) consists of two rapidly rotating bars with pins and a stationary shroud.



- During DA's pilot testing, when water was added for dust control, the tests demonstrated a GFC buildup on the paddles and interior mixer corners. BNI alleviated this problem by modifying the mixers and adding pin mill operation to the post-mix cycle. In addition, nylon coating was added to the agitator paddles, and the mixers were modified to reduce the total flat surface area within the mixers' interior.

c. Dust Control and Water Addition: The DA pilot test demonstrated that LAW and HLW mixers required an addition of 4% to 5% (by weight) liquid to effectively mitigate airborne dust. The blue area in the sketch to the right shows the liquid addition area.



Bomb-Bay
Discharge Doors

- Since the GFCs within the LAW and HLW mixers tends to agglomerate and lump when water is added, a liquid flow distortion bar will be used to improve performance. The bar consists of a rapidly rotating bar with pins located close together to create a moving curtain of material over the paddles during mixing.

2. **Out of Specified GFC Blend**: BNI is designing the mixers with two "Bomb-Bay" discharge doors (DA's terminology), at the bottom of each mixer drum (see sketch above). These doors are utilized for (1) maintenance and (2) for discharging out-of-specified GFC batch materials.

4.2.2 GFSF LAW and HLW Safety Requirements

1. **LAW GFSF Equipment**: The LAW Glass Former design, to date, does not contain any ITS SSCs. BNI states in the LAW PSAR that there are no SSCs that have been credited with prevention or mitigation of an accident within LAW or another facility. BNI is currently conducting ISM meetings related to:

   a. Previous LAW ISM activities identified three principal hazards associated with excessive additions of sucrose to the process:

   - Sucrose evolves gases including hydrogen, carbon monoxide, ammonia, and hydrocarbons that are flammable hazards in the LAW offgas system.
   - Ammonia in combination with nitrite, nitric acid, and water vapor, can form ammonium nitrate through either a gas or liquid phase reactions.
   - Thermolytic evolution of hydrogen in the MFPV could explode and result in loss of confinement and associated release of radionuclides.

b. Currently, the safety requirements (non-ITS) in the engineering specification for the GFSF (24590-BOF-3PS-T0007) applicable to the LAW equipment include lockable isolation valves to isolate equipment during maintenance. Filters are included on the mixers that exhaust to the atmosphere, and purge air downstream of the mixers are used to prevent air from migrating from the MFPV back into the mixers. These safety features were confirmed on design drawings, 24590-LAW-M6-LFP-00001, Rev. 4, *P&ID Melter Feed Process System Melter 1 Feed Preparation and Feed*; 24590-LAW-M5-V17T-00001, Rev. 0, *Process Flow Diagram LAW Concentrate Receipt & Melter 1 Feed (System LCP, GFR, and LFP)*; 24590-CM-POA-MH00-00001-08-00036, Rev. 00E; *P&ID LAW Mixer #1*; and 24590-CM-P0A-MH00-00001-08-00379, Rev. 00D, *P&ID LAW Inert Fill Hoppers*.

The need for future re-evaluation of ISM meeting results regarding changes/additions of ITS and non-ITS equipment of GFC hazards within BOF, HLW, and LAW is identified by AFI **D-06-DESIGN-031-AFI-06**.

2. **HLW GFSF ITS Equipment**: The GF feed lines provide GFCs to the HLW Melter Feed Preparation Vessels. The glass former feed line isolation valve (slide valve) and purge air limits the release of radiological material from the MFPVs.

   - Safety Class: The GF feed line located between the HLW GFSF mixers and the MFPVs have isolation valves (slide valves) that are Safety Class valves. These slide valves are automatically actuated and close when the MFPVs are in full sparge mode. The safety function of the slide valves will ensure confinement of radioactive materials.
   - Safety Significant: The GF line purge air system is Safety Significant. The air purge valve located between the GF mixers and the HLW MFPVs will prevent air from migrating back into the mixers from the MFPV. The safety function of the GFSF air purge will ensure loss of contamination control protection.

4.3 GFSF Software, Electrical, and Instrumentation and Control

The GF electrical and instrumentation and control (I&C) equipment, and GFSF software are commercial grade; there are no ITS components. The electrical and I&C systems provide the motive power and means of controlling the GFSF equipment/system. High-level documents such as the WTP Contract, Basis of Design, Operations Requirements Document, and PSAR do not directly specify electrical distribution and I&C systems. In order to evaluate the adequacy of the GFSF electrical distribution and I&C systems, the Design Assessment Team evaluated lower-level documents such as the GFSF engineering specifications, datasheets and vendor documents.
The Team assessed the available documents for the adequacy of the GFSF design and to what extent the requirements were satisfied by the vendors performing the design for the respective systems.

The Team discovered that BNI is not finished with the GFSF design including electrical, I&C, and GFSF system software. The Team also discovered that although DA is designing the GFSF electrical and I&C equipment, BNI is developing the GFSF software functional specification and GFSF system software, (see Table 01; LOI No. 25). The Assessment Team identified AFI **D-06-Design-031-AFI-08** to further evaluate the GFSF electrical, I&C, software functional specification, GFSF system software, GFSF control logic diagrams and I&C testing once the BNI design has matured. Evaluating the GFSF design, as identified under AFI D-06-Design-031-AFI-08, is important in order to understand how the GFSF will be operated and controlled during WTP operations.

In addition, BNI did not have datasheets for the low-voltage induction motors, adjustable speed drives, and the UPS equipment as required by BNI's GFSF Specification No. 24590-BOF-3PS-G000-T00007. 24590-BOF-3PS-G000-T00007, Section 3.11.14 requires an instrument database, which was not available during this assessment. Review of this database is important because the database contains all the instrument tags identified in the GFSF procurement. DA will submit the final datasheets and instrument database to BNI as the design matures. The further evaluation of the GFSF datasheets and instrument database is identified by AFI **D-06-Design-031-AFI-09**.

5.0 GFSF ISSUE RESOLUTION AND SYSTEM TESTING

1. BNI resolved issues identified in Issue Resolution Plans (IRP) M16 and P10. These plans were developed as responses to the External Flowsheet Review Team (EFRT) issues. Both M16 and P10 involve GFC analysis related to LAW vitrification. The Design Assessment Team concurs with the IRP team's M16 and P10 GFSF issue resolutions described below:

   - <u>M16, GFC Misbatch of Melter Feed (24590-WTP-PL-ENG-06-0028)</u> – The EFRT determined that there is a significant WTP risk involving incorrect GFCs delivery to the LAW melter feed. If a GFC misbatch were to occur, this could lead to LAW operational problems in the melter due to changes in glass characteristics.
     - BNI revised the Integrated Sample and Analysis Requirements (ISARD) (24590-WTP-PL-PR-04-0001, Rev 1) to include sample point number LAW 6. This sample is taken from LAW's MFPV every 16 hours. This sample is intended to verify that the appropriate GFC mixture has been received within LAW's MFPV.

   - <u>P10, GFC Analysis at Silos (24590-WTP-PL-ENG-06-0039)</u> – The EFRT determined that an incorrect GFC could be delivered to the LAW melter feed if the GFCs coming from BOF GFSF silos were incorrect. BNI has implemented the following actions to ensure correct GFC silo delivery:
     - BNI will utilize the vendor's GFC chemical composition data as verification that the GFCs being delivered from the vendor have the correct chemical composition. This vendor data will be given to the WTP GFSF operator upon GFC silo delivery.
     - BNI will rely on the GFC analysis at the LAW MFPV to ensure that the correct GFC batch was delivered to the LAW Facility, as shown in M16 above.
     - BNI will design administrative controls and procedures (yet to be developed) to assure that the correct GFCs are delivered to the proper GFSF silos.

2. The GFSF design relies heavily on automated systems. Additional testing of GFSF equipment, I&C systems, and software, beyond what is specified in BNI's GFSF Specification (24590-BOF-3PS-G000-T0007), may be required during cold and hot commissioning to ensure a fully functioning GFSF system. The Assessment Team previously identified AFI D-06-DESIGN-031-AFI-08, in Section 4.3 of this report, to further evaluate the GFSF equipment, I&C systems, and software, once BNI's design has matured.

6.0 CONCLUSION

Since BNI's GFSF design is incomplete, the Design Assessment Team could not determine whether the GFSF design (as a whole) was adequately designed and constructed in accordance with the WTP Contract, DE-AC27-01RL14136, and BNI's GFSF Specification, 24590-BOF-3PS-G000-T00007. However, the Team did analyze BNI's GFSF design at the current level of design and construction completion. A description of the Team's assessment results is illustrated throughout Section 4.0 of this report. Also, the team identified nine AFIs that will require further DOE evaluation, once BNI's GFSF design matures; the AFIs are listed throughout Section 4.0 and are re-capped in Section 7.0.

7.0 RECOMMENDATIONS, ASSESSMENT FOLLOW-UP ITEMS (AFI), OBSERVATIONS, OR FINDINGS

The Design Assessment Team did not identify any Findings or Observations during this assessment. However, nine AFIs have been identified and assigned the following numbers. The AFIs will be tracked to closure using the Consolidated Action Reporting System (CARS).

1. **D-06-DESIGN-031-AFI-01**: Further Evaluation of the GFSF foundation design
2. **D-06-DESIGN-031-AFI-02**: Further evaluation of vendor weld procedures and welder certifications
3. **D-06-DESIGN-031-AFI-03**: Further evaluation of the GFSF equipment design along with review of testing maintenance and inspection plan.
4. **D-06-DESIGN-031-AFI-04**: Further Evaluation of the GFC blend building and GFSF Motor Control Center (MCC) building
5. **D-06-DESIGN-031-AFI-05**: Re-evaluation of the GFSF model to verify the transfer simulation of all 13 GFC to the HLW blend silo
6. **D-06-DESIGN-031-AFI-06**: Further evaluation of ISMS meeting results and GFSF design regarding changes/additions of ITS and non-ITS equipment regarding GFC hazards within BOF, HLW and LAW
7. **D-06-DESIGN-031-AFI-07** identifies DOE's future evaluation of the chemical hygiene plan and operating procedures.
8. **D-06-DESIGN-031-AFI-08**: Further evaluation of BNI's GFSF electrical, I&C, software functional specification and system software, control logic diagrams as well as I/C testing
9. **D-06-DESIGN-031-AFI-09**: Further evaluation of the GFSF datasheets and instrument database

8.0 REFERENCES

24590-WTP-PL-ENG-06-0028, *Issue Response Plan for External Flowsheet Review Team (EFRT) Recommendations – M16 Misbatching of Melter Feed*, August 24, 2006.

BNF-003-98-0188, *BNFL Report Glass Formers Characterization*, August 03, 2000.

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24590-CM-POA-MH00-00001-06-00001, *Blending & Full Line Concept*, Rev. 00A, December 21, 2004.

24590-CM-POA-MH00-00001-06-00002, *Pneumatic Truck Unload System*, Rev. 00A, December 21, 2004.

24590-CM-POA-MH00-00001-06-00003, *Bella Mixer Dust Mitigation*, Rev. 00A, December 21, 2004.

24590-CM-POA-MH00-00001-09-00009, *Dynamic Air Pneumatic Conveying Systems*, Rev. 00A, March 22, 2004.

24590-CM-POA-MH00-00001-12-00002, *Pilot Test Report*, Rev. 00C, July 14, 2005.

24590-CM-POA-MH00-00001-13-00024, *Seismic Design Calculations – LAW Mixers*, Rev. 00A, June 22, 2005.

24590-CM-POA-MH00-00001-13-00035, *Weighing Systems*, Rev. 00C, May 13, 2006.

24590-CM-POA-MH00-00001-13-00040, *Mechanical Design Calculations for HLW & LAW Mixers*, Rev. 00B, October 13, 2006.

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24590-LAW-M4C-GFR-00001, *LAW Blended Glass Former Average Densities*, Rev. 0, November 21, 2005.

24590-LAW-M4C-GFR-00002, *Low-Activity Waste Glass Formers Reagent Hopper Batch Capacity Calculation*, Rev. 0, December 18, 2005.

24590-LAW-MEC-LFP-00001, *Design Pressure and Design Temperature Calculation for LFP System*, Rev. B, August 1, 2006.

24590-WTP-DB-ENG-01-001, *Basis of Design*, Rev. 1G, July 5, 2006.

24590-WTP-PL-ENG-06-0028, *Issue Response Plan for External Flowsheet Review Team (EFRT) Recommendations – M16 Misbatching of Melter Feed*, August 24, 2006.

24590-WTP-PL-ENG-06-0029, *Issue Response Plan for External Flowsheet Review Team (EFRT) Recommendations – P10 Glass Formers Analysis at the Silos*, July 25, 2006.

24590-WTP-PSAR-ESH-01-002-03, *Preliminary Safety Analysis Report to Support Construction Authorization; LAW Facility Specific Information,* March 31, 2006.

24590-WTP-PSAR-ESH-01-002-04, *Preliminary Safety Analysis Report to Support Construction Authorization; HLW Facility Specific Information,* March 31, 2006.

24590-WTP-PSAR-ESH-01-002-05, *Preliminary Safety Analysis Report to Support Construction Authorization; BOF Specific Information,* March 31, 2006.

24590-WTP-SED-ENS-03-002-03, *Safety Envelope Document; LAW Facility Specific Information*, March 13, 2007.

24590-WTP-SED-ENS-03-002-04, *Safety Envelope Document; HLW Facility Specific Information*, March 2, 2007.

24590-WTP-SED-ENS-03-002-05, *Safety Envelope Document; BOF Specific Information*, February 21, 2007.

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RPT-W375-SA00001, *Waste Treatment Plant Explosive Hazard Evaluation*, Rev. 0, March 10, 2000.

WSRC-TR-2002-0282, *Characterization of HLW and LAW Glass Formers – Final Report*, Rev. 1, July 15, 2003.

WSRC-TR-2003-00037, *Pilot Scale Testing – Transport of HLW Glass Former Chemicals Proof of Principle Test Results*, Rev. 0, February 26, 2003.

WSRC-TR-2003-00209, *Evaluation of Wetting Agents to Mitigate Dusting of Glass Forming Chemicals during Delivery to the Melter Feed Preparation Vessel*, Rev. 0, June 2003.

TABLE 1: Table 1 contains ORP LOIs and BNI responses to ORP's LOIs. The responses shown below are quoted BNI responses. These responses were used along with GFSF Contract documents (shown in Section 8.0 of this Assessment Report) by the Design Assessment Team to evaluate BNI's GFSF design.

Department of Energy – Office of River Protection: Glass Former Storage Facility and Glass Former Design LINES of INQUIRY (01,02,03) D-06-DESIGN-031		
ORP: Lines of Inquiry (LOI)		**BNI: Contractor Response**
1. Regarding GFSF Spec. 24590-BOF-3PS-G000-T0007, Rev 4, para. 3.2.2.1 *The receiving station shall have the capability of off-load pressure discharged trucks equipped with onboard blowers at a transfer rate of 30,000 lbs.* (1) Is this a typical transfer rate/industry standard for dry chemical delivery trucks?	Ryan	The transfer rate is determined by the equipment onboard the delivery truck. A transfer rate of 30,000 lbs./hr. is not an uncommon rate. It is not necessarily an industry standard.
2. Regarding GFSF Spec.24590-BOF-3PS-G000-T0007, Rev 4, para. 3.2.2.3 *The receiving station shall be supplied with a suitable flexible connection and a quick connector to bulk truck*; and para. 3.2.2.5-states that *Receiving and offloading equipment shall minimize the potential for cross contamination of GFCs during transport to their specified storage silo. The design shall have a visual indication both at the Receiving Station and at the GFSF control room to prevent an Operator from making an incorrect silo selection.* How is this being incorporated into the design: (1) How will offloading equipment minimize the potential of GFC cross contamination during individual silo deliveries if a typical flexible connection at silos and a quick connector to bulk truck is utilized? (2) What visual indication will be utilized both at the receiving station and control room to prevent an operator from making an incorrect silo selection for delivery?	Ryan	1. Each Silo has a separate fill line; each fill line will be tagged with the GFC name, material C of C will be verified against the correct silo level. Silo fill line will have a cap and limit switch with indication in the GFSF control room. 2. Fill line will be tagged and Control room indication of opened fill line.
3. Regarding GFSF Spec.24590-BOF-3PS-G000-T0007, Rev 4, para. 3.2.3.2 and para. 3.2.3.5: How are the silos and hoppers being designed so that if material bridges, aching, ratholing or for some other reason does not flow out of the equipment properly recovery can be made without silo entry?	Ryan	The cone angle, discharge size & aeration devices have all been selected specifically for the application based on actual testing of the GFC's. If ratholeing or bridging does occur, the aeration devices can be manually manipulated to free the bridge or rathole. If this fails one of the aeration device couplings can be utilized to "rod out" the silo.

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ORP: Lines of Inquiry (LOI)		BNI: Contractor Response
4. Regarding GFSF Spec.24590-BOF-3PS-G000-T0007, Rev 4, para. 3.2.3.3: How are the silos (both barrel and cone) and hoppers being designed so that bulk materials can be accurately recovered up to 60 days of inactivity?	Ryan	The silo design a low pressure dry air blanket, which promotes positive displaced air flow to atmosphere. This design eliminates moisture absorption from the atmosphere and ensures the bulk materials flowability characteristics are not degraded, thereby allowing materials to be accurately recovered after up to 60 days of inactivity.
5. In order to control feed rate, how is the GF equipment designed to ensure that the maximum feed rate from the bin will always be greater than the maximum expected operating rate of the feeder?	Ryan	All of the feeders are designed for flood fill conditions & the bins are designed to discharge material at a rate greater than what is required by the feeders.
6. How are the Silos being designed/constructed to meet GFSF Spec.24590-BOF-3PS-G000-T0007, Rev 4, para. 3.2.3.4, which states that *Storage Silos shall be designed to limit moisture absorption from the atmosphere and to maintain a temperature range that ensures bulk material flowability characteristics are not degraded*?	Ryan	All of the silos include aeration devices and a low-pressure dry air (-40 °F Dew Point) blanket from the bottom up. In addition, the Borax and Sucrose silos are insulated to control temperature. This limits moisture absorption from the atmosphere and maintains the temperature range to ensure that the bulk materials flowability characteristics are not degraded.
7. Regarding GFSF Spec.24590-BOF-3PS-G000-T0007, Rev 4, para 3.2.3.7 are the Borax and Sucrose silos and hoppers insulated?	Ryan	The Borax and Sucrose silos are insulated with a spray-on insulating coating. (See par 4.5.2 of G000-T0007 and SDDR M-05-00230) The filling profile has been considered in the silo design.
8. It appears as though the silos are eccentrically filled. What previsions have been made to ensure that the silos can withstand the non-uniform loading conditions and resulting bending moments?	Ryan	The Fill connection for each of the storage silos is at the geometric center of the silo, which will minimize eccentric loading. Silo design calculations (24590-CM0POA-MH00-00001-13-00001 thru 08) include a factor for eccentric loading.
9. Are the Vibra-Jet Bin Aerators designed to cycle on and off regularly to facilitate a concentric discharge and avoid ratholing or arching of GF chemicals? Also, what aerates the silo contents above the cone section?	Ryan	The Vibra-Jet Bin Aerators will cycle on & off only when material is being discharged from the silo. The Vibra-Jets will cycle on & off in zones to facilitate concentric discharge. In addition, a single Vibra-Jet will be utilized for a continuous dry air (-40 °F Dew Point) blanket which promotes positive air flow up through the material & out to atmosphere through the bin vent dust filters on top of the silos.
10. What design features have been incorporated into the silo design/construction to withstand expansion and contraction due to weather conditions in order to prevent thermal ratcheting?	Ryan	None, the silos are all welded construction. ORP NOTE: BNI Provided additional information; see Section 4.1.1(3.a) of this Assessment Report for additional information.

Department of Energy – Office of River Protection:
Glass Former Storage Facility and Glass Former Design LINES of INQUIRY (01,02,03) D-06-DESIGN-031

ORP: Lines of Inquiry (LOI)		BNI: Contractor Response
11. What design features have been incorporated enabling silos to withstand lateral pressures and hoop stresses that can occur due to moisture migration between stagnate areas of the GFCs.	Ryan	None, there will not be moisture migration because of the silo dry air flow from the bottom to the top of the silo.
12. What design features have been incorporated to ensure that the maximum feed rate from cone/bin is always greater than the maximum expected operating rate of the feeder/slide?	Ryan	All of the feeders are designed for flood fill conditions & the bin discharges are sized to discharge at a rate greater than what is required by the feeders.
13. The GF design and pilot test tested GFC blends for mass flow requirements. However, specification T0007, Rev 4, deletes the silo mass flow requirement. How does this affect the pilot test results, GF design and function of the mechanical elements?	Ryan	The "Mass Flow" wording in paragraph 3.2.3.2 of the G000-T0007 specification was changed to "First in - First out" to be more generic ("Mass Flow" is a Jenike & Johanson term) and to more accurately describe the condition that is desired. This change has no effect on the pilot test results, the GFSF design, or function of the equipment.
14. GFSF Spec. 3.2.7.3 *All feeders (or equivalent) shall be provided with isolation valves on inlet side.* Is there still an isolation valve at the inlet side of the feeder?	Ryan	Yes, as shown on the P&IDs, there are slide gate valves at the inlets of each feeder for maintenance purposes.
15. Has the bolt sizing for silo changed from originally specified? If so, how?	Ryan	The silos are all welded construction except for the silica silo, which has a field joint. Bolting design and supply is by the silo vendor. ORP NOTE: Per additional BNI information; One silo, Silica Silo is bolted; no change has been made in original bolt sizes.
16. Will there be any effects/changes on fabrication/procurement of the GFC system equipment/components/piping (silos, weigh hoppers, blenders, mixers, inert fill hoppers, etc.) based on the results of the Silvan corrosion study? If so, what changes are expected? Meeting minutes CCN: 135974 dated August 8, 2006 state DA will include a 0.04" corrosion allowance and will revise drawing accordingly.	Babel	Silvan did not do a "Corrosion Study". BNI typical corrosion allowance for air receivers is 0.04". Originally Silvan included no corrosion allowance in their submitted calculations. They have agreed to add 0.04" to their material thickness with no cost or schedule impacts. Their revised submittal drawings & calculations include this additional material thickness.

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ORP: Lines of Inquiry (LOI)		**BNI: Contractor Response**
17. GFSF Spec.9.10 Design Reviews and Meetings BNI Meeting Minutes CCN: 127785 and CCN: 135974 show items discussed upon the 50% and 80% design reviews. Are items discussed during design reviews tracked individually to resolution, are they tracked to resolution as part of weekly teleconference minutes or is Dynamic Air tracking items to closure and submitting final verification?	Babel	BNI tracks the action items from the design reviews. In this case action items are discussed during the weekly conference calls with Dynamic air and are documented through the weekly conference call meeting minutes.
18. Are HLW and LAW drawings/isometrics of feed chute (piping and valves) and walkways for the mixers and feed chute going from the mixers to the MFPV available?	Babel	Draft Isometric's for the LAW chute are available and have been provided. The HLW chute and platforms have not yet been designed.
19. Has the contractor submitted the instrument database according to Specification para. 3.11.14?	Ramsay	Yes, a preliminary informal submission was made to agree on format. A formal submittal will be made once the list is fully populated.
20. Explain UPS scheme as shown on DRWG # 08-00069 with respect to inverter, battery, etc.	Ramsay	See attached diagram. If there are additional questions they will be addressed separately. ORP NOTE: UPS diagram is sufficient for current level of GFSF design completion. See Diagram below; last page.
21. How are the signals from the humidity transmitters going to be utilized in the control scheme and what drawings detail this?	Ramsay	The signals from the humidity transmitters will be used for monitoring only. A high humidity set point will be used to generate a corresponding alarm to notify the Operator of the condition. System operation will proceed as normal. Final control logic diagrams will include this detail.

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ORP: Lines of Inquiry (LOI)		**BNI: Contractor Response**
22. BOF PSAR Table 3A-10 lists a matrix depicting possible adverse interactions between some of the GFCs when mixed together. When reviewing 24590-WTP-RPT-ESH-01-001, Rev 2, dated 23MAR06, we found that Borax when mixed with Sodium Carbonate also may cause possible adverse reactions if mixed together. This was not listed within BOF PSAR Table 3A-10. Please review these two documents and confirm that both identify all potential chemical interactions with adverse consequences. If BNI concludes the BOF PSAR is in error, in this regard, please identify the ABNCR for this discrepancy.	Ryan	There are two reactions identified in 24590-WTP-RPT-ESH-01-001, Rev. 2 for the GFCs that are not in the BOF PSAR Table 3A-10. Borax with sodium carbonate produces heat, and borax with zinc oxide produces water soluble toxic products. As the design evolves or new hazards or reactions are identified, safety evaluations are performed to capture changes that affect the AB. Both of these reactions are being added to the PSAR via safety evaluation 24590-WTP-SE-ENS-06-0223. There are no changes to the hazards as a result of these added reactions
23. BOF PSAR Table 3A-10 lists a matrix depicting possible adverse interactions between some of the GFC when mixed together. Have ISMS reviews and hazards analyses been performed to quantify hazards when GFCs are mixed in GF Hoppers, Blenders, and Piping, including the hazards associated with the misloading and/or mistransfer of GFC within the silos. Please provide the results.	Ryan	Section 3.3.3.17 of the BOF PSAR discusses the evaluation of the hazard analysis for the glass former storage facility. As described in 24590-WTP-ESH-01-001, the GFCs were not identified as extremely hazardous substances. Chemical reactions from mixing these GFCs are considered industrial hazards within BOF, and there were no consequences identified that required ITS controls. These same chemical reactions between the GFCs would occur in BOF where they are combined and blended, and any effect in other facilities would be reduced. Potential hazards associated with the effect of GFCs to the HLW and LAW process are being evaluated separately.
24. Are there drawings available that detail the enclosures for foundation fieldbus and Profibus terminations (e.g., GFR-PNL-00001, GFR-PNL-00002, GFR-ENCL-00001 and GFR-ENCL-00004)? These drawings probably were part of the basis for the electrical loading and panduit sizing calculations performed for GFSF Control Enclosure 00004.	Ramsay	Dynamic Air has submitted detailed Schematics and Network Diagrams that detail the Foundation Fieldbus and Profibus terminations for all of the enclosures listed.

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ORP: Lines of Inquiry (LOI)		**BNI: Contractor Response**
25. When does BNI plan to have a Software Functional Specification for the GFSF control systems?	Ramsay	The Software Functional Specification will be based on Software Definition Documentation and control logic diagrams submitted by Dynamic Air. These are due be submitted by late in March of 2007. The SFS will not be produced by BNI until late 2007
26. BNI document <u>SCT-M0SRLE60-00-168-01</u> is a summary regarding a trip report involving Jenike and Johanson, Inc. Powder Flow Specialist that SRTC has contracted to measure/characterize the physical properties of the 13 WTP Glass Former Chemicals? How has the results of this report been incorporated into the WTP GF design?	Ryan	The document referenced was utilized for bidding purposes only. Dynamic Air procured samples of each GFC and tested them in their lab. The GFSF design is based on their findings.
27. A Safety Equipment List supplied by the Seller is required by the specs to be submitted at 50% design review and the final submitted at 90% design review, please provide us with a copy?	Ryan	There is no requirement for the vendor to submit a "Safety Equipment List" for the GFSF.
28. Will the HLW Seismic Calculations/Calculations for HLW GF equipment need to be revised using the revised seismic ground motion spectra (RGM)?	Ryan	The HLW glass former Mixers and associated transfer piping system are quality level CM, non-ITS, Seismic Category SC-IV and are designed to UBC-1997. Thus the Revised Ground Motion (RGM) does not impact GFSF equipment and no calculations will be revised.

<u>UPS SCHEMATIC</u>

REFERENCE ORP LOI no. 20 and BNI response above:
DRAWING No. 24590-CM-POA-MH00-00001- 08-00069 with respect to inverter, "Main Elements of UPS System"

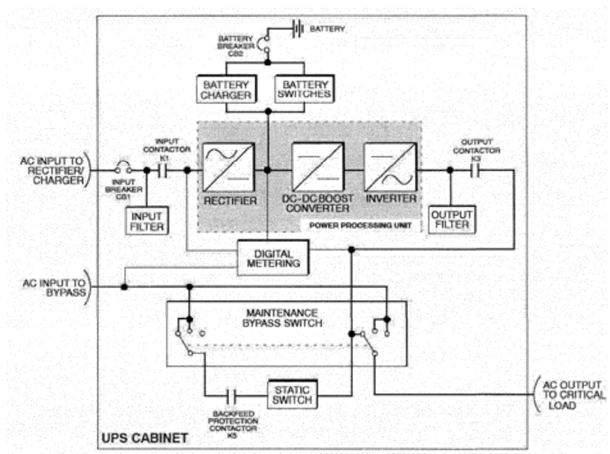

Figure 7–1. Main Elements of the UPS System