WEST VALLEY NUCLEAR SERVICES COMPANY

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Document No.: WVNS-TRQ-019

Title: Test Request SF-12 Vitrification Qualification Run II

Revision: 0

Date: 9/21/89

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WV-1008, Rev. 2
BLB0666:ENG-412

Doc. Number WVNS-TRQ-019

Revision Number 0

Revision Date 9/21/89
Engineering Release # 1684

West Valley Demonstration Project

TEST REQUEST SF-12

VITRIFICATION QUALIFICATION RUN II

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BLB0666:ENG-412

WV-1816

RECORD OF REVISION

PROCEDURE

If there are changes to the procedure, the revision number increases by one. These changes are indicated in the left margin of the body by an arrow (>) at the beginning of the paragraph that contains a change.

Example:

> The arrow in the margin indicates a change.

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	09/89

RECORD OF REVISION (CONTINUATION SHEET)

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REV. 0

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TEST REQUEST SF-12

VITRIFICATION QUALIFICATION RUN II

Rev. 0

1.0 INTRODUCTION

1.1 Test Planning

Run SF-12, Vitrification Qualification Run, will be conducted to invite independent surveillance to verify equipment operability and procedural control. SF-12 is the last test in the FACTS testing program. Results from earlier runs will be included in final test planning. Prototypic Melter Feed Make-Up methods will be used for the feed.

This Test Request is intended to outline the individual run objectives, data, and subsequent output. It serves to communicate run objectives and planned activities to interested organizations prior to the completion of the detailed instructions. Detailed instructions for the run will be included in a Test Procedure. These two test planning documents together with the test reports will satisfy the requirements under Engineering Procedure, EP-11-003, Development Test Control. These documents provide controls complying with the experiment and development test requirements of the OCRWM document, OGR/B-14, Quality Assurance Requirements for High-Level Waste Form Production.

A post-test summary report will be submitted following the run, with a Final Test Report following all of the operations. If all data collection or analysis is not completed at that time the report will be revised under controlled document procedures when the data are ready.

1.2 Run Description

Run SF-12 is the final qualification run of the vitrification equipment, and is last in the FACTS testing series. The run will encompass 45 processing days to test the capability of the vitrification equipment during continuous processing. A target on-line efficiency of 70 percent is necessary to demonstrate a rate sufficient to complete the processing of the High-Level Waste within two years. The aim of the run is to simulate radioactive processing conditions as much as possible. Melter conditions, especially, will be held up to control and performance criterion as in the Waste Acceptance Preliminary Specification (WAPS). The run activities/objectives part of the Test Request has been expanded

into three sections: Section 2.0 will cover waste qualification related items, those parameters directly related to product quality; section 3.0 will cover equipment items, hardware development for the final facility; and section 4.0 will cover process testing items, tests to determine the proper control range for process parameters.

The vitrification process flow sheet for the FACTS testing program is shown in simplified form in figure 1. The process can be broken up into 4 areas: Feed preparation; Vitrification; Off-gas cleanup; and NO_x abatement.

Feed preparation consists of the Temporary Cold Chemical system, the CFMT, the MFHT, and the Slurry Sample station. The CFMT is the collection vessel for all feed components. Feed composition is verified by analytical results before the feed is transferred to the MFHT.

Recycle solution from the SBS will be used in the feed make-up. Recycle from SF-11 will be used for the initial batches, and process recycle accumulated during the run will be used for the succeeding batches.

The Temporary Cold Chemical System, TCCS, will be used, along with the computer programs which will be used to make up feed from a waste stream and Cold Chemicals. Each batch must fit into the feed batch cycle time if Melter operations are to be continuous.

Each of the feed batches will be made-up as follows:

- Waste sludge simulant will be made up and stored in 63D-18, the Outside Feed Storage Tank (OFST).
- The sludge will be transferred to the CFMT. Samples will be drawn and analyzed.
- The sludge will be concentrated and samples of overheads taken to assess losses.
- Based on samples separate batches of glass forming chemicals and waste components necessary to make the target glass, will be made in the TCCS and transferred.
- Samples and shimming will be completed as necessary.

Target concentrations, sampling, and acceptance limits will be specified in the Feed Make-Up Standard Operating Procedure and implementing Work Order. Summary of the feed make-up, analytical results, and acceptance will be included in the Test Summary Report.

SF-12
SLURRY FEED FLOW DIAGRAM

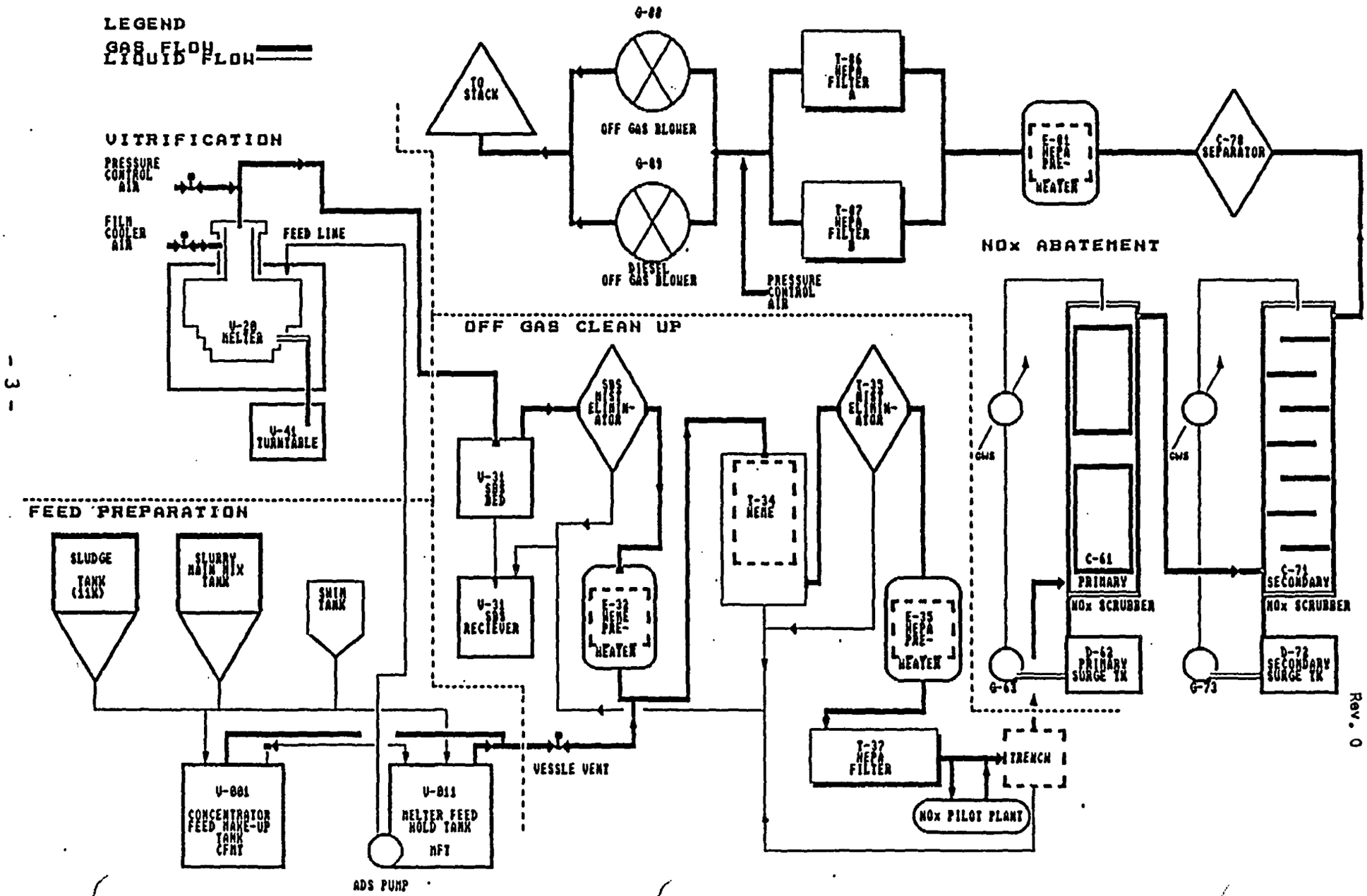

FIGURE 1

The Vitrification area consists of the Slurry Fed Ceramic Melter, SFCM, and the turntable. Process control of the melter is assured by maintaining the bulk glass temperature at 1150°C ±50°C. Also the SFCM pressure is controlled to maintain ventilation and pull any effluent into the off-gas cleanup equipment.

As a start-up technique, the run will begin with a high feed rate to cool the plenum in an attempt to minimize film cooler pluggage problems. A start-up ramp to the target rate will be included in the test procedure. The target feed rate will be a run sheet value, which will be selected based on feed data and a melter energy balance. A start-up ramp will be specified for later operation based on this work.

Detection of Canister Lobe position relative to the pour stream will be continued.

Post run activities will include shutdown of the melter and support systems to make way for conversion of CTS to the vitrification facility. Following the run, and the off-gas particulate sampling, the melter will be shut down. Excess solution will be processed through the melter to convert all feed materials to glass to eliminate any disposal problems. Neither feed rate nor feed composition will be held to the same limits as the run. Feed will be collected, processed, sampled, and accepted as melter feed on the basis that the resultant glass will not interfere with later melter activities. Feed rate and duration will be scheduled on an as available basis.

To shut down the melter, the glass will be removed, first by airlift, and then by the suction canister technique. Three or four canisters will be used, with the intent of checking the amount of glass left behind. Once the glass has been removed, the melter ports will be opened up to allow it to cool. Once the plenum, and the nozzle M refractory thermocouples read less than 400 °C, the melter can be moved.

The off-gas clean up and NO_x abatement equipment prepare the melter and concentrator discharge for release to the atmosphere. The off-gas clean up area is in CTS and consists of the prototypical in-cell clean up processes.

During the steady state operation of the melter, off-gas work will also be done. Particulate samples will be drawn to determine elemental decontamination factors for the melter, SBS, and the HEME. NO_x removal efficiencies will also be examined. A catalytic conversion pilot plant will be run on a process side stream to demonstrate operation of the zeolite catalyst under process conditions.

The NO_x abatement area is in 01-14 building were existing scrub columns are use to absorb NO_2 from the off-gas. This equipment is not prototypical of the final system, but is used to support the FACTS program.

1.3 Cold Testing of the Vitrification System

This Test Request will govern the integrated operation of the Slurry Fed Ceramic Melter (SFCM), and all of the equipment associated with this run. The operation of this equipment has been analyzed under the Safety Analysis Cold Testing of the Vitrification System HG:85:0226. Cold Testing is by definition, nonnuclear and Safety Class N; it has been further classified as a low hazard activity, which includes typical industrial hazards. This Run Plan provides the bounds for operating the Vitrification System within the Safety Analysis. It is intended that these instructions be supplemented by a qualified engineer from the Vitrification Process Technology and Test group who will be available during the run.

2.0 PROCESS CONTROL AND WASTE QUALIFICATION ACTIVITIES/OBJECTIVES

These process control features are designed to enable operation of the Slurry Fed Ceramic Melter in a control "window" which will give an acceptable product, and which will allow processing to continue in a normal manner. Long term processing will allow us to provide a statistical basis for our control capability.

2.1 Melter Glass Temperature

2.1.1 Activity

The SFCM glass temperature is controlled by adjusting power to the melter electrodes. The control point is obtained by calculating an average temperature from as many as six thermocouples in the bulk glass, and filtering the average temperature so that PID loop does not over adjust the input power. This somewhat arbitrary average is controlled to within $\pm 10^{\circ}C$ of the set point, even during process transients. The control allows the operator to focus on the other process events, as the melter temperature is maintained on an even keel. The melter has a temperature gradient within it, which changes as processing conditions change. Only the bulk glass is controlled so that all processed glass passes through that region of the melter, reaches a minimum of $1100^{\circ}C$ (per the WAPS).

Besides the controller variability, the bulk glass temperature depends on the accumulated errors in the system. The thermocouples, the transmitters, and the drift due to aging of the t/c junction. To verify that the melter temperature is adequately accurate, the Test Procedure shall include verification of calibration of the instruments involved in maintaining the temperature, and periodic engineering checks that the installed thermocouples are indicating as expected.

2.1.2 Timing

Complete test prerequisites. Maintain temperature control throughout the run.

2.1.3 Data

The completed instrument calibration checklist and recorded temperature data are collected.

2.1.4 Output

The average (control) temperature and the individual thermocouples will be examined to verify control during the run.

2.2 Melter Feed Rate/Canister Fill

2.2.1 Activity

Control of melter feed rate is important for the operation of the melter. A steady rate keeps the efficiency of the melting process high. Over feeding can cause cold cap instability which would then potentially cause pressure surges in the melter. The feed rate is also used to monitor glass production, which can be translated to canister fill.

Feed rate is monitored by a variety of methods which are compared against one another as part of the normal operation. Plenum temperature fluctuations can be caused by changes in feed rate, but they can be caused by other things as well. Level drop in the feed tank is monitored, but this method is only good for long time periods, because a significant change in the level over time must be observed to calculate the feed rate. The feed flow meter is monitoring the pulsed flow of the ADS pump, however, the integration of the pulses is not very reliable, and includes any flush water added to the melter.

Feed rate control will be described in the Test Procedure. Canister fill will be monitored and checked by weighing the filled canister after it is removed from the turntable. The canister fill specification is 85 $\pm$5 percent.

2.2.2 Timing

During run.

2.2.3 Data

Manual and automatic data collection for each canister.

2.2.4 Output

Report on fill accuracy by the different methods.

2.3 Composition

2.3.1 Activity

Feed composition target will be the "Cold" version of the WVDP reference 4 composition, without ruthenium, rhodium, or some of the rare earth elements. Statistics on the laboratory analysis and on the composition will be provided for each batch. Feed will be prepared per Standard Operating Procedures which are described in the Test Procedure.

2.3.2 Timing

Feed make up.

2.3.3 Data

Feed Analysis

2.3.4 Output

Report on all elements greater than 0.5 weight percent in the glass.

2.4 Glass

2.4.1 Activity

Glass composition will be verified by taking and analyzing shard samples from the top of each canister.

2.4.2 Timing

Samples will be taken from the tops of canister after they are removed from the turntable.

2.4.3 Data

Analysis of the shards.

2.4.4 Output

Comparison of expected glass composition to the predicted glass based on the feed slurry.

3.0 EQUIPMENT CONFIGURATION

3.1 Wall Slurry Sample Station (SSS) Use and Sample Verification

3.1.1 Activity

The Slurry Sample Station, SSS, is the in-cell arrangement of sampling hardware necessary to take slurry samples. This arrangement is being tested as part of the FACTS program. The SSS will be used for routine sampling of the MFHT and the CFMT. Also, multiple samples from one of the vessels will be taken to separate and laboratory error from sampling error. Equipment shake out will result in better sampling procedures and perhaps design improvements.

3.1.2 Timing

During run.

3.1.3 Data

Sample analysis.

3.1.4 Output

Sampling error band.

3.2 Use Turntable E-Seal and Remote Canister Change Out

3.2.1 Activity

The Turntable aligns the canisters, contains the glass stream, and controls air flow through or past the glass stream and melter discharge. The Turntable load cell and LVDT are used to align the canister under the pour spout. The Turntable top hat assembly provides a transferring seal to allow changing canisters in the turntable during the operation. The operation and effectiveness of this seal must be demonstrated. Air inleakage will effect melter discharge heater operation. Control and identification of inleakage and resultant problems are necessary to continue melter operation.

3.2.2 Timing

Install and check out before the run.

3.2.3 Data

Operability comments and inleakage.

3.2.4 Output

See data.

3.3 CTS Off-Gas Equipment Operation

3.3.1 Activity

Off-gas clean up within the CTS is provided by a series of mechanically simple devices. The only motive force used to drive the system is the process vacuum. Additionally, the conditions of operation may have a profound effect on the operation of each device. Operating conditions of the SBS and the HEME are changed during nominally steady melter conditions in conjunction with particulate sampling. The particulate sampling and analysis is used to assess the effect of the different operating conditions.

The following parameters may be adjusted during the run, as described in the Test Procedure:

Surfactant is used in the SBS to limit entrainment of scrub solution, surface tension measurements of the scrub solution may be used to assess and modify the surfactant concentration.

The HEME may be run wet and dry, by adjusting the HEME pre-heater. Although a HEME is usually run wet, it can also be used like a washable filter. If the HEME is run dry, the SBS and the HEME would be flushed on-line as part of the operation.

The temperature of the SBS is controlled by the cooling water flow to the Bed. The temperature sets the water collection rate at the SBS and the downstream humidity.

Steam may be added to the melter off-gas jumper to increase the effective humidity in the off-gas stream. This is not expected to be a normal operational technique, but rather used to broaden the range of tested humidities.

The SBS collects the larger particulate from the melter. The scrub solution together with the particulate are recycled to the CFMT. Sparging, flushing, and jetting may be demonstrated as part of the transfer of this material from the SBS bed and receiver to the CFMT. The effects of these activities on the operation of the rest of the off-gas will be observed. Sludge remaining in the SBS bed will be quantified after the run.

The vessel vent will be operated to support feed makeup activities.

3.3.2 Timing

1. Operate SBS continuously.
2. Switch from wet to dry based on completion of off-gas particulate samples.
3. Vessel vent flow set as indicated in the test procedure, and pressure control during periods of concentration.

3.3.3 Data

1. Off-gas particulate samples-impactor and Gelman filters, frequency per the sampling plan in test procedure.
2. Slurry feed analysis.
3. Laboratory measurement of surface tension.
4. Equipment characterization - SBS sludge collection, inspection, and photographic data.

3.3.4 Output

1. Particulate Sample Analysis
2. Interim Assessment of Surfactant
3. Assessment of Wet/Dry HEME Operation
4. Assessment of receiver solution transfer on off-gas system.

3.4 IR TV

3.4.1 Activity

Gain experience in the use and operation of the IR TV and improve use of the steam cleaner.

3.4.2 Timing

Periscope installed prior to run.

3.4.3 Data

1. Temperatures and cooling air flow data.
2. Video tape of SFCM surface (per VOS instruction).

3.4.4 Output

Action list for improvement of system.

3.5 ADS Pump

3.5.1 Activity

Update ADS Feed Pump controls and feed calculations as necessary and enhance feed monitoring based on experience of earlier runs.

3.5.2 Timing

Complete before the start of the run

3.5.3 Data

See mass balance

3.5.4 Output

See mass balance

3.6 Off-Gas Emissions During Idling (optional)

3.6.1 Activity

Monitor off-gas emissions during idling, immediately following run. Measure emissions at different Melter Plenum Temperatures if possible. Calculate DFs across off-gas equipment.

3.6.2 Timing

Following the end of the run period.

3.6.3 Data

Off-gas particulate and SBS solution samples.

3.6.4 Output

Emission concentration curves for the test period.

4.0 PROCESS TESTING

4.1 Feed Rate Enhancement

4.1.1 Activity

1. Continue power skewing to hold the bottom electrode between 990 and 1050°C. The current power settings are at a A:B:C ratio of 1:1.45:1.45.

2. Target slurry solids loading of 425 g/L ± 5 percent, or as required to support melter steady-state operation.

3. Feed rate adjusted to hold plenum temperature with a feed ramp at start up.

4.1.2 Timing

During run.

4.1.3 Data

Steady-state feed rate.

4.1.4 Output

Plenum temperature output and assessment of feed rate.

4.2 Tracer Studies

4.2.1 Activity

Soluble and/or insoluble tracers will be used to show that feed batch transfers can be accomplished quantitatively and if CFMT, MFHT, and SFCM are homogeneous.

4.2.2 Timing

Tracers added to the feed during feed preparation.

4.2.3 Data

1. Five feed samples just prior to the start of feeding for all feed vessels.

2. Feed samples from MFHT at least every four hours during feed periods (frequency may differ during hot operations).

3. Airlift and sample glass at least every four hours.

4. Five melter glass samples prior to the start of feeding.

5. "Boat" on melter floor to sample potential sediment.

4.2.4 Output

Analytical lab results to process model work.

4.3 CFMT Concentration/Melter Interaction

4.3.1 Activity

Feed preparation including concentration during melter processing.

4.3.2 Timing

Feed preparation during the run.

4.3.3 Data

1) Boilup rate and heat transfer data.

2) Demister performance data (per PNL instructions).

4.3.4 Output

CFMT boil up rates.

4.4 NO_x Pilot Plant (Selective Catalytic Reduction-SCR)

4.4.1 Activity

Operate pilot plant for selective catalytic destruction of NO_x, to expose the catalyst to the possible poisoning effects of the process, assess effects of excess ammonia, and to gain operating experience with the process control configuration.

4.4.2 Timing

Pilot plant may run at any time during melter operation with nitrate containing feeds - maximize up time.

4.4.3 Data

1. NO_x Concentration Monitor
2. Reactor Temperatures
3. Outlet Ammonia Concentrations
4. Ammonia usage rate

4.4.4 Output

1. NO_x Efficiency Data of SCR
2. Continuing Catalyst Lifetime Tracking
3. Outlet Ammonia Concentrations

5.0 PREREQUISITES

This is a list of probable run prerequisites for SF-12. The final list will be contained in the detailed run instructions.

1. Instrument sign-off as calibrated and ready.
2. Tracers added as necessary.
3. Particulate sampling hardware is ready, filters weighed.
4. NO_x Scrubbers filled to operating level.
5. IR TV installed and ready.
6. Baseline samples of scrub solutions, slurry feed, melter glass, and sludge.

6.0 STANDARD PRACTICES

6.1 Run Reporting

6.1.1 A brief summary of the run will be issued within 15 working days of the termination of the run.

6.1.2 A debriefing of the participants of the run will be completed within 10 working days after termination of the run. As a minimum; the shift engineers, shift supervisors, operators, and laboratory personnel will be debriefed. The debriefing notes will be assigned and scheduled. This document will be forwarded to the participants no more than 10 working days after the debriefing.

6.1.3 A compilation of all the data, log books, etc., will be collected and forwarded to the MRC within four weeks of the termination of the run. See Section 6.0 for the listing of data collected. The exception to the time limit may be the chemical analysis. However, when this data are obtained, it will also be forwarded to the MRC and filed at a minimum under MRC - 1400. This information and data are filed for later use and needs to be comprehensive. It need not contain any conclusions, but should provide all the raw material from which conclusions could be drawn.

6.1.4 A Test Summary Report (TSR), will be issued within 90 days of run completion. If all data collection or chemical analysis is not completed at that time, the report will be revised when the data are ready.

6.1.5 The TSR completed for SF-12, a quality level C run, shall be reviewed and approved by the Manager Vitrification Test Group, Quality Assurance, and the Manager Vitrification Process Development.

6.2 Standard Practices

The purpose of this section is to outline the various responsibilities and duties during the run, so that a clear understanding of what is expected is defined.

6.2.1 A Shift Engineer from Vitrification Test Group will be present during the run to direct the technical operation of the equipment. The Shift Engineer is authorized to modify run parameters within the run sheet limits in the test procedure to achieve objectives of the run and to modify the test procedure using test exceptions (TEs) as outlined in EP-11-003. Technical conduct of the run will be as directed by the Test Procedure and as amended by the Vitrification Test group manager.

Melter process/analytical technical recommendations from the Process Development Group shall be directed through the Test Group Manager for implementation. The Vitrification Test Group Manager will act as both the Cognizant Test Manager and Test Implementation Manager.

6.2.2 In the event of plant emergency or personnel injury, equipment under test will be put in a safe shutdown, or idling condition as necessary.

6.2.3 At each shift change, the incoming Operators, Supervisors, and Shift Engineers will read the log book to update their understanding of the systems operational status. The review should take place as soon as possible after shift change as follows: 1) shift supervisors, shift engineers, and control room operators; 2) operators in direct support of melter and process equipment; 3) other personnel involved on shift. The above personnel will indicate their review of the operations log by log entry and initials. The historical period to be reviewed is the span since last on shift or five calendar days.

6.2.4 Log entries are to be made by Operators, Shift Engineers, and any other involved Project personnel. In the development program of FACTS it is important that uncertainties, anomalies, unplanned events, and observations be recorded. The entry shall have the time of the observation and the initials of the individual making the entry. Process control changes shall also be noted in the log such as power or flow rate changes.

6.2.5 A Shift Engineer or Shift Supervisor shall review data log sheets and summarize shift operation at lease once per shift as a check of the run progress.

6.2.6 Operational ranges and set points for the run equipment will be listed on run sheets. The acceptable ranges for the Run Sheet values are given in the test procedure. Run sheets will be filled out and signed by the Shift Engineer as necessary to control the process.

6.2.7 The run sequence is illustrated in the Activity Diagram, in the test procedure. This diagram shows the prerequisites and the interrelationships among the different pieces of equipment. The Shift Engineer will conduct the run, modifying the run sheet values as necessary to meet the run objectives. However, the change or addition must be logged in the operations log book including the reason for the change.

7.0 PERSONNEL QUALIFICATION

Operators shall be WVNS Operators who have received training on the Theory and Operation of the joule-heated Melter and auxiliary system. The Shift Engineers associated with the vitrification equipment are persons with experience in the operation of the CTS equipment. They are identified in Section 4.2.1.

8.0 DATA DISPOSITION

Copies of the following information shall be sent to MRC for permanent retention following the run:

1) Test Requests, Test Procedures and any Test Exceptions.

2) Copies of the Test Log - pages from the Vitrification Operations Log Book and any other log book used as part of this run. (Sample Log, DCS Log, etc.).

3) Canister characterization data sheets.

4) Signed off activity diagram.

5) All completed Manual Data Sheets.

6) Completed Analytical requests or a table of sample information and results.

7) Checked process log sheets from run (feed) periods.

8) Prerun training attendance sheet.

9) DCS Configuration Record

10) Computer logged run data shall be duplicated and stored in compliance with site procedures for storage of magnetic media.