Assurance of In Tank Processing's Safety Basis

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Assurance of In-Tank Processing's Safety Basis

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Technical Programs
High Level Waste Engineering

March 1995

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EXECUTIVE SUMMARY

This report documents the efforts made to assure the adequacy of In-Tank Processing's Safety Basis. Safety studies have determined that the original facility design did not provide adequate assurance of confinement of radioactive materials and chemical hazards associated with postulated accident sequences. Facility upgrades and analyses have been, or are being, completed to resolve these inadequacies.

The In-Tank Processing facilities contain significant inventories of radioactive materials and organic chemicals. Unmitigated accident consequences are severe enough to warrant the installation of systems, structures or components to prevent or mitigate internal and external events. Unlike many nuclear facilities, the In-Tank Processing facilities are "open air" facilities which are not contained within a single, or even a series, of structures that have safety grade containment or confinement systems. Consequences from events at the In-Tank Processing facilities are not impacted by reduction factors typically associated with such systems.

In evaluating the potential backfit upgrades for the In-Tank Processing systems, prevention represents the only practically achievable means to upgrade the facility design and improve safety. A series of upgrades has been defined which, when taken together, provide sufficient assurance that hazards are confined in a manner which protects facility, co-located and off-site personnel.

Primary upgrades and analyses relate to the prevention of a waste tank deflagration. This upgrade includes the design, construction, testing, procedures and training related to portable emergency purge ventilation equipment. Key assumptions in this approach is the preservation of a minimum of three days time required to build up to a flammable vapor in a waste tank and the mixing of the vapor space. Actions to protect these assumptions have been defined and are being implemented.

Other upgrades have been defined for lesser hazards which have the potential for endangering the facility, co-located or offsite personnel. These upgrades include both hardware modifications and procedural improvements. The systems which are impacted by these upgrades are described in this report and the basis for the upgrades, as well as alternatives considered, is discussed.

Upon completion of those upgrades and analyses designated as required for startup, the In-Tank Precipitation facility will be able to begin operations with assurance that hazards can be adequately confined.

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REVISION LOG

Revision 0	Initial issue	November 1994
Revision 1	Incorporated comments from DOE-SR & DOE-EH	March 1995

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ABBREVIATIONS AND ACRONYMS

CLFL	Composite Lower Flammability Limit
DOE	Department of Energy
DOE-HQ	Department of Energy, Headquarters
DOE-SR	Department of Energy Field Office, Savannah River
DWPF	Defense Waste Processing Facility
EPVE	Emergency Purge Ventilation Equipment
FOSC	Facility Operating Safety Committee
HLWE	High Level Waste Engineering
ITP SAR	In-Tank Processing Safety Analysis Report (Addendum to TF SAR)
JCO	Justification for Continued Operation
PRA	Probabilistic Risk Assessment
SRS	Savannah River Site
SSCs	Structures, Systems, and Components
STPB	Sodium Tetrphenylborate
TF SAR	Tank Farm Safety Analysis Report
USQD	Unreviewed Safety Question Determination
WSRC	Westinghouse Savannah River Company

1.0 INTRODUCTION

Safety studies of the In-Tank Precipitation and Extended Sludge Processing have concluded that the "original" design and safety analyses failed to provide an adequate assurance of the confinement of the hazards in these facilities. These facilities are necessary to prepare waste from the H-Area and F-Area Tank Farms for feed to the Defense Waste Processing Facilities (S-Area and Z-Area). Therefore, assurance that the facility safety basis is adequate has received high priority within both Westinghouse Savannah River Company and the Department of Energy.

This report is the third in a series (see References 1 and 2) and serves to describe the safety basis for upgrades and analyses required prior to startup of the In-Tank Precipitation facility. The plant, personnel, and programs have been, or are being, upgraded to assure proper confinement of the hazards described below. Long term actions to continue to improve the facility safety basis are planned.

The basic hazards in the In-Tank Processing facilities include:

- Deflagrations/Explosions - purge and inerting systems are needed to prevent the build up of flammable vapors. If flammable vapors are allowed to build up in the presence of oxygen and with a spark source, a deflagration could occur releasing radioactivity to the environs and potentially offsite.
- Radioactive Releases from Solids Fires - waste streams need to be confined within the In-Tank Processing facilities. Some waste streams contain organics and, if allowed to accumulate and dry for substantial periods of time, the solids formed can support combustion and release radioactivity in the smoke created from a solids fire.
- Radioactive Releases from a Spill - the waste streams need to be confined within the In-Tank Processing facilities. If the waste is allowed to leak (particularly above ground), radioactivity would be released to the environs and potentially offsite.
- Chemical Releases - hazardous chemicals (specifically benzene) need to be controlled in the In-Tank Processing facilities. If process upsets are allowed to go uncorrected, chemical releases could have an adverse impact on the facility workers.
- Nuclear Criticality - criticality has been demonstrated to be incredible (not physically possible with existing waste streams) in the In-Tank Processing facilities. However with fissile material present, administrative controls requiring sampling of each new (unanalyzed) feed batch are prudent.

The initial design / safety reviews for In-Tank Processing facilities were performed as a part of the design/project system. Design Process Hazards Reviews and Quality Assurance Assessment Plans were used to identify the controls necessary to protect against facility hazards. Since that time, additional safety studies including the Confinement Assessment Program have been performed and upgrades have been identified to improve upon the original safety basis.

Most notably, Emergency Purge Ventilation Equipment was provided to ensure that, following design basis natural phenomena events, benzene deflagrations in a waste tank could be prevented. Other identified upgrades have included the hardwiring of critical alarms / interlocks, qualification / modification of above ground transfer lines, and elimination of sodium tetraphenylborate (benzene hazard) storage. The Safety Analysis Report, Operational Safety Requirements, operating procedures and personnel training have also been upgraded to address concerns related to the confinement of hazards within the In-Tank Processing facilities. The ongoing analyses relate to waste tank vapor space mixing to ensure that benzene layering (or pockets of benzene vapors) do not form. Section 4.2 describes the modeling, laboratory, and in-plant activities supporting the vapor space analyses.

The In-Tank Processing Safety Analysis Report Addendum (Reference 3) is composed of consequence and probabilistic analyses. Since In-Tank Processing facilities are "open air" facilities, the consequence analyses do not credit active systems in the reduction of dose (source term). The unmitigated consequences for events within the In-Tank Processing facilities are shown in Table One. The most severe consequence accidents relate to deflagration in a waste tank. The waste tanks can withstand natural phenomena events, such as an earthquake (Reference 4); however, the installed waste tank ventilation systems are assumed to fail. The safety analyses and operating requirements now maintain a minimum time required for a tank to reach the lower flammability limit thus allowing time for portable emergency ventilation equipment to be installed.

Fault trees determine the frequency at which an event will occur. The fault trees are utilized to identify and define those systems, structures and components which can be used as preventors - reducing the frequency of an event. Systems, structures or components which are identified as preventors are assigned a higher functional classification and receive tighter administrative controls commensurate with their safety importance.

Four basic areas: Confinement Assessment, Geotechnical, Functional Classification and Safety Analysis Upgrade; make up the safety program for In-Tank Processing.

The Confinement Assessment Program identified the hazards, barriers and challenges to the barriers for In-Tank Processing facilities. By identifying and protecting the barriers closest to the hazard, the facility workers, co-located workers, off-site populations and the environment are protected. Activities within this program have recently focused on potential operator errors. Special emphasis has been placed on those operating parameters which can impact the time required to build up flammable vapors in Tank 48 during processing.

This work has identified areas of concern and corrective actions have been, or are being, implemented. Ongoing work includes additional analyses related to flammable vapor generation (see Section 4.2).

The Geotechnical program for resolving the seismic safety issues for In-Tank Processing has investigated the geotechnical soil properties and the risk associated with a seismic event. Program results (Reference 4) have been incorporated into the In-Tank Processing Safety Analysis Report Addendum.

The functional classification process involves application of the recently revised methodology (Reference 5) to identify barriers and to confirm the proper assignment of functional classifications to systems, structures and components in the In-Tank Processing facilities. This effort includes the assessment of the existing systems, structures and components against the design criteria applicable to the functional classification. The difference between the existing equipment capability and the design criteria is being evaluated under a backfit process and modifications initiated as appropriate. Geotechnical analyses and the Confinement Assessment analyses related to barrier identification have driven upgrades to the functional classification of some components.

The safety analysis upgrade centers around the development of a safety analysis that complies with DOE Order 5480.23 (Reference 6). The activities include the development of Technical Safety Requirements and an upgraded Safety Analysis Report which covers all Tank Farm operations (including In-Tank Processing).

This safety program establishes the adequacy of the In-Tank Processing "Safety Basis" as documented in the applicable Authorization Basis Documents. These studies focused on the steps necessary to prevent the possible buildup of flammable vapors and/or release of hazardous materials. The approach of prevention, versus mitigation after the event, is the most practical solution given the design of In-Tank Processing facilities. By implementing a preventive approach, which provides multiple layers of defense, assurance is provided that the hazards associated with In-Tank Processing are confined.

The following sections of this report describe the four areas of the Safety Program, the systems impacted by the program, the system upgrades required, alternatives considered and the basis for the upgrades chosen.

2.0 SAFETY PROGRAM

The safety of the In-Tank Processing facilities has been reviewed, studied and re-reviewed over the years. Special emphasis has been placed on the new hazards related to the In-Tank Precipitation facilities. Recommendations from the overall Safety Program have resulted in upgrades which have improved the facility safety beyond that provided in the original design.

2.1 CONFINEMENT ASSESSMENT PROGRAM

The Confinement Assessment Program was initiated in response to concerns raised during the Department of Energy Environment, Safety and Health (DOE-EH) Technical Safety Review of Defense Waste Processing and In-Tank Processing facilities (Ref. 7). The fundamental objective of the Confinement Assessment Program for the In-Tank Processing facilities is to:

Assure that a qualified barrier(s) is in place to prevent release of radioactive/hazardous materials in a manner that could have a health and safety impact on exposed populations (facility, co-located or off-site).

A barrier will consist of a hard boundary (tank, pipe, cell wall, etc.), instrumentation which monitors the integrity of the hard boundary (e.g. leak detection), and preventive systems that stop the propagation of events which may lead to a breach of the hard boundary (e.g. flammable vapor purge systems).

2.1.1 Methodology

Application of the Confinement Assessment Program at the In-Tank Processing facilities requires:

- 1) Definition of the In-Tank Processing facility segments;
- 2) Screening of facility segments for significant hazards;
- 3) Identification of preliminary hard boundaries and integrity monitors;
- 4) Identification of preventive systems (including consideration of operator errors);
- 5) Qualification of the barriers; and
- 6) Identification / documentation of the final barriers.

Identifying and controlling barriers provides additional levels of protection (beyond those required by the original safety analyses) for facility, co-located and off-site personnel. Key definitions related to the Confinement Assessment Program are presented in Table Two. Steps 1 through 5 were documented in an Interim Report. Step 6 will be completed along with the functional classification activities.

2.1.2 Interim Results

A summary of the results of the interim work (Reference 2) is provided in Table Three. The table lists the major components within In-Tank Processing which were identified as barriers under the Confinement Assessment Program. The table also shows the results of an engineering assessment of the equipment qualifications. The Interim Report provided actions to be taken prior to startup of the In-Tank Precipitation facility to address areas of concern identified (the shaded areas in Table Three). These actions include:

- 1) Complete the design, testing, procedures and training associated with the Emergency Purge Ventilation Equipment (EPVE). These actions were required because the EPVE was identified as a preventive system. The actions are complete.
- 2) Complete the seismic review of miscellaneous transfer lines (Tank 48 to 49 transfer line, Tank 49 to valve box, Tanks 40, 41, 42, and 51 transfer lines) and required modifications prior to use. This action is required to confirm that the transfer lines will not fail (resulting in limited access to Tanks 48 and 49) during an Evaluation Basis Earthquake. The lines from Tank 48 to the filter building have been qualified for the vibratory motion associated with a 0.2g Blume earthquake and for events producing a six inch differential settlement (Reference 8). Formal analysis and the identification of required modifications for other above ground lines is continuing.
- 3) Establish periodic monitoring of the filter cells to supplement the sump level instrumentation. This action is required to supplement the filter cell integrity monitoring for filter/piping leakage. This administrative control has been established via Section 6.5.15.10 of the 241-82H Operational Safety Requirements (Reference 9).
- 4) Provide an alternate means of STPB handling which alleviates the potential for excessive, long term inventories of benzene in the STPB Storage Tank. The design for this modification is underway (Reference 10).
- 5) Confirm that rapid facility shutdown (manual pump trips), damage assessments, radiation surveys, and appropriate spill response steps are incorporated into emergency procedures. This action is necessary to ensure potential spill sizes are limited, to provide for additional integrity monitoring, and to define / support spill response. A review has been completed which provides this confirmation (Reference 11).
- 6) Assure filtrate hold tank room high radiation alarm procedures require tripping the filter feed pump. This action is required to support the integrity monitoring of the filter because the existing interlock may be susceptible to single failure. A hardwired alarm is being provided; response procedures will require feed pump trips (Reference 12).

Since issuance of the Interim Report, work has continued on the Confinement Assessment Program. Special emphasis has been placed on the operating parameters which can affect the time required to buildup to the composite lower flammability limit (CLFL) in Tank 48. This time must be maintained at greater than three days and is a key assumption related to both the ITP SAR Addendum and the Confinement Assessment Program. Operating parameters related to other hazards have also been reviewed.

2.1.3 Incorporation of Operator Error Scenarios

Recent safety analysis reviews by WSRC have focused on expected plant operations and the potential for operator error impacting the accident scenarios. An integral part of Confinement Assessment is assuring that the operations staff can not inadvertently cause the plant to be operated outside of its safety envelope. The reviews are broken down into a series of analyses including:

- a) Review of Cycle One Time to CLFL,
- b) Validation and Uncertainties related to Cycle One Time to CLFL,
- c) Analysis of other Operating Parameters, and
- d) Ongoing Cycle One Time to CLFL Analyses.

Note: In-Tank Precipitation is operated in Cycles which are composed of three or more batches of waste addition and processing. For additional information on Cycle One see Reference 17.

Review of Cycle One Time to CLFL

The Cycle One Time to CLFL analyses were performed by a multi-disciplinary team of plant and laboratory personnel. The team was led by P. L. Rutland, a principle engineer at ITP. The review focused on twelve key operating parameters which can influence the time to CLFL. The review (Reference 13) resulted in a series of modifications and procedural revisions including:

- Raising the minimum Tank 48 exhaust flow to a value greater than 100 scfm,
- Requiring actions to reduce CLFL if 25% CLFL is reached,
- Installing a flow restricting orifice in the wash water addition line,
- Administratively controlling bearing water addition,
- Confirm the vapor space mixing analysis,
- Physically blanking the wash water line during other process operations,
- Installing a flow totalizer in the sodium tetraphenylborate addition line, and
- Improving sampling plans and uncertainties.

Validation and Uncertainties related to Cycle One Time to CLFL

The validation of the Cycle One Time to CLFL analysis was performed by a team of safety analysts lead by M. J. Hitchler, a senior safety analyst/manager in Engineering & Construction Services. This team focused on confirming the methodology used by the Rutland committee and analyzing the uncertainties related to key parameters. The review (Reference 14) found that the basic methodology and the recommendations from the Rutland report were sound. The validation efforts included propagating uncertainties in both nominal and bounding safety case calculations. Additional analyses of waste tank vapor space mixing are underway as described in Section 4.2.

For the nominal case the time to CLFL for Cycle One will be no less than 25 days and for the safety case the time to CLFL is approximately 10 days.

The validation process identified several additional upgrades needed to support these conclusions. A full listing is provided in Section 4.1, but these upgrades include such items as:

- Revising the Operational Safety Requirements to require the 300 scfm ventilation flow and to require immediate action upon reaching 25% CLFL,
- Completing uncertainty analyses for specific operating parameters,
- Completing chemistry / analytical work to improve the uncertainties related to benzene generation and dissolution,
- Establishing administrative limits on the amount of exposure the excess sodium tetraphenylborate solids may receive,
- Installing a spoolpiece in the addition lines to prevent inadvertent additions, and
- Establishing confirmatory data collection as a part of Cycle One operation.

Analysis of other Operating Parameters

The analysis of other safety assumptions was performed by reviewing the commitments identified in the Authorization Commitment Matrix (Reference 15). The Matrix contains approximately 700 commitments which were drawn from the Safety Analysis Reports, Operational Safety Requirements, Process Requirements and System Design Documents. These commitments were reviewed to identify those that could be impacted by an operator error. This analysis (see Reference 16) evaluated each commitment and categorized the commitments as either:

• Design - commitments related to, or limited by, the design of the facilities.	77 total
• Test/Calibration - commitments which specify test and/or calibration requirements. This category was dominated by surveillance requirements.	286 total
• Administrative - commitments related to administrative controls which are implemented by procedures and/or programs. Most of these commitments related to specific requirements to be included in the operating procedures.	93 total
• Sampling - commitments related to the composition of various feed and product streams. Sampling commitments are controlled by the Process Requirements and the Chemistry Manual.	23 total
• Operating - commitments implemented by the operations staff. These commitments are those most susceptible to operator error.	181 total

Operating commitments were then reviewed to determine their potential impact on the analysis. Commitments were considered closed by:

- Taking credit for alternate means of detection. 56 total

Example: If during the verification of annulus ventilation flow, an error was made - the annulus vacuum alarm provides for an alternate means of detection. Therefore this commitment was considered closed.

- Review of the accident analyses found that the commitment had a limited impact on the analysis. 89 total

Example: While the HEPA delta-P is monitored to ensure that the HEPA is not overloaded, HEPA loading has only a limited impact on the analysis and ventilation flow is monitored separately.

- Review of the accident analyses found no impact. 32 total

Example: The requirement to provide annulus pumping capability within 24 hours has no bearing on the accident frequency nor on the consequences.

Fifteen commitments remained open after completion of this analysis. These commitments are listed in Table Four along with the commitment number and the actions to be taken. The fifteen open commitments can be grouped into four basic sets.

Seven of these commitments are related to flammable vapor monitoring in the waste tanks. Existing procedural controls and instrumentation do not provide for redundant monitoring which would catch an operator error. While the existing surveillance requirements are set at a conservative frequency (12 hours versus a minimum of 72 hours to CLFL), if an instrument is calibrated incorrectly the surveillance may be compromised. The Confinement Assessment Program is requiring that the Operational Safety Requirements be revised to include surveillances which cross check the installed flammable gas monitor readings against portable instrumentation. In the case of Tank 48 and 49, the cross check should be performed once every 24 hours. For other In-Tank Processing waste tanks, where minimum times to CLFL are greater than nine days, the cross check can be performed once every seven days.

Five open commitments relate to the cleanup of solids after a leak of precipitate. If the cleanup process does not sufficiently clean away the solids (to less than 10% of the original spill), the safety analysis assumption could be compromised.

Two commitments relate to the control of waste transfers into and out of In-Tank Processing. Inadequate control of these transfers could lead to operations outside the safety analysis.

The last commitment relates to the design temperature limit on filtrate system piping. Existing temperature alarms have settings based on the corrosion control limits (70°C) in the tank and the piping design limit is 60°C.

The operating parameter / operator error review described above was supplemented by an engineering review of the ITP SAR Addendum. The engineering review was performed by a member of the original Time to CLFL working group. No additional areas of operator error / operating parameter concerns were identified.

Ongoing Cycle One Time to CLFL Analyses

Ongoing analyses are described in Section 4.2 and focus on resolving tank vapor space mixing concerns prior to full Cycle One operations. Additional analysis of future cycles will confirm that safety margins can be provided for higher curie concentrations. Analytical chemistry experiments are underway at Savannah River Technology Center and at the Georgia Technology Institute to reduce uncertainties related to the benzene generation and dissolution phenomena. The Hot Functional Program Plan (Reference 17) describes the special operations to be completed prior to and during the first cycle of In-Tank Precipitation operation. Special operations such as vapor space sampling will be conducted within the scope of the defined operating envelope using normal operating procedures. The normal procedures will be supplemented by special procedures to gather additional data on plant operation. Additional engineering support will be provided during key phases of Cycle One operation and a peer review group has been established to review the analysis.

Analytical work and Cycle One data collection may show that the flammable vapor concentrations within Tanks 48 and 49 can be controlled at levels less than CLFL by the use of passive ventilation techniques. Output from these analyses may impact future safety analysis work in that more or less systems, structures and components may be needed to constitute the barriers at In-Tank Processing.

Based on current operating plans (Reference 28) for In-Tank Precipitation, more than two years are available to analyze higher curie content batches. If the three day time to CLFL can not be maintained for future operations, alternatives, such as permanently installed - safety class - ventilation equipment, may be required.

2.1.5 Functional Classification Upgrades

WSRC and the DOE have long recognized that structures, systems, and components constructed in the past may not meet the stringent design criteria established by today's nuclear design standards. The upgrading of existing equipment to meet new standards is commonly referred to as "backfitting". Backfitting all structures, systems, and components is both impractical and unwarranted. The DOE has recognized a need for a graded approach to backfitting (Reference 18). The graded approach concept evaluates and backfits systems, structures and components based on their "safety importance". A thorough graded approach includes evaluation of facility worker, co-located workers, and environmental impacts as well as impacts to the off-site populations.

At the Savannah River Site, the graded approach extends well beyond backfitting decisions. Administrative controls, including work controls, procurement and design are implemented using a graded approach. Simply stated - the more "safety importance" an item - the more stringent the administrative control. The graded approach is implemented through the application of functional classifications. These classifications (in order of "safety importance") are:

- Nuclear Safety,
- Critical Protection,
- Production Support, and
- General Services.

For administrative controls and design criteria, there is limited difference between Nuclear Safety and Critical Protection classifications; the break between Critical Protection and Production Support is significant. Both Nuclear Safety and Critical Protection equipment is generally considered "safety important".

The functional classifications at In-Tank Processing are defined in Reference 19 which has undergone several revisions during the last year. These revisions have maintained the functional classifications in line with the Safety Program. The Confinement Assessment (barrier identification) and Geotechnical analyses have driven upgrades to some component classifications. The assignment of higher functional classifications for these components has assured proper administrative controls and established the appropriate set of design criteria to be used in future design / backfit analyses.

In addition to the Confinement Assessment logic described in Section 2.1, a barrier identification effort was performed in accordance with References 5 and 20. This process maintains a graded approach but uses a different terminology - "safety class" equating to Nuclear Safety and "safety significant" equating to Critical Protection. This process is similar to the Confinement Assessment Program methodology but utilizes specific dose versus frequency criteria to assign functional classifications. The safety class and safety significant barriers are listed in Table Five for each accident sequence analyzed in the ITP SAR Addendum and includes results from the Geotechnical analyses. Both Confinement Assessment analyses and this later work found that with the inclusion of the Emergency Purge Ventilation Equipment; sufficient systems, structures and components were in place to support the required number of barriers for each major hazard. However some systems, structures and components were not identified as Nuclear Safety or Critical Protection, so upgrades to the functional classifications were initiated.

Since the original assignment of functional classifications, upgrades have included:

System, Structure or Component	Original	Current
Processing Waste Tank Structures	CP	NS
Filter Building Exhaust Components	PS	CP
Exhaust HEPA delta-P (Filter bldg & tanks)	PS	CP
Filter Feed Pumps, Filters and Jumpers	PS	CP
Tank 48 and 49 Annulus Fans	PS	CP
Emergency Purge Ventilation Equipment	--	NS
Waste Transfer Lines (aboveground sections)	CP	NS
Waste Tank Cooling Coils (inside tank)	PS	CP
Filter Cell structure	--	NS

In addition to these functional classification upgrades, a new "system" (refer to Table Seven) has been added to specifically address those hardwired interlocks used in the fault trees in the safety analysis. This addition allows these interlocks to be readily identified by facility personnel.

The barrier and geotechnical activities also identified administrative controls necessary to assure barriers are maintained. For example: control of vehicular traffic during transfers is necessary because the existing waste transfer lines are susceptible to vehicle impacts. A new administrative Operational Safety Requirement (6.5.13) was created to establish this control.

A detailed codes and standards compliance analysis and backfit determination has not been performed for all components related to the Safety Program for In-Tank Processing. The Confinement Assessment Program has evaluated component qualification for the startup of the In-Tank Precipitation facility (refer to Table Three). Formal determination under the new site-wide functional classification process is planned during Cycle One.

2.2 Other Safety Studies

Many safety studies, other than those described above, have been performed on the In-Tank Processing facilities as a part of the overall Safety Program. Several key studies which have resulted in modifications that have improved facility safety are listed here.

Three types of Process Hazards Reviews (PHRs) are performed in In-Tank Processing facilities: Design PHRs, Pre-Operational PHRs and Periodic PHRs. Currently, ten PHRs (Reference 1) are associated with In-Tank Processing facilities. PHRs can result in either mandatory "actions" or recommendations which can be plant, people or program oriented. Examples of plant modifications resulting from PHRs include:

- Installation of a filter cell ventilation to filter feed pump interlock,
- New beta/gamma detectors in the storm water system,
- Vehicle collision barriers around aboveground transfer lines,
- Expanded Public Address system, and
- Improved containment around the slurry pumps.

NOTE: While not applicable to the In-Tank Processing facilities, the Process Safety Management Rule, 29CFR1910.119, would require the performance of PHRs. In-Tank Processing administrative systems have been compared to the requirements of this rule and found to be in general compliance (Reference 21).

A comprehensive review of the In-Tank Processing Safety Analysis Report Addendum was initiated and performed by WSRC personnel in early 1994 (Reference 22). The purpose of the comprehensive review was to ensure that, consistent with the existing format and content, the best possible safety documentation was available for startup. The review focused on:

- Ensuring consistency with the facility configuration,
- Confirming accident sections properly described the safety envelope, and
- Providing a more useful SAR for plant personnel for USQDs.

A dedicated team reviewed each section of the ITP SAR Addendum accident analyses in detail. The associated fault trees were also included in the review. Special attention was paid to the accident sequences, plant response, credited equipment, and implicit / explicit accident assumptions.

The review resulted in a series of analytical activities designed to further characterize the solids combustibility which demonstrate the margins between the bounding assumptions and actual conditions. Several plant modifications (such as hardwiring alarms and limiting the transfer routes) were also initiated. In addition, the review resulted in revisions to the ITP SAR Addendum to clarify the equipment credited, assumptions made, and the bounding nature of the accident analyses.

Generic comments from the review included:

- Accident sequences/fault trees did not fully describe the scenarios;
- More chemistry data was needed on solids combustibility, vaporization source terms and benzene generation in off normal situations;
- Pipe break modes and frequencies needed to be defined; and
- Tighter leak detection / monitoring requirements were needed.

Structural reviews of the In-Tank Processing facilities were performed to determine the resistance to natural hazards phenomena (Reference 23). The reviews identified weakness in the filter / stripper building and in the control room building. Modifications resulting from these reviews have been completed to strengthen the original building structures.

The DOE-EH Technical Safety Review, which initiated the Confinement Assessment Program, also created a series of specific findings and concerns. The resolution of these specific findings has led to the upgrade of filter cell leak detection, chemistry sampling, the Distributive Control System / interlocks, filter cell remotability, seismic analyses and other safety analyses. The findings are listed in Table One of Reference 2.

Decomposition of sodium tetraphenylborate has been studied (Reference 24) to gain a better understanding of thermal and chemical decomposition mechanisms. A technical recommendation to modify the existing design to preclude the use of the sodium tetra-phenylborate storage tank was reinforced by the Confinement Assessment Program and design work has been initiated. The original 188,000 gallon tank is located in the cold feeds area and was part of the largest benzene release accident scenario. By eliminating the storage tank, cold feeds area hazards have been greatly reduced.

Fire Hazards Analyses are performed to address the potential for fires within a facility. The Fire Hazards Analysis for In-Tank Processing (Reference 25) identified a number of corrective actions which have been implemented and several areas where waivers were required. Additional fire detection devices were installed in the facility and, as a part of the Site-wide fire protection upgrades, the fire water delivery system was extensively modified.

The potential for nitrogen asphyxiation within the stripper building has been studied extensively. Smoke tests within the building identified several stagnant zones and additional oxygen monitoring has been installed. Administrative controls for building entry, special training, and entry door alarms tied to the loss of ventilation are also in place.

3.0 SAFETY UPGRADES

As described in Section 2 a series of safety studies related to In-Tank Processing facilities have been completed and have resulted in actions to upgrade the facility. Some upgrades are completed; other upgrades are still in progress. The In-Tank Processing systems are listed in Table Six along with their current functional classification. While many In-Tank Processing systems have been upgraded, the following systems relate to the confinement of hazards within In-Tank Precipitation and have been impacted by recent safety analyses:

- **Building Ventilation (HVAC):** The HVAC system provides environmental control to personnel and equipment areas and provides a ventilation flowpath (and filtering) for the control of contamination. The system also contains both radiation and flammable gas monitors.
- **Chemical Feeds (CHEM):** The CHEM system provides chemical storage and distribution. The system consists of storage tanks, unloading pumps, distribution pumps, and distribution piping. The distribution piping may carry inhibited wash water or other chemicals from the cold feeds storage area to the ITP/ESP tanks.
- **Distributed Control System (DCS):** DCS includes both the Texas Instruments D/3 Distributive Control System and the CSI Programmable Logic Controllers. These components provide for remote monitoring and automatic/manual control of process variables. The system boundary is defined at the I/O boards.
- **Filtrate (FT):** The FT system processes high level waste slurries from Tank 48 in three ways: washing, filtering (concentrating), and benzene stripping. The system includes the filter feed pumps (which pump precipitate through the filters), the filters, strippers, filtrate hold tanks and feed system to Tank 50.
- **Storm Drains (SSEW):** SSEW controls and monitors rainwater runoff from the Tank Farm. In-Line Beta and In-Line Gamma monitors detect potential contaminated runoff diverting runoff to retention basins for processing.
- **Tank 48/49 Heating Ventilation / Waste Tank Equipment (48HV, 49HV, 48WTE, 49WTE):** HV equipment provides continuous nitrogen purge of the tanks and air purging of the tank annuli. WTE equipment includes the waste tank itself and equipment that support processing in the tanks.
- **Waste Transfer (WTS):** WTS provides for waste transfer among the ITP/ESP processing tanks (Tanks 40, 42, 48, & 49), the ITP feed tank (Tank 41), the S-Area and Z-Area feed tanks (Tanks 50 & 51), and to S-Area and Z-Area via the inter-area lines. The system consists of transfer pumps, primary transfer jets, valve boxes, and the Low Point Drain Tank with associated ventilation and pumps.

3.1 Pre-Upgrade System Designs

The liquid waste byproducts of the SRS separations processes consist of a concentrated radioactive caustic solution of salts and, in some streams, a highly radioactive insoluble metal oxide/hydroxide sludge. After transferring waste from the separations facilities (called canyon buildings) to receiver tanks in the tank farms, the sludge is allowed to settle, leaving a supernatant salt solution layer above the sludge. This supernatant salt solution layer is decanted and concentrated by evaporation to solid salt. The in-tank processes prepare the salt and sludge waste for feed to DWPF and the Saltstone Facility (Z Area). The two in-tank processes (In-Tank Precipitation and Extended Sludge Processing) and the associated facilities are shown in Figures One through Three. The Authorization Basis Documents which govern the operation of these facilities are listed in Reference 26. A listing of the technical baseline documents for these facilities can be found in Reference 27.

Building Ventilation

The Building Ventilation System (Figure Four) consists of three independent systems located in the Filter/Stripper Building (BLDG. 241-96H). The air pressure of the Filter Building, Stripper Building and the Laboratory is kept at a slightly lower level than the surrounding atmosphere pressure to confine any potential leakage of airborne radioactive particulate but the system is not credited for dose (source term) reduction in the safety analyses. The Filter Building and Stripper Building HVAC systems are essentially "once through" systems (i.e. the air entering the building is never recirculated). A commercial heat pump and air handling system is supplied for the Main Control Room and the Electrical Control Room (MCC and switch gear) and is also a once through design. Major components of the Building Ventilation system consist of dampers, inlet and exhaust ducting, fans, filters, humidifiers, heat pumps, heating and cooling coils, stacks, and associated controls.

The Filter Building, the Stripper Building and the Laboratory HVACs comprise the Building Ventilation System and are designed to:

- prevent accumulation of flammable benzene vapors in the Filter Cells;
- prevent or minimize the release of airborne radioactive particulate through air flow control and the use of HEPA filters;
- control the ambient air temperature and relative humidity for personnel, electronic equipment and process needs; and
- prevent or minimize the displacement of oxygen from a nitrogen gas leak.

Chemical Feeds

The Chemical Feeds System (Figure Five) is located adjacent to the waste tanks in the Cold Feeds Area and has several different cold chemical feeds that are used in the In-Tank Processing facilities. The main process chemicals are Sodium Tetrphenylborate (STPB) and Sodium Titanate (ST) which are used for Tank 48 precipitation and adsorption processes. Wash water (inhibited/caustic water) is supplied to Tank 48 from tanks in the Cold Feeds Area. Oxalic acid is also stored in a separate tank. The STPB tank (20 ft. high by 40 ft. dia., holding 188,000 gal.) has an aqueous solution containing up to 650 ppm of benzene (inherent impurity). The tank vapor space can reach concentrations of benzene above the lower flammability limit. In addition, failure of this tank concurrent with failure of the Oxalic Acid tank can lead to benzene vapor concentrations in excess of emergency response planning guides. The tank is blanketed with nitrogen and is appropriately vented for benzene accumulation (through a HEPA filter) to ensure there is no fire or chemical release hazard.

The ST Tank (20 ft. high by 12 ft. dia., holding 17,000 gal.) contains isopropanol and water mixture to suspend the sodium titanate, an inert inorganic compound. Though the volume of potential alcohol vapor releases during processing functions is quite small, the potential flammability effects are included in the safety analysis. This solution generates a maximum vapor of 9400 ppm which is well below the LFL of 20,000 ppm for isopropanol. Overfill interlocks are installed. Emergency response planning guides are not exceeded by a rupture of this tank.

Sodium Hydroxide is mixed with Well Water and stored in a 10,000 gallon Inhibited Water Tank for use in several other systems for cleaning tanks, lines, strippers, riser spray rings, and the filters prior to and after cleaning with other chemical solutions. The Wash Water tank and supply system is designed to provide a continuous supply of wash water to Tank 48 during the washing step.

The Cold Chemical Feeds Area has truck access to permit chemical unloading to specific tanks. Tanker truck unloading to the chemical line feeder headers is performed with flexible hoses.

Distributed Control System

The Distributed Control System (DCS) is designed to provide a computerized, integrated remote control and monitoring system (Figure Six) which receives inputs from field instruments and Programmable Logic Controllers (PLCs). The Texas Instruments® Distributive Control System integrates the remote processors (PLCs and instruments) for greater operational efficiency and safety. A Classic® System provides monitoring functions only.

The DCS provides:

- Alarm and interlock functions for process and safety systems;
- Process graphical displays that provide a pictorial representation of the ITP/ESP equipment and their real-time status in relation to the process;
- Face plate displays that provide up to 16 fields of detailed systems and components information; and
- Trend displays to graphically present selected time windows of past and current operational data.

In Tank Processing facilities can be shut down from multiple local control stations. The facilities and processes are designed to shut down automatically or by manual actions under accident conditions to a safe and passive state.

Filtrate

The Filtrate System (Figure Seven) is designed to filter highly radioactive, salt precipitate solution from Tank 48, separating the radioactive solids from low level radioactive salt solution. The waste stream containing the solids (tube side) is routed back to Tank 48 and the filtrate solution (shell side) is routed through the benzene stripper columns.

Filtrate from the filter flows to the stripper columns and flows down through the column packing against a high volume flow of humidified nitrogen gas to remove the aromatic volatile gasses of primarily benzene and alcohol to maintain process within feed specifications. The filter is back-pulsed when needed with filtrate driven by nitrogen gas in brief pulses designed to clear the solids lodged in the filter.

The filtered and stripped salt supernate solution is pumped to the Filtrate Hold Tanks where it is sampled to validate compliance with process and DWPF Saltstone acceptance limits. If acceptable, the filtrate will be pumped to Tank 50 to await transfer to the Saltstone facility. If the supernate solution is outside the criteria, it is returned to Tank 48 for reprocessing.

The In-Tank Precipitation process also requires that the concentrated precipitate solution be washed with water to lower the sodium content to within DWPF Vitrification feed specifications. The Wash water is stored in the Filtrate Hold Tanks and tested prior to transfer to Tank 22. The Filtrate System has the ability to detect leaks from the process equipment and rooms, and to pump the leakage from the filter cells, stripper and filtrate hold tank rooms to a safe process system storage point.

Gamma radiation monitors on the filtrate lines downstream of the filters are provided to measure the level of radioactivity in the filtrate and alert the operators to abnormal conditions such as filter breakthrough. The monitors are located on the second floor of the filtrate hold tank area close to the piping penetration in the south wall. A primary radiation monitor, commonly referred to as the snowplow radiation monitor, and a redundant radiation monitor are placed in series along the pipe.

Storm Drains

The Storm Drains System is a facility run-off water leak detection and monitoring system designed to detect and isolate contaminated run-off water. The system consists of a 241-28H Control Room recorder, diversion gate control, switch/annunciator lights, area storm drains and manholes, diversion gates, gamma monitors (Figure Eight), retention basin, and level indicators. The diversion gates are designed to control the direction of storm/run-off waters. The gates are rising stem gate valves that may be locally or remotely electrically operated, or manually at the valve location. The 241-28H Control Room has level indication/annunciation from limit switches on the valve stems. Local position indication are marked gauges.

The system is aligned in the diverted position for maintenance, waste transfers, or for actual diversion of contaminated water. Visual verification is required by an operator when an alarm sounds to assure that the valve did operate and divert. Administrative controls for the reopening of the valve must be accomplished after a maintenance or actual diversion has occurred.

The retention basin is a large lined reservoir that retains radioactive or chemically contaminated water for clean-up processing. The H-Area Control Room operates this system. The 241-82H Control Room operators are required to call the H-Area Control Room when a radioactive or chemical material spill occurs and routinely divert to the basin when a known spill potential is present such that no unwanted or inadvertent releases will be made.

Tank 48/49 Heating Ventilation / Waste Tank Equipment

Tank 48 System (both HV and WTE) function is to provide a chemical reaction vessel where highly radioactive dissolved salt solution from the tank farms is reacted with Sodium Tetrphenylborate for precipitation of highly radioactive solids as a precipitate slurry, and Sodium Titanate is used to process out suspended radionuclides by adsorption. Another significant function is to prevent the accumulation of flammable gases that could create an explosion and/or fire that would cause release of radioactive materials to the atmosphere, surface or subsurface. The system interfaces with the Nitrogen System for nitrogen purge flow in the tank primary vapor space that will maintain flammable gases below the Composite Lower Flammability Limits (CLFL). Tank 49 also has a nitrogen purge ventilation system and acts as a storage tank for the precipitate prior to transfer to the DWPF Vitrification process.

Tank 48 and 49 system functions are:

- Use as the primary waste processing tank in ITP (48 only, 49 is for storage);
- To maintain the processed highly radioactive precipitate contents in a safe and controlled manner;
- To prevent the formation of flammable gases in the vapor space above the contents liquid surface to prevent explosion and/or fire; and
- To prevent the release of unacceptable amounts of radioactive or chemical hazardous materials to the environment in both airborne and surface releases.

Tanks 48 and 49 are existing facility structures transferred from H-Tank Farm control and to In-Tank Processing and the 241-82H Control Room. The tanks are a Type III-A design (Figure Nine) which have been modified for use in ITP. Tanks 48 and 49 are equipped with nitrogen purge Ventilation systems (Figure Ten) to prevent potential explosions or fire. Instrumentation is installed to monitor and maintain the tank primary vapor space inert and free of significant concentrations of flammable gases. The nitrogen flow is regulated by the oxygen levels monitored in the tank to maintain Minimum Oxygen Concentration limits. An automatic exhaust fan inlet damper is used to sense tank pressure variances and signal controls to a valve to modulate the tank pressure. Plant Air is used to control the valves. The HEPA Filter contains a prefilter and two HEPA filters to prevent release of unwanted particulate entrained in the purge gases. A separate exhaust system purges the annulus area. The annulus purge and ventilation system uses an ambient air purge flow. A steam heater heats and dries the inlet annulus air. The heater steam condensate drains to the storm sewers.

Waste Transfer System

The Waste Transfer System (Figure Eleven) is designed to transfer waste to ITP & ESP from F- & H-Area Tank Farms, wastes between Tanks 40, 41, 42, 48, 49, 50, and 51 as well as to transfer processed output wastes from In-Tank Processing to DWPF facilities.

The system consists of transfer pumps or jets, transfer gang valves, diversion boxes, valve boxes, transfer lines, and a low point drain tank. The tanks and facility interface are connected via double wall transfer piping lines. To minimize the number of physical transfer lines, diversion boxes with jumper lines (controlled by the H-Area Tank Farm) are used to establish desired flow paths. All transfer lines and pumping facilities are provided with catch tanks and containment systems for collecting and routing fluids back to the primary waste reservoirs. Leak detection instruments are installed in the containment areas to alert operators of leaks.

Most of the existing lines and the new lines are shielded with lead and are installed below ground. Transfer pumps are located such that they allow gravity flows to a common collection point. Waste transfer pumps have a telescopic suction line to accommodate various waste levels in the tanks. Slurry pumps are used to keep the viscous wastes homogenous when the wastes are to be transferred.

A Low Point Drain Tank between In-Tank Processing (Tank 50) and DWPF Saltstone facility has a transfer pump and an agitator to collect and pump salt solution back into the pipe line. Ventilation is provided in the Low Point Drain tank even though upstream organic content is limited to prevent the possibility of the vapor space above the solution reaching the Composite Lower Flammability Limit.

Transfer lines have a carbon steel secondary pipe jacket to prevent and control leakage. Segments without a secondary liner are contained within structures (valve boxes, filter cells, diversion boxes, etc.) designed to contain potential leaks. Leak detection in these structures and of transfer piping jackets is provided and alarm outputs are routed to the appropriate control room.

3.2 Required Functionality

The "Safety Basis" team, both High Level Waste Engineering personnel and Safety Services analysts, established revised functionality requirements necessary for these systems to support the assumptions and requirements of the Safety Program discussed in Section 2 of this report. The sections below describe those functionality requirements which are beyond the system's original (1991) design. Original functional requirements are defined in the Authorization Basis Documents and technical baseline documents (References 26 and 27).

Building Ventilation

A review of hazards related to the Building Ventilation found that the potential for flammable vapor buildup in the filter cells increases if ventilation is lost. A requirement to trip filter feed pumps (see Filtrate System) was established. Smoke testing of the ventilation system in the filter/stripper building found that "dead zones" existed and that the stack oxygen monitor was insufficient to protect operating personnel from asphyxiation. A functional requirement to detect low oxygen concentration within these dead zones was established.

Chemical Feeds

The original design of the STPB storage failed to consider severe natural hazards events and coincident tank ruptures. A requirement was established to prevent the potential for large (in excess of emergency response planning guides) benzene releases in the Cold Feeds Areas. Functional requirements have also been established to control several key chemical feed processes related to Time to CLFL studies. These requirements include physically limiting the wash water flowrate, continuous monitoring of wash water flow, flow totalizer capability for STPB additions, and addition of chemicals below the waste surface (downcomer extension) to minimize foaming.

Distributed Control System

As originally designed and analyzed, the Distributed Control System provided process safety interlock functions which were identified within the safety analysis fault trees. These interlocks helped reduce the frequency of off-normal events with the potential for harming facility, co-located and off-site personnel. A requirement was established to hardwire the interlocks identified in the safety analysis fault trees.

Filtrate

The increase in risk associated with a loss of filter cell ventilation warranted a new requirement to trip filter feed pumps if ventilation is lost. In addition, the original design did not account for differential settlement that might occur following an earthquake. Failure of the lines (Tank 48 to and from the filter cells) could create a harsh (high radiation) environment and prevent the installation of Tank 48 and 49 Emergency Purge Ventilation Equipment (see Tank 48/49 Heating Ventilation / Waste Tank Equipment). A functional requirement to maintain integrity after a six inch differential settlement was established. This functional requirement was extended to the filter cell structure so that leaks within the cell would be shielded and not prevent operator access to Tank 48 or 49. To reduce the potential for filter clogging, functional requirements to improve the backpulse system and provide for chemical cleaning were established. The safety studies also identified that the leak detection system in the filter cells (a nitrogen bubbler / dip tube) might not detect slow leaks which might dry and collect prior to reaching the sump. A requirement to provide for improved leak detection to prevent the accumulation of dried solids was established.

Storm Drains

The original storm drain system includes gamma monitors to detect high gamma radiation in the storm water runoff. Safety studies identified that some waste streams from In-Tank Processing could be high in beta emitters; therefore, a functional requirement for beta monitors was established.

Tank 48/49 Heating Ventilation / Waste Tank Equipment

Functional requirements related to the acquisition and application of site-specific geotechnical data were established. The waste tank primary shell and concrete supporting structure have been demonstrated to withstand the Evaluation Basis Earthquake. The nitrogen purge ventilation system was found to fail at low magnitude events - both earthquake and wind/tornado. A functional requirement to provide post-natural phenomena event ventilation was established. In addition, requirements to improve ventilation flow measurement accuracy and to provide cross-checks for flammable vapor monitors were established.

Waste Transfer

Safety studies identified a concern that the planned transfer routes would include routing organic laden wash water through satellite jumpers. These jumpers contain multiple valves allowing for the selection of a large number of routes. In order to limit the potential for the mis-transfer of organic laden wash water, a functional requirement to have dedicated lines for these routes was established. The geotechnical studies established requirements to qualify the above ground waste transfer lines to withstand both the anticipated vibratory and settlement effects from earthquakes. Safety studies also identified the potential for deflagrations in the enclosed spaces between the primary pipe wall and secondary liner. While leak detection devices are in place, upgraded administrative controls were recommended.

3.3 Post-Upgrade System Designs

The following sections describe the post-upgrade system designs which meet the upgraded functional requirements. Upgrades which are not complete are shown in *italics*. Each upgrade will be completed prior to radioactive operations in the In-Tank Precipitation facilities.

Building Ventilation

A hardwired interlock (Table Seven) has been installed to trip the filter feed pumps if the filter building ventilation fans trip. This interlock reduces the potential (frequency) of flammable vapor concentrations in the filter cells. To reduce the potential for nitrogen asphyxiation in the filter/stripper building, sixteen remote oxygen monitors were installed. Figure Twelve shows the location of these monitors. A central control unit activates the building and doorway alarms if a low oxygen condition is detected.

Chemical Feeds

The STPB delivery system is being modified to allow "just-in-time" delivery. This upgrade alleviates the need for storage of STPB and eliminates the large benzene hazard in the Cold Feeds Area. The chemical addition systems are being modified to install a flow limiting orifice in the wash water addition line which limits the potential for large water additions, which in turn, prevents larger than analyzed benzene generation. A wash water flow monitoring system and STPB totalizer is also being installed (See Figure Thirteen). The chemical addition downcomers are being extended to reduce the potential for foaming.

Distributed Control System

Interlocks identified as a part of the safety analysis fault trees were upgraded to hardwired, as necessary. These hardwired interlocks are listed in Table Seven. The Distributed Control System may mirror the hardwired interlock or contain additional interlocks, providing a defense-in-depth feature for these functions.

Filtrate

As described in Building Ventilation, a filter feed pump to loss of ventilation interlock has been installed. The filter cells and filter feed / return lines have been analyzed and shown to be able to withstand the vibratory motion and six inch differential settlement. *Chemical cleaning modifications and upgraded backpulse systems are being installed as shown in Figure Seven.*

Storm Drains

Beta/gamma monitors have been installed in the Storm Drain system (see Figure Eight) to provide detection of potential leaks containing beta emitters.

Tank 48/49 Heating Ventilation / Waste Tank Equipment

In Tank Farm waste tanks, the time to build up to a flammable mixture is greater than 9 days and in many cases is on the order of months. Portable ventilation systems are used routinely with the Tank Farm, so a similar strategy was adopted for In-Tank Precipitation. In order to provide for post-natural event waste tank ventilation for Tanks 48/49, a requirement to control the time required to buildup to a flammable vapor concentration in the tanks to a minimum of three days was established. Portable ventilation, Emergency Purge Ventilation Equipment, was designed for this purpose. The EPVEs are designed so that they can be "hand-carried" and installed on top of the tanks within 12 hours to provide ventilation in the event that the normal exhausters fail and cannot be restored within a 12 hour period.

Only one EPVE is required for each tank to maintain the flammable vapor concentrations well below the flammable range. There are two designated risers on each tank for use with the EPVEs. These risers will be accessible following a seismic event, 0.2g (Reference 3). A qualitative comparison was made of the proximate equipment and structures to records of similar configuration subjected to loadings representative of a 0.25g peak ground acceleration seismic event or tornado with a wind speed of 185 mph. The potential collapse and resulting interactions that could affect access were included in the comparison. It is concluded that a 0.25g peak ground acceleration seismic event would not produce any significant interactions that would preclude access to the tank top risers. Four EPVEs will be stored in a seismically qualified (0.2g) location adjacent to the In-Tank Processing facilities. Another four units (for a total of eight EPVEs) will be stored in a separate "missile proof" facility on site. The separate facility will be qualified to withstand high wind (137 mph) events. The EPVE will be functionally tested periodically, and equipment necessary to install and run the units (including portable CLFL monitors) will be staged. Operations and maintenance personnel will be trained on the installation and operation of this emergency equipment.

Each EPVE consists of one downcomer to connect the duct to the tank riser, flexible duct sections, one HEPA filter with a dP indicator, and one engine/blower assembly including fuel tank. The equipment is connected together using quick disconnect couplings provided on each duct section. No special tools are required to assemble these units. All necessary miscellaneous support equipment (i.e., portable CLFL monitors, personnel protection equipment, tools, drainage hose, duct support stands, and portable lifting devices) will also be stored with the equipment. The lifting device will be used to remove the riser plugs so that the downcomers can be inserted into the tank riser openings. All of the components have been designed or selected to ensure that they satisfy the portability requirements assumed in the analysis.

Waste Transfer

The transfer routes were restricted to ensure that organic laden wash water would not be transferred through satellite jumpers (Figure Eleven). *The seismic analysis of above ground transfer lines is underway to determine what, if any, modifications need to be made prior to startup of In-Tank Precipitation.*

3.4 Administrative Upgrades

Throughout the recent safety analysis efforts, various new and revised administrative controls have been identified. Upgrades completed in past revisions to the Operational Safety Requirements include:

- Limiting Conditions for Operation and Surveillances for the EPVEs;
- Upgraded filter cell inspection requirements;
- Enhanced waste stream feed specification and sampling requirements;
- Upgraded controls for hardwired interlocks; and
- Limiting Conditions for Operation and Surveillances related to the Waste Transfer lines.

Administrative upgrades identified by recent safety analyses include:

- Providing additional filter cell leak detection / inspections;
- Revising the nitrogen purge ventilation minimum flow requirement to 300 scfm and to require immediate action upon reaching 25% CLFL;
- Revising the Minimum Oxygen Concentration limit to below the benzene and hydrogen MOC (defense in depth - not specifically credited in the analysis);
- Providing an additional surveillance to cross check the waste tank CLFL monitor readings;
- Adding an administrative Operational Safety Requirement to control vehicular traffic during above ground transfers; and
- Specifying the Process Requirements necessary to support the Time to CLFL calculations.

These administrative upgrades will be incorporated into the applicable documents prior to startup of In-Tank Precipitation.

3.5 Alternatives Considered

The previous sections describe the upgrades being provided prior to In-Tank Precipitation startup. The upgrades do not bring the systems into full compliance with the definition of a safety class system. High Level Waste Management supports the above upgrades as the most practical approach to assure the confinement of hazards in the In-Tank Processing facilities. The upgrades establish the measures necessary to ensure facility worker, co-located and public safety. Longer term studies will evaluate the systems, structures and components against the specified design criteria and modifications will be analyzed in a formal backfit process.

Alternate proposals were considered during the execution of the safety studies.

- Building Ventilation - A no action alternative related to oxygen monitoring was rejected because of the high potential for nitrogen leaks to occur. A single monitor with an extensive sampling system was also rejected because of the lag time encountered in this design. Additional benzene monitors were not deemed necessary because benzene is detectable (odor) at very low concentrations and does not present the same asphyxiation hazard.
- Chemical Feeds - Continued use of the STPB tank is authorized by the existing Authorization Basis Documents, therefore, a no action alternative was considered. However, independent recommendations from both internal technical reviews and outside reviews drove the acceptance of abandoning the storage tank. An option to have the tanker trucks dump straight into the waste tank was rejected because of risks associated with vehicular traffic around the waste tank and the need for careful flow control. The flow limiting orifice in the wash water system was deemed to be the most effective since it is passive and requires no operator action.

- Distributed Control System - No action alternatives were considered since the DCS has a very high availability factor. This option was rejected due to low reliability (the DCS trips offline often, but is easily restarted). Full electrical separation and isolation was considered but dismissed due to cost and programmatic delays. Full electrical separation was not warranted since the hardwired interlocks are not credited in the mitigation of consequences.
- Filtrate - A no action alternative was considered for the seismic qualification/analysis because an earthquake which failed the lines would also most likely trip the filter feed pumps. However, since a spill could inhibit EPVE installation, the additional safety margin gained by the seismic qualification of these lines was deemed necessary. Several different backpulse and cleaning system designs were considered. The accepted design meets the functional requirements without exceeding cost or programmatic limits.
- Storm Drains - Environmental permitting and DOE Order requirements specified this upgrade.
- Tank 48/49 Heating Ventilation / Waste Tank Equipment - Upgrade of the existing ventilation system was considered but exceeded cost and programmatic limits. Permanently installed hardware, versus the portable hardware option, was also considered. Analytical studies necessary to demonstrate low consequences related to a release were pursued in the 1989 to 1992 time frame. Additional analytical studies to show that the CLFL would never be reached were also considered. The option chosen was determined to be within cost and programmatic limits and acceptable - given the three days available to respond to the event.
- Waste Transfer - A no action alternative was considered for the seismic qualification/analysis because an earthquake which failed the lines would also most likely trip the transfer pumps. However, since a spill could inhibit EPVE installation, the additional safety margin gained by the seismic qualification of these lines was deemed necessary. The restricted transfer routes were accepted in conjunction with transfer plans after the New Waste Transfer Facility is online.

3.6 Conservative Assumptions

Conservative assumptions related to the safety analyses are discussed in Reference 3. Conservative assumptions related to the Time to CLFL calculations (see References 14 and 29) include:

- Nitrogen inerting was not considered in normal, offnormal, or accident situations;
- Humidity in the vapor space is not considered (would increase the CLFL); and
- Energy deposition in waste is set at a theoretical maximum.

4.0 ONGOING AND FUTURE SAFETY ACTIVITIES

As discussed in the previous sections, efforts to assure the adequacy of In-Tank Processing's safety basis have been completed. These efforts identified a combination of completed, ongoing and future upgrades which provide assurance that hazards in these facilities are confined. The actions necessary prior to In-Tank Precipitation startup will ensure that facility, co-located, off-site populations, and the environment are adequately protected. Near-term activities, prior to and during Cycle One operations, will further enhance safety by reducing uncertainties related to Time to CLFL calculations and assessing system designs against appropriate design criteria. Out-year activities will include the completion of the upgraded Tank Farm safety analyses and the completion of funded backfit modifications.

4.1 Prior To In-Tank Precipitation Startup

The following comprehensive list of activities has been developed from the safety studies discussed in this report. The activities are grouped according to the type of work required and will be entered into the Master Tracking System.

<u>ITP SAR Addendum</u> Add aboveground transfer lines and Filter Cells as SCIs Incorporate Time to CLFL analysis Update Confinement Assessment discussion Incorporate geotechnical analyses	<u>241-82H OSR</u> 25% CLFL limit action statement should be changed to take IMMEDIATE action Raise minimum ventilation flow to 300 scfm Reduce O2 concentration limit to 8% Cross check surveillance for LFL monitors Admin. for traffic control during above ground transfers
<u>Plant Modifications</u> Wash water flow restricting orifice Wash water blank STPB "just-in-time" delivery and totalizer CLFL monitor upgrade Tank 48 Variable Depth Sampler Seismic qualification/modification of transfer lines Chemical cleaning and Backpulse Chemical addition downcomer	<u>Instrument Loop Uncertainty Verification</u> Ventilation flow monitoring Wash water flow rate STPB totalizer Reel Tape tank level instrumentation D2 and D4 riser internal tank temperature CLFL monitors
<u>Procedure Revisions</u> Incorporate changes driven by OSR revision Incorporate Changes driven by Process Requirements ARP for high CLFL Tank 48 roundsheet - minimum ventilation flow OA dumpster restrictions CHEM-1, pre-reaction samples Control of excess STPB at end of each batch STPB exposure time limits Sodium molarity limits Monitoring benzene release rates to ensure that all trapped benzene is released during the excess STPB dissolution. Controls to monitor total waster addition rate to below 14 gpm +/- 2 gpm including pump bearing seal leakage.	<u>Other Actions</u> A review of the impact on the time to CLFL from facility modifications. Issue Hot Functional Program Plan Revise functional classification assignments Resolve benzene monitor deficiencies Review precipitate spill cleanup procedures Review ITP transfer procedures Review ITP chemical transfer procedures Review Tank 48 temperature alarm setpoints Execute ITP CLFL Safety Issue Resolution Program Provide Tank 49 Time to CLFL calculations Issue report on 1983 demonstration test data

4.2 Near-Term Activities

Prior to and during Cycle One, which is composed of four batches (each 3 to 4 months in duration) Safety Program activities will be focused on the resolution of concerns related to vapor space mixing and flammable vapor generation. Reference 29, *ITP CLFL Safety Issue Resolution Program Plan*, provides the detailed scope, schedule and logic for these activities. The logic diagram below (extracted from Reference 29) depicts the laboratory, in-plant and modeling activities. The activities are broken down into three phases which support key decisions (milestones) during Cycle One.

LOGIC MATRIX OF CLFL ISSUE RESOLUTION PROGRAM

4.3 Out-Year Activities

The following activities will be ongoing with completion dates in or beyond 1996:

- Development of the Upgraded Tank Farm Safety Analysis Report
- Functional Classification Backfit Modifications, if needed

5.0 REFERENCES

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Figure One: In-Tank Processing Facilities
(highlighted by shading or crosshatch)

Figure Two: In-Tank Precipitation - Process Diagram

Figure Three: Extended Sludge Processing - Process Diagram

^a Or to Evaporator Feed Tank or to Tank 21H for use in sludge/salt removal.

^b Either Tank 51H or 40H is used at a time. They are not used simultaneously.

Figure Four: Building Ventilation

Figure Five: Chemical Feeds

Figure Six: Distributed Control System

Figure Seven: Filtrate

Figure Eight: Storm Water **NOTES:**

- a) Weir keeps detectors submerged in ~15 in. of water.
- b) Monitor Hi activity/failure alarm diverts storm water to basin
Monitor Hi activity alarm starts vacuum pump (peristaltic pump system not in use)
- c) Diversion gate controls NOT shown

Figure Nine: Type IIIA Waste Tank

**Cooled Waste Storage Tank, Type III (Stress Relieved
Primary Liner, 1,300,000 Gallons)**

Figure Ten: Nitrogen Purge Ventilation **Notes:**

- 1 - Two duplicate lines - only one shown
- 2 - Conservation vent relieves at ± 5 " H₂O
- 3 - One of two shown, Low flow interlock stops exhauster
- 4 - Low flow interlock stops nitrogen addition
- 5 - A spare nozzle is installed in another riser, nitrogen hard piped to spare

Figure Eleven: Waste Transfer System

Figure Twelve: Filter/Stripper Building Oxygen Monitors

Figure Thirteen: STPB - "Just in Time" Delivery

Figure Fourteen: Emergency Purge Ventilation Equipment

† The safety function can be met without the HEPA installed. The filter is provided for occupational contamination control.

Table One: In-Tank Processing - Unmitigated Consequences†

<u>Facility Segment</u>	<u>Onsite</u>	<u>Offsite</u>
Tank 48	1.6E+04 REM	2.6E+01 REM
Tank 49	1.6E+04 REM	2.6E+01 REM
Tank 50	3.9E00 REM	6.3E-03 REM
Cold Feeds	810 ppm	1.3 ppm
	(IDLH for Bz is 3000 ppm)	
Filter Cells	4.7E+01 REM	7.7E-02 REM
Filtrate Hold Tanks/Strippers - Rad.	3.6E-01 REM	5.8E-04 REM
Benzene	23.7 ppm	0.04 ppm

Note: Extended Sludge Processing tanks 40, 42 and 51 have unmitigated consequences on the same order of magnitude as those for Tanks 48 and 49.

† Unmitigated Consequences are derived from the In-Tank Precipitation Hazards Analysis, (WSRC-TR-93-633, Revision 1, dated May 23, 1994) prior to the upgrades presented in this report..

Table Two: Confinement Assessment Definitions

CONFINEMENT ASSESSMENT PROGRAM - The program through which the safety of facility, co-located and off-site population safety will be enhanced by assuring that a qualified barrier (or barriers) is in place to prevent release of radioactive/hazardous materials in a manner that could have a health and safety impact on exposed populations.

BARRIER - The combination of systems, structures and components which, for a given HAZARD provide a HARD BOUNDARY (tank, pipe, cell wall, etc.), instrumentation which monitors the integrity of the hard boundary (e.g. leak detection), and preventative systems that stop the propagation of events which may breach the HARD BOUNDARY (e.g. flammable vapor purge systems). Barriers must be qualified to withstand specific CHALLENGES. Administrative controls may act as a preventive measure against operator errors.

CHALLENGES - Internal or external events which could cause the failure of a HARD BOUNDARY. CHALLENGES include equipment failures, operator errors† and natural phenomena. CHALLENGES do not include acts of sabotage nor events which require greater than nine days to develop the potential for breaching the HARD BOUNDARY.

FACILITY SEGMENT - For the purposes of the CONFINEMENT ASSESSMENT PROGRAM, segments are identified through a review of the facilities. A FACILITY SEGMENT must be associated with a HAZARD and be physically isolated from other segments. The isolation must be such that a failure in one FACILITY SEGMENT does not propagate to another FACILITY SEGMENT.

HARD BOUNDARY - The structures or components which physically contain the HAZARD. The HARD BOUNDARY is normally the closest qualified boundary to the hazardous material. A HARD BOUNDARY need not be air tight, so long as the HAZARD is controlled in a manner which prevents a health and safety impact on exposed populations.

HAZARD - For the purposes of CONFINEMENT ASSESSMENT PROGRAM, a HAZARD is defined as any hazardous material inventory which, if released, could posed a health and safety impact. Inventories are established for each FACILITY SEGMENT. Normal industrial hazards, such as non-energetic chemical releases, are not within the scope of this Program. Only those inventories which, if unmitigated, could exceed the dose criteria provided in the WSRC 9Q Manual as implemented by the E7, 2.25 Procedure (Reference 13) will be considered for inclusion.

† The review of CHALLENGES includes a review of potential operator impacts on analysis assumptions.

Table Three: Evaluation Summary for Major Components

March 1995

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
BLDG AND STRUCTURES									
FILTER CELLS	NS	EBE	OK	OK	OK	N/A	Y	Y	Filter Cells are qualified for NPH loading (up to and beyond EBE) Cells have been analyzed for internal def. Cells are designed of stainless steel to withstand the harsh environment Single failure is not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
CHROMATE WATER									
c. Distribution Piping and Cooling Coils (CP - inside tanks up to siphon preventers)	CP	F	F	N/A	OK	N/A	Y	Y	System piping outside the tanks is susceptible to NPH events - tank internal piping (cooling coils) can survive a seismic event Internal deflagration is not applicable The coils are designed for the waste tank environ. Single failure is not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier The chromate system cooling coils and waste tanks are monitored for corrosion inhibition
PUMP HOUSE GAMMA MONITOR	PS	F	F	N/A	OK	F	Y	Y	Component is not designed for Seismic, Wind or Single failure; however post-event inspections for siphoning are sufficient and the ARMs would detect a large siphon The monitor is not exposed to a harsh environ. Operator actions and admin. controls are in place to identify and respond to a breach of this barrier

Table Three Explanations:

Table was extracted from the Confinement Assessment Program Interim Report (Reference 2).

Evaluations represent engineering judgment based on best available information.

Shaded Cells in the Table indicate areas of concern addressed by Confinement Assessment (prior to startup) actions

Existing classification based IE Procedure 2.12 modified by the analyses described in this report

Symbols: EBE - Survives Evaluation Basis Earthquake, F - Assumed to Fail, N/A - Qualification category not applicable to the component,

OK - Component meets qualification intent, Y - Procedural controls are in affect

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
FILTRATE									
a. Tank 48 Filter Feed Pumps	CP	OK	OK	N/A	OK	N/A	Y	Y	Discharge lines are structurally qualified for seismic and wind loadings. Pumps qualified for 2 over 1 considerations Pumps contain no significant vapor space - internal def. is not applicable Pumps are designed for the waste tank environ. Single failure not applicable to passive function - see interlock for trip function Operator actions and admin. controls are in place to trip the pump if necessary
b. Filters and Jumpers	CP	F	OK	N/A	OK	N/A	Y	Y	Filters and jumpers aren't seismically qualified; they are contained within the cell which is qualified for seismic and wind Internal def. and single failure are not applicable Designed to withstand the high radiation exposure Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
f. Filter Cell Leak Detection	CP		F	N/A	OK		Y	Y	Filter cell leak detection is not designed for NPH challenges and a breach of the piping could occur during a seismic event - a wind event can not penetrate the cells Appropriate sections were designed for the harsh environment System was not designed for the single failure criteria therefore additional inspections are required Operator actions and admin. controls are in place to respond to an alarm
j. Primary Waste Lines Above ground portions NS, below grade portions are CP.	NS	EBE	OK	OK	OK	N/A	Y	Y	Primary waste transfer lines in the filtrate system are now qualified to withstand the NPH Challenges Enclosed space deflagrations have been analyzed The lines are designed for a harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
h. Underliner Leak Detection	PS	F	F	N/A	OK	F	Y	Y	Underliner leak detection not designed for NPH Challenges however post-event inspection are sufficient Applicable portions designed for harsh environ. System contains single failures however post-event inspections sufficient Operator actions and admin. controls are in place to respond to an alarm
FILTER BRKTHRU INTERLOCK	CP		F	N/A	N/A		Y	Y	Interlock not designed for NPH and a seismic event could cause a tube rupture therefore emergency procedures for rapid shutdown are required. A wind event can not cause a tube rupture. Interlock is not exposed to a harsh environment While there are redundant interlocks a single failure may exist therefore steps to shutdown filter flow upon receipt of high radiation in the filtrate hold tank room are required Operator actions and admin. controls are in place to respond to an alarm
ARM INTERLOCK Note: The Area Radiation Monitors are also called VAMPs.	CP	F	F	N/A	OK	F	Y	Y	This interlock detects high radiation on the tank top and trips the filter feed pump. It is not designed for NPH events. However post-event inspections are sufficient since the lines themselves are qualified. The detection portions of the interlock are designed for high radiation fields While some singles failures may exist; multiple ARMs are available and post-event inspections are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
TANK 40 H&V									
g. Constant Air Monitors (Tank and Annulus)	PS	F	F	N/A	N/A	OK	Y	Y	Tank Deflagration is not considered since time to CLFL is controlled to greater than 9 days. Constant Air Monitors were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of overpressurization or leaks into the annulus are minimal The system is not exposed to a harsh environment Conductivity probes and dip tubes provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 40 WTE									
a. Tank Wall and Roof Structure	NS	EBE	OK	OK	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure
d. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. High Liquid Level Conductivity Probe (HLLCP)	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
n. Annulus Conductivity Probes	PS	F	F	N/A	OK	F	Y	Y	Annulus Conductivity Probes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS	F	F	N/A	OK	F	Y	Y	Dip Tubes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 41 H&V									Tank Deflagration is not considered since time to CLFL is controlled to greater than 9 days.
g. Constant Air Monitors (Tank and Annulus)	PS	F	F	N/A	N/A	OK	Y	Y	Constant Air Monitors were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of overpressurization or leaks into the annulus are minimal The system is not exposed to a harsh environment Conductivity probes and dip tubes provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 41 WTE									
a. Tank Wall and Roof Structure	CP	EBE	OK	OK	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
d. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. HLLCP	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm
n. Annulus Conductivity Probes	PS	F	F	N/A	OK	F	Y	Y	Annulus Conductivity Probes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS	F	F	N/A	OK	F	Y	Y	Dip Tubes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
TANK 42 H&V									Tank Deflagration is not considered since time to CLFL is controlled to greater than 9 days.
g. Constant Air Monitors (Tank and Annulus)	PS	F	F	N/A	N/A	OK	Y	Y	Constant Air Monitors were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of overpressurization or leaks into the annulus are minimal The system is not exposed to a harsh environment Conductivity probes and dip tubes provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 42 WTE									
a. Tank Wall and Roof Structure	NS	EBE	OK	OK	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure
c. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. HLLCP	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
n. Annulus Conductivity Probes	PS	F	F	N/A	OK	F	Y	Y	Annulus Conductivity Probes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS	F	F	N/A	OK	F	Y	Y	Dip Tubes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 48 H & V									
a. Fans - Tank Purge	CP	F	F	N/A	OK	F	Y	Y	Fans are not designed for NPH loading nor single failure. The EPVEs provide qualified backup for this function The system is not exposed to a harsh environment Operator actions and admin. controls are in place to respond to failures
f. Composite LFL Monitor (Installed)	CP	F	F	N/A	OK	F	Y	Y	Installed CLFL monitor is not qualified for NPH Challenges or single failure however the portable instruments stored with the EPVEs provide a qualified backup Not exposed to a harsh environment Operator actions and admin. controls are in place to respond to an alarm
g. Constant Air Monitor (Annulus)	CP			N/A	OK		Y	Y	CAM is not qualified for NPH Challenges or single failure therefore post-event inspections are required Not exposed to a harsh environment Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
l. Vent. Piping/Ducts/Acc Upstream of Tk Purge Fan	CP	F	F	N/A	OK	F	Y	Y	Fans are not designed for NPH loading nor single failure. The EPVEs provide qualified backup for this function. Duct failure would cause a limited release. The system is not exposed to a harsh environment Operator actions and admin. controls are in place to respond to failures
p. Emergency Purge Ventilation Equipment	NS	EBE	OK	N/A	Operator actions required to install	OK	Y	Y	EPVEs were designed for the NPH Challenges and single failure System is not exposed to harsh environment Operator actions and admin. controls are in place to respond to failures
Portable Composite LFL	CP								
TANK 48 WTE									
a. Tank Wall and Roof Structure	NS	EBE	OK	OK	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure
d. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. HLLCP	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
n. Annulus Conductivity Probes	CP			N/A	OK		Y		Annulus Conductivity Probes were not designed to the NPH Challenges therefore post-event inspections are required Designed for the high radiation exposure Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS			N/A	OK		Y	Y	Dip Tubes were not designed to the NPH Challenges therefore post-event inspections are required Annulus Conductivity Probes were designed for the high radiation exposure Operator actions and admin. controls are in place to respond to an alarm
TANK 49 H & V									
a. Fans - Tank Purge	CP	F	F	N/A	OK	F	Y	Y	Fans are not designed for NPH loading nor single failure. The EPVEs provide qualified backup for this function The system is not exposed to a harsh environment Operator actions and admin. controls are in place to respond to failures
f. Composite LFL Monitor (Installed)	CP	F	F	N/A	OK	F	Y	Y	Installed CLFL monitor is not qualified for NPH Challenges or single failure however the portable instruments stored with the EPVEs provide a qualified backup Not exposed to a harsh environment Operator actions and admin. controls are in place to respond to an alarm
g. Constant Air Monitor (Annulus)	CP			N/A	OK		Y	Y	CAM is not qualified for NPH Challenges or single failure therefore post-event inspections are required Not exposed to a harsh environment Operator actions and admin. controls are in place to respond to an alarm
i. Vent. Piping/Ducts/Acc Upstream of Tk Purge Fan	CP	F	F	N/A	OK	F	Y	Y	Fans are not designed for NPH loading nor single failure. The EPVEs provide qualified backup for this function Duct failure would cause a limited release. The system is not exposed to a harsh environment Operator actions and admin. controls are in place to respond to failures
p. Emergency Purge Ventilation Equipment	NS	EBE	OK	N/A	Operator actions required to install	OK	Y	Y	EPVEs were designed for the NPH Challenges and single failure System is not exposed to harsh environment Operator actions and admin. controls are in place to respond to failures
Portable Composite LFL	CP								

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag.	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
TANK 49 WTE									
a. Tank Wall and Roof Structure	NS	EBE	OK	OK	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure
d. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. HLLCP	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm
n. Annulus Conductivity Probes	CP			N/A	OK		Y	Y	Annulus Conductivity Probes were not designed to the NPH Challenges therefore post-event inspections are required Annulus Conductivity Probes were designed for the high radiation exposure Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS			N/A	OK		Y	Y	Dip Tubes were not designed to the NPH Challenges therefore post-event inspections are required Annulus Conductivity Probes were designed for the high radiation exposure Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
TANK 50 H & V									
Not required since time to CLFL is greater than 9 days and consequences are minimal									
TANK 51 H&V									
Tank Deflagration is not considered since time to CLFL is controlled to greater than 9 days.									
g. Constant Air Monitors (Tank and Annulus)	PS	F	F	N/A	N/A	OK	Y	Y	Constant Air Monitors were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of overpressurization or leaks into the annulus are minimal The system is not exposed to a harsh environment Conductivity probes and dip tubes provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
TANK 51 WTE									
a. Tank Wall and Roof Structure	NS	EBE	OK	OK ^a	OK	N/A	Y	Y	Tank's walls and roof structures are designed for NPH Challenges (including best estimate internal deflagration) Tanks designed for harsh environment Single failure not applicable to passive function Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Riser Plugs	CP	EBE	OK	N/A	OK	N/A	Y	Y	Same as Roof Structure
d. VAMPs	CP	F	F	N/A	OK	F	Y	Y	VAMPs were not designed for NPH Challenges. However post-event inspections are sufficient since the tanks themselves are qualified. VAMPs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
e. HLLCP	CP	F	F	N/A	OK	F	Y	Y	HLLCP were not designed to the NPH Challenges however wind and seismic events can not cause overflows HLLCP were designed for the high radiation exposure System wasn't designed to meet the single failure criteria however mass balances during transfers are deemed sufficient Operator actions and admin. controls are in place to respond to an alarm
i. Annulus Conductivity Probes	PS	F	F	N/A	OK	F	Y	Y	Annulus Conductivity Probes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
o. Annulus Dip Tubes	PS	F	F	N/A	OK	F	Y	Y	Dip Tubes were not designed to the NPH Challenges however post-event inspections are sufficient since the consequence of leaks into the annulus are minimal Annulus Conductivity Probes were designed for the high radiation exposure Dip tubes and CAM provide sufficient single failure protection Operator actions and admin. controls are in place to respond to an alarm
WASTE TRANSFER SYSTEM									
a. Waste Transfer Pumps (telescoping)	PS	OK	OK	N/A	OK	N/A	Y	Y	Discharge lines qualified structurally for NPH events - confirmatory analyses are underway Appropriate components are designed for harsh environment Single failure is not applicable to passive function - see interlock for pump trip Operator actions and admin. controls are in place to identify and respond to a breach of this barrier
b. Primary Transfer Jets	PS	OK	OK	N/A	OK	N/A	Y	Y	Same as Transfer Pumps (above).

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
c. Leak Detection Instrumentation	PS	F	F	N/A	OK	F	Y	Y	Not designed for NPH Challenges - However post-event inspections are sufficient since the tanks themselves are qualified. Designed for the high radiation exposure System wasn't designed to single failure criteria however multiple ARMs are available Operator actions and admin. controls are in place to respond to an alarm
d. Area Radiation Monitors (includes interlocks)	CP	F	F	F	OK	F	Y	Y	ARMs were not designed for NPH Challenges. However post-event inspections are sufficient since the lines themselves will be qualified. ARMs designed for the high radiation exposure System wasn't designed to single failure criteria however multiple VAMPs are available Operator actions and admin. controls are in place to respond to an alarm
e. Waste Transfer Lines and Secondary Liners Above ground portions NS, below grade portions are CP.	NS		OK	N/A	Failure could result in a spill	N/A	Y	Y	Not all above ground transfer lines are fully qualified for seismic events and a failure could lead to a spill that would prevent installation of EPVEs therefore qualified / modification of these lines is required Single failure not applicable for passive function Operator actions and admin. controls are in place to identify & respond to breach of this barrier
f. Waste Transfer Gang Valves	PS	F	F	N/A	OK	F	Y	Y	Equipment is not designed for NPH events nor single failure however does not cause a release and manual actions can be taken Appropriate components are designed for harsh environment Operator actions and admin. controls are in place to respond to an alarm
Pump Spray Chamber Conductivity Probes	PS	F	F	N/A	OK	F	Y	Y	Equipment is not designed for NPH events nor single failure however the spray chamber drains back into the waste tank Appropriate components are designed for harsh environment Operator actions and admin. controls are in place to respond to an alarm
ARM to Pump Interlocks	CP	F	F	N/A	OK?	Y	Y	Y	see Area Radiation Monitors above
Diversion Box (HDB-7)		F?	OK	note-10	OK	N/A	Y	Y	outside ITP/ESP and only used for emergency transfers of precipitate from 49 to 48

Table Four: Open Commitments from the Operator Impact Review

Description of Commitment	#	System	Actions
Verify that the concentration of flammable vapors in Tank 40 is less than 25% of the CLFL once every 12 hours.	1	40HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 41 is less than 25% of the CLFL once every 12 hours.	1	41HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 42 is less than 25% of the CLFL once every 12 hours.	1	42HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 48 is less than 25% of the CLFL once every 12 hours.	1	48HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 49 is less than 25% of the CLFL once every 12 hours.	1	49HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 50 is less than 25% of the CLFL once every 12 hours.	1	50HV	Establish periodic cross checks with portable monitor
Verify that the concentration of flammable vapors in Tank 51 is less than 25% of the CLFL once every 12 hours.	1	51HV	Establish periodic cross checks with portable monitor
Programmatic controls shall be implemented to preclude inadvertent transfers of materials (for example: unintended acid addition to solutions containing tetraphenylborate [TPB]).	35	MISC	Review of chemical addition procedures
Clean-up following a leak into the filter cell will dilute the residue to less than 10% of the original precipitate concentration.	51	FT	Review of spill cleanup procedures
Clean-up following a leak into the annulus of Tank 48 will dilute the residue to less than 10% of the original precipitate concentration.	24	48WTE	Review of spill cleanup procedures
Clean-up following a leak into the annulus of Tank 49 will dilute the residue to less than 10% of the original precipitate concentration.	24	49WTE	Review of spill cleanup procedures
No other transfers will be allowed through HDB-5, HDB-7, and HDB-8 (NWTF) while ITP wash water is being transferred.	62	MISC	Review of transfer procedures
Clean-up following a leak into ITP-related valve boxes, transfer line jackets, and HDBs will dilute the residue to less than 10% of the original precipitate concentration.	64	MISC	Review of spill cleanup procedures
Clean-up following a leak into the filter feed or return line jacket will dilute the residue to less than 10% of the original precipitate concentration.	54	FT	Review of spill cleanup procedures
Every 12 hours while filtering, monitor the filtrate temperature to ensure filtrate temperature does not exceed 140°F.	60	FT	Assure additional alarms set at 140°F (60°C)

These commitments were extracted from the In-Tank Processing Authorization Commitment Matrix (see Ref. 15)

Table Five: Preliminary Functional Classification Review Results

Introductions: Each accident sequence in the ITP SAR Addendum has been evaluated using the methodology prescribed by the new functional classification procedure (E7, 2.25, Rev. 2). For each event the frequency and unmitigated consequence is listed to show if the safety class (SC) or safety significant (SS) criteria are exceeded. In cases where the criteria is exceeded, barriers are identified.

Abbreviations: SAR - In-Tank Processing Safety Analysis Report, Revision 4

EMHA - Emergency Management Hazards Assessment (SSE-ETS-930141)

HAD - Hazards Assessment Document (EPD-TAF-94-0003)

Seismic JCO - JCO for Continued Operation of H-Tank Farm and Startup of the ITP Facility Under Interim Seismic Safety Basis (HLW-OVP-940100, Rev. 1)

MAJOR ACCIDENTS**Tank 48/49 Purge Ventilation Related:**

Vapor Explosion (SAR 3.4.1, 3.4.2), Solids Fire (SAR 3.4.3, 3.4.4) and

Vapor Explosion & Solids Fire (SAR 3.4.12, 3.4.13, 3.4.14)

Initiating Event Frequency (DBE/Vent. Loss):

5 E-02/YR

(SAR C-4)

Consequence (Site Boundary):

1.9 rem

(EMHA 4,5-RD-2)

S.C. Criterion @ 5 E-02/YR is 0.5 rem

S.C. Item (preventive):

*S.C. EPVEs (LCO 3.2.2)

Provides air purging to prevent flammable vapor buildup

*S.C. Waste Transfer Lines (above ground, seismic qualified)

Prevents spill, concurrent with ventilation loss, which would inhibit EPVE access

*S.C. Filter Cell (seismic qualified)

Provides shielding from spills inside cell

SSCs/Admin Controls needed to ensure performance:

*S.C. DBE & DBT Storage

*S.C. Flammable Vapor Generation Rate Program (OSR 6.5.15.1)

*S.C. Procedures/Response Plan for EPVEs

Levels of Control: Required Total No. = 3 (2 for > S.C. + 1 for energetic event)

*S.S. Ventilation-related Alarms/Interlocks (LCO 3.2.1,3.3.1)

*S.S. Portable CLFL Monitors (LCO 3.2.2)

*S.S. Nitrogen Blanket (LCO 3.2.1)

*S.S. Shift Rounds Surveillance

Table Five: Preliminary Functional Classification Review Results (con't)

Deflagration/Fire in Waste Tank Annulus (SAR 3.4.9)

Initiating Event Frequency (Leak/Ignition):

7.9 E-03/YR

(SAR 3.4.9.3)

Consequence (Site Boundary):

6.9 rem

(EMHA 4-RD-12)

S.C. Criterion @ 7.9 E-03/YR is 5.0 rem

S.C. Item (preventive):

*S.C. Tank Structure - primary wall (LCO 3.2.6)

*S.C. Corrosion control program (OSR 6.5.6)

Implicitly assumed in frequency calculation.

*S.C. Ignition Source Control Program (OSR 6.5.2)

Reduces Ignition probability to 1 E-03, resulting in an accident frequency of

7.9 E-06 and S.C. criterion of 25 rem.

Levels of Control: Required Total No. = 3 (two besides S.C. item)

(2 for > S.C. + 1 for energetic event)

*S.S. Annulus CAM (LCO 3.3.2)

*S.S. Annulus Ventilation System (LCO 3.2.3)

*S.S. Annulus Conductivity Probes (LCO 3.3.2)

Table Three: Evaluation Summary for Major Components (continued)

SYSTEM and COMPONENT	Func. Class	Seismic	Wind	Internal Deflag	Harsh Environ.	Single Failure	Operator Em. Act.	Admin. Controls	Comments
Valve Boxes	CP		OK	OK	OK	N/A	Y	Y	Not all above boxes are fully qualified for seismic events and a failure could lead to a spill that would prevent installation of EPVEs therefore qualified / modification is required Internal def. has been analyzed Single failure not applicable for passive function Operator actions and admin. controls are in place to identify & respond to breach of this barrier
MISCELLANEOUS									
a. Backfill (affecting NS Tanks)	CP	EBE	OK	N/A	N/A	N/A	N/A	N/A	Backfill (berms) are analyzed in seismic analyses and remain intact for EBE
Backfill affecting CP tanks	PS	EBE	OK	N/A	N/A	N/A	N/A	N/A	Same as above
Wash Water System Flow restricting orifice is CP, other parts of system PS.	CP	F	F	N/A	OK	F	Y	Y	System is susceptible to NPH events and single failures but is not needed to function Not exposed to harsh environment Operator actions and admin. controls are in place to respond to an alarms
Bearing Water System	PS	F	F	N/A	OK	F	Y	Y	System is susceptible to NPH events and single failures but is not needed to function Not exposed to harsh environment Operator actions and admin. controls are in place to respond to an alarms

Table Five: Preliminary Functional Classification Review Results (con't)Large Liquid Waste Release/Fire (SAR 3.4.10)

Initiating Event Frequency (Large Release/Ignition):

3.3 E-02/YR

(SAR A. 2-30)

Consequence (Site Boundary):

2.5 rem

(EMHA 4-RD-7,8,9,10 & 5-RD-5,6)

S.C. Criterion @ 3.3 E-02/YR is 0.5 rem

S.C. Item (preventive):

*S.C. Qualified Transfer Lines (seismic, tornado missile)

*S.C. Siphon Mitigation Program (OSR 6.5.9)

SSCs/Admin Controls needed to ensure performance:

*S.C. Admin Control of vehicles/crane during transfers

*S.C. Shift Surveillance (Roundsheets and mass balances during transfers)

Levels of Control: Required Total No. = 2 (one besides S.C. item)

*S.S. ARMs Alarm/Interlock (LCO 3.3.3)

*S.S. HLLCP High Level Alarm (LCO 3.2.7)

*S.S. Cooling Cools (siphon preventers)

*S.S. Spill Response Procedures

Table Five: Preliminary Functional Classification Review Results (con't)

Filter Cell Deflagration/Solids Fire/Spill (SAR 3.4.6.1)

Initiating Event Frequency (Jumper Leak):

8.8 E-03/YR

(SAR 3.4.6.1)

Consequence (assume spill/path to river):

1.65 rem

(Seismic JCO Table 1)

(per HAD, Deflagration/Solids Fire consequences are much smaller, ie, 77 mrem offsite)

S.C. Criterion @ 8.8 E-03 is 5 rem

Consequence at 100 m to worker:

47 rem

(HAD Table 5)

S.S. Criterion @ 8.8 E-03/YR is 25 rem

S.S. Item (preventive):

*S.S. Filter Cell Sump to Filter Feed Pump Interlock (LCO 3.3.2)

Levels of Control: Required Total No. = 2 (1 for > 25 rem + 1 for energetic event)

*S.S. Filter Cell Solids Inspection Program (OSR 6.5.10)

*S.S. Sump HI Lvl Alarm (LCO 3.3.2)

*S.S. Leak-to-Sump Response Procedure (includes 90% dilution)

Enclosed Spaces (SAR 3.4.6.2)

Initiating Event Frequency (Line Leak):

1 E-02/YR

(SAR 3.4.6.2)

Consequence (assume deflagration) at 100 m to worker:

6 rem

(see calculation)

Calculation: Maximum source term for LDBs is 0.35 gal. (SRT-LWA-94-0095).

Comparing with .12 gal/2 rem used by SAR for filter cell, $2 \text{ rem} \times .35/.12 = 6 \text{ rem}$.

S.S. Criterion @ 1 E -02/YR is 25 rem (Consequence is below criterion).

Table Five: Preliminary Functional Classification Review Results (con't)

Deflagration in Filtrate Hold Tank (3.4.5)

SAR consequences (0.34 rem @ 100 m and 5.5 E-04 at site boundary) are below S.C. and S.S. criteria for any frequency. Credit is taken in the analysis for the filter breakthrough interlock and no analysis is provided for consequences arising from its failure. Assuming (worst case) that interlock failure results in unacceptable consequences to the worker but not to the public, the following safety significant items provide adequate controls:

- *S.S. Filter
- *S.S. Filter Breakthrough interlock
- *S.S. Tank 48 Post Reaction Sample
Filter breakthrough monitors detect gamma radiation - sampling is needed to ensure alpha emitter concentrations are within acceptable limits.

Tank 50/22 Deflagration (SAR 3.4.7, 3.4.8)

SAR unmitigated consequences and frequency not quantified (considered not credible). HAD consequences for Tank 50 (51 mrem @ 144 m and 0.3 mrem at site boundary) are below S.C. and S.S. criteria for any frequency. Existing Controls include ventilation instrumentation (LCO 3.3.1) and Inadvertent Transfers Program (OSR 6.5.4).

Solids Fire in Non-Inerted Tank (SAR 3.4.11)

SAR unmitigated consequences (12 rem @ 100 m and 2 E-02 rem at site boundary) are below S.C. and S.S. criteria for any frequency. Existing controls include dedicated jumpers for the transfer of washwater, procedural controls prohibiting other transfers when wash water is transferred, and limits on concentration of dissolved STPB in washwater.

Table Five: Preliminary Functional Classification Review Results (con't)

CHEMICAL ACCIDENTSAbnormal Benzene Release/Waste Tank (SAR 3.3.1.9)

Initiating Event Frequency (Inadvertent Chem Addition):

2.4 E-03/YR

(SAR 3.3.1.9)

Consequence at 100 m to worker:

93 ppm

(SAR 3.3.1.9)

S.S. Criterion @ 2.4 E-03/YR is ERPG-2 (50 ppm)

S.S. Item (preventive)

*S.S. Admin Control on Inadvertent Transfer (OSR 6.5.4)

*S.S. Flammable Vapor Concentration < 25% CLFL (LCO 3.2.1)

Benzene Deflagration in Stack / Column Cleaning (SAR 3.3.1.12)

Initiating Event Frequency (Vent. Fail):

4.6 E-04/Yr

(SAR 3.3.1.12)

Consequence in SB to worker:

440 ppm

(SAR Table 3-4)

Considered a common industrial hazard

Benzene Release - Stripper Building (SAR 3.3.1.10)

Initiating Event Frequency (PRV Fail):

8.7 E-02/YR

(SAR 3.3.1.10)

Consequence in SB to worker:

1300 ppm (less than IDLH)

(SAR Table 3-4)

Considered a common industrial hazard

Nitrogen Asphyxiation (SAR 3.3.1.11)

Initiating Event Frequency (Boundary Breach):

8.8 E-03

(SAR 3-16)

Consequence in SB to worker:

Fatality (If rescue/resuscitation unsuccessful)

Considered a common industrial hazard

Table Six: Systems & Functional Classifications

System Name ¹	Acronym	Func. Class
Backup Power (Standby Diesel Generators)	EEP	PS
Bearing Water	BW	GS
Breathing Air	BA	PS
Building Ventilation	HVAC	CP
Buildings & Structures	BLDG	NS/CP ⁵
Chemical Feed (includes WA, ST and STPB)	WA,ST,STPB	CP/PS ⁶
Chromate Water	CRW	CP/PS ⁷
Cooling Tower Water	CTW	PS
Distributed Control System	DCS	PS
Filtrate	FT	NS/CP ⁸
Fire Protection	FP	PS
Flush Water	FW	GS
Inhibited Water	IW	GS
Med. Press. Steam / Low Press. Steam	MS / LS	GS
Nitrogen	LN	CP
Normal Power	ELNA/ELNH	PS
Oxalic Acid	OA	PS
Plant Air / Instrument Air	PA / IA	PS
Process Water	PWS	GS
Storm Drains	SSEW	CP / PS ⁴
Tank 40 Heating Ventilation (ESP)	40HV	CP
Tank 40 Waste Tank Equipment (ESP)	40WTE	NS/CP ²
Tank 41 Heating Ventilation	41HV	CP
Tank 41 Waste Tank Equipment	41WTE	CP
Tank 42 Heating Ventilation (ESP)	42HV	CP
Tank 42 Waste Tank Equipment (ESP)	42WTE	NS/CP ²
Tank 48 Heating Ventilation	48HV	NS/CP ³
Tank 48 Waste Tank Equipment	48WTE	NS/CP ²
Tank 49 Heating Ventilation	49HV	NS/CP ³
Tank 49 Waste Tank Equipment	49WTE	NS/CP ²
Tank 50 Heating Ventilation	50HV	CP
Tank 50 Waste Tank Equipment	50WTE	CP
Tank 51 Heating Ventilation (ESP)	51HV	CP
Tank 51 Waste Tank Equipment (ESP)	51WTE	NS/CP ²
Vessel Vent Gas	VVS	PS
Waste Transfer	WTS	NS/CP ⁸
Well Water	WW	GS

1 System Boundaries are defined on the P&IDs. See drawing M-M3-H-0001.

2 Tank walls & primary roof NS for function of "gross containment".

3 Emergency purge ventilation equipment NS for function of "post-accident ventilation".

4 Only radiation monitors and diversion valves are CP.

5 EPVE (seismic) Storage Facility is NS (for seismic function). Filter cells are NS ("gross containment").

6 Chem Addition Flow Valve is CP for Wash Water interlock function.

7 Cooling coils and piping to/including siphon preventers are CP.

8 Above-ground portions of Transfer Lines are NS.

Table Seven: Hardwired Interlocks

The OSR or the SAR cite these interlocks as being part of the overall safety analysis (consequence or frequency) for In-Tank Processing. Because the interlocks are associated with safety functions, the circuits are hardwired and redundant to applicable DCS functions. The equipment associated with these interlocks typically involves two or more systems. The specified classification pertains to the device which senses the abnormal condition and provides the interlock signal; the circuit which conveys the signal to the equipment involved in the interlock function; and includes the interlocked equipment as well if a positive action (e.g., a valve closure) is required. Equipment that is merely de-energized is not included in the interlock classification.

The entries are classified per procedure # 2.12, Rev. 1, Functional Classifications, Interim, 8/31/92 of the 1E manual. The OSR and SAR serve as the basis for inclusion in this table.

Interlock Description	LCO # or SAR Sec.	Func. Class	2.12 Criteria
a. Separator Level to Drain Valve	3.3.1.11	PS	A
b. Exhauster to Offgas Control Valve	3.3.1.2	PS	A
c. Filtrate Hold Tank N ₂ Blanket to Filtrate Pump	3.4.5	PS	A
d. Filtrate Rad. Monitor to Filtrate Valves	3.4.5	CP	A
e. ARMs (Vamps) to Transfer Pumps ¹	3.4.10	CP	A
f. Purge Exh. Fan to N ₂ Supply Vlvs TK48,49	4.2.1.10	CP	A
g. Exhaust HEPA dP to Exhaust Fan (Fil Bldg)	4.2.5.3	CP	A
h. Exhaust Fan to Filter Feed Pump (Fil Bldg)	4.2.5.4	CP	A
i. N ₂ Supply to Purge Exhaust Fans TK 48,49	4.3.1.5	CP	A
j. HEPA dP to Purge Exhaust Fans TK 48,49	4.3.1.6	CP	A
k. TK delta-P to N ₂ Supply Vlvs TK 48,49	4.3.1.7	CP	A
l. CLFL to Wash Water (Isolation valve)	4.3.1.8	CP	A
m. Filter Cell Sump to Filter Feed Pump	4.3.2.5	CP	A

1) For Tank 41, the interlock is to Transfer Jet supply isolation valve.