APPENDIX B SUMMARY VULNERABILITY LISTING

Table B-1. Summary Vulnerability Listing. (41 pages)

Item No.	Description	Opportunities for Improvement	Rank
		LOP and LVP System	
LOP/LVP-01	The collective significance of project self-identified issues indicates overall functionality of LOP/LVP systems is indeterminate	1.1. Complete self-identified actions. 1.2. Implement independent confirmation of effectiveness of issue resolution actions.	High Pre CD-4
LOP/LVP-02	The complex abatement system design with numerous safety and permit affecting controls is likely to impact ability to sustain operations and meet throughput requirements.	2.1 Revisit permit conditions and abatement system requirements to consider: a. Current/evolving safety concerns and flowsheet conditions. This may justify elimination, substitution or simplification of the equipment selected to address some constituents of concern. For example, substitution of the carbon beds with alternatives for Hg abatement that are less hazardous and more compatible with achieving throughput objectives. b. Costs associated with throughput impacts as part of any associated economic evaluation c. Regulatory basis for including abatement equipment currently identified in the permits and eliminate from the permit those that do not clearly perform an abatement function (such as the WESP which removes particulates from the offgas, thus to reducing changeout frequencies of HEPA filters). Equipment such as the WESP would then be operated as non-permit affecting. d. Crediting the inherent/overall abatement effectiveness of the melter in combination with the LOP/LVP system (such as for halides and organics). This may justify elimination, substitution or simplification of the equipment selected to address individual constituents of concern. e. Potential to implement alternative regulatory strategies to minimize risks associated with MACT testing.	High Pre CD-4
LOP/LVP-03	There appears to be insufficient redundancy available to avoid single point equipment failures affecting both melters.	3.1 Generally, the single point failures are an inherent aspect of the design and therefore specific meaningful OFIs are not apparent. OR modeling would aid in understanding the full extent of the throughput impacts and potential options to minimize those impacts. 3.2 Evaluate the viability of installing a reduced flow capacity bypass line around the entire LVP system downstream of the HEPA filters as a possible means to improve the ability to safely perform intrusive maintenance on the LVP system bypass valves and equipment.	High Pre CD-4
LOP/LVP-04	Single point instrument failures, interlocks, required calibrations and surveillances can result in unaccounted throughput impacts.	4.1 Confirm, via hazard analysis and discussions with regulators, that all interlocks are required or warranted. 4.2 Verify OR Model considers impacts due to maintenance and calibrations. 4.3 Plan mini-outages for instrument maintenance, loop calibrations, and surveillances (account for these in OR model). 4.4 Consider procedural approach to allow one loop out of service for redundant loops (i.e. designate primary and secondary loops in the DCS).	High Pre CD-4
LOP/LVP-05	Adequacy of design to support control of integrated system equipment/components under various expected operating conditions (e.g. startup, shutdown, low flow, melter surges, etc) and abnormal operating conditions not demonstrated.	5.1 Develop a dynamic process model with control features to aid planning of commissioning, operational start up and shut down and as a tool to aid future alternate process operating scenarios. 5.2 Continue development of "Technical Manuals" as a means to develop and integrate start-up/shut-down sequences and responses to abnormal conditions. 5.3 Consider developing a "reduced scope" WTP Integrated Processing Strategy Description (WIPSD) to develop system level integrated start-up/shut-down sequences and responses to abnormal conditions.	High Pre CD-4
LOP/LVP-06	Lack of functional testing of LOP equipment performance at vendors.	6.1 Review compliance with the performance specifications for each piece of equipment to determine if some level of performance testing should be completed prior to commissioning. 6.2 Establish performance criteria on individual units and overall system as part of start-up and commissioning planning. 6.3 Develop a dynamic process model as a tool to improve confidence that equipment performance requirements can be achieved.	Medium Pre CD-4

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LOP/LVP-07	Intrusive maintenance performed on the LOP System (including the Condensate Receipt vessel) will require both melters to be in idle with the cold cap burned off. Other nonintrusive maintenance requiring a process cell entry could also result in idling both melters.	7.1 7.2 7.3 7.4 7.5	Add associated maintenance to the OR Model which reflects both melters off-line. Determine if additional design features are necessary to facilitate maintenance on the LOP system. Conduct detailed task analysis and methodically identify potential hazardous situations to confirm that entry to wet process cell vessels (LCP and LFP) is possible without shutting down both melters. Consider relocating the pressure relief devices to another C5 area (3rd wet process cell), or pipe them directly into the C5 header would decrease the exposure potential to the maintenance workers during an entry into the wet process cell and would allow one melter to be operational during wet process cell maintenance activities (note that this may drive re-evaluation of the safety significance of the C5 system). Consider crediting the C5 ventilation system in the melter annulus as the final mitigation of a pressure event. This would allow for the removal of the pressure relief devices, thereby eliminating the hazard of off-gas releases into an occupied wet process cell (note that this may drive re-evaluation of the safety significance of the C5 system).	Medium Pre CD-4
LOP/LVP-08	Over time, the film cooler may build-up insoluble vitreous deposits not removed by the existing water sprays. Ability or need to manage the vitreous build –up is indeterminate based on the length of testing and a lack of quantification of the quantity of the vitreous deposits.	8.1 8.2 8.3	Demonstrate and confirm whether vitreous build-up is a problem or not (rate of accumulation not quantified in testing). Write procedures to perform inspection of film cooler during annual spray nozzle replacement. Prepare design for device/procedure to remove build up in film cooler/offgas lines – if required.	Low Post CD-4
LOP/LVP-09	The Melter Film Cooler, Offgas lines (including Wall Penetrations) and the SBS DownComer can be removed and replaced mechanically (i.e. bolted and threaded connections) but these components are currently reflected to last the life of the melter. WTP has not demonstrated that these components can be removed and replaced with active melters during operations.	9.1	Demonstrate during commissioning that the Film Cooler, Offgas line (including Wall Penetration) and SBS Down-Comer can be removed, cleaned or replaced and put back in service under operational conditions. Note that this will further challenge the commissioning durations. This risk to commissioning could be reduced through additional testing at VSL.	Medium Pre CD-4
LOP/LVP-10	The "special" pressure relief devices (LOP-SP-00003/8) that vent melter gas in an off-normal event to the C5 Wet Cell cannot be isolated for maintenance, calibration or replacement.	10.1 10.2	Since these are non-safety devices, consider installing duplicate relief devices that include isolation devices to minimize impacts to production during maintenance. During commissioning, develop and demonstrate method for replacement and/or testing of the special relief devices. Note that this will further challenge the commissioning durations. This risk to commissioning could be reduced through additional testing at VSL.	Medium Pre CD-4
LOP/LVP-11	The impact of solids accumulation and the effectiveness of their removal within the SBS and SBS Condensate Vessel is not demonstrated other than over limited pilot scale test durations.	11.1 11.2	The use of surrogate solids to demonstrate solids recirculation and removal behavior should be factored into commissioning of the SBS system prior to taking the melter into cold operation. This would provide the earliest opportunity to identify and make any modifications to vessel internals or potential add additional instruments or sensors using existing spare nozzles. Further checks should then be made in cold commissioning to minimize the risk of needing changes later in hot operations. Note that this will further challenge the commissioning durations. This risk to commissioning could be reduced through additional testing. Convert a spare SBS vessel port to allow periodic camera inspection of the internals.	Medium Pre CD-4
LOP/LVP-12	The cooling margins for the SBS cooling jacket, cooling coil and condensate vessel appears to be eroded. This condition also impacts the current/expected margin on the associated BOF chilled water exchangers CHW-HX-00003A/B.	12.1 12.2 12.3	Confirm via project analysis that the sizing of the BOF chillers is adequate and that there is adequate cooling margin for control of the SBS system. Evaluate the impact of operating the chillers simultaneously rather than in a duty/standby mode on the plant availability, power demands, control approach, etc. Evaluate the need for equipment changes and the revised control approach if simultaneous operation of the chillers is an acceptable work around.	Medium Pre CD-4
LOP/LVP-13	The Vendor changed the SBS design temperature inputs for the top head without formal WTP approval. Therefore, the design may be out of conformance with requirements.	13.1	Verify design inputs to the Vendor calculation are valid and the Vendor Thermal analysis outputs are accurate and reasonable per project approved procedures.	Low Post CD-4
LOP/LVP-14	It is indeterminate if the O-ring gasket provided by the Vendor for the SBS Top Flat Head and Mating Flange can withstand the thermal loading from the Offgas System during operations.	14.1 14.2 14.3 14.4	Consider alternative high temperature gasket materials compatible with existing flange surfaces such as Perfluoroelastomer (FFKM) or High Temperature Resistant Silicone. In conjunction with new O-Ring material, re-analyze thermal worst case-steady state calculation to see if temperature at the flange can be reduced. If necessary, reanalyze and remanufacture SBS Top Flat Head flange and mating flange to support high temperature flat gasket (such as Metaflex used on the SBS inlet line connections). Review hazard analysis for SBS to confirm that potential failure of O-ring has been considered.	High Pre CD-4

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LOP/LVP-15	VSL SBS down-comer testing design changes not carried forward or incorporated into SBS design.	15.1 Evaluate and incorporate proposed VSL design changes to the offgas down-comer (i.e. adding perforations at the bottom of the down-comer).	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LOP/LVP-16	Documented analysis not evident to discount Ozone as a potential corrosion agent within and downstream of WESP.	16.1 Conduct and document analysis to determine impact of ozone generated in WESP.	Medium Pre CD-4
LOP/LVP-17	Inconsistencies in design documents could lead to design errors that impact the functionality of the equipment or impact future design changes.	17.1 An extent of condition review should be conducted to determine if there are other design media problems.	Medium Pre CD-4
LOP/LVP-18	Ammonium nitrate formation may be possible in the preheater and HEPA filter systems and also downstream of the caustic scrubber (i.e. in the exhaust stack and stack sampling/monitoring system). The rate of build-up, if any, is unknown but, based on lessons learned could require periodic removal/flushing in the future.	18.1 Evaluate the need for an ammonium nitrate detection and removal system for the preheaters and 1st stage HEPA filter units. This could be as simple as a view ports (either sight glass or ball valve ports for fiber optic cameras could be used) and a water flushing systems since ammonium nitrate is water soluble. A drainage system into a collection tank may be needed for the flushing option but this could be retrofitted into the plant when and if needed. 18.2 Evaluate means to flush the exhaust stack and associated sampling and monitoring system piping. 18.3 Consider incorporation of periodic inspection of selected systems on an opportunistic basis. 18.4 Evaluate other areas of potential ammonium nitrate accumulation and determine if inspection and/or clean-out capability should be incorporated prior to start-up.	Medium Pre CD-4
LOP/LVP-19	Replacement and repair of pre-heater elements will likely require both melters to be placed in idle mode, thereby potentially impacting throughput.	19.1 Install additional isolation valves to allow preheaters to be changed out whenever needed without having to place both melters in idle (however, it is recognized that there may be space constraints to implement this option). This approach may give personnel more buffer space from the operating preheater system. It would be practical to install isolation valves during construction to ensure there is adequate room to install additional valves.	Low Post CD-4
LOP/LVP-20	A number of instruments, valves and test ports for the HEPA filters are elevated (10-14 feet off the HEPA filter room floor). Using ladders or temporary scaffolding to perform maintenance at elevation will be less efficient and potentially more dangerous to personnel.	20.1 Design permanent scaffolding or mezzanine to allow safe access to all instrumentation, valves and test ports in the HEPA filter room L-0304H. Other LVP areas may have similar piping configurations and permanent scaffolding or mezzanines will have to be installed here as well.	Low Post CD-4
LOP/LVP-21	There may be an insufficient number of isolation valves to safely replace the B train HEPA filters without placing both melters in idle mode.	21.1 Double valve isolation should be required to protect people from the potential gas temperature hazard in all types of operational scenarios. 21.2 Manual valves across the B train HEPA filter banks need to be installed similar to the ones planned for A HEPA filter train. 21.3 The manual valves and control valves for A train could be swapped around to allow the manual valves to isolate the control valves. This will provide better isolation to repair/replace the internals parts of the control valves when needed.	Low Post CD-4
LOP/LVP-22	The HEPA filter qualification limits for low flow may be challenged under certain operating conditions thereby impacting filter performance.	22.1 Exhauster controls could be preset for minimum flow rate of ~4600 ACFM at the exhauster (accounts for additional air introduced downstream of the HEPA filters). This would ensure minimum flow requirements for A train is always being met. In addition, provide an alarm for low flow conditions at the HEPA filters. 22.2 Below are several other options to be considered for improvement in HEPA filter Operation. a. Switch operations to the backup HEPA B train during periods of low flow (Admin Control). b. Remove one of the HEPA Filter banks in parallel making both the main and backup banks identical (Engineering Control). c. Add additional valves around HEPA filters 1A and 2A to allow operation of each one separately (more operational flexibility) so 2 trains in parallel is still viable for the higher flow conditions. DP monitoring equipment would also have to be added so each unit could run independently. f Option b or c is implemented then the minimum flow rate of ~4600 ACFM could be reduced to ~2800 ACFM at the exhausters.	Medium Pre CD-4
LOP/LVP-23	Vendor requirements for minimum straight pipe lengths needed to achieve accurate flow measurements do not appear to be met for the flowmeters located downstream of the HEPA filters	23.1 Review minimum straight piping requirements for flowmeters manufacturer/vendor to ensure performance under current piping configuration. Modify piping drawings and/or Control and Instrument drawing 24590-WTP-JO-50-00012 as required.	Low Post CD-4

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LOP/LVP-24	Monitoring a COx concentration difference across carbon beds as an indication of fire may prove to be difficult to successfully implement.	24.1 Revisit the decision to rely on a COx concentration difference rather than a CO concentration difference as an indication of a potential carbon bed fire. The pilot scale test experience indicates that a CO concentration difference is more stable to measure, is consistent with recommendations from the literature, and would be less likely to be affected by interactions with the currently proposed guard bed. However, safety basis development may require testing of actual oxidation reactions in a configuration equivalent to the plant equipment to define a bounding ratio between CO and CO2 reaction products in order to use a CO concentration difference as a fire detection set point. 24.2 Consider a multi-attribute monitoring approach for fire detection. This could involve something like a 3 out of 4 voting approach using gas temperature difference, combined with CO, Hg, and SO2 concentration difference. 24.3 Continue with planned testing to identify performance of the proposed guard bed material. It is possible that the guard bed material will not adsorb CO2 after a predetermined "conditioning time period" and not interfere with COx concentration differences (depends on air flow through guard bed producing complete reaction of lime bed to CaCO3 prior to being placed into service). Use currently planned test data as input to address the identified vulnerability.	High Pre CD-4
LOP/LVP-25	The carbon bed temperature elements have not been demonstrated to be a sufficient or effective means to determine the progress/condition of a fire or support recovery efforts.	25.1 Consider developing a method for determining if carbon oxidations are occurring within the isolated carbon beds as an indication that a fire is actually occurring or, if occurring, has stopped. Possible alternatives could be: a. Modeling the actual plant equipment to determine if carbon bed or gas phase temperature probes could become a more accurate indication of a localized hot spot when gas flow through the bed is stopped. b. Determine if gas pressure monitoring could be used as a method for evaluating the isolated carbon bed equipment for localized oxidation reactions, recognizing the potential for leakage of the isolation valves. c. Determine if some type of thermal scan (e.g., infrared) could indicate the presence of localized carbon oxidation reactions. d. Determine if monitoring for convective gas flow from bed could be used to indicate the presence of localized carbon oxidation reactions. e. Determine if a gas sample loop, with CO gas composition monitoring, that is activated only when an automatic carbon bed bypass has occurred, could be used to indicate the presence of localized carbon oxidation reactions.	High Pre CD-4
LOP/LVP-26	No clear definition of a carbon bed fire has been found in the documents reviewed.	26.1 Complete planned set point analysis to define a carbon bed fire. 26.2 Consider developing and implementing a test program, combined with modelling, where carbon bed fires are actually generated to define the system characteristics expected to be observed during a real fire.	Medium Pre CD-4
LOP/LVP-27	There is only a limited definition of the operating conditions that minimize the potential for experiencing a carbon bed fire.	27.1 Develop a system testing approach that avoids passing off-gas through the carbon beds during DRE Testing. This would likely involve establishing the carbon bed performance for organic removal in an off-line equipment set-up (not installed plant equipment). 27.2 Develop a model of the actual plant equipment for evaluating conditions that could result in a carbon bed fire in the actual plant scale equipment/geometry. Based on input from project personnel, it appears that some consideration of simulation tools to accomplish this activity has been considered in the past, but not implemented. Input data to validate modeling would be available from the VSL pilot-scale tests (24590-101-TSA-W000-0009-166-00001) and the ongoing test program described in 24590-WTP-3PN-MWK0-00010. Factory acceptance flow distribution tests are available to approximate the flow characteristics of non-ideal bed packing. It would be anticipated that the model could be used to: a. Determine a minimum total gas flow rate to avoid the potential for gas mal-distribution. b. Determine if an actual plant equipment test with high risk gas component compositions is warranted. c. Identify organic, nitrate/nitrite, and other component limits in the melter feed that could be evaluated on a batch by batch basis during operation to reduce the risk of experiencing a carbon bed fire. d. Identify potential constraints on transients that occur during changes in the operating mode. Examples include: carbon bed start up after adsorbent replacement and transition of the melter from idle to operating mode (the carbon bed characteristics may impose a limit on how rapidly the melter feed rate can be increased). te the risk of fire for the guard bed material ultimately selected.	High Pre CD-4

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LOP/LVP-28	No minimum gas flow rate has been defined for safely operating the carbon beds.	28.1 Once a flow mal-distribution condition is identified by modeling, incorporate a gas distribution test, similar to that performed by the vendor acceptance test, in the bed replacement procedures that determines the minimum gas flow required to avoid conditions that increase the potential for experiencing a fire (could vary each time a bed is replaced). 28.2 Incorporate control logic into the current system that precludes operation of the carbon bed units in a parallel configuration. 28.3 Consider addition of a controlled air (or inert gas) purge to maintain a minimum gas flow rate through the carbon adsorber to protect against gas flow mal-distribution. The set point for a controlled air bleed could be revised based on a flow distribution test each time the carbon bed media is replaced.	High Pre CD-4
LOP/LVP-29	There are no gas temperature monitoring instruments evident in the piping between adsorber units.	29.1 Consider installation of gas temperature monitoring and control response instrumentation on off gas lines between the two adsorber units (LVP-ADBR-00001A and LVP-ADBR-00001B) or only allow operation of a single adsorber unit at a time (preclude lead-lag operating configuration).	Medium Pre CD-4
LOP/LVP-30	There is no evidence that limits are identified/established for allowable rate changes of component concentrations in the carbon adsorber inlet gas.	30.1 Based on plant equipment modelling proposed in OFI 27.2, adjust operating procedures as needed to eliminate operating conditions that could initiate a carbon bed fire.	Medium Pre CD-4
LOP/LVP-31	It appears that the current OR model understates the potential impact of carbon bed operation on the calculated plant availability.	31.1 Define a documented basis for a false positive indication of a carbon bed fire, or an actual fire, based on experience with carbon beds in other industries. It is likely that there will be considerable uncertainty in application of this type of input to the plant equipment configuration. Consider addressing the carbon bed fire issue as part of a sensitivity study in the OR modelling effort as a method of evaluating the uncertainty in input information.	Medium Pre CD-4
LOP/LVP-32	The presence of carbon fines represents a source of ignition has not been thoroughly analyzed.	32.1 The Donau BAT37 bulk material is reported to have a measured ignition temperature of 409 °C. It appears that fines accumulations in the carbon adsorber system would not be a fire ignition temperature issue based on the simplified evaluation. However, it is recommended that a formal consideration of carbon fines accumulation be added to the project safety documentation for completeness. This issue could become more important upon collection of more information on the guard bed material based on the currently planned configuration (with guard bed following the carbon bed). 32.2 There is an indication that there may be a preferred order for bed replacements during unloading/loading sequence. The scenario is potentially controlled by replacing the carbon bed first (depositing carbon bed fines on the front face of a used guard bed), the guard bed second (removing carbon fines that may have deposited with the discarded guard bed), and the discharge filter last.	Medium Pre CD-4
LOP/LVP-33	Maintaining personnel egress routes during carbon bed replacement activities may be challenging.	33.1 There appear to be limited opportunities to address the limited space available around the adsorber units. One approach could be to perform an evaluation of the loading and unloading procedures to identify where the required temporary equipment, supporting the activity, can be located while maintaining required egress routes throughout the activity. As an alternative, the carbon bed supplier does appear to offer a smaller package for receipt of fresh material. It may be possible to design a loading system that uses a smaller receipt package that can be directly maneuvered over a carbon bed inlet port and eliminate the intermediate transfer from super sack to hopper (followed by transfer of hopper to the inlet port) as a method to reduce loading equipment space requirements at the expense of needing to handle additional receipt packages.	Low Post CD-4
LOP/LVP-34	The mercury monitor represents a single point failure.	34.1 Install a duplicate mercury monitor.	Medium Pre CD-4
LOP/LVP-35	There appears to be inadequate isolation of carbon beds upon detection of a potential fire.	35.1 Expand the carbon bed isolation control system to include valves YV-0423A and YV-0423B, or YV-0423C.	Medium Pre CD-4
LOP/LVP-36	Shrinkage of the proposed guard bed particles could occur after loading.	36.1 The significance of this vulnerability should be indicated by the currently defined test program. 36.2 Consider investigating a guard bed material that begins as calcium carbonate.	Medium Pre CD-4
LOP/LVP-37	Condensed water may collect within the carbon beds during time periods when the carbon bed is bypassed and cooled, thereby impacting the ability to complete bed replacement activities.	37.1 The significance of condensate collection in the carbon bed is indeterminate at this time and the location of condensate collection is difficult to predict. It is likely that operating experience will be required to identify if condensate collection will become an actual issue. If identified in the future, some potential methods of resolution could be considered: a. Operate the off-gas system at a reduced SBS temperature for a time period prior to by-pass of the carbon beds during a routine shut-down. b. Periodic monitoring/purging of differential pressure/sample lines and addition of insulation to instrumentation lines prone to collecting condensate. c. Develop a dry air purge of bed discharge ports as part of the bed replacement procedure.	Medium Pre CD-4

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LOP/LVP-38	No dedicated ports supporting the carbon bed loading bypass test were found.	38.1 Install or identify ports for challenge gas detection equipment installation.	Low Post CD-4

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LOP/LVP-39	The basis for carbon bed sizing appears to be uncertain.	39.1 Re-evaluate the Hg basis for the LAW facility flowsheet. Consider updating 24590-WTP-RPT-PR-01-011 as a means to reevaluate the mercury pathway and concentrations at LAW and to re-visit the viability of previously discounted alternative technologies/approaches for mercury removal and abatement (see notes section above regarding potential alternatives for mercury removal/abatement). 39.2 Re-evaluate and confirm the accuracy/adequacy of the sizing basis for the carbon beds.	Medium
LOP/LVP-40	Underestimation of TCO skid thermal cycling.	40.1 An analysis of the thermal loading on the TCO skid should be performed to determine whether the materials of construction can accommodate the stresses imposed by the thermal cycling. Although considered unlikely, this analysis may result in redesign of equipment. 40.2 Use the DCS to track thermal cycles of the equipment, if this is determined to be an important parameter for equipment longevity. 40.3 Consider opportunistic based periodic inspection of stress points to confirm that thermal cycling is not affecting equipment.	Low Post CD-4
LOP/LVP-41	Heat-up and cool-down temperature profiles for TCO skid not considered in OR model.	41.1 Consider the ability to invoke operational conditions/controls that would reduce the need to cool down the TCO skid. 41.2 Model the startup sequence of the LVP equipment to see if the 11 hr heat up time is a critical time for system start up. If this time is prohibitive for startup consider installing higher capacity heaters (this could be done as a post CD-4 modification). 41.3 Conduct analysis to determine the maximum flow increase that can be accommodated by the electric heater to remain above the catalyst operating temperature. A new limit on flow rate increase may result.	Medium Pre CD-4
LOP/LVP-42	The viability of the current TCO maintenance approach and associated throughput impacts are indeterminate.	42.1 Complete evaluation of maintenance evolutions so impacts are understood and included in the OR model. 42.2 Determine the disposal paths for removed equipment (e.g. catalysts). 42.3 Generate plans for qualifying replaced or repaired equipment/components.	Medium Pre CD-4
LOP/LVP-43	The current and proposed design of pH control suffer from an unknown lag time between addition of caustic and the resulting change of pH as indicated by the pH meter. The WTP proposed change relies on the operator to observe changes in the pH reading and react accordingly.	43.1 pH control could be improved if caustic addition is carried out in the suction line of pumps LVP-PMP-00003A/B (using a vortex mixer) upstream of the pH meter. This will ensure a minimum lag time between caustic addition and the pH meter. 43.2 Adding mechanical agitation to the vessel would improve mixing and may allow for automatic control in current configuration.	Low Post CD-4
LOP/LVP-44	There is no way apparent to remove an accumulation of insoluble solids, potentially, in LVPTK-00001 (caustic scrubber recirculation vessel).	44.1 Consider alternate means of agitating the tank inventory to ensure insoluble solids stay suspended so that they are removed during transfers to RLD-VSL-00017A/B. 44.2 Consider periodic/opportunistic inspections to determine if solids are accumulating.	Low Post CD-4
LOP/LVP-45	The effects from other unit operations on the startup and shutdown of caustic scrubber have not been fully analyzed/determined.	45.1 Consider performing a system wide study/model on the effect of startup/shutdown of individual units has on the whole LOP/LVP system.	Medium Pre CD-4
LOP/LVP-46	There is no direct means evident to monitor the condition of packing or mist eliminators within the caustic scrubber.	46.1 Consider periodic/opportunistic inspections of packing integrity.	Low Post CD-4
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IC-CO-01-V-01	Industrial HMI Human Factor Engineering principles have not been adequately implemented in HMI screens. Situational awareness of the operator will be reduced hindering the ability to make operational or process decisions quickly and accurately.	IC-CO-01-OFI-01.1: Modify HMI objects to include all relevant information for equipment and instruments. Add English worded equipment status to all objects. (Stopped, Running, Failed etc.) IC-CO-01-OFI-01.2: Incorporate process relevant trends on overviews that include process goals and alarm/trip levels. IC-CO-01-OFI-01.3: Only include information on overviews relevant to the goals for the system. Indicate system trip status, process status and equipment status. Omit information not relevant to the operation of the system such as miscellaneous room temperatures. IC-CO-01-OFI-01.4: Perform assessment of current HMI configuration for all systems and implement NUREG-0700 recommendations for HMIs. Review other industry standards for HMIs including ASM Consortium recommendations for HMIs, OPTO 22 White Paper – Building an HMI that works and ASEE HMI Good Practices.	Medium Pre CD-4

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IC-CO-01-V-02	A requirement of the BOD is that 'Simple, common-sense design modes of operational control to ease operability in both normal and abnormal situation will be factored into the design'. System wide implementation of parallel device operation (fans, pumps etc.) utilizes a nonstandard approach as identified in CLIN 3.2 Table 2 – 16 Error analyses following testing Error Ref #2, 3. This approach has not changed and is still present in the LAW parallel operation of devices.	IC-CO-01-OFI-02.1: Implement single PI controllers logically for all instances of dual controllers for parallel devices into a common header with single process variable feedback. IC-CO-01-OFI-02.2: Remove all dual control faceplates from the HMI screens, CSLDs, CDIs and other related documentation prior to startup and commissioning. IC-CO-01-OFI-02.3: Assess controls for basic day to day operations to determine if procedures will be required to accomplish the tasks. If simple tasks require procedures to ensure that they are completed without error then they should be re-worked to assist the operators to be successful in operating the system.	Medium Pre CD-4

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IC-CO-01-V-03	CLIN 3.2, Ref RPP-44491 3.8.7, identified an issue regarding the supervisor override of interlocks. This issue has not been addressed within the current system and will be exacerbated by the lack of functional descriptors within the system.	IC-CO-01-OFI-03.1: Enhance all graphics to display English word descriptors for interlocks and create a standardized method for determining at a glance hazard assessment for the interlocks.	Medium Pre CD-4
IC-O-01-V-01	There appears to be no protection from an event that could cause an excessive depression in a C5 area. Any obstruction of flow could create a situation where the cell depression exceeds the readable range of the pressure instrument.	IC-O-01-OFI-01: Include additional requirements in the functional requirements specification (FRS) and requirements traceability matrix (RTM) for prevention of excessive depression in C5 areas. Prevention can be achieved either logically (via ICN), hardwired (power interrupts to the drives) or preferably using both methods in a nested fashion.	Medium Pre CD-4
IC-O-02-V-01	The cascaded startup of the HVAC system is an entirely manual process. The onus is completely on the operating user to perform the repeatable steps, in the correct order, at the correct time to facilitate a successful startup of the HVAC system. Furthermore the startup is not sufficiently defined to establish steps for a coherent HVAC system startup.	IC-O-02-OFI-01.1: Author a master procedure to start the HVAC as a coherent system that considers the expected flows and depressions throughout the system during startups and what initiators are required to provide cascaded startup of the system. IC-O-02-OFI-01.2: Once a satisfactory procedure is established new sequences should be programmed that will initiate the HVAC startup based on a combined set of system prerequisites and step/transition based sequential function chart (SFC) logic. Each fan set startup routine will comprise its own 'sub-sequence' that will be initiated by a master scheduler.	Medium Pre CD-4
IC-O-02-V-02	The cascaded shutdown of the HVAC system is not controlled in a manner to ensure cascaded confinement of radiological materials. Certain logical trips will shut down the C2 supply and extract fans simultaneously with the remaining equipment tripping out of service due to process anomalies.	IC-O-02-OFI-02.1: Author a master procedure to shut down the HVAC as a coherent system that considers the expected flows and depressions throughout the system during shut downs and what initiators are required to provide cascaded shutdown of the system. IC-O-02-OFI-02.2: Once a satisfactory procedure is established new sequences should be programmed that will initiate the HVAC shut down based on a combined set of system/ fan set trips and step/transition based logic. Each fan set shutdown routine will comprise its own 'sub-sequence' that will be initiated by a master scheduler. In the event that the shutdown sequence does not operate correctly a set of bounding fan trip conditions will exist to override-stop the fans to ensure the system is ultimately shut down.	Medium Pre CD-4
IC-O-02-V-03	The currently proposed parallel fan operation is fundamentally flawed in its execution. Industry engineering practices indicate dual process control into a common header with a single process variable to result in unstable control. This issue was identified in CLIN 3.2 RPP-50775 and is still present system wide (not restricted to LAW systems).	IC-O-02-OFI-03.1: Eliminate all instances of independent PI control throughout the project (WTP in its entirety) as identified in CLIN 3.2, Table 2-16. IC-O-02-OFI-03.2: Simulate situation conforming to target environmental conditions to provide adequate proof of concept for control of parallel fans into a common header using new control scheme.	Medium Pre CD-4
IC-O-02-V-04	The current control schemes identified in the CSLD requirement documents identify responses to process anomalies re: fan trips, failed dampers etc. that will likely not provide adequate response times necessary to maintain HVAC operations without interruption.	IC-O-02-OFI-04.1: Establish new baseline for initiating a duty/standby changeover. The AHUs and Fan Sets should be treated as a single operating unit of which any failed component constitutes a failure. E.g. a failed discharge damper during startup should initiate the changeover, currently the damper failing would only cause a failover once the fan running signal is on which could cause a delay of seconds or minutes. IC-O-02-OFI-04.2: Expand error trapping for devices associated with fans to capture failures as soon as possible. E.g. a discharge damper that fails to move off the closed limit could be captured with a secondary, shorter, timer. This would allow a response to a predictable outcome to be almost instant (within 5s) without waiting for the fan to be running and the process to be insufficient to maintain pressure differentials.	Medium Pre CD-4
IC-S-01-V-01	System descriptions (SD) are no longer the source for system requirements. Since the CSLDs are used as both the requirements and the basis for test documents there is no longer complete correlation back to system requirements defined in the SD. Discrepancies between upper tier documents and implementation documents indicate that requirements, critical or non-critical, could have been overlooked and will not be identified as incorrect during testing.	IC-S-01-OFI-01.1: Identify critical design requirements from baseline documentation and create a requirements traceability matrix (RTM) that can be used to re-validate the software to verify functionality of each system per NQA-1 2000 Requirement 3, Section 400. IC-S-01-OFI-01.2: Re-evaluate test acceptance criteria on a functional system basis to ensure that the functional requirements of each system are met based on the derived requirements from upper tier documents. IC-S-01-OFI-01.3: For computer programs used for operational control, computer program test procedures should be created that demonstrate the required performance over the range of operation of the controlled function or process per NQA-1 2000 Requirement 11, Section 400.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

IC-S-06-V-01	The PPJ control system is Level A software which requires full implementation of DOE Safety Software Guide and Software Quality Assurance (SQA) Work Activities. The requirements being supplied to the contractor do not contain traceability to upper tier documents and do not convey the requirements in a manner that is clear and concise to any discipline that may be required to perform a review.	IC-S-06-OFI-01.1: Derive PPJ requirements from baseline documentation, hazard, risk assessment and allocation of safety functions to protection layers. This can accomplished through updates to the SSRS or generation of new SSRS that define what the requirements are but not how they are going to be accomplished. IC-S-06-OFI-01.2: Base all software development and testing criteria on software requirements to ensure functionality is met and hazards identified during risk assessment are implemented, verified and validated. IC-S-06-OFI-01.3: Eliminate the use of CSLDs as requirements for PPJ software development. They do not clearly define the requirements or their delineation from upper tier documentation. The SSRSs already developed (used in conjunction with Desk Instructions to develop the CSLDs) are a clear, concise, traceable, English worded document set that can be used to derive the requirement of an individual SIS/SIF and remain independent of the actual implementation. The current proposed mechanism for development of the PPJ software requires the supplier to recreate documentation that already exists in the SSRS documents.	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
IC-S-07-V-01	Current life cycle documentation will be cumbersome to maintain and update during startup, commissioning and operations.	IC-S-07-OFI-01.1: Eliminate and/or replace all requirements and design documentation that will be affected by software modifications that do not affect higher level requirements. Day to day software modifications to meet functional requirements, as designed, should not incur additional paperwork. Review design document sets for the control system software to establish the level of effort required to make a software change and how the accumulation of these types of changes will impact the commissioning schedule.	Medium Pre CD-4
IC-S-09-V-01	There is currently no scope or procedure for implementing cyber security for the WTP control system. Compatibility and implementation issues related to the control system software could result in extended implementation of NIST and DOE requirements.	IC-S-09-OFI-01.1: Establish a means of providing adequate cyber security measures for the selected software and hardware that comprises the ICN for WTP that complies with DOE Order 205.1B.	Medium Pre CD-4
IC-S-10-V-01	The documentation that defines the SIS and corresponding layers of protection does not appear to be consistent with the CSLDs or CDIs in all cases.	IC-S-10-OFI-01.1: Re-evaluate LPs identified within the SISs to verify their implementation in the respective systems. Create functional requirement documents linking LPs with ICN design documents to provide traceability and tracking of these functions. IC-S-10-OFI-01.2: Eliminate any ICN functions that are part of an SIS to establish a clear delineation between the safety systems and the plant control system.	High Pre CD-4
IC-S-02-V-01	The Integrated Control Network, the plant system control system, has been developed using an inappropriate quality assurance grading level because the software grade was determined incorrectly by not adequately considering all hazards and hazard controls.	The Opportunities for Improvement related to this vulnerability include: • IC-S-02-OFI-1.1: Define the ICN boundaries and interfaces, consistently and commiserate with the functions attributed to the ICN. • IC-S-02-OFI-1.2: Define (or redefine) the WTP specific functions requirements performed and controlled by the ICN. Flow down of requirements from upper-tier documents will provide the test criteria when functionality is confirmed during software development. • IC-S-02-OFI-1.3: Evaluate (or reevaluate) the hazards, risk, safety, and permitting compliance controlled or affected by the ICN and its subsystems without regard to the likelihood or credibility of accident scenarios or consequence mitigation, per 10 CFR 830. Generate a full list of questions to evaluate software compliance. Use a full implementation of DOE O 414.1C and ask all the compliance questions generated above prior to assigning a software grade. • IC-S-02-OFI-1.4: Use a standard set of documents, such as ISO/IEEE, to organize required software documents, descriptions, etc. An experienced software engineer would then be able to navigate without recourse to the originators or maintainers.	High Pre CD-4
Confinement Ventilation Systems			
HVAC-01-1	Instrument uncertainties are calculated incorrectly challenging instruments ability to work properly.	□ Perform an evaluation that includes uncertainty analysis for all fan control loops including alarm and interlock set points. This ensures chosen set points are reasonable and control loops can operate as designed without routinely challenging interlock set points.	High Pre CD-4
HVAC-01-2	The C2/C3 DP monitor scheme, as currently designed, will not work.	□ Perform a market search to find instrument with less uncertainty or raise the C2 depressions particularly in the rooms where DP Monitors are located.	High Pre CD-4
HVAC-02-4	Controlling parallel fans with two separate controllers results in unstable fan control.	□ Use one control and spit the signal between the two ASDs.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-11-4	Risk of contamination backflow in a Swabbing/Finishing Line.	□ Increase flow from swabbing cells to finishing line, provide airlocks when feasible, increase in-bleed filter capacity.	High Pre CD-4
HVAC-12-3	Zone C2 to C3 doors have less than 100 fpm.	□ Make sure volumetric flow rate into C2/C3 areas is 100 fpm (minimum) through a single open door.	High Pre CD-4
HVAC-12-4 HVAC-31-6	No airflow parameter identified for the open doors between C3 and C5 zones.	□ Provide at least 125 linear fpm through the open C3/C5 door to ensure adequate inflow to prevent the escape of contamination.	High Pre CD-4
HVAC-25-1 HVAC-25-2	C2 supply fan bypass not adequately evaluated and appears it will not work.	• Provide a calculation of the BYPASS system to more adequately predict the ventilation parameters for the loss of power event. • Correct the V&ID drawings to depict the anticipated air flow rates and pressure drops. • Reduce infiltration quantity to a minimum.	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
HVAC-31-1	Lack of engineered controls for cell entries through subchanges.	• Convert subchange rooms to cell entry rooms with standalone airlocks. Airlocks would eliminate the need to adjust the dampers. They can be set up so there is virtually no opportunity for operator error. • Develop a system model to determine the impact of opening subchange doors. • Add indicating lights to the damper and door position to indicate the door and damper are in the correct position prior to opening the door or adjusting the damper. • Add positioning equipment to the cell doors and subchange dampers that prevents the door from being opened prior to the damper being in the correct position and prevents the damper being adjusted before the cell door is closed. • Add engineered positioning equipment to the damper to position the damper automatically based on cell door position.	High Pre CD-4
HVAC-31-2 HVAC-31-3	Life safety and emergency response issues related to subchanges	• Convert subchange rooms to cell entry rooms with standalone airlocks. This would allow personnel to enter the cell entry room from the corridor and vice versa without having to adjust damper or door position. • Convert subchanges to airlocks to eliminate the need to install breaker bars. • Install breaker bars on subchange doors.	High Pre CD-4
HVAC-31-4	Subchange rooms too small to accommodate all personnel and equipment associated with typical entries.	□ Convert subchange rooms to cell entry rooms with standalone airlocks. This would allow personnel to enter the cell entry room from the corridor and vice versa without having to adjust damper or door position.	High Pre CD-4
HVAC-31-5	Cell entry doors to not have hose pass-throughs.	□ Convert subchange rooms to cell entry rooms with standalone airlocks in order to allow personnel to enter the cell entry room from the corridor and vice versa without having to close the cell entry door. Note: This would eliminate the need to close the cell door during entries.	High Pre CD-4
HVAC-31-8	Adjusting of subchange dampers along with opening and closing doors causes changes in the C5V flow.	• Develop a ventilation system model to demonstrate the change in airflow and the impact on depression when adjusting subchange dampers and opening and closing cell entry doors. • Convert subchanges to airlocks where the cells are completely isolated from the corridors.	High Pre CD-4
HVAC-31-9	Function of transfer duct between L-0108 and L 0109 (and L-0114 and L 0115) is not evaluated.	• Develop a model to validate the current system configuration. • Provide evaluation to demonstrate the proper function of the transfer duct between rooms L-0108 and L-0109 (and L-0114 and L-0115).	High Pre CD-4
HVAC-32-1	Airflow through canister import rollup doors is not included in the design.	• Define the flow rate through the rollup doors and add it to the design flow rates. Make other adjustments to depression values and transfer grill and inbleed flow rates to reflect modified depression values. • Modify or replace rollup doors to eliminate leakage through the doors.	High Pre CD-4
HVAC-32-2	Airflow through the canister import hatch has not been evaluated.	□ Define the flow rate through the rollup doors and add it to the design flow rates. Make other adjustments to depression values and transfer grill and inbleed flow rates to reflect modified depression values.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-33-1	Variation in airflow through the finishing lines as a result of opening and closing finishing line doors is not quantified as part of the design.	• Define the flow rate through the rollup doors and add it to the design flow rates. Make other adjustments to depression values and transfer grill and inbleed flow rates to reflect modified depression values. • Modify or replace rollup doors to eliminate leakage through the doors.	High Pre CD-4
HVAC-42-1	C5 exhaust fans are not sized based on the latest calculated exhaust temperatures at the exit of Pour Caves.	• Revise calculations to incorporate a maximum realized exhaust air temperatures based on the worst case off-normal operating condition with a margin of safety assigned to the pressure drop calculations and determine if redesign of the current C5V exhaust fans is required. • Investigation and validation is required to ensure that all confinement ventilation system instruments, wiring and sensors are specified to meet the temperature limits as calculated by the optimum off-normal condition to achieve the required performance and reliability.	High Pre CD-4
HVAC-44-2	Lack of redundant cooling in Buffer Storage and Canister Rework areas.	• Evaluate the feasibility of installing 100% standby FCUs for the Container Buffer Storage and the Container Rework Area. Availability of additional space to house redundant FCUs and associated ductwork must be investigated. • Investigation and validation is required to ensure that ASTM (24590-WTP-DB-ENG-01-001) requirements are complied with for all Buffer Storage ventilation system which may be exposed to temperatures higher than 140^0 F. External surface of Buffer Storage ventilation system will be provided with adequate insulation to protect the workers from contact with hot surfaces above 140^0F where applicable.	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
HVAC-45-1 HVAC-46-1	Off-normal operations analysis not performed.	□ Identify all possible off-normal conditions. □ Provide evaluation for each off-normal condition to determine impact on facility depression and temperatures. This evaluation may include assessing C5V component capacities. □ Provide facility modifications or work around to ensure facility confinement and temperature limits are satisfied. □ Evaluate the impacts on the balance of plant chilled water system flow, pumps and power requirements. □ Analyze the recovery mode after occurrence of an off-normal event with any control modifications and system hardware modifications if any.	High Pre CD-4
HVAC-48-1	Unverified cooling capacity for safety significant equipment rooms and Non-Safety Battery Rooms.	□ Evaluate the current electrical heat loads and verify the capacities and available margins of all purchased SS Air Conditioning equipment serving SS spaces as well as Non-safety battery rooms. □ Redesign the SS Units as necessary to meet the SS functional requirements.	High Pre CD-4
HVAC-51-1	Radial HEPA filters are not qualified for use.	□ Radial HEPA Filter technical issues and testing is managed by a separate engineering design group. WDOH approval will be required for use of radial HEPA filters in LAW.	High Pre CD-4
HVAC-53-1 HVAC-53-3	Lack of redundancy in stack sampling and monitoring equipment results in increased downtime since these components require extensive maintenance.	□ Revise Radioactive Air Emissions Notice of Construction Permit Application for the Hanford Tank Waste Treatment and Immobilization Plant. □ Add redundant stack sampling and monitoring systems so that inspections and maintenance can be performed while the standby system operates. Install inspection ports and develop remote inspection techniques using boroscope cameras. □ Design an enclosure to capture thermally hot hazardous chemical vapors to protect employees during removal of sample probes for inspection. □ Add redundant stack sampling and monitoring systems so that maintenance can be performed while the standby system operates.	High Pre CD-4
HVAC-53-2	C5V air stream temperature exceeds stack monitoring equipment rating.	□ Develop a computer simulation of the facility HVAC System and evaluate thermal loads going to the C5V exhaust system.	High Pre CD-4
HVAC-54-1	Low Flow ventilation design presents multiple inherent vulnerabilities.	□ Develop remote decontamination techniques such as HEPA vacuum cleaners deployed from the overhead crane. □ Prior to hot commissioning operations should perform detailed clean-up and inspect and repair any damage to cell coatings.	High Pre CD-4
HVAC-55-1	LAW C1V, C2V, C3V and C5V Cascade Low Air Flow HVAC System design causes the control system to be complex	□ A recommended design change would be to combine the C1V, C2V, C3V and C5V ventilation systems into a separate, independent dedicated PLC. Having a separate PLC for the C1V, C2V, C3V and C5V ventilation systems will allow early start-up testing and identification of control systems deficiencies. Modifications to the ventilation system controls could be completed earlier in the commissioning phase to minimize cost and schedule impacts.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-55-2	LAW HVAC control Systems are currently combined with 32 other process control systems.	□ A recommended design change would be to combine the C1V, C2V, C3V and C5V ventilation systems into a separate, independent dedicated PLC. Having a separate PLC for the C1V, C2V, C3V and C5V ventilation systems will allow early start-up testing and identification of control systems deficiencies. Modifications to the ventilation system controls could be completed earlier in the commissioning phase to minimize cost and schedule impacts.	High Pre CD-4
HVAC-56-1	The LAW Ventilation system needs to have a Hazard analysis performed to identify the Failure Modes and Effects for normal and off normal operations, start-up, production, cleanout & flushing and maintenance.	□ It is recommended that a hazards analysis be performed on the LAW Ventilation system to identify the Failure Modes and Effects for normal and off normal operations, start-up, production, clean-out & flushing and maintenance. Functions and Requirements and accurate V & IDs with alarms and interlock set points must be developed and documented.	High Pre CD-4
HVAC-01-3	Instrument range should be a compound range (e.g. -5 to +5) rather than recording only one direction (e.g. 0 to +5).	□ Re range the differential pressure transmitters to include a compound range. This would capture the magnitude of differential pressure reversals.	Medium Pre CD-4
HVAC-01-4 HVAC-02-5 HVAC-02-6 HVAC-03-1 HVAC-11-5 HVAC-24-1	Documentation Discrepancies.	□ Review and fix documentation discrepancies.	Medium Pre CD-4
HVAC-02-1	C2V fan control will not work.	□ Consider using a different control scheme. Perhaps running the C2V AHUs at a fixed speed and control the exhaust by sensing header pressure. Or consider controlling on flow using a flow element.	Medium Pre CD-4
HVAC-02-2	Lack of safeguards against excessive depression.	□ Add interlocks and or alarms to prevent excessive depression due to loss of control of the fan.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
HVAC-02-3	As currently designed C3V Fan Control Pressure Transmitter (C3V-PDT-2117) will not work to control C3V depression.	□ Place C3V-PDT-2117 in a C3 area or room that is exhausted by C3V.	Medium Pre CD-4
HVAC-02-7	Loss of Power results in C5V at a fixed speed rather than controlling flow or zone differential pressure.	□ Determine the driving factors (heat removal, confinement etc.) for determining the fix speed value and establish the fixed speed value.	Medium Pre CD-4
HVAC-11-1	The LAW Facility secondary to tertiary zone differential pressure exceeds the recommended differential pressure range of- 0.1 to -0.15 inches w.g. from DOE-HDBK-1169-2003, resulting in excessive door opening pressures (life safety concern).	□ Evaluate the basis for the nominal differential pressure requirement identified for the Secondary (C3) zones of -1.6, -1.4, and -1.5 inches w.g. relative to atmospheric pressure. Lowering the differential pressure between C2 zones and C3 zones will result in a lower force required to open zone transition doors. □ If it's not feasible install breaker bar for each door exceeding force (above required) to set door in motion.	Medium Pre CD-4
HVAC-11-2	Low duct air velocities will result in deposition of radionuclides in the ductwork.	□ Evaluate ductwork configuration to identify opportunities to modify duct sizes, or air flows, in an effort to improve transport velocities to better align with the recommended 2,500 fpm minimum duct velocity criteria.	Medium Pre CD-4
HVAC-11-3	Flow cascades directly from a C2 zone to a C5 zone through an inbleed.	□ Evaluate LAW facility structure to identify opportunities to relocate existing C2 to C5 in-bleeds such that the cascade flow path includes a C3 zone to prevent migration of contamination directly from the C5 zone to the C2 zone. If it is not practical to relocate C2 to C5 in-bleeds, evaluate feasibility for installation of HEPA filtration to minimize migration of contamination through inbleed.	Medium Pre CD-4
HVAC-12-1	Combustion and inhalation hazard not considered in establishing ventilation rates.	□ Evaluate the potential of combustion hazard, and the potential inhalation hazard of substances that are present in or could be released to the workroom. (DAC, Hydrogen, CO2, NOx.)	Medium Pre CD-4
HVAC-12-2	No HEPA filters on C5V exhaust duct inlet.	□ Provide "Out-bleed" HEPA filtration for the primary confinement areas. Increase velocity in the exhaust ductwork.	Medium Pre CD-4
HVAC-12-5	**1.** Some areas in the LAW facility have been labeled as C2/C3 and as C3/C5 resulting in inconsistent application of design values.	□ Establish ventilation zones in a three-tiered manner in conjunction with single zoning where the each zone based on the worst case scenario.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-12-6	Potential for flow from C3 to C2 areas upon loss of power.	☐ Develop a computer simulation (model) of the LAW facility HVAC system to evaluate the safety and operability of the system. Computer simulation should evaluate the facility HVAC systems ability to accommodate dynamic operations (e.g., personnel access, routing of waste canisters and drums), failure of equipment (e.g., supply and exhaust fans), and safety requirements (e.g., hydrogen mitigation, heat removal and confinement).	Medium Pre CD-4
HVAC-12-7	C5 exhaust fans/motors could be undersized based on collective vulnerabilities.	☐ Evaluate all aspects affecting C5V exhaust fans size and capabilities.	Medium Pre CD-4
HVAC-21-1	Installed inbleed configurations cannot be verified to match pressure drop calculations.	☐ Compare "as built" Inbleed design to the original "as calculated design" and evaluate any changes that may affect performance.	Medium Pre CD-4
HVAC-21-2 HVAC-21-4 HVAC-21-6	Flow through inbleeds will decrease as inbleed filters load.	☐ Install an automatic damper on the Inbleed to control filter loading by measuring air flow rate through the Inbleed allowing the damper to open as the filter loads increase until the damper is wide open or install fan powered supply on the Inbleed or replace filter with electro static precipitator (ESP). ☐ Change C5 exhaust control from zone depression to zone flow.	Medium Pre CD-4
HVAC-21-3	Fire damper inspection and maintenance will result in bypassing the inbleed and may result in surges in C5 flow.	☐ Install "windows" on access doors for visual inspections. ☐ Enlarge access doors to facilitate fire damper maintenance.	Medium Pre CD-4
HVAC-21-5	Inbleed filter loading affects HEPA filter differential pressure making it difficult to monitor HEPA filter loading.	☐ Modify Inbleed for automatic damper control, supply fan to eliminate the effect of filter loading or replace the filter with a electrostatic precipitator (ESP).	Medium Pre CD-4
HVAC-21-8	The INBLEED pressure drop calculation did not include dirty filter loading and additional sub-change damper DP.	☐ Consider alternate means of filtration such as ESPs or roll filters to minimize pressure drop through INBLEEDS.	Medium Pre CD-4
HVAC-23-1	Strength of walls for L-0305 room may not be adequate for high differential pressure created when opening plenum doors to C2V supply air handlers while the supply fans are operating.	☐ Strengthen room walls meet increased differential pressure requirements. ☐ Install relief dampers to connect to outside atmosphere.	Medium Pre CD-4
HVAC-25-3	Zone pressure controls for cascading zone will be unstable.	☐ Revisit control strategy by utilizing branch dampers to provide pressure control for C2, C3 and C5 areas. ☐ Modify INBLEED s for automatic control for filter loading replacing the pressure gauges.	Medium Pre CD-4
HVAC-25-4	LAW C2V Supply System Pressure Drop calculation error.	☐ Revise the pressure drop calculation for additional filter differential pressure for the supply fans.	Medium Pre CD-4
HVAC-31-10	Opening of door L-0106-2 between subchange L-0106 and buffer crane maintenance area in L-0110 was not considered in subchange operation.	☐ Develop a model to evaluate the impact of facility operations, such as accessing the buffer crane maintenance through subchange L-0106, on the ventilation system.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
HVAC-31-7	Inbleeds don't function during entries.	☐ Convert subchanges to airlocks where the inbleed is located between the corridor and cell entry room. This would allow the inbleed to function continuously.	Medium Pre CD-4
HVAC-34-1	Lack of airlocks between rooms of different differential pressures may result in ventilation upsets.	☐ Add an airlock for accessing rooms LCB004 and L-B009. ☐ Add an airlock for accessing rooms L-0117 from LC0109 and L-0119 from LC0111.	Medium Pre CD-4
HVAC-35-1	Lack of redundancy of C2V exhaust fans.	☐ Provide a calculation demonstrating the facility can continue in normal operation with a single operating C2V exhaust fan. ☐ Install larger fans that have the capacity to provide full C2V exhaust flow with a single fan operating. ☐ Install a backup fan. ☐ Construct some sort of protection over the fans to prolong the operating life of the fans and motors.	Medium Pre CD-4
HVAC-35-2	C2 exhaust flow control method will not provide accurate flow control	☐ Switch C2 exhaust flow control from maintaining duct pressure to a using flow element	Medium Pre CD-4
HVAC-35-3	Lack of pre-filters to protect HEPA filters.	☐ Provide an evaluation to demonstrate why pre-filters are not necessary in the C2V exhaust airstream. ☐ Modify the C2V exhaust system design to include pre-filters.	Medium Pre CD-4
HVAC-41-1	Lack of Deluge Spray System to protect the C5V HEPA from soot loading.	☐ Investigate if deluge spray system can be added to the current design if the HEPA Filter housings. ☐ Investigate if the current Fire Suppression System reliability can be improved.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-41-2	Lack of smoke dampers on inbleeds to protect C5V HEPA filters from soot loading.	▯ To make the design consistent with the PT and HLW, add smoke dampers and associated controls for the LAW in-bleed assemblies.	Medium Pre CD-4
HVAC-43-1	Ventilation System Evaluation not performed per the DOE Implementation Plan of DNFSB 2004-2 Recommendation.	▯ Recommend that the 2004-2 evaluation be performed for the LAW facility. ▯ Based on the new 2004-2 evaluation reconcile any gaps which are identified.	Medium Pre CD-4
HVAC-44-1	Inadequate Buffer Storage and Canister Rework area cooling capacity for anticipated heat loads.	▯ Evaluate if the purchased FCUs can be modified to make up for the shortage of cooling capacity. This option will add to the current power requirement including replacing the current motor. This change will also increase the chilled water flow to the balance of plant, thereby impacting the pumps and chiller capacity. ▯ Redesign and replace existing FCUs will be necessary if modifications to purchased FCUs is not achievable. This option will require motors larger than the current 50 HP and 25 HP respectively. This change will also increase the chilled water flow to the balance of plant, thereby impacting the pumps and chiller capacity.	Medium Pre CD-4
HVAC-47-1 HVAC-47-2	Lack of standby fan coil units in C2 and C3 airspaces.	▯ A 100% standby FCU is recommended for L0121 C2V Filter Room, L0317- C3V Fan Room, L0319A- C3V Filter Room, LB029C5V Filter Room and LB028-C5V Fan Room, but if it is not feasible then a high temperature alarm in the space to alert the maintenance staff for repairing the failed FCU in a timely manner. ▯ Evaluate the possibility of increasing the cascade airflow coming into spaces to offset heat loads during failure of the FCU. ▯ Investigation and validation is required to ensure that ASTM requirements are complied with for all exhaust system which may be exposed to temperatures higher than 140^0 F. External surface of Exhaust System components will be provided with adequate insulation to protect the workers from contact with hot surfaces.	Medium Pre CD-4
HVAC-51-2	C5V design may result in non-uniform loading of the multiple filter banks.	▯ Evaluate opportunities to install balancing dampers on the C5V exhaust.	Medium Pre CD-4
HVAC-51-3	Contamination traps in HEPA filter housings.	▯ Evaluate modifications that can be made to the filter housing to prevent build-up of contamination or cleaning the housing inner floor.	Medium Pre CD-4
HVAC-51-4	C5V design does not include the ability to balance air flow through filter housing.	▯ Develop technical justification to confirm that the HEPA filter rated flow will not be exceeded during all operation and maintenance modes. Install balancing dampers. HVAC Operating procedures will be prepared to monitor HEPA filter DPs and adjust damper positions periodically to balance air flows and pressure drops.	Medium Pre CD-4
HVAC-52-1	Radiation Source Term values are inconsistent and may require additional evaluation.	▯ Perform radiation dose rate calculations for expected normal operating conditions and upset conditions. Evaluate installing HEPA filters on the C5V ducting where the air from the process cell enters the C5 ducting.	Medium Pre CD-4
HVAC-52-2 HVAC-52-3	C5V HEPA Filter Radiation Source Term and filter operating parameters are not integrated for LAW operation.	▯ C5V HEPA Filter operating and replacement strategy needs to be developed for LAW Operation	Medium Pre CD-4
HVAC-52-4	Lack of HEPA filter replacement strategy for LAW commissioning.	▯ C5V HEPA Filter replacement strategy needs to be developed for LAW commissioning and startup. Ducting needs to be inspected for debris removal before startup testing is performed.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
HVAC-03-2	Temperature Controller does not meet +/-3°F control tolerance required by System Description.	▯ Evaluate the design requirements to determine if a broader range of control is acceptable.	Low Post CD-4
HVAC-21-7	Inbleed back draft dampers cannot be checked for leakage.	▯ Redesign Inbleed to facilitate back draft damper testing.	Low Post CD-4
HVAC-22-1 HVAC-22-2	C5V fan motor, bearings, and adjustable speed drive may exceed rated temperatures.	• Evaluate temperatures and heat transfer effect on fan motor, fan bearings and ASD. • Move ASDs to corridor and away from heat sources. • Provide supplemental cooling to the ASD's and fan motors. • Convert fan bearing lubricant from grease to oil.	Low Post CD-4
HVAC-23-2	Lack of filters in the C2V bypass duct.	▯ Install means of filtration for bypass duct such as an ESP.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

HVAC-42-2	C5V duct and equipment burn hazards.	□ Investigation and validation is required to ensure that ASTM requirements are complied with for all ventilation system which may be exposed to temperatures higher than 140^0 F. External surface of will be provided with adequate insulation to protect the workers from contact with hot surfaces, where applicable.	Low Post CD-4
HVAC-44-3	Contamination trap in buffer storage cooling ductwork section.	□ Redesign the ducting arrangement for the Buffer Storage Area FCU to avoid accumulation of radiological contamination.	Low Post CD-4
HVAC-49-1	Code Compliance Matrix did not include Safety Significant Direct Expansion Air Conditioning Units used for the E & I Rooms & Secondary Off-gas Room.	□ Revise the current Code Compliance Matrix to include SS Air Conditioning Units and their compliance in a timely manner for WDOH approval.	Low Post CD-4
		Electrical Distribution System	
ROR-ELEC-1: Vulnerability #4, #5, and #6	The ITS UPS units: # UPE-UPS-20301, -20302, and -20303 are undersized for design demand load.	The Review Team recommends performing the upgrade on ITS UPS units (200 kVA UPS units upgraded to 400 kVA UPS units), as identified in the Bechtel white paper. UPS feeders should be included in the replacement. WTP Electrical Engineering should evaluate feeding both UPS mains and UPS bypass inputs from the same load group to allow additional reductions in the load calculation permitted for "non-coincidental loads". WTP Electrical Engineering should also evaluate replacement of the downstream distribution panel UPE-PNL-20301 along with its panel feeders, which will likely be undersized for the UPS output breaker which protects them once the 400 kVA UPS units are installed.	High Pre CD-4
ROR-ELEC-1: Vulnerability #8, #9, # 18	UPS battery banks: # UPE-BATT-20301 and -20302 are undersized in the capacity needed to provide the required UPS run time required by the design load profile during a loss of offsite power DBE. Additionally All ITS UPS battery banks: # UPE-BATT-20301, -20302, and -20303 have not been sized to provide the full UPS rated output for the required run time as directed by 24590-WTP-DB-ENG-01-001 Section 8.4.11. This issue is compounded as it appears the equipment rooms in which the batteries are to be installed are too small to accept the number of batteries needed, when using the batteries identified in the drawings.	The Review Team recommends that WTP project perform battery run/capacity calculations for ITS UPS batteries to ensure batteries proposed by the UPS vendor have the capacity to meet the run time requirements for safe system shutdown during a LOOP DBE. Note: As stated in the basis column, this issue will be compounded if the UPS units are upgraded from 200 kVA units to 400kVA units as proposed in the BNI white paper, as battery capacity, and battery physical size will need to greatly increase to meet the UPS full rated output run time requirements from 24590-WTP-DB-ENG-01-001 Section 8.4.11.	High Pre CD-4
ROR-ELEC-1: Vulnerability #16, and ROR-ELEC-4 Vulnerability #8 and #9	Main LAW facility 13.8kV - 480V service transformers: MVE-XFMR-20603, -20604, and 20606 are undersized for existing design load	The design team recommends that BNI consider feeding facility UPS Unit Mains, and Bypass Inputs from the same load group which will allow BNI to take a reduction in design loading calculations for non-coincidental loads. This, along with some minor load management, may reduce design loads below the transformer ratings; however, the concern over lack of spare facility electrical capacity identified in the previous vulnerability entry will still exist. Also it should be noted that if the ITS UPS units are upgraded from 200kVA to 400kVA as proposed, the transformer loading would once again be higher than the transformer ratings, and would not be correctable by UPS input changes or simple load management.	High Pre CD-4
ROR-ELEC-2: Vulnerability #1	Elevated ambient temperatures negatively impact electrical equipment operation.	The electrical review team recommends that the BNI Electrical Engineering design group re-evaluate the ambient and radiant temperatures anticipated in these areas and ensure equipment is properly rated, or ensure supplemental cooling and/or insulation is added for the equipment as required.	High Pre CD-4
ROR-ELEC-2: Vulnerability #2	Melter Electrode Bus Electrical Ratings may not be adequate for the expected melter loads when operated at potential temperatures in the melter gallery.	Re-evaluate bus amperage rating for identified high risk areas. Provide supplemental cooling if justified.	High Pre CD-4
ROR-ELEC-2: Vulnerability #4	No evidence of final NRTL listing and labeling exists for the melters.	Obtain final NRTL Field Evaluation product mark or procure equipment with the NRTL listing and labeling.	High Pre CD-4
ROR-ELEC-3: Vulnerability #1	No spare melter power supply capacity.	The review team recommends BNI install output inverter and transformer units in each of the spare compartments of each power supply's lineups.	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
ROR-ELEC-3: Vulnerability #2	Melter power supply component isolation is inadequate.	The review team recommends that BNI evaluate the worker safety requirements for these areas and develop barriers, procedures, or alternate isolation points.	High Pre CD-4
ROR-ELEC-3: Vulnerability #4	No evidence of final NRTL listing and labeling exists for the melter power supplies MVEPSUP-20001 and -20002.	Obtain final NRTL Field Evaluation product mark or procure equipment with the NRTL listing and labeling.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

ROR-ELEC-3: Vulnerability #5	No Melter Standby Power provided.	The review team recommends BNI, or DOE, perform another evaluation to determine if potential cost savings still outweigh potential costs of equipment and production losses. Should BNI and DOE decide to provide back-up power to the melters, switchgear MVESWGR-20603 and -20604 each have an available "equipped space" to which a standby diesel generator can be connected and configured to back feed the switchgear bus and provide backup support to both melter power supplies. Connection of a generator at either of the available "equipped spaces" would preclude the use of those spaces to feed a third melter power supply, however, the limited capacity of the LOP/LVP system in the LAW facility already makes connection of a third melter implausible without expanding the facility.	High Pre CD-4
ROR-ELEC-4: Vulnerability #1	Low Voltage Release.	Evaluate the addition of time delay circuits to the low voltage release mechanisms to permit the electrical system to ride through electrical grid sags and brownouts.	High Pre CD-4
ROR-ELEC-1: Vulnerability #1	AHJ and NEC inspection Role performed by BNI Design Project personnel.	The review team feels that an independent AHJ and inspection program should be considered by DOE.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #2	Lack of Conduit Schedules and Wire Run drawings.	The review teams recommend that DOE attempt to negotiate procurement of the SetRoute software from Bechtel.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #10	No post installation service test is planned for ITS UPS system batteries: UPE-BATT-20301, -20302, and -20303 to demonstrate capability of the batteries to provide 2 hours of run time upon LOOP.	The Review Team feels it is imperative that a battery service test be performed on all ITS UPS batteries, prior to turn over from construction, to ensure batteries were not damaged in shipping or installation.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #11 and ROR Vulnerability #12	The feeder conductors for panels UPE-PNL-20301 and -20302 are undersized for the demand load.	See OFI on ROR-ELEC-1 Vulnerability #4 and #5 above.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #13	UPE-UPS-20301, -20302, and -20303 feeder conductors undersized for UPS full load currents and battery recharge currents.	The Review team recommends replacement of the ITS UPS main and bypass feeder conductors with two parallel sets of 500 kcmil conductors as part of the proposed UPS upgrade.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #14 and ROR-ELEC-4, Vulnerability #7	Very little to no spare capacity provided on Panels: UPE-PNL-20301, -20302, and on Switchboards LVE-SWBD-20101; LVE-SWBD-20102; Switchboard LVE-SWBD-20201; and on LVE-SWBD-20202.	There appears to be no requirement for spare capacity of the electrical system in the LAW facility, and none has been provided. The is not an issue if no changes are needed within the facility to support operations; however the likelihood of no additional loading being needed seems optimistic.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #15	General Systemization Layout of MCCs.	MCC systemization was identified as a concern in CLIN 3.2, RPP-44491, Rev 0, Section 3.8.6 and continues to be a concern for potential operability impacts at the LAW facility. WTP Electrical Engineering Design may evaluate adding additional controllers to the MCCs, or rearrange loads to permit system specific maintenance and control.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #17	ITS UPS units not qualified for DBE flood conditions of 0.92 ft. of water.	The review team recommends that the ITS UPS units be qualified for 5.04" flood levels or mounted on pedestals that are 11.04" or greater in height.	Medium Pre CD-4
ROR-ELEC-2: Vulnerability #3	Single phase AC Bus passes thru ferrous metal enclosure, creating magnetic heating.	The review team recommends BNI perform a review of all single phase conductors for inappropriately placed magnetic material.	Medium Pre CD-4
ROR-ELEC-3: Vulnerability #6	Melter Power Supply Grounding.	The review team recommends that BNI re-evaluate the supply output to determine if the melter power bus has been provided with an adequate equipment grounding conductor.	Medium Pre CD-4
ROR-ELEC-4: Vulnerability #3	There is not currently a formal "Code of Record" for the Waste Treatment Plant.	The review team feels that BNI should issue a formal code of record that identifies all applicable codes and revisions used in the design of the facility.	Medium Pre CD-4
ROR-ELEC-4: Vulnerability #6	C5V-FAN-00005A, and C5V-FAN-00005B circuit conductors are not symmetrically shielded type cable, or not installed in metal conduit that is bonded across each joint, in accordance with manufacturer's instructions.	The review team recommends replacement of the C5V motor circuit conductors, between the ASD units and the motors, with symmetrically shielded cables, or recommends the addition of bonding jumpers across conduit joints. In general the review team recommends that all larger ASD supplied motors in the WTP use symmetrically shielded ASD/VFD cable.	Medium Pre CD-4
ROR-ELEC-1: Vulnerability #3	General Drawing Discrepancies.	The review team recommends correction of drawing errors.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank

Table B-1. Summary Vulnerability Listing. (41 pages)

ROR-ELEC-1: Vulnerability #7	No Hydrogen monitoring or ventilation calculations available to demonstrate that potential VRLA battery off gassing can be alleviated. Following the review period, DOE provided the review team with a draft copy of an initial ventilation analysis performed by BNI to address battery hydrogen venting. The draft calculation was rejected by DOE. Follow up analysis is pending.	The design review team recommends finalizing hydrogen ventilation calculations to ensure VRLA potential off gassing is alleviated or add hydrogen monitoring if required.	Low Post CD-4
ROR-ELEC-2: Vulnerability #5	Grounding & Isolation of electrical equipment around melter glass pool not adequately demonstrated or documented.	The review team recommends BNI perform grounding inspection and testing prior to operation to correct any discrepancies.	Low Post CD-4
ROR-ELEC-2: Vulnerability #6	Project Documentation may not be accurate, or may be obsolete and not marked as canceled or superseded.	Eliminate documentation errors to improve system performance.	Low Post CD-4
ROR-ELEC-3: Vulnerability #3	Current Transformers (CT1s) do not support individual electrode current control in present configuration.	The review team recommends BNI evaluate the recent CT installation configuration to determine if it is complete and incorporated into the control system.	Low Post CD-4
ROR-ELEC-4: Vulnerability #2	Facility Power Study Input Files not in Hanford standard software.	The review team recommends DOE issue a contract to perform a facility power study using SKM Power Tools for Windows, so that operations has useful input files to use in the facility during commissioning and operations. DOE has informed the review team that the Hanford Site standard software may be changing to ETAP, if that change takes place this vulnerability will go away. However, at the time of the review a discrepancy between software products used for the WTP project and at the Hanford Site exists; therefore, this will remain listed as a low consequence vulnerability.	Low Post CD-4
Radiological Control and Industrial Safety			
RC-1-V001	Potential for Contamination to Migrate Due to Adjacent Contamination Zones and Low Flow Ventilation Design.	• Evaluate the currently defined work processes for each process system, identify potential areas where contamination may migrate, and define any additional engineering or administrative controls that will be needed to ensure personnel are appropriately protected while minimizing the use of PPE. To evaluate the Project as a whole it is recommended these actions be documented in a Contamination Control Strategy Document. • The Project should define anticipated airborne levels to be anticipated in the facility and mitigating controls. • The Project should evaluate the use of a mock up facility for work evolutions where potential for significant dose can result.	High Pre CD-4
RC-1-V-002	Inability to Meet Contamination Control Limits for Container Release.	• Develop a technical basis that documents statistical representative sampling and equivalency of surveying at 500 cm2 vs. 100 cm2 (legal release criteria) and also addresses the adequacy of the sampling media used for swabbing the container. The approach for release of the containers should be coordinated with other Hanford Contractors to ensure they understand the survey results prior to their accepting of the containers for disposal. • Evaluate the potential that the container can be contaminated (on the Finishing Line) from the time when the smear samples were taken to when the sample results were received.	High Pre CD-4
RC-1-V-003	Radiation Doses to Personnel are Undetermined for Operations, Maintenance and Waste Management Activities	• Accelerate the identification and definition of Operation, Maintenance, and Waste Management tasks and then revise the dose assessment report to accurately reflect anticipated dose. • Establish a mockup facility/area to confirm anticipated dose and contamination levels and to reduce exposure to radiation by the workers for tasks expected to be high risk or have high radiological consequences. • Reconsider whether the contract limit of 500 mR/hr for the container will allow for contact-handled work (for both Operations and Maintenance).	High Pre CD-4
RC-1-V-004	Inability to Effectively Perform Hands-On Maintenance Activities.	• Accelerate the evaluation of Maintenance and Operational evolutions to understand hazards, mitigation techniques, and ability to perform required tasks. • Evaluate the ability to remotely perform Maintenance tasks (such as spray nozzle replacement). If not possible, identify alternative methods for maintenance. • Establish a mockup facility/area to confirm anticipated dose and contamination levels and to reduce exposure to radiation by the workers for tasks expected to be high risk or have high radiological consequences.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

SH-1-V-001	Insufficient Evidence of Compliance with Operational Safety and Health Requirements in Design.	• WTP should verify and validate (i.e. walk down) those systems where design is substantially complete and identify equipment that will need to be retrofitted (engineered solutions) to ensure compliance to regulatory requirements during commissioning activities. • For those activities whereby an engineered or administrative means cannot be achieved to perform the task, develop a technical basis process to seek a waiver from the requirement (i.e. daily crane inspections in the Finishing Line).	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
SH-1-V-002	Inadequate Implementation of the Hazards Analysis Process.	• BNI should define and document the chemical source term coming into the LAW and document for current and future use. • As part of 24590-WTP-PIER-MGT-13-0964 the Project has drafted a CAP that includes a corrective action to develop a formal process that requires engineering and ES&H, at specific points in the design process, to evaluate the 10 CFR 851.22 (b) hierarchy of controls and provide a basis for how each is being addressed. The process needs to be defined (as just mentioned). • The Project should consider either realigning the safety analysis process to appropriately evaluate industrial and chemical hazards and associated mitigating techniques as part of the design process or expanding the WTP Hazards Analysis Procedure (AHA) to include not only the process for hazards identification to protect workers in the field, but also the newly developed hazards analysis process for design (including EA CPs feeding back into the design process). • The Project should also consider revising the title to one or both of the procedures to minimize personnel being confused with the duplicate titles or only have one procedure (versus two) which addresses the hazards identification and mitigation process for both design and field implementation.	High Pre CD-4
SH-1-V-003	Deficient Exposure Assessments for Operational and Maintenance Activities.	• Identify and define appropriate source terms for each of the exposure assessments (including defining the chemical source term feed for LAW), revise those incorrect exposure assessments (that currently exist), and complete qualitative exposure assessments for the remainder of the process systems. • It is recommended the Project identify key Operational and Maintenance Activities and incorporate into qualitative exposure assessments. • Revise procedure(s) (institutionalize) to ensure controls identified in the exposure assessments are integrated and considered during the design as part of the Engineering and Industrial Hygiene processes.	High Pre CD-4
SH-1-V-004	Potential Weakness in the Systematic Analysis of Thermal Stress/Heat Hazards to Personnel.	□ The Project should perform a LAW Thermal Analysis Study to define and understand both individual and cumulative thermal hazards and needed mitigating techniques. Results of the evaluation should take into account existing design of the facility and possible needed design changes. □ Upon identification of anticipated thermal conditions, it is recommended the Project work with the Medical Department and evaluate industry best practices and revise the existing heat stress program to more aggressively protect the workers (i.e. biological monitoring, medical determination of fitness, hydration requirements, etc.).	High Pre CD-4
		LSH System	
LSH-F-28-V-01	Configuration Management is inadequate.	LSH-F-28-OFI-01.1: Review and evaluate design documentation to ensure correct requirements were applied. Review design verification documents to ensure correct versions of design were reviewed and verified. LSH-F-28-OFI-01.2: Revise configuration management system to ensure that: • only current revisions of documents are retrievable (with exception for historical reviews) • controlling documents are identified and maintained current • applicable documentation is associated to and retrievable by the system designation and/or the equipment number.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LSH-M-14-V-15	No acceptable means to secure the spray nozzle CCB to the melter surface has been identified. Detailed spray nozzle changeout requirements, procedures and timelines have not been developed and evaluated. There is no upper closure on the spray nozzle CCB, which can act as a chimney while lifting the spray nozzle. The spray nozzle CCB as designed allows direct line of sight with the melter glass pool at some stages of the changeout. The existing off-gas spray nozzle changeout system and process does not adequately control contamination release, thermal exposure, radiation exposure, air flow or personnel access.	LSH-M-14-OFI-15.1: Develop a secure method to stabilize the spray nozzle CCB on the melter surface. LSH-M-14-OFI-15.2: Design and utilize a gamma-gate and closed changeout box that is compatible with the spray nozzle. LSH-M-14-OFI-15.3: Develop a methods and additional equipment to maximize efficiency and minimize personnel hazards. LSH-M-14-OFI-15.4: Modify spray nozzle CCB and lift method to maintain containment during spray nozzle changeout. LSH-M-14-OFI-15.5: Design and procure a ladder or platform to access the spray nozzle support plate and lid assembly.	High Pre CD-4
LSH-M-14-V-16	During consumable changeout, both the clean and spent CCBs have the potential to become pressurized vessels. The +/- vessel pressures introduce the potential for the spread of contamination, CCB equipment damage and/or operations production impact.	LSH-M-14-OFI-16: A HEPA filtration system should be considered for design and installation on the CCB to mitigate pressurization / vacuum, and to reduce the potential for equipment damage and the spread of contaminated material.	Medium Pre CD-4
LSH-F-18-V-04	The integrated design review of the LAW design is not documented. The review team requested a copy of the LSH, LMH and RWH integrated design review documents and BNI has not provided the document to date.	LSH-F-18-OFI-04: Complete an independent external integrated design review of all LAW systems.	High Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LSH-S-08-V-01	PIER process is inadequate for tracking issues found in earlier reviews.	LSH-S-08-OFI-01: Pick one tracking system, and log and track all issues that are found via any review process. Further classify the issues and assign closing criteria commiserate with the severity of the issue.	Medium Pre CD-4
LSH-W-07-V-05	Inadequate Lift Capability in Consumables Import/Export Area.	LSH-W-07-OFI-05: Revise design to add a swing jib crane and specified laydown space for the spent consumable transport boxes.	Medium Pre CD-4
LSH-M-14-V-09	Temperature limitations of the bubbler neoprene rubber air supply port gasket and Super OLube silicone grease are incompatible for expected bubbler port environment.	LSH-M-14-OFI-09: Determine anticipated temperatures in the vicinity and resulting temperatures of the bubbler air supply port gasket and utilize appropriate materials.	Medium Pre CD-4
LSH-M-14-V-08	No criteria or specs have been found for: • Inspection of the bubbler air supply ports during changeout, • Application of the Super O-Lube silicone grease, • Installation of the neoprene gasket, • Verification of proper operation of the bubbler air supply.	LSH-M-14-OFI-08.1: Define specifications for application of Super O-Lube lubricant and installation of the neoprene gasket on the bubbler air supply port. LSH-M-14-OFI-08.2: Develop means to verify proper operation of new bubblers after installation.	Medium Pre CD-4
LSH-F-11-V-05	If the LSH process crane is out of use for maintenance that can be performed using the limited functionality of the west platform, the CCB handler crane will not be able to access import and export hatch.	LSH-F-11-OFI-05.1: Time maintenance accordingly with delivery of consumables. LSH-F-11-OFI-05.2: Evaluate different methods of importing and exporting consumables to allow access to the hatch during maintenance of LSH process crane.	Low Post CD-4
LSH-F-09-V-01	Lack of info on the operation and failure modes of the Component Carrier (grapple for consumables).	LSH-F-09-OFI-01: Attain more information and operational understanding of the Component Carrier.	Low Post CD-4
LSH-F-01-V-01	Issues found by the review of DOE-HBK-1132-99 are issues that should be resolved by using this or a similar best practices handbook.	LSH-F-01-OFI-01: It is recommended that a best practices handbook be established and followed to limit amount of design errors.	Medium Pre CD-4
LSH-F-11-V-01	The current bubbler crate width (12') will not fit through the entrance door into the truck bay (12').	LSH-F-11-OFI-01.1: Unpack bubblers at a different location and design a custom bubbler carrier to transfer consumables for delivery to System LSH. LSH-F-11-OFI-01.2: When a permanent bubbler manufacturer is identified, evaluate a new bubbler transport crate that will be able to meet the requirements of the system design.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LSH-F-11-V-02	Truck bay crane capacity (10 ton) will not be able to lift current bubbler crate (13.5 ton).	LSH-F-11-OFI-02.1: Unpack bubblers at a different location and design a custom bubbler carrier to transfer consumables for delivery to System LSH. LSH-F-11-OFI-02.2: When a permanent bubbler manufacturer is identified, evaluate a new bubbler transport crate that will be able to meet the requirements of the system design.	Low Post CD-4
LSH-F-11-V-03	The current bubbler crate width (12') may or may not fit onto the width of the unloading platform (~12').	LSH-F-11-OFI-03.1: Unpack bubblers at a different location and design a custom bubbler carrier to transfer consumables for delivery to System LSH. LSH-F-11-OFI-03.2: When a permanent bubbler manufacturer is identified, evaluate a new bubbler transport crate that will be able to meet the requirements of the system design.	Low Post CD-4
LSH-F-11-V-04	The current bubbler crate height will not allow the truck bay crane to pull the bubblers out of the crate (vertical orientation).	LSH-F-11-OFI-04.1: Unpack bubblers at a different location and design a custom bubbler carrier to transfer consumables for delivery to System LSH. LSH-F-11-OFI-04.2: When a permanent bubbler manufacturer is identified, evaluate a new bubbler transport crate that will be able to meet the requirements of the system design.	Low Post CD-4
LSH-M-14-V-12	One gamma gate per two melters will not be sufficient to support anticipated plant operations.	LSH-M-14-OFI-12: Re-evaluate gamma gate usage and consider a second gamma gate for active use or as a spare.	Low Post CD-4
LSH-M-14-V-11	There are no clear requirements for the engineered air gap beneath the gamma gate, and the complex high velocity air flow through the air gap has not been analyzed resulting in an unanalyzed impact to air balance and possible subsequent spread of contamination.	LSH-M-14-OFI-11: Define criteria for gamma gate engineered air gap and determine impact of turbulent air flow on the spread of contamination.	Medium Pre CD-4
LSH-M-14-V-05	Alternative equipment is being provided by vendors without an equivalency analysis being conducted to assess the equipment's ability to meet the critical attributes.	LSH-M-14-OFI-05.1: Define critical attributes and requirements for all equipment. LSH-M-14-OFI-05.2: Conduct equivalency analyses for all substitute equipment.	Medium Pre CD-4
LSH-M-14-V-10	The characteristics of the Kevlar strap at the maximum normal and off-normal temperatures expected should be further evaluated and the basis documented on a Mechanical Data Sheet.	LSH-M-14-OFI-10: Define criteria for Kevlar strap and document on a Mechanical Data Sheet.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LSH-F-17-V-01	Normal System LSH maintenance evolutions will significantly impact production.	LSH-F-17-OFI-01.1: Establish a detailed task analysis that addresses industrial safety, radcon, operational, and staffing issues to evaluate impact on production. LSH-F-17-OFI-01.2: Develop a remotely operated method to change melter consumables so that the requirement for de-energizing the melter will be for equipment protection purposes only and LOTO can be eliminated.	High Pre CD-4
LSH-F-17-V-04	Heat-up / Cool-down rates for the melter glass pool have not been calculated for the actual case while doing System LSH maintenance evolutions.	LSH-F-17-OFI-04: Perform pilot melter tests that simulate actual conditions during melter consumable change out: melter idle and simulated C5V and C3V airflows to the plenum space from a bubbler hole. Scale up the results for the full-scale LAW Melter using Computational Fluid Dynamics simulations.	Medium Pre CD-4
LSH-F-17-V-03	Melters idled for another reason, such as work on LOP or LVP, can't be used to "campaign" System LSH consumables.	LSH-F-17-OFI-03: Identify maintenance evolutions for System LSH interfacing systems that are already compatible with a campaigntype strategy, and investigate mitigations that would enable simultaneous work for the currently incompatible ones.	Medium Pre CD-4
LSH-F-17-V-02	Serious contamination releases will result in significant production interruptions.	LSH-F-17-OFI-02: Develop a remotely operated method to change melter consumables while maintaining confinement to the C5V annulus.	Medium Pre CD-4
LSH-F-26-V-01	Melter containment has not been demonstrated during melter maintenance evolutions.	LSH-F-26-OFI-01.1: Perform the necessary calculations and simulations to ensure containment, including how to coordinate LOP and C5V as well as what the air gap should be between the melter gamma gate and the melter shielded enclosure. LSH-F-26-OFI-01.2: Redesign the melter consumable change out process to preserve a pressure seal between the CCB / melter gamma gate and the melter shielded enclosure while the melter plenum is exposed.	High Pre CD-4
LSH-W-07-V-04	Hazard Analyses and ALARA Reviews are inadequately addressed for spent consumable handling.	LSH-W-07-OFI-04: Perform hazards analyses and ALARA Reviews; redesign system LSH as required to mitigate industrial and radiological hazards.	Medium Pre CD-4
LSH-M-14-V-07	No plans have been developed for cleaning glass spall and drips from the melter shielded enclosure, melter port consumable seating surfaces, bubbler air supply ports, CCB lid/interior, gamma gate or bagging station surfaces. Methods and equipment for decontaminating the interior of the CCB have not been provided.	LSH-M-14-OFI-07.1: Develop tools and processes for removing glass from melter and equipment surfaces including subsequent decontamination and inspection. LSH-M-14-OFI-07.2: Evaluate the radiological issues associated with the CCB and provide capability to decontaminate the interior of the CCB if necessary.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LSH-M-14-V-14	Sufficient details regarding bagging station operations are not available, and the disposition of radioactive bagging station waste not defined.	LSH-M-14-OFI-14: Develop processes and procedures for bagging station operations and radioactive waste disposition. A thermal sealing method should be considered.	Medium Pre CD-4
LSH-F-20-V-03	Designated space for storage and local maintenance of contaminated equipment and tools in the melter gallery needs to be defined and maintained consistent with operational travel routes. Storage of lifting equipment needs to be provided in the truck bay and the melter gallery.	LSH-F-20-OFI-03.1: Designate storage areas for tools and equipment. LSH-F-20-OFI-03.2: Provide controlled designated storage space for contaminated equipment	Low Post CD-4
LSH-M-14-V-02	There are insufficient funds & resources allocated to address; • Equipment obsolescence • Equipment preservation and degradation • Equipment re-inspection, refurbishment and/or replacement effort that will be required (9) months prior to startup.	LSH-M-14-OFI-02: Develop long term funding and plans that address obsolescence, warranties, and replacement or refurbishment for all equipment procured.	High Pre CD-4
LSH-M-14-V-04	Funding and schedules for all periodic maintenance activities have not been developed, and critical spare parts and consumables such as bubblers are not yet scheduled to be ordered and held in-stock to support commissioning and startup.	LSH-M-14-OFI-04: Develop schedules for periodic maintenance activities and procure critical spare parts and consumables to be held in-stock to support commissioning and startup activities.	High Pre CD-4
LSH-F-18-V-02	Procedure completion and training needs are not aligned. Operating procedures and maintenance instructions are partially complete and the current scheduled completion date is not aligned with Operations need for operator training, in that, they are scheduled to be complete after they are needed for operator training.	LSH-F-18-OFI-02: Align procedure completion date, including validation and approval, with the date needed for training purposes.	Medium Pre CD-4
LSH-M-13-V-03	Equipment and methods for replacement of "life of melter" components have not been provided.	LSH-M-13-OFI-03.1: Develop engineered tools, equipment, and procedures for replacement of "life of melter" components. LSH-M-13-OFI-03.2: Procure and maintain "life of melter" components in spares inventory, and equipment necessary for changeout.	Medium Pre CD-4
LSH-F-21-V-01	System LSH will need defined interfaces with other systems, which are not documented in the system description.	LSH-F-21-OFI-01: Form an interdisciplinary team with members that are familiar with all melter/throughput interfacing systems and plant operations and task them with developing detailed task analyses that document a safe way to perform all critical maintenance evolutions, using the existing design if possible. Perform this work early enough to reduce upsets on the critical path as low as practicable and to provide lead time in case extensive redesign and rework efforts are necessary.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LSH-M-16-V-01	Maintenance equipment failure modes and incidents should be identified and understood prior to plant operation to mitigate or reduce equipment/plant down time.	LSH-M-16-OFI-01: Identify maintenance equipment failure modes and accidents prior to plant operation.	Medium Pre CD-4
LSH-M-13-V-07	Equipment testing needs to be done in applicable thermal environment.	LSH-M-13-OFI-7: Test equipment in expected environmental conditions with range of exposure times to verify equipment operation and to establish constraints on operations, as applicable.	Medium Pre CD-4
LSH-W-19-V-01	Failed or spent LAW melters may not meet the requirements of the Hanford Dangerous Waste Permit.	LSH-W-19-OFI-01: Clarify the conditions to satisfy for successful LAW melter disposal when transitioning from construction permit to the start-up/commissioning/operating permit.	Low Post CD-4
LSH-M-14-V-13	No form of thread protectors or covers in melter alignment pin locator holes are planned when the gamma gate alignment pins are not installed.	LSH-M-14-OFI-13: Design, procure and install threat protector inserts/caps on all unused alignment holes in the melter surface.	Low Post CD-4
LSH-F-10-V-01	Environmental qualifications have not been conducted or documented on plant equipment. Most environmental and operating conditions such as temperature, dose rate, evolution sequence, rates and times, etc. have not been determined.	LSH-F-10-OFI-01.1: All LSH area environmental conditions should be clearly defined and documented.	Medium Pre CD-4
LSH-W-07-V-01	An engineered solution to provide vertical to horizontal transition of long length equipment has not been adequately defined or equipment provided. Potential loss of confinement due to puncture of or pulling disposal bag off of consumable during bagging, pig- tailing, and export operations.	LSH-W-07-OFI-01: Provide an engineered system, such as a strongback, to transition long length equipment from the vertical to horizontal position for the potentially structurally fragile spent consumables	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LSH-W-07-V-03	Spent melter consumables and other secondary wastes are packaged for transportation but not for disposal.	LSH-W-07-OFI-03: A disposal plan and disposal path for all LSH process waste and spent consumables should be clearly defined. Perform alternatives study including life cycle cost impacts for providing required waste characterization, volume reduction, and waste treatment, and packaging for disposal functions at WTP, existing Hanford facility, new Hanford facility, or offsite vendors. Waste Incidental to Reprocessing (WIR) determinations should also be compiled as necessary.	Medium Pre CD-4
LSH-S-15-V-01	Maintenance task evaluations and procedures have not been provided. Therefore, it could not be determined that maintenance best practices have been considered nor incorporated.	LSH-S-15-OFI-01: Incorporate maintenance best practices into procedures and processes early and incorporate the conclusions into the design.	Medium Pre CD-4
LSH-F-18-V-03	Detailed work plans, task analyses and corresponding schedules have not been developed to thoroughly evaluate all anticipated routine and non-routine O&M activities. Therefore realistic timelines and throughput expectations for glass production rates have not been established. Previously captured in CLIN 3.2 (see RPP-50775) and not yet resolved.	LSH-F-18-OFI-03: Develop realistic expectations for glass production rates, using detailed task breakdowns.	Medium Pre CD-4
LSH-M-14-V-03	The accessibility and maintainability of critical plant components have not been demonstrated, and equipment for O&M activities may not be practical. This issue was previously captured in CLIN 3.2 (RPP-50775) and has not yet been resolved.	LSH-M-14-OFI-03: Realistically model and evaluate anticipated O&M activities. Non-routine ops should be modeled and evaluated as well.	Medium Pre CD-4
LSH-M-14-V-01	Long term preservation maintenance requirements have not been addressed beyond basic storage requirements (environment), for 88% of equipment received to date.	LSH-M-14-OFI-01: Develop long term preservation maintenance requirements and plans for all equipment in storage and upon receipt of new equipment.	Medium Pre CD-4
LSH-F-20-V-05	Inadequate permitted waste storage area.	LSH-F-20-OFI-05: Perform work planning including consideration of schedules for bubbler replacement, spent bubbler export, ILAW container receipt, and RWH exports and evaluate impact from lack of waste storage.	Medium Pre CD-4
LSH-W-07-V-02	No provision for removal of the air bottles on the spent bubblers or rendering them incapable of holding pressure prior to exporting for disposal.	LSH-W-07-OFI-02.1: Provide means for removal of bottles or for rendering spent bottles incapable of holding pressure at WTP or at the yet to be defined secondary waste repackaging/treatment facility. LSH-W-07-OFI-02.2: Delete on-board air supply system from the bubbler design.	Low Post CD-4
LSH-M-13-V-02	Equipment and means for maintenance of the CCB lift head have not been provided; additional equipment needs to be provided.	LSH-M-13-OFI-02: A designated CCB maintenance station with an appropriate maintenance platform and CCB test panel needs to be provided. Similarly, a test panel should be provided to verify gamma gate function following servicing.	Low Post CD-4
LSH-M-13-V-04	Capability to move equipment from the melter gallery to the contaminated equipment (C3) maintenance room has not been provided.	LSH-M-13-OFI-04: Provide monorail or other means of lifting equipment from the melter gallery operating deck (19' el) to the 28' el.	Low Post CD-4
LSH-M-13-V-01	Some maintenance activities on the Process Crane must be performed using the crane maintenance platform at the east end of the melter gallery, trapping the CCB Handler Crane, resulting in no crane coverage of the melter gallery while servicing the Process Crane.	LSH-M-13-OFI-01: Assess frequency and duration of crane maintenance activities and incorporate into production throughput estimates to determine need for alternate maintenance platform. As necessary, modify west crane maintenance platform such that most if not all of the process crane maintenance activities can be performed.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LSH-F-20-V-02	Umbilical cables to the CCB while it is on the melter, import station, or export station are laid on the operating deck walking surface, creating a tripping hazard; similarly, umbilical cables to the gamma gate on the melter create a tripping hazard. These cables will also create obstructions for moving rolling platform ladders, shielded cover removal tool, and other equipment.	LSH-F-20-OFI-02.1: Provide conduit to import and export stations for the CCB, with junction and short umbilical jumpers for the CCB near the gate. LSH-F-20-OFI-02.2: Provide umbilicals on swing booms or similar to the CCB and gamma gate when installed on the melter.	Low Post CD-4
LSH-F-20-V-01	Access to the top of the CCB needs to be provided while it is on the melter, import station, or export station for routine and recovery operations.	LSH-F-20-OFI-01.1: Provide platforms at the import and export stations. LSH-F-20-OFI-01.2: Provide rolling/moving platform for use on the melter.	Low Post CD-4
LSH-F-20-V-04	The design of the consumables cart requires use of fall protection.	LSH-F-20-OFI-04: Verify required operations are consistent with provisions provided.	Low Post CD-4
LSH-CO-24-V-01	Workspace environment in and near the melter is not defined for proposed operator/maintenance technician actions to install/remove consumables for service.	LSH-CO-24-OFI-01: Define workspace environment and include in operations and maintenance procedures.	High Pre CD-4
LSH-F-18-V-01	The operations and maintenance procedure (includes: EOP's, abnormal, alarm response, system task and technical safety requirements) development process is fundamentally flawed.	LSH-F-18-OFI-01: Include all job hazards analysis and job task analysis prior to developing procedures. Validate the procedures after all hazards and tasks are known and included in the procedure.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LSH-CO-24-V-04	The assumption of an operator reaction time of 30 minutes for a casualty response may be insufficient regarding restoration of power and providing an air compressor upon loss of ISA system. The operation of the bubblers is essential to melter operation per the 4/22/14 telecon with VSL. Failure of all bubblers within a single melter will result in loss of temperature control in respective melter.	LSH-CO-24-OFI-04.1: Revisit the 30 minute response assumption for operators regarding restoration of ISA or electrical service for reasonableness and validate the assumption by test. LSH-CO-24-OFI-04.2: Develop procedures and training regarding loss of ISA. LSH-CO-24-OFI-04.3: Identify the supply of back-up air. Identify proper air fittings and hardware to accommodate the supply of back- up air. LSH-CO-24-OFI-04.4: Identify the connection to the ISA for the back-up air supply.	High Pre CD-4
LSH-CO-24-V-03	HMI's and associated proposed operator actions, in aggregate, do not appear to sufficiently incorporate key principles of industry best practice to ensure operator response to normal evolutions. The current design does not appear to consider Function Allocation (automated vs. human performance), Task Loading (demands of a given task), Precision Requirements (crane operation), error tolerance (interlocks), Environmental Conditions, Workspace Size, Geometry and Layout (Cable trip hazards associated with power and control lines to the Gamma Gate and CCBs).	LSH-CO-24-OFI-03: Take necessary steps to incorporate key principles of industry best practice to ensure operator response to normal evolutions.	Medium Pre CD-4
LSH-S-06-V-01	Conduct of Operations Principles have not been adequately factored into the facility.	LSH-S-06-OFI-01 Greater attention needs to be paid to incorporating Conduct of Operations principles into the design and logistics of the facility. A simulation/mockup facility would aid in alleviating some of the concern. (see LSH-S-12-OFI-01)	Medium Pre CD-4
LSH-S-12-V-01	Lack of a simulation, mockup, training facility increases the risk of error in performing new and/or complicated evolutions.	LSH-S-12-OFI-01: Identify or construct a facility that can be used to simulate, mockup, and train on evolutions to be performed.	Medium Pre CD-4
LSH-CO-24-V-05	Current LSH mechanical handling equipment design does not include 2 specific elements of the design philosophy that are included in the Operations Requirements Document regarding decontamination and disposal of contaminated equipment. The absence of space for decontamination and disposal of contaminated equipment will lead to a lack of function and will have a negative impact on operation, throughput, spread of contamination and radiation exposure.	LSH-CO-24-OFI-05: Review the design philosophy for this and other omissions in the LAW design and modify design as necessary.	Medium Pre CD-4
LSH-CO-24-V-02	Any necessary rotational orientation of the consumables (except the bubbler) is not identified to the operator prior to installation in the melter.	LSH-CO-24-OFI-02: Identify rotational requirements. Make appropriate modifications/markings on equipment that require rotational orientation.	Low Post CD-4
LSH-M-13-V-06	Crane indexing capabilities have not been provided. Much of the crane use involves movement between discrete locations; increased operational efficiencies can be realized by addition of crane index features.	LSH-M-13-OFI-06: Provide crane indexing capability; preferably auto-indexing capability.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
		LPH System	
LPH-IC-1-V001	There are many inconsistencies between the requirements documents such as the Mechanical Sequence Diagram and the implementation of these requirements on the Logic Diagrams. Since there is no narrative or cross-walk between the requirements and the logic diagrams it is difficult to review, and will be difficult to verify and validate that the requirements are met.	LPH-IC-1-OFI001: □ Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. o If the requirements are incorrect, the requirements documents should be updated. o If the implementation is incorrect, it should be corrected. • Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. • Scrub the logic diagrams to correct the labels and ensure consistency among the off-sheet connectors. • Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-IC-1-V002	Alarms and Interlocks for Elevator position mis-match not described on the Mechanical Handling Diagram can lead to loss of configuration control.	LPH-IC-1-OFI002: □ Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. ○ If the requirements are incorrect, the requirements documents should be updated. ○ If the implementation is incorrect, it should be corrected.	Medium Pre CD-4
LPH-IC-1-V003	ICN Screens don't use equipment noun names.	LPH-IC-1-OFI003: Revise the ICN screens to use labels that are consistent with facility documentation.	Low Post CD-4
LPH-IC-2-V001	The local control panels for the LPH Pour Cave Turntable and Elevator are located in R3/C3 areas. Since they are located immediately behind the Pour Cave Elevator, these rooms will also be thermally very hot. Since these locations do not provide a view of the equipment being operated, there is no reason for the panels to be located in these unhealthy areas.	LPH-IC-2-OFI001: Consider moving the Local Control Panels LPH-PNL-0001/4/7/10 to LCB-004 either in the corridor, or across the wall from the current position.	Medium Pre CD-4
LPH-IC-2-V002	A PIER regarding the pinching of the Monorail Hoist Festoon was closed by changing the operator message described on the logic diagrams 24590-LAW-J3-LPH02016002/02017002/02018002/02019002. These changes were not made.	LPH-IC-2-OFI002: Investigate why the correction suggested by the PIER and reviewed, does not appear on the logic diagram. There appears to be a disconnect between the direction to correct a document and its implementation.	Medium Pre CD-4
LPH-HST-1-V001	LAW Pour Cave Hoist Data Sheet Inconsistencies.	LPH-HST-1-OFI001: Provide a detailed analysis of the requirements of the pour cave hoists. Establish a bounding design and document the basis in a formalized document that provides the specific inputs used in the design (provide details for hoist sizing, operating envelope, number of movements, travel speeds, etc.). Review this information against what is procured and define what requirements need to change or what items already procured need to be modified to meet the requirements. This analysis needs to be documented as well.	Low Post CD-4
LPH-HST-1-V002	LAW Pour Cave Hoist Capacity Inadequacy.	LPH-HST-1-OFI002: Provide a detailed analysis of the lifting requirements of the pour cave hoists. Establish the bounding scenario that provides the basis for hoist capacity and make changes where appropriate (re-rate the hoists to lift more than 10 tons). This may also require a specific weight limit be placed in the design of the Container Recovery Lifting Frame LPH-RCVY-00003.	Medium Pre CD-4
LPH-HST-1-V003	LAW Pour Cave Hoist High Hook Limit Related to Preliminary Container Recovery Frame Design.	LPH-HST-1-OFI003: Establish a bounding design envelope for the container recovery lifting frame and complete the design for it. Provide a design that is consistent with the requirements for off-normal events (load limit, flange design that can be grappled, flange design that can support the load limit, etc.).	Low Post CD-4
LPH-HST-1-V004	LAW Pour Cave Hoist Design Temperature Inconsistencies.	LPH-HST-1-OFI004: Provide a detailed analysis of the environmental requirements of the pour cave hoists. Establish the bounding scenario that provides the basis for temperature values within the pour caves and transfer corridor. Update data sheets and verify with vendor if changes are required to meet the environment. Make changes where necessary (different lubricants, localized cooling, higher inspection frequencies, etc.). Review with HVAC if hoist requirements affect HVAC design.	Medium Pre CD-4
LPH-HST-1-V005	Hoist Specification Requirement Deficiencies.	LPH-HST-1-OFI005: Establish the actual requirements of the engineering specification and validate the hoist supplier has met the requirements. Provide documentation to validate the requirement was met.	Medium Pre CD-4
LPH-HST-1-V006	LAW Pour Cave Trolley Recovery Design Inadequacies.	LPH-HST-1-OFI006: Reassess recovery scenarios and provide a detailed analysis/calculation for cable sizing. Undertake a proof test to ensure cable and swivel ring design can recover a loaded hoist within the curved section of the monorail beam.	Medium Pre CD-4
LPH-HST-1-V007	LAW Pour Cave Hoist Recovery Design Inadequacies.	LPH-HST-1-OFI007: Assess the impacts of load recovery and assess if additional design features should be implemented. If the impact is great enough, it may be necessary to add a secondary motor on the LPH hoists. Undertake a proof test to ensure the redesign can adequately recover from a seized motor with a full load through remote recovery operations.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LPH-HST-1-V008	LAW Pour Cave Hoist FAT Test Deficiencies.	LPH-HST-1-OFI008: Establish an adequate FAT test plan that meets the requirements of the engineering specification. Undertake a proof test to ensure the existing hoists can adequately meet all the tests required in the plan and document the results.	High Pre CD-4
LPH-HST-1-V009	Monorail Hoist Maintenance Platform Inadequacies.	LPH-HST-1-OFI009: Modify the fixed handrail section to include a spring loaded gate that can swing open and allow for the festoon to pass through. Modify the removable grating area and provide an opening directly below the monorail beam to allow for items to pass through utilizing the monorail beam. Another option is to add permanent lifting devices directly above the removable grating sections to aid in maintenance tasks.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-BFSTR-1-V001	Insufficient shield door design basis.	LPH-BFSTR-1-OFI001: The LAW Facility Shielding Confirmation Calculation, 24590-LAW-Z0C-W13T-00002, should be revised to include the shield door design verification. The verification should include the actual buffer storage container configuration and source term to identify if the current door design will perform the expected shielding effect. The verification calculation should drive design modifications, if necessary, to ensure maintenance activities can be performed as intended and safely.	Medium Pre CD-4
LPH-BFSTR-1-V002	Additional interlocks needed for transfer corridor shield doors.	LPH-BFSTR-1-OFI002: Add the shield door position sensor inputs as an added interlock for all crane bridge movements. This will lower the risk of a collision due to human error.	Low Post CD-4
LPH-BFSTR-1-V003	Additional cameras needed in container export area.	LPH-BFSTR-1-OFI003: Install two additional cameras, located in the container transfer corridor, to provide an elevation view of the container export position.	Medium Pre CD-4
LPH-BFSTR-1-V004	Incorrect buffer storage and finishing line container import temperature.	LPH-BFSTR-1-OFI004: Clearly define the container temperature profile, for all operating modes, prior to containers entering temporary storage and re-run the CFD models for long term transient analysis. The model out puts should be used to refine operating limitations, insulation configurations, and HVAC cooling air profiles.	High Pre CD-4
LPH-BFSTR-1-V005	Insufficient Buffer Storage CFD analysis.	LPH-BFSTR-1-OFI005: Clearly define the container temperature profile, for all operating modes, prior to containers entering temporary storage. Update CFD model to accurately analyze all storage geometries, cooling air patterns, and operating conditions. Then re-run the CFD models for long term transient analysis to identify the true maximum temperature locations and the frequency at which they occur. The model out puts should be used to refine operating limitations, insulation configurations, and HVAC cooling air profiles.	High Pre CD-4
LPH-BFSTR-1-V006	Excessive buffer crane operating temperature.	LPH-BFSTR-1-OFI006: Execute the above OFI, for the CFD analysis, and use the output model data to identify the true operating environment and procedures for which the crane will perform. If temperatures are above the cranes design operating conditions then modify the crane to meet the new operating conditions or use the container re-work area as a cold container storage location that could also be designated as the crane park position. Parking the crane in the rework area, between container moves, would ensure the crane is located within its design basis operating environment and only periodically enter elevated temperature zones.	Medium Pre CD-4
LPH-BFSTR-1-V007	Insufficient Buffer Storage Capacity.	LPH-BFSTR-1-OFI007: Expand the container buffer storage area by one of the following; • Increase buffer storage by facility design modifications to expand area designated for container storage both long and short term. • Increase container cooling capability to reduce the storage time for the container to be reduced to target temperature for the finish line import. This would increase flexibility and overall throughput using the current container buffer storage area. • Modify operating procedures to allow more efficient management to current container buffer store to achieve facility throughput and validate these operating procedures through model validations.	Medium Pre CD-4
LPH-TOOL-1-V001	Inadequate design basis documentation.	LPH-TOOL-1-OFI001: Revise design and fabrication documentation to ensure accurate and as-built information.	Low Post CD-4
LPH-TOOL-2-V001	Inconsistent grapple load rating.	LPH-TOOL-2-OFI001: Increase the grapples safe working load design to 25,000 lbs. to handle all container conditions.	Low Post CD-4
LPH-TOOL-2-V002	LAW production container volume, weight, and center of gravity calculation, 24590-LAWM0C-LRH-00004, does not include an Overpack condition.	LPH-TOOL-2-OFI002: Revise calculation to include the addition of over packing material to the outside of the container. This will provide a basis for future non-conforming container handling designs.	Low Post CD-4
LPH-TOOL-2-V003	Grapple temperature limitations.	LPH-TOOL-2-OFI003: Add grapple markings to clearly identify temperature limitations the same way safe working loads are identified. Consider adding instrumentation to directly measure the container flange temperature, in the pour cave, prior to using the grapple.	Low Post CD-4
LPH-TOOL-2-V004	Grapple excessive load testing.	LPH-TOOL-2-OFI004: Revise BNI procurement process to ensure vendors test equipment according to contractual documentation and that all requirements are consistent between documents.	Low Post CD-4
LPH-TOOL-2-V005	Design requirement not verified in factory acceptance testing.	LPH-TOOL-2-OFI005: The requirement should be validated during start-up testing to ensure these critical characteristic are met.	Low Post CD-4
LPH-TOOL-2-V006	Requirements for factory acceptance testing not fully being performed.	LPH-TOOL-2-OFI006: All required performance design requirement should be performed as part of an additional FAT or demonstrated through analysis.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-BSMF-1-V001	Container Recovery Lifting Frame issues.	LPH-BSMF-1-OFI001: Identify an alternate storage location for the Container Recovery Lifting Frame that will allow the current conceptual design to be utilized. Redesign the lifting frame so it can be transferred through the Buffer Store Maintenance Facility door.	High Pre CD-4
LPH-BSMF-1-V002	Transfer of ILAW container and Lower Overpack from the Container Transfer Corridor to LFH issue.	LPH-BSMF-1-OFI002: Prepare a design change to modify the energy chain trough so the modifications can be completed prior commissioning of the facility. The modification needs to ensure minimal work will be required in a contamination area to transfer the ILAW container and lower overpack.	High Pre CD-4
LPH-BSMF-1-V003	Buffer Store Maintenance Facility Crane (LPH-CRN-00001) issues.	LPH-BSMF-1-OFI003: Prepare a document that evaluates potential loads to be lifted by the maintenance crane.	Low Post CD-4
LPH-OR-1-V001	CCN 068381, LAW Facility LPH System - RAM Assessment and Basis, recovery logic inconsistent with equipment operability.	LPH-OR-1-OFI001: Revise the recovery logic for a failed pour cave turntable motor and update the OR Model. Add the Buffer Store Crane positioning lasers to the OR Model.	Medium Pre CD-4
LPH-OR-1-V002	24590-CM-POA-MJKG-00003-15-01, Failure Mode, Effects, Reliability, Maintainability, and Criticality Analysis, inconsistencies.	LPH-OR-1-OFI002: Revise the FEMCA for the Buffer Store Crane to include "non-normal" environmental conditions due to the high environmental temperature. Revise the duty cycle and operation time of the Buffer Store Crane to align with the current container handling and sequencing methods.	Medium Pre CD-4
LPH-OR-1-V003	Inconsistencies in the MTBF data for the Buffer Store Crane.	LPH-OR-1-OFI003: Develop and document a robust logic for the Buffer Store Crane MTBF value to be used in the OR Model and update the OR Model accordingly.	Low Post CD-4
LPH-OR-1-V004	24590-WTP-MDD-PR-01-001, Operations Research (WITNESS) Model Design Document, inconsistencies.	LPH-OR-1-OFI004: Revise the OR Model to be consistent with the current sequencing and handling strategy.	Low Post CD-4
LPH-CPS-1-V001	Potentially insufficient design margin for working load capacity of Container Park/Export Stands.	LPH-CPS-1-OFI001: Perform confirming structural calculation using the redefined working load calculated for the maximum anticipated weight and a 25% design margin. Re-run the functional test conducted by the Vendor using a 20,000-lbs simulated Container bottom for the possible higher working load.	Medium Pre CD-4
LPH-CPS-1-V002	Durability of Park/Export Stand thermal insulation material over a 40-year operating life is not documented.	LPH-CPS-1-OFI002: Resume contacts with Pittsburgh Corning Corp and obtain documented evidence of the durability of the selected insulation material over 40 years at 460°F. Modify the existing Park/Export Stands prior to commissioning to provide a way to facilitate the replacement of the insulation material blocks.	Low Post CD-4
LPH-CPS-1-V003	Design of the manufactured Container Park/Export Stands may result in unnecessarily complex maintenance.	LPH-CPS-1-OFI003: Modify the existing Park/Export Stands prior to commissioning to provide a way to facilitate the replacement of the insulation material blocks.	Low Post CD-4
LPH-CPS-1-V004	Thermal conductivity of the selected thermal insulating material for the Container Park/Export Stands doesn't meet the WTP thermal conductivity requirement.	LPH-CPS-1-OFI004: Update calculation 24590-LAW-M4C-C5V-00003 using the actual physical properties of the thermal insulation material and verifies that the 4"-thick blocks are sufficient to meet the 150°F maximum allowable temperature for the concrete floor.	Low Post CD-4
LPH-CPS-1-V005	The truncated Container Export Stands will provide an insufficient thermal protection of the concrete floor below.	LPH-CPS-1-OFI005: Develop a detailed calculation to verify the temperature conditions of the floor at the east end of the Transfer Corridor and define need for additional localized thermal insulation.	Medium Pre CD-4
LPH-CPS-1-V006	FAT Test of the Container Park/Export Stands was not conducted in a representative temperature configuration.	LPH-CPS-1-OFI006: Re-run the heat tests for the Park and Export Stands) in a more representative temperature environment to verify that the concrete floor is not overheated.	Low Post CD-4
LPH-CPS-1-V007	Lack of calculations to support the design and validate the performance of the fabricated Container Park/Export Stands.	LPH-CPS-1-OFI007: Develop documentation (primarily calculations) to validate that the revised final design of the Park/Export Stands actually meets the expected performance of preventing damage to the concrete floor from the heat dissipated by the Containers.	Low Post CD-4
LPH-CTB-1-V001	Bogie thermal shield design differences between the Design Proposal Drawing and the fabricated Bogies are not documented.	LPH-CTB-1-OFI001: Re-run the Manufacturer's thermal analysis of the Container Transport Bogies for the expected higher ambient temperature range, and verify that the temperatures of the Bogie most fragile components including the motor and junction boxes remain acceptable.	Medium Pre CD-4
LPH-CTB-1-V002	No I&C Component prevents a Bogie from colliding with a filled Container standing on an Export Stand.	LPH-CTB-1-OFI002: Equip the two Export Stands with a Container Presence Detection Instrument signaling to the ICN and the Operator (Manual mode) the presence of a Container on an Export Stand.	Medium Pre CD-4
LPH-CTB-1-V003	Wall of the Corridor at Column Line 12.5 in not protected from radiant heat dissipated by a filled Container on a Bogie parked at Position 15.	LPH-CTB-1-OFI003: Conduct a thermal analysis, verify the surface temperature level of the north and south corridor wall at and near Position 15, and define the needs for adding insulation material and stainless steel liner in this area during the construction phase prior to commissioning (similar to the wall configuration at the east end of the Corridor near the Export Stands).	High Pre CD-4
LPH-CTB-1-V004	Non-finished surfaces of the Corridor walls will trap volatile contamination migrating from Pour Caves resulting in challenging cleanup work.	LPH-CTB-1-OFI004: Conduct a detailed thermal analysis of the Container Transport Corridor focused to the identification of the natural circulation thermal plumes and air temperatures. Evaluate the needs for applying epoxy coating to the unfinished upper surfaces of the Corridor.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-CTB-1-V005	Performance of IR Transmitters measuring Container surface temperature before export to System LFH is not demonstrated.	LPH-CTB-1-OFI005: Perform tests of the selected IR Transmitters in a representative environment to demonstrate the performance of these essential Container surface temperature measurement components prior to commissioning.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LPH-CTB-1-V006	Maximum temperature requirement for Conductor Bar design is significantly lower than anticipated temperatures near filled Container.	LPH-CTB-1-OFI006: Verify the acceptable temperature range for the cover material of the installed conductor bars, resume contacts with the Manufacturer, and evaluate the option of replacing the conductor bars by a product with an alternative cover material resisting to higher temperatures if the durability of the installed material cannot be demonstrated in the expected temperature conditions.	Medium Pre CD-4
LPH-CTB-1-V007	Engineering Specification for Transport Bogie design defines a temperature environment not representative of anticipated higher ambient temperatures in the Transfer Corridor.	LPH-CTB-1-OFI007: Re-run the Manufacturer's thermal analysis of the Container Transport Bogies for the expected higher ambient temperature range, and verify that the temperatures of the Bogie most fragile components including the motor and junction boxes remain acceptable.	Low Post CD-4
LPH-CTB-1-V008	Value of the maximum Container weight shown on DPD and in Engineering Specification for Container Transport Bogie is misleading.	LPH-CTB-1-OFI008: Revise Note 4 on DPD 24590-LAW-M0-LPH-00026 and Section 5.6.2.1.2 of Engineering Specification 24590WTP-3PS-MQR0-T0003 with correct value of product container weight.	Low Post CD-4
LPH-CTB-1-V009	Maximum payload of the Bogie is defined for a service that the Bogie may never be providing during the Facility operating life.	LPH-CTB-1-OFI009: Update Engineering Specification 24590-WTP-3PS-MQR0-T0003 and System Description to reflect alternative approach for transporting test weights for the overhead hoists within the Corridor.	Low Post CD-4
LPH-BMA-1-V001	Bogie Maintenance Hoist not adequate to lift the Container Transport Bogies to access the underside of the Bogies.	LPH-BMA-1-OFI001: Develop detailed maintenance/repair procedures for the Container Transport Bogies that minimize the need for a lengthy disassembly of bogie parts prior to lift the failed bogie from the rails	Medium Pre CD-4
LPH-BMA-1-V002	Discrepancy in location of Bogie Maintenance Hoist between Vendor's calculation and Structural Steel Drawing.	LPH-BMA-1-OFI002: Re-run Calculation 24590-LAW-SSC-S15T-00015 with the correct location of the monorail and hoist so that the structural resistance of the structural steel in the Bogie Maintenance Area is verified.	Low Post CD-4
LPH-BMA-1-V003	Use of Bogie Recovery Systems will pull contamination inside the Bogie Maintenance Area.	LPH-BMA-1-OFI003: Develop maintenance procedures to wipe-out the contamination from the wire ropes before it is dispersed inside the components of the Bogie Recovery Systems located in the Bogie Maintenance Area	Medium Pre CD-4
LPH-PC-1-V001	High ambient air temperatures in the pour cave affect pour cave equipment and cause a natural convection air plume out of the top of the open pour cave/bogie tunnel door.	LPH-PC-1-OFI001: Perform a CFD of the HVAC interaction of the bogie corridor (L-B025B) and all four pour caves at full LAW facility throughput. Install additional cooling in the LAW Facility and modify the LAW Facility HVAC C5V system as required to preclude excessive temperatures based on the CFD analysis. Convert all the "delay time" requirements in the canister handling scenarios to actual canister temperatures requirements.	High Pre CD-4
LPH-PC-1-V002	Pour Cave shielded windows are overheated.	LPH-PC-1-OFI002: Design a thermal barrier to prevent radiant heating of the pour cave windows by hot containers in the turntable cooling position.	Medium Pre CD-4
LPH-PC-1-V003	Filled containers which cannot be promptly exported from the pour cave will require LAW Facility production to be reduced.	LPH-PC-1-OFI003: Install temperature instruments to base filled container movements based on temperature of the containers rather than time since the initial glass pour and allow containers which happen to be cool enough to be immediately processed out of the area.	Medium Pre CD-4
LPH-PC-1-V004	If the Seal head cameras overheat and fail, pour operations through the respective melter spout must be stopped until the camera is replaced.	LPH-PC-1-OFI004: Increase the cooling to the Seal head camera areas.	Medium Pre CD-4
LPH-PC-1-V005	Failure of the Seal head cooling water piping will require shutdown of the Seal head and respective melter pour spout. Leaks will mobilize contamination and increase the risk of the spread of contamination.	LPH-PC-1-OFI005: Perform a B31.3 piping stress analysis on the Seal head cooling water pipe.	Medium Pre CD-4
LPH-PC-1-V006	Air temperatures of up to 650°F on loss of pour cave cooling water will cause severe equipment problems. Inadequate pipe sizing may cause cooling water supply problems.	LPH-PC-1-OFI006: Install backup cooling systems as required to mitigate a loss of pour cave cooling water. Perform an Engineering calculation to verify the Rule-of-Thumb sizing method chose the correct piping sizes, or accept the risk and wait until startup and fix any incorrectly sized piping then.	Medium Pre CD-4
LPH-PC-1-V007	Cold commissioning will demonstrate adequacy of container bottom within a modified overpack. This will allow an adequate container to be procured if required.	LPH-PC-1-OFI007: Perform a prototypical pour of the LAW glass, or accept the risk and test the container during cold commissioning. It any case, this item should be resolved prior to hot operations with radioactive materials.	Low Post CD-4
LPH-PC-1-V008	Increased maintenance entries to restore pour cave lighting.	LPH-PC-1-OFI008: Evaluate the suitability of the electric light fixtures in the pour caves. This item should be done after pour cave temperatures are re-evaluated.	Low Post CD-4
LPH-PC-1-V009	High container temperatures due to inadequate container cooling directly impact LAW Facility throughput. Excessive yielding of the container flange may preclude sealing of the container with a lid which must be inserted into a round hole and create non-conforming ILAW packages.	LPH-PC-1-OFI009: Increase cooling to the filled container flange area to reduce the time it takes for the container flange to cool and regain its strength. Install an instrument to measure the temperature of the filled container in the cooling position on the Turntable.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-PC-1-V010	While the container grapples are reliable, failure of the grapple to release a container will shut down operations in the respective pour cave and could require extensive recovery efforts.	LPH-PC-1-OFI010: Design and procure a Grapple that can be remotely disengaged.	Medium Pre CD-4
LPH-PC-1-V011	After cutting the pour cave hoist cable, recovery of the pour cave will involve a manned entry with containers in the pour cave.	LPH-PC-1-OFI011: Install a hoist with redundant drives for the trolley wheels, and hoist to allow independent recovery without cutting the hoist cable.	Medium Pre CD-4
LPH-PC-1-V012	The contamination levels in the pour caves will be a mystery until a sample is taken or an entry is made.	LPH-PC-1-OFI012: Install the CAM system described in the System Description to allow retrospective analyses to be done for the pour caves.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LPH-PC-1-V013	Overpacks, and containers within overpacks, will not be able to be remotely handled while in overpacks limiting LAW Facility throughput if manual handling must be done. Use of conventional lifting & rigging gear will increase the quantity of potentially contaminated items which must be handled and controlled.	LPH-PC-1-OFI013: Design and procure a lightweight, high strength, remotely handled, lifting frame to handle overpacks, and containers in overpacks, when lifting them to/from the Pour Cave Turntable is required.	High Pre CD-4
LPH-PC-1-V014	The natural circulation hole in the Container Lower Overpack will increase radiant heating of the Turntable and Turntable base.	LPH-PC-1-OFI014: Perform a CFD thermal analysis of the pour cave turntable with radiant heating from the modified overpack. Reperform the turntable seismic analysis if the temperature increase exceeds the bounds of the existing seismic analysis. Install heat shields and thermal insulation on the turntable as required. It is suspected that Pour Cave L-B013C will have the highest temperatures during normal operation. A new thermal analysis of the Turntable should be done, and if the Turntable metal temperatures increase above the Turntable's seismic analysis temperature assumptions/limits, a new seismic analysis should be done.	High Pre CD-4
LPH-PC-1-V015	A motor with an operating surface temperature of 239°F is a personnel hazard. The Pour Cave Elevator motors are supplied with a 105°C (189°F) temperature rise creating a personnel hazard greater than 140°F.	LPH-PC-1-OFI015: Install a removable, expanded metal heat shield around the motor to prevent personnel from contacting the hot surfaces and still enable maintenance to be done.	Low Post CD-4
LPH-PC-1-V016	Missing Vendor documentation needed to support maintenance.	LPH-PC-1-OFI016: Correct the Vendor Manual 24590-CM-POA-MJW0-00001-11-00001. Perform an extent of conditions review of the WTP PIER data base and determine if this is a unique occurrence. If the review shows there are enough occurrences of lost vendor documents in PADC, take corrective actions as required.	Low Post CD-4
LPH-PC-1-V017	Potential equipment damage to Pour Cave Turntable locking actuator.	LPH-PC-1-OFI017: Ensure a timer in the control system is monitoring the run time of the Turntable locking actuator motor. If the actuator motor exceeds a run time setpoint, the control system stops pour cave equipment operations until Operating/Maintenance personnel have investigated and corrected the failure of the Turntable locking pin actuator to lock the turntable in position.	Medium Pre CD-4
LPH-PC-1-V018	Overheating the Turntable bevel gear drive oil, will reduce the life of the bevel gear drive.	LPH-PC-1-OFI018: Use a synthetic oil with a higher rated operating temperature and install a heat shield to protect the Turntable bevel gear drive from the hot container sitting in the Lower Overpack.	Medium Pre CD-4
LPH-PC-1-V019	Overfill of container will impact facility throughput, require immediate maintenance actions, result in a large contamination cleanup effort, and impose unplanned costs on the facility.	LPH-PC-1-OFI019: Install an overfill spout to direct the molten glass to a safe area. A system similar to the WTP HLW melter installation could be used. The WTP HLW melter has a spill port closed by a disk secured with an aluminum bolt that will melt when exposed to molten glass and spill the molten glass to a safe area in the cave below the canister.	High Pre CD-4
LPH-PC-1-V020	Failure to detect glass build-up in a Melter spout bellows can lead to blockage of the bellows and render the respective Melter pour spout inoperable.	LPH-PC-1-OFI020: Install a camera in the Pour Cave to look upward into the bellows when the container is lowered to the Turntable to allow the Operator to determine if any glass is building up on the Melter pour spout bellows.	High Pre CD-4
LPH-PC-1-V021	If the replacement melter Vendor uses original design drawings rather than "as-built" drawings to determine allowable Melter pour spout installation tolerance, the replacement melter may not be able to pour glass into a container.	LPH-PC-1-OFI021: Create a Melter replacement document that captures all the special places the Melter replacement Vendor must fabricate the replacement Melter with tight dimensions and tolerances which are Not-To-Be-Exceeded in any case.	Medium Pre CD-4
LPH-PC-1-V022	Installation of an Elevator weigh instrument with a very small or no temperature margin can cause operational and maintenance problems.	LPH-PC-1-OFI022: Install an Elevator load cell that is rated for the temperature of the installation area.	Medium Pre CD-4
LPH-PC-1-V023	If maintenance must be performed on the modified Pour Cave Elevator Lift Table and it must be lifted from the Elevator, the lift must be planned due the R5/C5 Pour Cave area.	LPH-PC-1-OFI023: Update the 24590-CM-POA-MJW0-00001-03-36 Rev 00D with a VDCN to show the correct weight and centerof-gravity.	Low Post CD-4
LPH-PC-1-V024	The sides of the Pour Cave Elevators in rooms L-B012 & L-B014 around the location of the door hinges, handles, and lubrication ports may be over 140°F.	LPH-PC-1-OFI024: Provide removable expanded metal barriers to protect personnel from high temperature surfaces.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LPH-PC-1-V025	If improper oil is used in the Container Elevator, the heat will degrade the oil and cause Elevator gear drive problems. If the oils in the gear reducers degrade at the same rate, all four Elevators will experience problems are approximately the same time.	LPH-PC-1-OFI025: Use Elevator gear reducer oil suitable for the temperature service.	Low Post CD-4
LPH-PC-1-V026	Indeterminate specification of mode of operation for the Model 60 series Container Elevator load cells may cause problems if an improper mode is used.	LPH-PC-1-OFI026: Specify a proper instrument mode of operation to preclude overfill of a container.	Medium Pre CD-4
LPH-PC-1-V027	LPH System Descriptions which is to be used to document the system should reflect the asbuilt system and the reason for the design.	LPH-PC-1-OFI027: Update the LPH System Description to reflect design changes.	Low Post CD-4
LPH-PC-1-V028	It appears the control system will allow a full container to be raised to the pour position. This will increase the risk of overfilling a container.	LPH-PC-1-OFI028: Update the SLPH ystem Description to reflect how the control system will control the system. If the control system will not perform/provide an acceptable control scenario to meet System Description requirements, revise the control system.	Medium Pre CD-4
LPH-PC-1-V029	During shift turnovers, if a partially filled container is placed on the Turntable for the next shift to complete the filling process, the oncoming Operator may not know a partially filled container is present if turnover is not proper. If the weight of the "empty" container is tared upon lifting it with the elevator, the container may be overfilled.	LPH-PC-1-OFI029: Strictly control the topping off of a previously poured container with an Operating Procedure. Install instrumentation (cameras) and lighting to allow the operator to inspect the container internals after moving the container to the Pour Cave Turntable.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LPH-PC-1-V030	Non-installation of Pour Cave MSMs transfers items to the LAW Facility Operations Contractor. Insufficient equipment complicates recovery operations and increases the risk of the spread of contamination; may impose operational delays.	LPH-PC-1-OFI030: Provide MSMs or other equipment capable of performing Pour Cave recovery operations.	Medium Pre CD-4
LPH-PC-1-V031	Cracking of the Pour Cave viewing windows may limit viewing.	LPH-PC-1-OFI031: Remove the Pour Cave windows, install video monitors at the Pour Caves, and install more replaceable cameras in Pour Cave to replace the viewing window functionality.	Medium Pre CD-4
LPH-PC-1-V032	Contamination on the surface of the Container Lower Overpacks may be physically pressed and imbedded in the lower surface of the container at 8 locations. The indentations will increase complexity of the decontamination process since "indentations" are being decontaminated rather than a smooth cylinder. Thermal distortion of the Lower Overpack may cause binding of the container and Overpack.	LPH-PC-1-OFI032: Remove the Lower Overpack ribs as recommended by the analysis in Vendor submittal 24590-QL-HC4-W00000085-T07-02-00001. Cut slots in the Overpack upper rim flanges recommended by the analysis in Vendor submittal 24590-QL-HC4W000-00085-T07-02-00001.	High Pre CD-4
LPH-PC-1-V033	Improper specification of equipment operating in high temperature environments will lead to premature failure of the Pour Cave Shield Doors. Inadequate specification of the setpoint of thermal switches & motor temperature rises can cause motors to trip out when exposed to high ambient temperatures.	LPH-PC-1-OFI033: Analyze the Pour Cave Shield Door ambient temperatures and supplied door motor/brake/gear motor/ gear reducers and determine if the installation must be upgraded. Specify and procure replacement motors for the high ambient temperature conditions as required.	Low Post CD-4
LPH-PC-1-V034	A review of Maintenance, Operating, Emergency, and Abnormal Operating Procedures for Pour Caves could not be done to verify no vulnerabilities exist.	LPH-PC-1-OFI034: Expedite the creation of the maintenance, operating, emergency, and abnormal operating procedures so they can be reviewed for Operational Vulnerabilities.	Medium Pre CD-4
		LMH System	
LMH-S-10-01	The facets of location, human resources, transportation, and parts availability need to be resolved to support fabrication of replacement melters.	LMH-S-10-OFI-1: Determine a schedule of need, a location for melter assembly, parts availability, and a method of transport for replacement melters. This scope lies with DOE.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LMH-F-15-V-01	It has not been demonstrated that the 0.1g new melter acceleration limit is adequate to protect the melter systems (refractory). It has not been demonstrated that the melter winch and rail system will operate within the 0.1g acceleration limit. It should be established what the correct maximum melter acceleration is and that value should be defined as the criteria for every new melter.	LMH-F-15-OFI-01.1: Develop and document the basis for the test torque setting ranges and the Load Limiting feature programmed ramp settings including the activities necessary to maintain them. Off-normal conditions should also be considered. LMH-F-15-OFI-01.2: Establish a periodic inspection program and monitor melter rail conditions regularly. Melter rails and wheels/rollers should be inspected and refurbished before each new melter movement. LMH-F-15-OFI-01.3: Definitively establish the acceleration and deceleration limits for new melters and document the basis. Monitor all new melters against the established acceleration criteria. LMH-F-15-OFI-01.4: Develop long term plans that address melter equipment obsolescence, warranties, and replacement or refurbishment for all equipment procured. LMH-F-15-OFI-01.5: Identify and document all critical attributes of equipment and components associated with the winch. Thoroughly test all those components accordingly and document these test. LMH-F-15-OFI-01.6: Identify a Subject Matter Expert that can assume responsibility for the basis of the design criteria used in the winch and rail design.	Medium Pre CD-4
LMH-F-05-V-01	The detailed process for containment of the spent/failed LAW melters has not been defined.	LMH-F-05-OFI-01: Develop a detailed process definition that will allow for procurement of needed equipment and account for allocation of funds during operations.	Medium Pre CD-4
LMH-S-11-V-01	Alternate vendors for refractory should be identified and plans/schedules for future replacement melter materials defined.	LMH-S-11-OFI-01: Alternate vendors for refractory should be identified and plans/schedules for future replacement melter materials defined.	Medium Pre CD-4
LMH-S-11-V-02	A consistent philosophy regarding manual and/or remote operations and maintenance should be determined, and the plant design should then be adjusted accordingly.	LMH-S-11-OFI-02: Develop a consistent philosophy regarding manual and/or remote operations and maintenance should be determined, and the plant design should then be adjusted accordingly.	Medium Pre CD-4
LMH-W-07-V-02	Inadequate melter decontamination approach.	LMH-W-07-OFI-02: Provide systems for decontamination of melter exterior, including the bottom, prior to commissioning to ensure capability to decontaminate is adequate.	Medium Pre CD-4
LMH-S-16-V-01	There are gaps in the LAW process of designating components to owning systems.	LMH-S-16-OFI-01: Designate each component to a system to ensure there are no gaps in the operations and maintenance of the equipment.	Medium Pre CD-4
LMH-F-01-V-01	Melter and facility dimensions should be carefully tracked and controlled to ensure melter ingress/egress access to the LAW facility. Careful consideration should be given to the installation of any and all additional components in this area, or any modifications to the melter design that could impact the nominal clearances available.	LMH-F-01-OFI-01: Melter, utility and equipment dimension stack-up should be carefully tracked to ensure melter ingress/egress access to the LAW facility is maintained and not impeded.	Medium Pre CD-4
LMH-CO-13-V-01	The current LMH system excludes the work scope of transferring a melter between the melter rails and a melter transport vehicle.	LMH-CO-13-OFI-01: Identify a method, system or equipment to transfer a melter from the melter rail system to a transport vehicle.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LMH-W-07-V-01	Inability to drain free liquids from cooling panels in spent melters.	LMH-S-04-OFI-1: Determine a method to drain all free liquids from a spent melter in preparation for waste disposal. Determination should be made prior to loss of access to the cooling panels during fabrication.	Medium Pre CD-4
LMH-CO-13-V-02	The current LMH system does not include disposal of a spent/failed melter	LMH-CO-13-OFI-02: Identify the final disposal criteria and prepare procedures and align equipment to implement disposal plan.	Medium Pre CD-4
LMH-F-14-V-01	System LMH does not address the 0.1g acceleration limit for a transport vehicle. (i.e., sub compartment transporter).	LMH-F-14-OFI-01: Consider use of submarine compartment transport vehicle in use at Hanford to transport melters including 0.1g acceleration instrumentation.	Medium Pre CD-4
LMH-S-11-V-03	Section 3.5 of 24590-LAW-3YD-LMP-00001 should be revised to use the correct reference.	LMH-S-11-OFI-03: Section 3.5 of 24590-LAW-3YD-LMP-00001 should be revised to use the correct reference.	Low Post CD-4
		LFH System	
LFH-LID-1-V001	LAW container lid ANSI N14.5 leak tightness and testing requirements do not match in the System Description as stated in the ILAW Product Compliance Plan.	LFH-LID-1-OFI001: • Define correct package type and seal requirement and update relevant documents. • Establish the correct test method/methodology and update relevant documents.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-LID-1-V002	LAW container leak testing was not implemented correctly.	LFH-LID-1-OFI002: • Establish the correct leak rate limit and update all relevant documents. • Establish the correct test method/methodology and update relevant documents. • Execute valid leak test. • Assess if seal design requires modification (seal/gasket type, threaded vs. welded, etc.).	Medium Pre CD-4
LFH-LID-1-V003	Lid seal design and method of lid deployment increases chances of seal damage.	LFH-LID-1-OFI003: • Revise lid gasket/seal type that is more robust and not suspect to damage. • Revise underside of lid to provide protection of seal when stacked in lid holder (i.e., standoff integrated into the lid that keeps the seal surface from contacting the next lid it is stacked on).	Medium Pre CD-4
LFH-LID-1-V004	Lid seal identification on DPD is incorrect.	LFH-LID-1-OFI004: Provide correct seal manufacturer/type/part number on applicable drawings.	Low Post CD-4
LFH-LID-1-V005	Lidding jib crane capacities do not have a documented basis.	LFH-LID-1-OFI005: • Define all the requirements/scenarios (including any off normal events) of the jib cranes. • Document the lifting requirements and provide an established margin for sizing the hoist. Documentation should be in the form of an approved calculation.	Low Post CD-4
LFH-LID-1-V006	Lidding jib crane design temperature conflicts with CFD analysis of finishing line equipment.	LFH-LID-1-OFI006: • Provide a detailed analysis of the environmental requirements of the cranes. • Establish the bounding scenario that provides the basis for temperature values within the finishing line. • Update data sheets and verify with vendor if changes are required to meet the environment. • Make changes where necessary (different lubricants, localized cooling, higher inspection frequencies, etc.). Review with HVAC if hoist cooling requirements affect HVAC design.	Low Post CD-4
LFH-LID-1-V007	Lidding Jib Crane FAT Test Deficiencies.	LFH-LID-1-OFI007: • Establish an adequate FAT test plan that meets the requirements of the engineering specification. • Undertake a proof test to ensure the existing jib cranes can adequately meet all the tests required in the plan and document the results.	Medium Pre CD-4
LFH-LID-1-V008	Finish Line MSMs design temperature conflicts with CFD analysis of finishing line equipment.	LFH-LID-1-OFI008: • Provide a detailed analysis of the environmental requirements of the MSMs. • Establish the bounding scenario that provides the basis for temperature values within the finishing line. • Update data sheets and verify with vendor if changes are required to meet the environment. • Make changes where necessary (different lubricants, localized cooling, higher inspection frequencies, etc.). Review with HVAC if hoist cooling requirements affect HVAC design.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LFH-LID-1-V009	Lid holder decontamination and refilling process has not been determined.	LFH-LID-1-OFI009: • Provide an effective method to safely decontaminate lid holder in L-0217C. • Install fixed lid magazine stand in L-0217A to safely refill lid holder. • Install jib crane with lid lifter dedicated for lid refilling. • Purchase 2 spare lid holders (one for each lidding line) to minimize downtime and keep lids refilled at all times.	High Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-LID-1-V010	Lid Press Tool and Lid Recovery Tool design temperature issues.	LFH-LID-1-OFI010: • Provide a detailed analysis of the environmental requirements of the tools. • Establish the bounding scenario that provides the basis for temperature values within the finishing line. • Update data sheets and verify with vendor if changes are required to meet the environment. • Make changes where necessary (stainless tubing, additional insulation).	Medium Pre CD-4
LFH-LID-1-V011	Lid recovery tool operation deficiencies.	LFH-LID-1-OFI011: • Provide a proof of principle test to validate the current design can remove a "tilted" lid, place on park stand, remove lid from stand via MSM and place in disposal bin. • If this cannot be done, revise design to allow for a valid method of lid removal and disposal (this may require new equipment be utilized instead of modifying existing designs). • Undertake a new proof of principle test to validate new/revised equipment can effectively meet the functions required in "lid recovery" operations.	High Pre CD-4
LFH-LID-1-V012	Lid disposal bin handling deficiencies.	LFH-LID-1-OFI012: • Provide a proof of principle test to validate the current design can hold lids without buckling, be removed "manually" in a safe manner. • If this cannot be done, revise design to allow for a valid method of lid disposal (this may require new bin design and new location for remote handling with jib cranes be utilized instead of modifying existing designs). • Undertake a new proof of principle test to validate new/revised equipment can effectively meet the functions required in "lid disposal" operations.	Medium Pre CD-4
LFH-IC-1-V001	The design for the LFH system is not in compliance with the requirements flow down as described in the Technical Baseline. It is not clear how requirements flow from the Mechanical Sequence Diagram or the Mechanical Handling Diagrams to the J3 Logic Diagrams, Function Diagrams and Sequential Function Diagrams. There is no way to verify that interlocks have been passed down to the J3 Logic Diagrams and no way to verify that they are implemented correctly.	LFH-IC-1-OFI001: □ Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. • Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. • Scrub the logic diagrams to correct the labels and ensure consistency among the off-sheet connectors. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-1-V002	Interlocks on the Lidding Bogie listed in the Mechanical Sequence Diagram 24590-LAWM1-LFH-00001 are not sufficient to protect the equipment from damage.	LFH-IC-1-OFI002: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. • Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-IC-1-V003	Interlocks on the Lidding Jib Crane listed in the Mechanical Sequence Diagram 24590-LAWM1-LFH-00001 are not sufficient to protect the equipment from damage.	LFH-IC-1-OFI003: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. □ Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-1-V004	Interlocks on the Sealing Jib Crane listed in the Mechanical Sequence Diagram 24590-LAWM1-LFH-00001, are not sufficient to prevent the equipment from damage.	LFH-IC-1-OFI004: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. □ Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-1-V005	Interlocks on the Decon Shield Door listed in the Mechanical Sequence Diagram 24590LAW-M1-LFH-00001 are not sufficient to protect against HVAC flow disruptions or the spread of contamination.	LFH-IC-1-OFI005: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. □ Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-1-V006	Interlocks on the Decontamination Power Manipulators and the Decontamination Turntable listed in the Mechanical Sequence Diagram 24590-LAW-M1-LFH-00001, are not sufficient to prevent the equipment from damage.	LFH-IC-1-OFI006: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. • Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

Item No.	Description	Opportunities for Improvement	Rank
LFH-IC-1-V007	Interlocks on the Swabbing Bogie (LFH-TRLY-00015 / 00005) listed in the Mechanical Sequence Diagram 24590-LAW-M1-LFH-00001, are not sufficient to prevent the equipment from damage.	LFH-IC1-OFI007: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. • Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-1-V008	There is no clear flow down of requirements from higher level documents to the Logic Diagrams. The J3 logic Diagrams attempt to correct this, but that puts them in violation of an upper-level requirement.	LFH-IC-1-OFI008: • Develop a compliance matrix that identifies where each interlock is implemented, and a criteria matrix that defines how the requirement will be tested. • Conduct a full review of the J3 Logic diagrams to ensure they meet the requirements of the upper level documents such as the System Description, the Mechanical Sequence Diagrams and the Software Control Narrative. • If the requirements are incorrect, the requirements documents should be updated. • If the implementation is incorrect, it should be corrected. □ Add a reference in the MSDs to the J3 Logic Diagrams where the interlock is implemented. Start-up and commissioning should include exhaustive testing of both success and failure paths and Off-Normal operations to "wring out" errors and identify improvements in operations and operator/control interfaces before operations begin.	Medium Pre CD-4
LFH-IC-2-V001	The way the carbon dioxide pelletizers, CDG-BLWR-00001/00002/00003/00004 are mounted orients the control panels between the Blasters and the Pelletizers. This provides no room for an operator or maintenance personnel to access the panels.	LFH-IC-2-OFI001: The carbon dioxide pelletizers, CDG-PLT-00001/00002 must be re-installed with a different orientation that allows proper access.	High Pre CD-4
LFH-IC-2-V002	The bogies (i.e. LFH-TRLY-00006/00007) are variously referred to as Trolleys in the equipment name, Bogies in the System Description; Carriages on the label of the Control Panels LFH-PNL-00002/00011, and as Carts on the HMI Screens.	LFH-IC-2-OFI002: Align the design of the facility so that each piece of equipment has one and only one name.	High Pre CD-4
LFH-IC-3-V001	The design provides no method of verifying compliance with Waste Affecting Criteria regarding temperature before the container is exported for transport to the disposal facility.	LFH-IC-3-OFI001: Redundant temperature transmitters similar to the ones provided at the end for the Pour Tunnel should be provided at the Monitoring/Export area. These instruments should have an appropriate quality level with pre and post calibrations to verify their operation and accuracy.	Medium Pre CD-4
LFH-TRLY-1-V001	Bogie thermal shield design differences between the Design Proposal Drawings and the fabricated Lidding and Decontamination Bogies are not documented.	LFH-TRLY-1-OFI001: Re-run the Manufacturer's thermal analyses of the Lidding and Decontamination Bogies for the expected higher ambient temperature range, and verify that the temperatures of the Bogie most fragile components including the motor, junction boxes, and cable carrier remain acceptable.	Medium Pre CD-4
LFH-TRLY-1-V002	The ICN does not prevent collision between the Lidding and Decontamination and Bogies when present at and moving to Position P4 in rooms L-0109C and L-0115C.	LFH-TRLY-1-OFI002: Update ICN to include interlocks preventing Bogie collisions in the Finishing Line.	Low Post CD-4
LFH-TRLY-1-V003	Absence of container centering guides on the bogie-mounted Swabbing Turntables may result in challenging container lifting operations and container dropping accidents.	LFH-TRLY-1-OFI003: Add bolted containers centering wedge assemblies around the top plate of the Swabbing Turntables (similar to the wedges installed on the Decontamination Turntables).	Medium Pre CD-4
LFH-TRLY-1-V004	Potentially insufficient maximum load capacity of bogie-mounted Swabbing Turntables.	LFH-TRLY-1-OFI004: Verify the acceptable load range for the Bogie-mounted Swabbing Turntables, resume contacts with the Manufacturer, and run a structural analysis of the turntable for the anticipated higher loads.	Low Post CD-4
LFH-TRLY-1-V005	Material of flexible electrical conduits to Bogie stand-mounted Power Junction Boxes may not be adequate for temperature conditions in the immediate vicinity of LFH Bogies.	LFH-TRLY-1-OFI005: Design and add local insulation for the electrical conduits connected to the Bogie Power Junction Boxes (and to any other junction box in the Finishing Lines located in the immediate vicinity of a side of a product container).	High Pre CD-4
LFH-TRLY-1-V006	Vendor's calculation for bogie bumper selection is based on incorrect gross weight and bogie speeds.	LFH-TRLY-1-OFI-006: Re-run the LFH Bogie Bumper Selection Calculation for the corrected weights and operating speeds to verify that the bumpers mounted on the fabricated and installed bogies are adequate prior to commissioning.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-TRLY-1-V007	Vendor's calculations for bogie container supports and bogie frame analysis are based on an incorrect maximum loading.	LFH-TRLY-1-OFI007: Re-run the structural calculations for the Lidding and Decontamination Bogies using the revised bounding payload to verify the structural resistance of the guides and chassis are adequate prior to commissioning.	Low Post CD-4
LFH-TRLY-1-V008	Length and travel of Container Present Sensor of Lidding and Decontamination Bogies may not be adequate for detecting presence of an Overpack.	LFH-TRLY-1-OFI008: Verify radial position, length, and travel of the Container Present Sensor mounted on the fabricated/installed Lidding and Decontamination Bogies against the most current design of the Container Lower Overpack.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LFH-TRLY-1-V009	Configuration of the recessed rails in the Finishing Line will promote the accumulation of contamination.	LFH-TRLY-1-OFI009: Develop procedures for frequent periodic decontamination work activities to prevent contamination buildup along the bogie tracks.	High Pre CD-4
LFH-TRLY-1-V010	Maintenance on Bogies in Swabbing and Export Rooms may be problematic due to contamination potentially pulled from Container Lidding Areas.	LFH-TRLY-1-OFI010: Develop procedures to minimize the spread of contamination into rooms that should stay clean while performing maintenance on the LFH Bogies.	High Pre CD-4
LFH-TRLY-1-V011	Absence of Finishing Line Bogie maintenance hoist may result in problematic bogie maintenance.	LFH-TRLY-1-OFI011: Develop maintenance procedures for LFH Bogies that minimize impact to the installed process lifting equipment.	Medium Pre CD-4
LFH-TRLY-1-V012	Lidding and Decontamination Bogies need to be disconnected from Power Cables and Carrier prior to maintenance which makes their transfer back to their respective process area problematic.	LFH-TRLY-1-OFI012: Define the maintenance areas actually available for maintaining the Lidding and Decontamination Bogies and develop procedures accordingly.	Medium Pre CD-4
LFH-TRLY-1-V013	Mechanical Handling Data Sheets and Thermal Analysis for the Swabbing Bogie-Mounted Turntables Define Incorrect Container Bottom and Side Temperatures.	LFH-TRLY-1-OFI013: Correct the discrepancies in engineering and Vendor's documentation package for the two Bogie-mounted Swabbing Turntables.	Medium Pre CD-4
LFH-TRLY-1-V014	High Probability of Damaging the Container Present Sensor of Bogie-Mounted Swabbing Turntables When Lowering Container Lower Overpack on Top Plate.	LFH-TRLY-1-OFI014: Re-locate the bracket and Container Present Sensor further away from the edge of the top plate after checking that the laser sensor can detect the presence of an object on the turntable from its modified location.	Medium Pre CD-4
LFH-DS-1-V001	Retrieval of Bogie Doors in Decontamination Rooms L-0109C/-0115C not yet possible.	LFH-DS-1-OFI001: Develop an easy method of door retrieval to minimize the impact of an occurrence of a door fail-to-move situation.	Medium Pre CD-4
LFH-DS-1-V002	Container decontamination and recovery of a contaminated container may be problematic.	LFH-DS-1-OFI002: • Demonstrate the capability of a CO2 system to decontaminate an ILAW Container. • Develop a method to export a non-conforming ILAW container.	High Pre CD-4
LFH-DS-1-V003	C5 Duct pressurization over C3 room & C2 Corridor pressure.	LFH-DS-1-OFI003: • Install a CO2 gas monitor instrument in Room L-217B to detect rising CO2 levels. • Invoke a periodic maintenance surveillance to inspect the CO2 exhaust ducting from the discharge of the C5V-FAN-00009/-00010 fans through the C3 rooms / C2 corridors to the tie-in point on the main C5V duct.	Medium Pre CD-4
LFH-DS-1-V004	Operation of the Carbon Dioxide (CO2) pelletizer and C5V vacuum pickup system may be problematic.	LFH-DS-1-OFI004: • Testing of the CO2 system to optimize container decontamination efficacy should be done before startup. • It would be best to start the testing and development of the integrated CO2 system as soon as possible to minimize the impact of the possible failure of the CO2 system to decontaminate an ILAW container on the LAW Facility commissioning.	High Pre CD-4
LFH-DS-1-V005	Decontamination system obsolescence and Vendor support.	LFH-DS-1-OFI005: DOE should begin the process to qualify another decontamination robot or other system, to replace the CO2 decontamination robots. In light of the time it has taken to develop the current Motoman® decontamination system, DOE should start the hunt for a replacement system immediately.	Medium Pre CD-4
LFH-DS-1-V006	Daily hoist inspections required by the Vendor with a "SHALL" in the maintenance manual will mean daily personnel entries into a C5 area. Decontamination rooms L-0109C and L0115C overhead container hoist maintenance, operation, and spare parts may be problematic.	LFH-DS-1-OFI006: Apply to the DOE for relief from the ASME Code, OSHA 1910.178, and Vendor Manual requirements in DOE/RL-92-36 Rev 1, Release 73, Hanford Site Hoisting and Rigging Manual Chapters 12 & 13. Tailor the ASME B30 Series Code requirements, OSHA 1920.178, and DOE/RL-92-36 Rev 1, Release 73, Hanford Site Hoisting and Rigging Manual Chapters 12 & 13 requirements in the SRD.	High Pre CD-4
LFH-DS-1-V007	Maintenance on the LFH-HST-00001 monorail hoist will be difficult.	LFH-DS-1-OFI007: Install a second access ladder to the LP0217A platform.	Low Post CD-4
LFH-OR-1-V001	24590-LAW-RPT-PO-05-0001, *LAW Reliability, Availability, and Maintainability Data Development Report*, errors.	LFH-OR-1-OFI001: Revise the RAM data development report and incorporated into the OR model and other documents.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-OR-1-V002	24590-WTP-MDD-PR-01-001, *Operations Research (WITNESS) Model Design Document*, errors and inconsistencies.	LFH-OR-1-OFI002: Compare information in the OR model, mechanical sequence diagrams, and the flowsheet, basis, assumptions, and requirements document and revise the documents as necessary for consistency. Rerun the OR model after all of the process steps and correct MTBF and MTTR data have been updated.	Low Post CD-4
LFH-OR-1-V003	24590-WTP-RPT-PET-07-003, *Waste Treatment Plant Reliability Availability Maintainability (RAM) Basis Report*, error.	LFH-OR-1-OFI003: Revise the RAM basis report to remove LFH-WELD-00001/00002 and verify the weld equipment has been removed from the OR model.	Low Post CD-4
LFH-SWAB-1-V001	24590-LAW-3YD-LFH-00001, *System Description for the LAW Container Finishing Handling System (LFH)*, issues and inconsistencies.	LFH-SWAB-1-OFI001: Revise the document to correct internal inconsistencies.	Low Post CD-4
LFH-SWAB-1-V002	24590-LAW-M0D-LFH-00066, *Mechanical Handling Data Sheet: North Swabbing Power Manipulator*, inconsistencies.	LFH-SWAB-1-OFI002: Revise the documents to correct inconsistencies.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LFH-SWAB-1-V003	24590-CM-POA-HDYR-00002-04-00002, *Bolted Pedestal and Frame Structures Structural Design Analysis and Calcs*, loss of configuration control.	LFH-SWAB-1-OFI003: The calculation needs to be completely reviewed and checked by a registered professional engineer and implement any design changes that result.	Medium Pre CD-4
LFH-SWAB-1-V004	24590-CM-POA-HDYR-00002-10-00001, *Swabbing Factory Acceptance Test Plan*, issue.	LFH-SWAB-1-OFI004: Complete full endurance test during commissioning activities.	Low Post CD-4
LFH-SWAB-1-V005	24590-CM-POA-HDYR-00002-21-00002, *Swabbing Manipulator Thermal Calculation*, cooling air issues.	LFH-SWAB-1-OFI005: Analyze air velocity at surface of the container and redesign cooling system to ensure temperature sensitive proximity sensors and compressed air tubing below critical temperatures.	High Pre CD-4
LFH-SWAB-1-V006	24590-CM-POA-HDYR-00002-14-00005, *Swabbing System Operating Guide for Decontamination and Swabbing Project*, missing instructions	LFH-SWAB-1-OFI006: Create and test swabbing programs for the lower container over packs prior to commissioning activities.	High Pre CD-4
LFH-SIFH-1-V001	Insufficient rotary valve isolation for maintenance.	LFH-SIFH-OFI001: Modify the inert fill hopper design to incorporate a manual slide gate for isolation directly above the rotary airlock valve.	Low Post CD-4
LFH-SIFH-1-V002	Failure to record requirements during factory acceptance testing.	LFH-SIFH-OFI002: This testing requirement should be added to commissioning test documentation.	Low Post CD-4
LFH-SIFH-1-V003	No adequate container temperature design basis.	LFH-SIFH-OFI003: Perform CFD thermal analysis to establish an actual container cooling temperature profile that the finish line equipment can be evaluated for potential impacts (good or bad). Until a believable container temperature design basis is established the finish line systems cannot be evaluated for maximum throughput.	High Pre CD-4
LFH-SIFH-1-V004	Performance requirements not fully met.	LFH-SIFH-OFI004: The design requirement for remote maintenance features cannot be readily corrected, nor should they. The frequency for equipment maintenance should be handled during routine maintenance for all equipment in the same area.	Low Post CD-4
LFH-SIFH-1-V005	Incorrect isolation valve in day tank.	LFH-SIFH-OFI005: The day tank upper butterfly valve should be replaced with a slide gate valve that can operate with a full pipe of dense inert fill material. Full functional testing should be performed during commissioning.	High Pre CD-4
LFH-SSS-1-V001	Inadequate materials of construction.	LFH-SSS-1-OFI001: The coil air supply line should be covered with high temperature sheathing to reduce any high temperature effects.	Low Post CD-4
LFH-SSS-1-V002	Limited glass sample capability.	LFH-SSS-1-OFI002: Redesign the glass shard pickup assembly to meet the glass sample requirement regardless of the glass height in the product container. I believe this is required to meet the contract requirement.	High Pre CD-4
LFH-SSS-1-V003	Insufficient shard pickup design.	LFH-SSS-1-OFI003: Retest the shard pickup assembly using a proto-typical MSM and prove the tool design can be controlled and glass shards can be generated for sample pickup. These tests should be performed on actual solid glass samples not on glass frit to ensure the tool can be used to generate glass shards for pickup.	High Pre CD-4
LFH-SSS-1-V004	The shard table does not prevent material from dropping into the container during MSM operations.	LFH-SSS-1-OFI004: Redesign the shard sampling tray to prevent material from dropping into the product container.	Medium Pre CD-4
LFH-SSS-1-V005	The shard pickup assembly cannot be remotely disassembled for cleaning between samples.	LFH-SSS-1-OFI005: Redesign the shard pickup tip assembly for remote disassembly for cleaning between samples. Demonstrate the remote disassembly capability using a proto-typical MSM.	Low Post CD-4
LFH-TOOL-1-V001	Inadequate design basis documentation.	LFH-TOOL-1-OFI001: Revise design and fabrication documentation to ensure accurate and as-built information.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LFH-TOOL-2-V001	Inconsistent grapple load rating.	LFH-TOOL-2-OFI001: Increase the grapples safe working load design to 25,000 lbs. to handle all container conditions.	Low Post CD-4
LFH-TOOL-2-V002	LAW production container volume, weight, and center of gravity calculation, 24590-LAWM0C-LRH-00004, does not include an over pack condition.	LFH-TOOL-2-OFI002: Revise calculation to include the addition of over packing material to the outside of the container. This will provide a basis for future non-conforming container handling designs.	Low Post CD-4
LFH-TOOL-2-V003	Grapple temperature limitations.	LFH-TOOL-2-OFI003: Add grapple markings to clearly identify temperature limitations the same way safe working loads are identified. Consider adding instrumentation to directly measure the container flange temperature, in the pour cave, prior to using the grapple.	Low Post CD-4
LFH-TOOL-2-V004	Grapple excessive load testing.	LFH-TOOL-2-OFI004: Revise BNI procurement process to ensure vendors test equipment according to contractual documentation and that all requirements are consistent between documents.	Low Post CD-4
LFH-TOOL-2-V005	Design requirement not verified in factory acceptance testing.	LFH-TOOL-2-OFI005: The requirement should be validated during start-up testing to ensure these critical characteristic are met.	Low Post CD-4
LFH-TOOL-2-V006	Requirements for factory acceptance testing not fully being performed.	LFH-TOOL-2-OFI006: All required performance design requirement should be performed as part of an additional FAT or demonstrated through analysis.	Low Post CD-4
RWH System			
Item No.	**Description**	**Opportunities for Improvement**	**Rank**
LRWH-F-06-V-01	Incomplete design of equipment and systems to implement waste handling and storage functions.	LRWH-F-06-OFI-01.1: Define, design, and provide lifting and handling equipment for each identified packaging. LRWH-F-06-OFI-01.2: Define waste export paths from each point of generation, define export location with consideration of interfacing systems or competing uses, and define and permit waste storage suitable for radioactive and chemical hazards with consideration of waste flow patterns and waste transport schedule. LRWH-F-06-OFI-01.3: Define, design, and provide waste size reduction equipment and facilities for caustic scrubber bed and mist eliminator as required to package in designated packaging. LRWH-F-06-OFI-01.4: Define radioactive and chemical hazard expected for the various waste streams and define and provide shielding, protective packaging, as required. LRWH-F-06-OFI-01.5: Obtain the WIR determination and evaluate ability to decontaminate to WIR requirements using dry wipe decon methods; define, design, and provide additional aggressive decontamination equipment and facilities as required.	High Pre CD-4
LRWH-F-07-V-01	The RWH process crane does not have an indexing system that defines its safe operating envelope(s).	LRWH-F-07-OFI-01.1: Utilize laser positioning and develop indexing or auto-indexing features for the RWH process crane. LRWH-F-07-OFI-01.2: Program engineering controls into the crane to avoid travel over the offgas piping.	Medium Pre CD-4
LRWH-M-02-V-01	Sufficient priority, resources and funding have not been allocated to LRWH maintenance work planning to ensure successful plant commissioning, startup and operations.	LRWH-M-02-OFI-01: Detail, model and evaluate all critical LRWH System activities and spaces. Factor the results of these evaluations back into the plant and system designs.	Medium Pre CD-4
LRWH-M-02-V-03	WTP is not following the DOE Hoisting and Rigging program, and no WTP specific hoisting and rigging program and/or critical lift program for the LRWH System have been defined nor is currently under development. It is unclear how a WTP LAW hoisting and rigging program or critical lift program will adequately protect critical at-risk Safety equipment.	LRWH-M-02-OFI-03: Restrictive crane envelopes, and more extensive physical and procedural barriers, should be added to protect critical Safety systems. The specific hoisting and rigging program and/or critical lift program for the LRWH must comply with the DOE Hoisting and Rigging Manual.	Medium Pre CD-4
LRWH-F-13-V-1	Transitioning an agitator or pump from a vertical position to a horizontal position is not identified in the current design or operation.	LRWH-F-13-OFI-1: Develop a methodology to export a spent agitator or pump which may require transitioning the spent equipment between a vertical and horizontal position.	Low Post CD-4
LRWH-F-13-V-1	A method to transport an agitator or pump from a) the process cell charge floor hatch area to the L-0207 floor hatch; and b) from El. 3 laydown area to the truck dock has not been identified.	LRWH-F-13-OFI-2: Develop a methodology to transport a spent agitator or pump.	Low Post CD-4
LRWH-O-03-V-01	Equipment and attachment points are not determined for recovery of the Process Area Bridge Crane to its maintenance position.	LRWH-O-03-OFI-1: Perform preliminary planning on how the crane would be recovered and what equipment is needed.	Low Post CD-4
LRWH-F-13-V-2	Replacement of 14 components (agitators and pumps) from tanks within the process cell may be completed within the 6 month schedule to replace a melter. However, each replacement activity will compete for a finite man-hour resource.	LRWH-F-13-OFI-3: Perform a man-power loaded melter outage including RP technicians, operators, and maintenance staff and include a simultaneous outage for replacement of 14 agitators and pumps and determine if throughput is reduced without modification such as staff augmentation.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LRWH-F-06-V-02	HEPA filters may develop too high a radioactive loading before pressure differential monitoring indicates a heavy particulate loading.	LRWH-F-06-OFI-02: Identify available ports on the HEPA filter assemblies and specify a method to monitor radioactive loading buildup during normal inspections (i.e. rounds).	Medium Pre CD-4
LAW-S-09-V-01	Experience performing startup and commissioning the LAW System RWH Process Area Bridge Crane for turnover to construction indicates that not performing these activities as soon as possible will delay all startup and commissioning activities as problems are uncovered late in the schedule when the project will be on the critical path for startup and commissioning.	LAW-S-09-OFI-01: Follow a "bottom up" startup and commissioning strategy to reduce upsets on the critical path during plant startup and commissioning; • Isolate an area from construction activities containing installed components, • Bring in plant services or equivalent temporary services, □ Startup / commission all components in the isolated area, • As the area can be extended, startup and commission interacting components and assemblies, • When a Facility System is entirely in an isolated area, begin startup and commissioning activities.	High Pre CD-4
LRWH-M-02-V-02	Funding & resources have not been allocated to address: • Equipment no longer under warranty. • Equipment preservation and degradation	LRWH-M-02-OFI-02: Develop long term funding and plans that address expired warranties, replacement and/or refurbishment of equipment.	Medium Pre CD-4
LRWH-M-02-V-04	Key LAW documents contradict each other regarding LRWH System scope.	LRWH-M-02-OFI-04: The specific activities included in the scope of the LRWH System and equipment, and all interactions with associated systems should be clarified and documented consistently in WTP documentation.	Medium Pre CD-4
LRWH-S-04-V-01	Many methods of secondary waste disposition and transfer paths within the facility remain undefined.	LRWH-S-04-OFI-01: Model all waste disposition streams and determine whether necessary equipment and transfer paths within the facility are adequate. Incorporate results into appropriate system descriptions.	Medium Pre CD-4
		LCP and LFP Systems	

Item No.	Description	Opportunities for Improvement	Rank
LCP/LFP-01	Potential for GFR component omission to cause premature melter failure.	1.1 Conduct impact assessment that defines the time period associated with omitting each glass forming component that could result in a premature melter failure 1.2 Define receipt of MFPV sample analysis results as hold point for initiating the next (or a fixed number of batches) glass former addition to mitigate potential for multiple mis-batch additions in a row based on the omission time periods that could result in premature melter failure 1.3 Use control system to identify gross changes in batch to batch glass former component additions as method of warning that a potential input error has occurred (i.e. use control system to flag large variances in expected inputs such as glass former weights)	Medium Pre CD-4
LCP/LFP-02	Capability to monitor feed slurry rheology during extended storage in MFPV/MFV is not defined/demonstrated.	2.1 Include agitator power trending and/or periodic (or perhaps continuous) pumping of tank contents through MFPV/MFV recirculation lines as part of monitoring scheme when melters placed in idle mode. An ASD is considered to be the best method for agitator control and trending parameters/performance. 2.2 Periodic sampling during long outages to test for rheology changes.	Low Post CD-4
LCP/LFP-03	Design basis temperature of 150°F for CRV, MFPV and MFV vessels may not be adequately conservative under off-normal conditions (extended idle periods).	3.1 Re-evaluate design basis temperature limits for vessels to increase operating margin and operational flexibility. Vessels appears adequately robust to support increasing the design basis temperature to 200°F. 3.2 Establish operational procedures and protocols to deal with prolonged periods of agitation operation in both CRV and LFP tanks (i.e. add water, temporary termination of agitation, etc). 3.3 Re-analyze LCP/LFP tank equilibrium temperature for the possibility of extended periods for melter idling. Calculate the tank equilibrium temperature using agitator heat input, latent heat of evaporation inside the tank, plant service air flow rate and vessel vent flow rates. 3.4 Evaluate the impact that the boric acid exothermic reaction has on the operation of the MFPV tank temperature. 3.5 Consider feeding glass formers into the MFPV tank over a longer period of time (5-7 hours) to prevent tank temperature approaching or exceeding the tank design temperature limit.	Medium Pre CD-4
LCP/LFP-04	Unknown ability of the LAW LFP Feed Prep and Feed Vessels to structurally support the external cooling panel sections.	4.1 Confirm unverified assumptions in analysis. 4.2 Update analysis and verify adequacy of vessel design.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LCP/LFP-05	The 40 year design life of the LFP Vessels is in question due to the lack of credible data to accurately predict the erosion wear for SA-240, 316L material.	5.1 Conduct additional CFD analysis with appurtenances modeled per vessel configuration to identify potential areas of accelerated erosion. 5.2 Based on the CFD analysis, consider remote vessel wall thickness monitoring (e.g. ultrasonic thickness transducers) permanently mounted to lower head and shell. 5.3 Conduct additional prototypic testing with relevant simulant to confirm relationship of agitator speed to fluid velocity at vessel head/walls. 5.4 Perform post-commissioning vessel inspections to determine evidence of premature erosion. 5.5 If still warranted from above, consider thermal spray hard coating of vessels and internals. - If thermal spray is considered, then also consider increasing the vessel design temperature to eliminate the need for the add-on cooling panels.	Medium Pre CD-4
LCP/LFP-06	The operating envelope has not been defined to ensure the requirement for mixing homogeneity can be met during normal plant operations.	6.1 Define operating envelope and how much deviation can be allowed. 6.2 Consider alternative level detection such as using existing dip tubes (add transmitter to long leg of specific gravity dip tubes). 6.3 Consider adjustable speed drive (ASD) on agitators to allow flexibility to achieve required mixing performance.	Medium Pre CD-4
LCP/LFP-07	Fixed speed agitators may not provide adequate flexibility to address variations in process conditions or recover after prolonged down time.	7.1 Consider adding ASD to agitators.	Medium Pre CD-4
LCP/LFP-08	Cooling jackets for MFPV and MFV tanks do not include pressure relief.	8.1 Evaluate the need for pressure relief for the MFPV and MFV cooling jackets. 8.2 Add pressure relief on the demineralized water system downstream of the PCV-2101 to control pressure for SBS as well a LFP cooling jackets.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LCP/LFP-09	Lack of comprehensive engineering strategy for removal of hard to remove solids or significant accumulations of solids in piping and vessels.	9.1 Develop comprehensive strategy for removal of blockages from piping and high shear solids from vessels. 9.2 Define features necessary for pipe and vessel flush equipment to implement solids removal strategy. 9.3 Design, test and demonstrate ability to deploy flush equipment. 9.4 Evaluate the need for additional spool pieces/cleanout ports to support pipe flushes. 9.5 Evaluate alternative flush chemicals. 9.6 Evaluate need for other slurry handling systems based on lessons learned from other facilities. 9.7 Consider tank farm lessons learned on removal of high shear solids.	Low Post CD-4
LCP/LFP-10	The LCP/LFP bulge drain systems do not appear to have adequate drain capacity when spray rings are turned on.	10.1 Consider additional controls for the flush water flow to the bulge spray rings such as: a. Install level monitoring in the bulge and change manual valve to a control valve which could be shut off automatically whenever the level in the bulge gets too high. b. Install smaller capacity spray nozzles. c. Install local liquid level gauge for operator to monitor liquid level. d. Install orifice to reduce flow and pressure to spray nozzles. e. Automate water spray system to limit time of flush and/or sequence flushes for short flushes followed by time drainage periods in a series of 2-3 cycles.	Low Post CD-4
LCP/LFP-11	Ability to automate using existing design features appears underutilized.	11.1 Consider fully automating transfer and flush sequences. 11.2 Consider adding equipment performance trending/monitoring parameters for display to operators. 11.3 Consider adding ASDs for agitator operation. 11.4 Incorporate remote monitoring/power option for auto-lubrication system	Low Post CD-4
LCP/LFP-12	A comprehensive equipment condition monitoring strategy/system is not evident so that process cell entries can be avoided.	12.1 Develop a formal comprehensive strategy for equipment performance monitoring. Review current design against the strategy and implement design changes as necessary.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LCP/LFP-13	Undemonstrated ability to install/replace pumps/agitators and other internal components that require alignment with the vessel base (such as bubbler tubes and thermowells).	13.1 Confirm the ability to change a pump/agitator under various vessel operating conditions during commissioning or as a mock-up 13.2 Consider the viability of incorporating additional alignment aids such as inverted cone to the base of the flange with the stabilizer guide.	Low Post CD-4
LCP/LFP-14	Current approach to ADS pump monitoring/trending may not be adequately indicative of performance.	14.1 Consider using a two or more point comparison of ADS pump air-line pressure as a better indicator of overall performance and as an operator aid e.g. the apex of the pump discharge pressure.	Medium Pre CD-4
LCP/LFP-15	Basis/definition of acceptable gear oil leakage rates and process impacts is not evident.	15.1 Perform calculations to quantify acceptable limits for leak rates and/or amounts each vessel can tolerate. 15.2 Finalize design features for checking and replacing gearbox oil utilizing existing riser piping at the 28" level.	Low Post CD-4
LCP/LFP-16	Adequate mock-up/testing facilities are not available/planned to support high risk contact maintenance activities (such as pump/agitator replacement) and testing/run-in of mechanical equipment	16.1 Conduct a formal and systematic analysis of maintenance infrastructure needs. 16.2 Identify and prepare an existing facility for use as a WTP mock-up/testing facility (e.g. 2101M, MASF at FFTF, etc.) or; 16.3 Design and build (e.g. pre-fab building) a testing/mockup facility at WTP. 16.4 Consider working with the tank farm contractor to establish a shared/consolidated mock-up facility.	Low Post CD-4
		LEH System	
LEH-IC-1-V001	Requirement Documents Conflict.	LEH-IC-1-OFI001: Correct the Export Handling Crane LEH-CRN-00003 software documentation for consistency and to agree with the calibration of the Laser Positioner ZT-0147. Verify that the programming matches the updated documentation. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming.	Medium Pre CD-4
LEH-IC-1-V002	Interlock Incorrectly Defined.	LEH-IC-1-OFI002: Correct the Export Handling Crane LEH-CRN-00003 documentation so the interlock shows the correct state. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank
LEH-IC-1-V003	Missing Interlocks.	LEH-IC-1-OFI003: Add interlocks to the design to; □ allow only one LFH hatch to be open at a time, □ prohibit the opening of a roll-up door when a hatch is open and, □ prohibit the opening of a hatch when a door is open. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming with special attention to interlocks that interface between LFH and LEH systems.	Medium Pre CD-4
LEH-CRN-1-V001	Jib Crane Data Sheets and Specification Inconsistencies.	LEH-CRN-1-OFI001: Revise all issued documents to reflect the de-rated capacity of the maintenance jib cranes (LEH-CRN00005/00006).	Medium Pre CD-4
LEH-CRN-1-V002	Structural Analysis of Export Bay Inconsistencies.	LEH-CRN-1-OFI002: Provide a full extent of conditions analysis on embeds that support loads on vertical walls of the LAW Export Bay to ensure the embed design meets equipment loads. (This may already be covered under PIER 13-0515, but this PIER was not provided by BNI during the review.)	Medium Pre CD-4
LEH-CRN-1-V003	Maintenance Jib Crane De-rating and Analysis of Embeds Inconsistencies.	LEH-CRN-1-OFI003: Provide a full extent of conditions analysis on embeds that support loads on vertical walls of the LAW Export Bay to ensure the embed design meets equipment loads (This may already be covered under PIER 13-0515, but this PIER was not provided by BNI during the review). Revise the embed anchorage calculation to provide the limit of the embed design. The results should show the actual load the embeds can support, including resulting crane capacity that produces that load.	Medium Pre CD-4
LEH-CRN-1-V004	Maintainability of LAW Export Bay Crane and Jib Crane Capacity.	LEH-CRN-1-OFI004: Investigate the feasibility of a different lifting system (i.e., single underhung or under-running type) to support the maintenance of the LAW Export Bay Crane designed to work within the limits of the facility and lifting capacity requirements. This might require additional structural support or utilizing other structural steel already in place. The new lifting system should have the ability to move over the entire range of the intended work zone.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LEH-CRN-1-V005	Maintainability of LAW Export Bay Crane and Jib Crane Reach.	LEH-CRN-1-OFI005: Investigate the feasibility of a different lifting system (i.e., single underhung or under-running type)) to support the maintenance of the LAW Export Bay Crane designed to work within the limits of the facility and lifting capacity requirements. This might require additional structural support or utilizing other structural steel already in place. The new lifting system should have the ability to move over the entire range of the intended work zone.	Medium Pre CD-4
LEH-CNTR-1-V001	Filled ILAW Container export temperature may affect Tank Farm Contractor (TOC) / Integrated Disposal Facility (IDF) operations.	LEH-CNTR-1-OFI001: Either increase the ILAW container cooling capabilities of WTP LAW facility, or construct ILAW container cooling facilities at either the TOC or IDF facilities.	High Pre CD-4
LEH-RCSH-1-V001	Contamination migration when transferring ILAW product container.	LEH-RCSH-1-OFI001: Evaluate the currently defined work processes and ensure an engineered or administratively-defined process is adequate for controlling contamination migration when transferring the ILAW Product Container from System LFH to the Transport Trailer and that confirmation is available, such as continuous air monitor, to ensure personnel are not inadvertently exposed to an airborne radioactivity area.	Medium Pre CD-4
LEH-RCSH-1-V002	LEH system compliance to design and operational safety and health requirements.	LEH-RCSH-1-OFI002: Verify and validate that all required codes and standards have been incorporated into the design of the LEH system and, if not within the design, the requirements and standards are within appropriate procedures for both operations and maintenance work evolutions.	Medium Pre CD-4
LEH-RCSH-1-V003	Thermal Temperatures on ILAW Transport Container Package.	LEH-RCSH-1-OFI003: Define/determine an external temperature (max operational parameter) of the transport container package that is expected to be encountered by personnel and then to verify that appropriate mitigation of the hazard has been defined. In addition, per the system description the transport vehicle will contain additional containers; therefore, a cumulative effect of the heat being generated from all shipment containers should be analyzed and determined as to what mitigating factors will be needed to ensure protection of personnel from a heat/thermal hazard.	Medium Pre CD-4
LEH-ICD-1-V001	Shielding of the ILAW product container transporter is not defined.	LEH-ICD-1-OFI001: Provide adequate details in ICD 15 for the requirements of the LEH system in regard to source term and shielding. The details should provide enough information for WTP to complete LEH design activities.	Medium Pre CD-4
LEH-ICD-1-V002	Essential elements of the authorization process for exporting ILAW containers from the LAW facility and review/approval of the shipping Manifest have not been defined.	LEH-ICD-1-OFI002: Provide adequate procedures for LEH export activities including ILAW Container shipping inspection and authorization requirements.	Medium Pre CD-4
LEH-ICD-1-V003	Potential conflict between Contamination limitations in Export High Bay and surface contamination of ILAW product containers.	LEH-ICD-1-OFI003: Align the design basis of the facility to the design implemented in regard to Contamination limitations in Export High Bay and surface contamination of ILAW product containers.	Medium Pre CD-4
LEH-ICD-1-V004	Duration of ILAW product container approval process prior to shipment not defined.	LEH-ICD-1-OFI004: Provide adequate procedures for LEH export activities including shipping inspection and authorization requirements.	Low Post CD-4
LEH-ICD-1-V005	Uncertainties in schedule for initial ILAW container production and transport.	LEH-ICD-1-OFI005: Provide adequate details in ICD 15 for the requirements of the LEH system in regard to the schedule for initial ILAW container production and transport. The details should provide enough information for WTP to complete LEH design activities.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LEH-ICD-1-V006	Open ICD 15 issues and actions may affect the operations in the LEH System.	LEH-ICD-1-OFI006: Provide adequate details in ICD 15 for the requirements of the LEH system and close open issues that may cause significant impact to the project. The details should provide enough information for WTP to complete LEH design activities.	Medium Pre CD-4
LEH-OR-1-V001	24590-LAW-RPT-PO-05-0001, Rev 0, *LAW Reliability, Availability, and Maintainability Data Development Report*, inconsistencies and RAM data issues.	LEH-OR-1-OFI001: Correct inconsistencies in *LAW Reliability, Availability, and Maintainability Data Development Report*, reevaluate sequence of operations when crane camera fails and either allow suspended loads to be landed or increase MTTR for camera replacement, and correct MTBF for LEH-CRN-00003.	Medium Pre CD-4
LEH-OR-1-V002	24590-WTP-MCR-PET-11-0058, Rev 0, *LAW Mechanical Handling System RAM Update*, inconsistencies.	LEH-OR-1-OFI002: Correct the *LAW Mechanical Handling System RAM Update*, so the data is consistent.	Low Post CD-4
LEH-OR-1-V003	CCN 068365, *LAW LEH System – RAMI – OR*, lacks bases for MTTR data.	LEH-OR-1-OFI003: Re-evaluate sequence of operations when a Load-out Bay Crane camera fails and either allow suspended loads to be landed or increase MTTR for camera replacement.	Low Post CD-4
LEH-OR-1-V004	24590-WTP-RPT-PT-02-005, Rev 7, *Flowsheet Bases, Assumptions, and Requirements*, is inconsistent on the number of ILAW containers to put on the transportation trailer.	LEH-OR-1-OFI004: Correct the *Flowsheet Bases, Assumptions, and Requirements*, so the data is consistent.	Low Post CD-4
LEH-OR-1-V005	24590-WTP-RPT-PET-07-003, Rev 1, *Waste Treatment Reliability Availability Maintainability (RAM) Basis Report*, redundant information.	LEH-OR-1-OFI005: Correct the *Waste Treatment Reliability Availability Maintainability (RAM) Basis Report*, so the data is consistent.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LEH-OR-1-V006	24590-WTP-MDD-PR-01-001, Rev 12, *Operations Research (WITNESS) Model Design Document*, inconsistency and missing information.	LEH-OR-1-OFI006: Correct inconsistencies in the *Operations Research (WITNESS) Model Design Document*, and re-evaluate sequence of operations when a Load-out Bay Crane camera fails and either allow suspended loads to be landed or increase MTTR for camera replacement.	Medium Pre CD-4
LEH-CRN-2-V001	LEH-CRN-00003 crane capacity may not be sufficient.	LEH-CRN-2-OFI001: Establish method for exporting non-compliant containers and validate LEH-CRN-00003 crane capacity is not exceeded.	Medium Pre CD-4
LEH-CRN-2-V002	LEH-CRN-00003 crane maintenance/inspection platform not easily accessible.	LEH-CRN-2-OFI002: Establish maintenance/inspection access requirements and make design modifications to ensure safe LEHCRN-00003 crane access.	Low Post CD-4
LEH-CRN-2-V003	Heavy maintenance strategy not defined for LEH-CRN-00003.	LEH-CRN-2-OFI003: Establish heavy maintenance activities and detail step-by-step sequences to establish design requirements for crane LEH-CRN-00003. Make design modifications to perform sequences such as doors or hatches in the maintenance platform.	Low Post CD-4
LEH-TOOL-1-V001	Inadequate design basis documentation for container grapple stands.	LEH-TOOL-1-OFI001: Revise design and fabrication documentation for container grapple stands to ensure accurate and as-built information.	Low Post CD-4
LEH-TOOL-2-V001	Inconsistent grapple load rating.	LEH-TOOL-2-OFI001: Increase the grapples safe working load to 25,000 lbs to handle all container conditions.	Low Post CD-4
LEH-TOOL-2-V002	LAW production container volume, weight, and center of gravity calculation, 24590-LAWM0C-LRH-00004, does not include overpack condition.	LEH-TOOL-2-OFI002: Revise calculation to include the addition of overpacking material to the outside of the container.	Low Post CD-4
LEH-TOOL-2-V003	Grapple temperature limitations.	LEH-TOOL-2-OFI003: Add grapple markings to clearly identify temperature limitations the same way safe working loads are identified.	Low Post CD-4
LEH-TOOL-2-V004	Grapple excessive load testing.	LEH-TOOL-2-OFI004: Revise BNI procurement process to ensure vendors test equipment according to contractual documentation and that all requirements are consistent between documents.	Low Post CD-4
LEH-TOOL-2-V005	Design requirement not verified in factory acceptance testing.	LEH-TOOL-2-OFI005: This requirement should be validated during start-up testing to ensure this critical characteristic is met.	Low Post CD-4
LEH-TOOL-2-V006	Requirements for factory acceptance testing not fully being performed.	LEH-TOOL-2-OFI006: This critical design requirement should be performed as part of an additional FAT or demonstrated through analysis.	Low Post CD-4
LEH-TOOL-2-V007	Inconsistent design requirements.	LEH-TOOL-2-OFI007: Revise data sheets, specification, and calculation to indicate a consistent and accurate grapple operating environment.	Low Post CD-4
LEH-TOOL-2-V008	Inaccurate model data for LRH process steps.	LEH-TOOL-2-OFI008: Engineering should perform a complete OR model input verification prior to model output is considered valid.	Low Post CD-4
		LRH System	
LRH-IC-1-V001	Inadequate Interlocks at LRH Roll Up Doors.	LRH-IC-1-OFI001: The addition of a photo-electric sensor with interlock would allow the detection of an obstruction before a collision has occurred and could interlock the roll-up door associated with a LRH conveyor to keep it from closing. The rolling doors should be interlocked with the associated conveyors to keep the door from closing while the rollers are operating.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LRH-IC-1-V002	Requirement documents are incomplete.	LRH-IC-1-OFI002: All interlock sensors/devices should be shown on a Mechanical Handling Diagram (MHD). All interlocks should be identified on the Mechanical Sequence Diagrams (MSD). All interlocks should be described in a text-based document with enough information to allow operations or maintenance to determine when or whether the interlock could be over-ridden or modified. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming.	Low Post CD-4
LRH-IC-1-V003	No Personal Safety Interlock on the Container Receipt Station.	LRH-IC-1-OFI003: Add an ICN monitored, hard-wired, lock-out buttons to each of the two Clean Container Receipt Station conveyor lines that will be activated prior to manned operations at that station, and will be deactivated by the receipt inspector before the Container Receipt Conveyor can be operated.	Medium Pre CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LRH-IC-1-V004	Conveyor Alarm Horns do not sound During Local Operation.	LRH-IC-1-OFI004: Wire the incoming container handling conveyors alarm horn to sound as described in the Software Requirements and Control Logic document in both Local and Remote modes to ensure that everyone in the area knows the conveyors are about to operate.	Medium Pre CD-4
LRH-IC-1-V005	Retractable Stop is not Required to be Extended to Open the Import Hatch.	LRH-IC-1-OFI005: Add the interlock requirements to the drawings and program the interlock that allows the Retractable Stop to be retracted when the Clean Container Import Hatch (LRH-HTCH-00001/0002) starts opening but requires it to be extended once the Closed switch indicates the hatch is not closed. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming.	Medium Pre CD-4
LRH-IC-1-V006	The Maintenance Control Panels are not described in the System Description.	LRH-IC-1-OFI006: The Control Logic document (24590-CM-POA-M000-00001-01-00001) should be amended to clarify the difference between the LRH conveyors Main Control Panel (MCP) door controls, and the Local Operator Interface (LOI). The MCP should be added to Section 6 of the System Description to describe the equipment and in Section 7 to discuss when and how these controls will be or not be used.	Low Post CD-4
LRH-IC-1-V007	The Configuration Tool Box items for the LRH Hoists and Receipt Conveyors depend on obsolete hardware and software.	LRH-IC-1-OFI007: Configuration toolkits for the LRH hoists and conveyors should be reviewed and updated or instruments replace, if necessary, prior to the beginning of commissioning.	Low Post CD-4
LRH-IC-1-V008	No Link between Interlocks and Requirements.	LRH-IC-1-OFI008: A requirements matrix would identify the source of the interlock requirements. A description of the interlocks in a higher –level document such as the System Design Document would allow the interlock function and purpose to be clearly understood by Operations, Maintenance and Engineering. Review requirements documents to verify that requirements have been correctly addressed and implemented in the logic diagrams and programming.	Low Post CD-4
LRH-IC-1-V009	Start-Stop control station in the LRH Clean Canister Receipt Area is not labeled.	LRH-IC-1-OFI009: Label all control stations in the LRH Clean Canister Receipt Area. Review equipment with stand-alone controls to verify that the controls are easily associated with the proper equipment and that the controls are properly labeled.	Low Post CD-4
LRH-IC-1-V010	The Software Acceptance Procedures do not identify test actions nor provide criteria for acceptance.	LRH-IC-1-OFI010: Evaluate procedures for preparing Software Acceptance Testing (SAT), evaluate the SAT tests that have been performed and either correct the test procedures and re-perform the SAT tests or, better, perform full field-testing.	Medium Pre CD-4
LRH-OR-1-V001	24590-LAW-RPT-PO-05-0001, Rev. 0, *LAW Reliability, Availability, and Maintainability Data Development Report*, inconsistencies and missing information.	LRH-OR-1-OFI001: Correct the inconsistencies in the *LAW Reliability, Availability, and Maintainability Data Development Report*, and work with TOC to develop new MTTR data based on historical availability of spare parts and personnel. Develop detailed list of spare parts to be maintained on site, and parts that are readily available from local vendors.	Medium Pre CD-4
LRH-OR-1-V002	24590-WTP-RPT-PT-02-005, Rev. 7, *Flowsheet Bases, Assumptions, and Requirements*, inconsistent data.	LRH-OR-1-OFI002: Correct the MTBF and MTTR data in the Flowsheet Bases, Assumptions, and Requirements documents so the data is consistent with data provided in the *LAW RAM Data Development Report* for the LRH conveyors.	Medium Pre CD-4
LRH-OR-1-V003	24590-WTP-MDD-PR-01-001, Rev 12, *Operations Research (WITNESS) Model Design Document*, inconsistencies and missing data.	LRH-OR-1-OFI003: orrect Operations Research (WITNESS) Model Design Document so the data is consistent with data provided in the *LAW RAM Data Development Report* and *Waste Treatment RAM Basis Report*, and update OR model to include conveyors that are not included in the current model. Verify redundant systems are truly redundant based on sequence of operations and sequence of maintenance.	Medium Pre CD-4
LRH-OR-1-V004	24590-WTP-RPT-PE-12-002, Rev 0, *2012 WTP Operations Research Assessment*, data omission.	LRH-OR-1-OFI004: Update OR model to include container grapple that is used in the Import High Bay area.	Low Post CD-4
LRH-CRN-1-V001	Empty LAW container deliveries will affect LSH and RWH operations.	LRH-CRN-1-OFI001: Perform a detailed task analysis of all the over-the-road shipping operations performed in the L-0118 truck bay to support LAW facility operations. Use the task analysis to develop integrated operating procedures across the LRH, LSH, and RWH systems. The integrated procedures should schedule truck bay operations at the facility level. Provide operator training to quickly improve their proficiency in handling empty LAW containers, removing container shipping hold-down gear, and the removal of container dunnage.	Medium Pre CD-4
LRH-CRN-1-V002	Empty LAW container handling by the LSH-CRN-00001 crane will have to be done by either moving the containers around each other or by moving the containers in controlled, sequential order.	LRH-CRN-1-OFI002: Develop operating procedures and operator aides to facilitate unloading containers from the over-the-road trucks. Provide operator training to quickly improve their proficiency in handling empty LAW containers with the LSH-CRN-00001 crane.	Medium Pre CD-4

Item No.	Description	Opportunities for Improvement	Rank

Table B-1. Summary Vulnerability Listing. (41 pages)

LRH-CRN-1-V003	LSH-CRN-00001 Crane usage for the LRH system.	LRH-CRN-1-OFI003: Provide operator training to quickly improve their proficiency in handling empty LAW containers with the LSH-CRN-00001 crane to minimize crane bumps/creeps. Procure, or lease, a scissor lift and have it staged on the WTP site for rapid response to an LSH-CRN-00001 crane maintenance need. (Note: this scissor lift may be used to service other overhead cranes such as the HRH crane in the HLW facility. There are several cranes on the WTP project where crane maintenance platforms were not installed since the overhead crane maintenance could be done from a scissor lift).	Low Post CD-4
LRH-CIS-1-V001	Inspection of incoming empty containers required by WTP Contract and ILAW PCP is problematic.	LRH-CIS-1-OFI001: A valid inspection procedure and design for removal of foreign material from the incoming container will need to be provided.	Medium Pre CD-4
LRH-CIS-1-V002	No safe access by personnel to delivery truck trailer.	LRH-CIS-1-OFI002: A design will need to be provided to give access to transporter trailer from the loading dock. This may require a ramp or platform or redesign of the import bay (increase the size to allow for proper access around the transporter and proper platforming).	Medium Pre CD-4
LRH-CIS-1-V003	No procedure available for removing container wrapping material and shipping cover.	LRH-CIS-1-OFI003: A valid inspection procedure and design for removal of wrapping material and shipping cover from the incoming container will need to be provided.	Medium Pre CD-4
LRH-CIS-1-V004	The angle of view doesn't allow the inspector to see inside the incoming 7.5' tall container.	LRH-CIS-1-OFI004: Provide an inspection station that can meet the inspection requirements while the containers are located on the receipt conveyors. This may require a permanent platform over the 3 conveyors and is accessed via ladders.	Medium Pre CD-4
LRH-CIS-1-V005	The inspection platforms cannot be located the closest possible to the empty container being inspected.	LRH-CIS-1-OFI005: Provide an inspection station that can meet the inspection requirements while the containers are located on the receipt conveyors. This may require a permanent platform over the 3 conveyors and is accessed via ladders.	Medium Pre CD-4
LRH-CIS-1-V006	Time required to unload the container delivery trailer may negatively impact the throughput of the LSH System.	LRH-CIS-1-OFI006: A study of the functional requirements of LRH and LSH processes as they relate to the import bay should be developed. Competing LSH activities may determine that the throughput is affected by the single crane and ineffective layout of the import bay, which may result in a redesign of the area.	Low Post CD-4
LRH-CIS-1-V007	Limited staging area for non-acceptable containers.	LRH-CIS-1-OFI007: A study of the functional requirements of LRH and LSH processes as they relate to the import bay should be developed. Competing LSH activities may determine that the throughput is affected by the single crane and ineffective layout of the import bay, which may result in a redesign of the area.	Low Post CD-4
LRH-CIS-1-V008	Problematic communication between Inspector in L-0118 and Operators at LOI in Room L0117 or in Control Room.	LRH-CIS-1-OFI008: It may be necessary to provide a local operator interface (for the receipt conveyors only) at the clean container receipt station, instead of the staging area.	Medium Pre CD-4
LRH-CIS-1-V009	Risk exists that proscribed material enters an inspected container in the Staging Area (Room L-0117).	LRH-CIS-1-OFI009: It may be necessary to provide a cover/shield over the staging conveyor area to eliminate the chances of material falling into containers that have already been inspected.	Low Post CD-4
LRH-CIS-1-V010	Proper angular orientation of the incoming container on the Receipt Conveyors is required but not defined.	LRH-CIS-1-OFI010: A simple solution would be a procedure that requires the container to be in a specific orientation/rotation at the receipt station. Another option would be to provide a new design for container marking/tracking that eliminates the need to provide the proper rotation. This may be as simple as marking the container in each quadrant so it can be viewed at any rotation.	Medium Pre CD-4
LRH-CNVR-1-V001	Container Weight Inconsistencies.	LRH-CNVR-1-OFI001: Provide a bounding weight for equipment design. This may be as simple as revising the LAW container weight calculation (24590-LAW-M0C-LRH-00004, Rev. 0) by adding a margin to the 1,321 lbs estimated weight. Use the results of the revised calculation as the input for all other equipment (where the container weight is the bounding input source). This includes the container DPD.	Low Post CD-4
LRH-CNVR-1-V002	Receipt Conveyor Design Inconsistencies.	LRH-CNVR-1-OFI002: A set of bounding inputs for design and procurement should be established and used for consistency. The South and North clean container receipt conveyor design and procurement documents should be revised to include all scenarios of conveyor loading; including the weight of the grapple. Vendor submittals will need to be assessed for impacts to current design limits.	Low Post CD-4
LRH-CNVR-1-V003	Staging Conveyor Design Inconsistencies.	LRH-CNVR-1-OFI003: A set of bounding inputs for design and procurement should be established and used for consistency. Vendor submittals will need to be assessed for impacts to current design limits for the South and North clean container staging conveyors.	Low Post CD-4
LRH-CNVR-1-V004	Airlock Conveyor Design Inconsistencies.	LRH-CNVR-1-OFI004: A set of bounding inputs for design and procurement should be established and used for consistency. Vendor submittals will need to be assessed for impacts to current design limits for the South and North clean container airlock conveyors.	Low Post CD-4
LRH-CNVR-1-V005	Transfer Conveyor Design Inconsistencies.	LRH-CNVR-1-OFI005: A set of bounding inputs for design and procurement should be established and used for consistency. Vendor submittals will need to be assessed for impacts to current design limits for the South and North clean container transfer conveyors.	Low Post CD-4
LRH-CNVR-1-V006	Import/Hatch Conveyor Design Inconsistencies.	LRH-CNVR-1-OFI006: A set of bounding inputs for design and procurement should be established and used for consistency. The South and North import/hatch conveyor design and procurement documents should be revised to include all scenarios of conveyor loading; including the weight of the grapple. Vendor submittals will need to be assessed for impacts to current design limits.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

Item No.	Description	Opportunities for Improvement	Rank
LRH-CNVR-1-V007	Conveyor Specification Inconsistencies.	LRH-CNVR-1-OFI007: A set of bounding inputs for design and procurement should be established and used for consistency. The South and North clean container handling conveyor specification should be revised to include accurate requirements, notably the information contained in Sections 1 (Scope), 2 (Applicable Documents) and 3 (Design requirements). Vendor submittals and documents will need to be assessed for impacts to current design limits.	Low Post CD-4
LRH-CNVR-1-V008	Conveyor Impact Loading Calculation Inconsistencies.	LRH-CNVR-1-OFI008: Update the vendor calculation to include the weight of the grapple with the correct weight of the container as the bounding scenario for the clean container handling conveyor roller impact loading calculation. Assess the bounding scenario against the current design to understand the adequacy of the installed equipment. The calculation assumption(s) should be validated against actual loading scenarios (spreading load across several rollers vs. one) to see if it is possible to exceed the stress limits.	Medium Pre CD-4
LRH-CNVR-1-V009	Conveyor Drive Motor Sizing Inconsistencies.	LRH-CNVR-1-OFI009: Update the vendor clean container handling conveyor drive motor sizing calculation to include the bounding weight scenario. Assess the bounding scenario against the current design to understand the adequacy of the installed equipment. Provide a project approved factor of safety for design of equipment.	Low Post CD-4
LRH-CNVR-1-V010	Conveyor Stress Analysis Inconsistencies.	LRH-CNVR-1-OFI010: Update the vendor clean container conveyor frame stress analysis calculation to include the bounding weight scenario. Assess the bounding scenario against the current design to understand the adequacy of the installed equipment.	Low Post CD-4
LRH-CNVR-1-V011	FAT Test Inconsistencies.	LRH-CNVR-1-OFI011: Reassess FAT test requirements in specification for the LRH conveyor system. Perform a valid startup test to meet the requirements and undertake the test using the accepted requirements.	Medium Pre CD-4
LRH-CNVR-1-V012	Structural Floor Design.	LRH-CNVR-1-OFI012: Validate loads defined in LAW Floor Loading Calculation 24590-LAW-S0C-S15T-00002, Rev. 2. Use this information to as input to LAW Steel Framing Calculation 24590-LAW-SSC-S15T-00009 to verify if steel framing design is adequate.	Medium Pre CD-4
LRH-RCSH-1-V001	Contamination migration at the Container Import/Hatch and Conveyor.	LRH-RCSH-1-OFI001: Evaluate the currently defined work processes and ensure an engineered or administratively-defined process is adequate for controlling contamination migration at the South and North clean container import hatches and conveyors, and that confirmation is available, such as continuous air monitor, to ensure personnel are not inadvertently exposed to an airborne radioactivity area. In addition, the process for how to decontaminate the clean container conveyor system and needed personnel and method for performance should be evaluated to determine feasibility given the location and intricacies of the system itself (and the impact to facility operations given the existing radiological design of the system).	Medium Pre CD-4
LRH-RCSH-1-V002	LRH System compliance to design and operational safety and health requirements.	LRH-RCSH-1-OFI002: Verify and validate that all required codes and standards have been incorporated into the design of the LRH system and, if not within the design, the requirements and standards are within appropriate procedures for both operations and maintenance work evolutions. Examples include installation of a dock ladder to provide route worker access to the truck bay, maintenance of ventilation components, potential heat stress within the LRH, emergency egress areas, etc.	Medium Pre CD-4
LRH-TOOL-1-V001	Inadequate design basis documentation for container grapple stand.	LRH-TOOL-1-OFI001: Revise design and fabrication documentation for container grapple stand to ensure accurate and as-built information.	Low Post CD-4
LRH-TOOL-2-V001	Inconsistent grapple load rating.	LRH-TOOL-2-OFI001: Increase the grapples safe working load design to 25,000 lbs to handle all container conditions.	Low Post CD-4
LRH-TOOL-2-V002	LAW production container volume, weight, and center of gravity calculation, 24590-LAWM0C-LRH-00004, does not include over pack condition.	LRH-TOOL-2-OFI002: Revise calculation to include the addition of over packing material to the outside of the container.	Low Post CD-4
LRH-TOOL-2-V003	Grapple temperature limitations.	LRH-TOOL-2-OFI003: Add grapple markings to clearly identify temperature limitations the same way safe working loads are identified.	Low Post CD-4
LRH-TOOL-2-V004	Grapple excessive load testing.	LRH-TOOL-2-OFI004: Revise BNI procurement process to ensure vendors test equipment according to contractual documentation and that all requirements are consistent between documents.	Low Post CD-4
LRH-TOOL-2-V005	Design requirement not verified in factory acceptance testing.	LRH-TOOL-2-OFI005: This requirement should be validated during start-up testing to ensure this critical characteristic is met.	Low Post CD-4
LRH-TOOL-2-V006	Requirements for factory acceptance testing not fully being performed.	LRH-TOOL-2-OFI006: This critical design requirement should be performed as part of an additional FAT or demonstrated through analysis.	Low Post CD-4
LRH-TOOL-2-V007	Inconsistent design requirements.	LRH-TOOL-2-OFI007: Revise data sheets, specification, and calculation to indicate a consistent and accurate grapple operating environment.	Low Post CD-4

Table B-1. Summary Vulnerability Listing. (41 pages)

LRH-TOOL-2-V008	Inaccurate model data for LRH process steps.	LRH-TOOL-2-OFI008: Engineering should perform a complete OR model input verification prior to model output is considered valid.	Low Post CD-4
LRH-HST-1-V001	Inconsistent operating environment requirements.	LRH-HST-1-OFI001: Revise design basis documentation to be consistent and perform impact analysis to ensure no impact to equipment life span or performance.	Low Post CD-4

Item No.	Description	Opportunities for Improvement	Rank
LRH-HST-1-V002	Incorrect factory testing requirements.	LRH-HST-1-OFI002: Perform an impact analysis for facility overall throughput capacity and verify the OR model assumptions for this hoist activities and process steps. Update all design basis documentation for the current maximum hoist speed.	Low Post CD-4
LRH-HST-1-V003	Failure to perform all required factory acceptance tests.	LRH-HST-1-OFI003: Perform testing requirements during the facility startup.	Low Post CD-4
LRH-HST-1-V004	Limited maintenance allowed from maintenance platforms.	LRH-HST-1-OFI004: Perform a maintenance requirements analysis for the hoists and available space to perform all material handling and maintenance activities.	Low Post CD-4

APPENDIX C

PATH FORWARD TO CORRECT PROGRAMMATIC DEFICIENCIES

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APPENDIX C PATH FORWARD TO CORRECT PROGRAMMATIC DEFICIENCIES

Table C-1. Path Forward To Correct Programmatic Deficiencies (3 pages)

Action
Inadequate Discipline in Design and Execution Control
Conduct reviews to ensure that the primary documents relied upon to establish design functions and requirements are accurate and complete. A key objective is to ensure that specific/quantifiable requirements are established.
Reintroduce and institutionalize multidisciplinary design reviews and monitor their effectiveness.
Conduct multi-discipline reviews of the individual system designs and associated documentation for compliance with the functions and requirements established in the primary documents. Confirm that any procured items, those in procurement, or presently installed meet the functions and requirements.
Implement sizing standards/guides for equipment to provide a standardized documented basis for design. These should include typical design margins to ensure a conservative design is achieved.
Provide project-approved design input for procurement documents; replace or supplement datasheet level information with technical bases.
Inadequate and Incomplete Control System Design Specification and Execution
Consistently define the ICN boundaries and interfaces commensurate with the functions attributed to the ICN.
Evaluate (or reevaluate) the hazards, risk, safety, and permitting compliance controlled or affected by the ICN and its subsystems.
Define (or redefine) the WTP specific functions requirements performed and controlled by the ICN and the PPJ, carefully tracking the flow down of requirements from upper-tier documents. Use these requirements to provide the detailed test criteria when functionality is confirmed during software development or for vendor acceptance criteria.
Use industry standard documentation sets (e.g. IEEE SE series) for the control system and the functional requirements, making it practical for review without recourse to the designer or maintainer
Eliminate the use of commingled design and requirements documents, and the use of logic diagrams as the sole means of defining functional requirements.
Develop software modification procedures and processes and ensure changes can be effectively isolated and verified with minimal regression testing required.
Conservatively evaluate the effect of manual controlled operations and the impacts on facility performance. Identify and implement increased automation for those areas where it is assessed that maximum benefit will be achieved.
Consider implementing current industry best practice in development of facility human machine interfaces.
Inadequate Analysis or Understanding of Production Capability
Realistic throughput for the facility.
Reconsider the bases and requirements for each system associated with facility performance. Confirm that intersystem interfaces and transitions are considered and integrated.

Develop detailed work plans for a representative set of critical maintenance and operations activities based upon fully-validated design input data that has been analyzed and accepted through a multi-discipline review process. Use this information to develop and validate an OR Model that incorporates a consistent process methodology across all plant systems.

Table C-1. Path Forward To Correct Programmatic Deficiencies (3 pages)

Action
Model all plant operations and maintenance activities in detail using the updated OR Model, scale simulations and mockups to validate throughput, space availability, remotability, accessibility, and availability of interfacing systems and organizations such that the production rate and margin can be accurately estimated at the facility and systems level.
Establish a formal and systematic design approach to identify and disposition issues that may adversely affect plant operations, maintenance and throughput. Address any redesign effort that may be required to minimize operational work-arounds, and unanalyzed production impacts.
Include reasonable and justifiable assumptions to predict performance and quality losses in the model basis and assumptions.
Maintain and utilize models, simulations, and mockups as primary operator training tools.
Consider incorporating lessons learned and operational feedback from the nuclear industry best practices that includes a specific structured approach to examine system operability and maintainability, using data based on years of operations.
Inadequate Implementation of ALARA Principles
Model and evaluate work tasks for each process system, identify potential areas where contamination may migrate, and document any additional engineering (i.e. remotely operated HEPA vacuum cleaners) or administrative controls (i.e. procedures) that will be needed to ensure personnel are appropriately protected.
Evaluate and document predicted possible airborne radioactivity work locations, given maintenance and operations tasks to be performed, and determine whether existing engineering controls will be effective in mitigating the airborne hazard.
Apply epoxy coating to the unprotected walls in the facility where radiological contamination could be present and operations or maintenance activities will be performed.
Accelerate the identification and definition of operation, maintenance, and waste management tasks and then revise dose assessment reports to accurately reflect anticipated dose.
Establish a mockup facility/area to evaluate and practice implementation of approaches to control worker dose and work area contamination prior to in-field execution of tasks expected to be high risk or have high radiological consequences.
Transfer of Scope and Risk to the Commissioning Phase
Identify all systems and components that require testing or functional demonstration as part of commissioning. Where feasible, identify off-line testing, modeling, simulations or mockups that may be used to minimize the risk of deferring these testing and functional demonstrations to commissioning
Develop a system for tracking all testing and functional demonstration activities being deferred to commissioning. Use the tracking system to support the planning and manage the risk of these activities.
Inadequate Implementation of Design Requirements for Waste Management

Reassess the adequacy of the functional requirements associated with secondary radioactive waste management to confirm that the full range of wastes anticipated over the life of the LAW Facility is addressed.
Reassess current secondary waste volumes and waste classifications to derive conservative estimates for design. Provide waste handling process design features to accommodate the forecasted waste volumes and classifications.

Table C-1. Path Forward To Correct Programmatic Deficiencies (3 pages)

Action
Update the OR Model to fully incorporate the waste management processes required to handle the estimated volumes of radioactive wastes generated over the life of the LAW Facility. Develop a range of anticipated scenarios and use the OR Model to assess the impacts of waste management activities on overall production. Assess areas that require design changes to ensure that LAW glass production is not impacted to the extent that mission objectives are jeopardized.
Evaluate the ICD-03 to ensure all roles, responsibilities and impacts to the involved contractors are understood and agreed so that operational control of WTP waste handling operations is established and maintained.
The DOE must ensure a facility to satisfy the secondary waste size reduction and repackaging requirements of the LAW facility is available prior to operation.
Inadequate Consideration of Industrial Safety and Industrial Hygiene Requirements
Define and document the chemical source term coming into the LAW Facility. The evaluation should consider historical information previously generated for the Hanford Tank Farms, and should also recommend routine area monitoring that may be warranted to ensure workers are appropriately protected. In addition, identify and incorporate into the design additional area monitoring that may be needed throughout the facility to ensure worker protection (other than areas associated with the offgas system).
Develop a formal process that ensures safety and health requirements and Industrial Safety and Health personnel are involved in the design process. The process should also list the hierarchy of controls and require a basis to be documented that describes how each control was addressed.
Verify and validate (i.e. walk down) those systems where design is substantially complete and identify equipment that will need to be retrofitted (engineered solutions) to ensure compliance to 10 CFR 851 requirements during commissioning activities. For those activities whereby an engineered or administrative means cannot be achieved to perform the task, develop a technical basis process to seek a waiver from the requirement (i.e. daily crane inspections in the finishing line).
Revise exposure assessments to accurately reflect chemical and environmental hazards anticipated during the design phase of the project.
Inadequate Consideration for Success of Operations/Maintenance Activities
Complete the hazards analysis for each (or a representative set of) anticipated manual operation or maintenance activity, including consumable replacement (e.g., bubbler, agitator, and pump) and consider mitigating the hazards through engineered methods.
Accelerate the development of detailed task analyses for a representative set of critical maintenance and operations activities based upon currently available designs using a multi-disciplinary review process.
Develop training simulations and mockups to include hands-on operations and maintenance activities.