Developing and Deploying Permeable Adsorptive Liners for Waste Disposal

Kevin D. Leary-DOE/RL

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Introduction

- DOE-RL is considering the bench-scale testing and possible deployment of a permeable adsorptive liner (PAL), as a potential alternative to the traditional double-liner system for hazardous, radioactive, and mixed waste landfills, warrants technical consideration for multiple reasons:
  - Life-cycle costs could be substantially lower than the standard double-lined system as there will be no leachate to treat and long-term monitoring requirements could be substantially reduced
  - Could significantly reduce the risk of post-closure vadose zone and groundwater contamination
  - Since there is no leachate to collect and treat, this approach will have a positive impact on any potential worker exposure issues
  - Enhanced regulatory acceptability for waste disposal

Background

- Baseline liner for landfills is a double-lined HDPE or composite system with a leachate collection system
- Permeable Reactive Barriers have historically focused on the Saturated Zone (e.g., Richland's In-Situ Redox Manipulation [ISRM] for Cr(VI) reduction)
- DOE Richland (RL) is evaluating changing the current practice of disposing of low-level waste in unlined trenches
- A Permeable Adsorptive Liner (PAL) has been proposed as a candidate for further evaluation

Waste Management 2004 Conference Tucson, Arizona

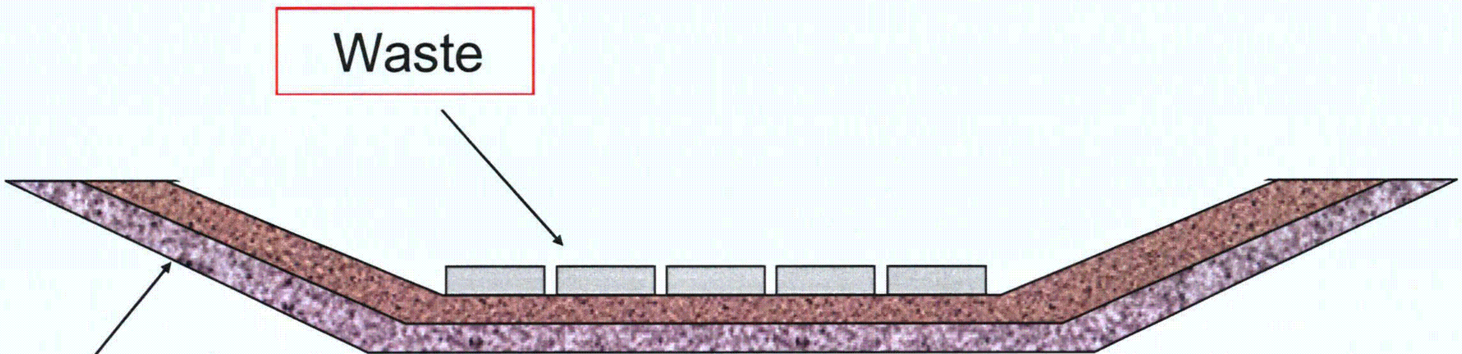
Mixed Waste Trench

Waste Management 2004 Conference Tucson, Arizona

Environmental Restoration Disposal Facility (ERDF)

Low-Level Burial Ground

Permeable Adsorptive Liner



Materials such as flyash, zeolite clay, various oxides and zero valent metals, granulated activated carbon (or finely crushed coal), phosphates, lime, and peat have all demonstrated their ability to strongly adsorb radionuclides and/or hazardous constituents

Steps to PAL Deployment

- **Phase I-Technical Validation of PAL concept-** A technical peer review panel, composed of technical experts from the national laboratories, academia, industry, and the regulatory community met on August 5-6, 2003 to evaluate PAL feasibility and technical merit. The concept was validated and recommendations were to proceed with Phase II

- **Phase II—Bench-scale testing coupled with lessons-learned, evaluation of retention technologies for problem contaminants (e.g., Tc 99, modeling, and lab-scale hydraulic, geotechnical, and geochemical testing of PAL for LLW-** PAL development will focus on the data gaps in our current knowledge base. There are a number of technical issues that warrant additional developmental work in the field of unsaturated zone reactive barriers, especially with materials capable of preventing the migration of Tc 99

Phase II-PAL Testing and Validation (cont.)

- Incorporate modeling results into PAL design and test in multiple sandbox experiments using projected RL leachate. Modeling and sandbox results should be iterative process.
- Experiments will assist in optimizing the physical, chemical, and geometric configuration characteristics of the PAL design in order to maximize long-term radionuclide and hazardous constituent attenuation.
- Liner deployment costs should be minimized using the graded approach to PAL design in both the laboratory and field
- The types, amounts, and configuration of the materials used in each PAL is dependent upon a variety of factors including waste composition (types and volumes), climate, and the results of the initial testing (i.e., modeling and lab/bench-scale testing)

Phase II-PAL Testing and Validation (cont.)

- Total life-cycle costs and Return on Investment (ROI) of this R&D will be determined after the initial lab/bench-scale test results are completed. The projected ROI will take into account all of the associated benefits cited on the next few slides

Phase III-PAL Deployment

- Deploy the PAL at a low-level waste trench to document performance and regulatory acceptability
- Evaluate the potential for deploying PAL at mixed-low-level waste (MLLW) trenches
- Evaluate the field-scale of testing of PAL for hazardous and/or MLLW at the future EPA test cell at DOD's National Environmental Technology Test Site (NETTS) Permeable Reactive Barrier National Test Site at Point Hueneme (south of Santa Barbara, CA). This effort is being championed by Dr. Lorne G. Everett
- After multiple years of testing and validating PAL performance, pursue regulatory approval of PAL to MLLW and hazardous waste disposal operations

Potential PAL Benefits

- Improved long-term waste containment performance
- Enhanced Performance Assessment for the LLBG's and may significantly decrease the amount of required waste pre-treatment (e.g., macro-encapsulation of certain waste prior to disposal)
- Enhanced credibility for technology acceptance will be supplied by the independent, technical experts
- Reduces total life-cycle costs for waste disposal
    - Potential for reducing landfill closure cover cost and long-term monitoring

PAL Benefits (cont.)

  - Potential cost savings in avoiding groundwater or vadose zone contamination and subsequent costly remediation

- Avoids the potential “bath-tub” affect of traditional double-lined systems
- Eliminates leachate collection and treatment during the operating life of the facility since it is a passive system. This has a positive effect on any potential worker exposure issues related to leachate treatment
- Potential applications to other waste disposal sites in the DOE complex

Path Forward (cont.)

- Focus sandbox studies on both the performance of a single, large low-level mega-trench as well as the cost and performance of various "designer" PAL's that incorporate waste segregation
- Apply a graded approach to the PAL design (e.g., if only LLW is disposed and does not contain any actinides, then flyash and zeolite clays should suffice as an effective PAL)
- Perform a risk assessment at the completion of the bench-scale studies
- **Phase II End-state-** of lab/bench-scale studies for LLW disposal should be completed between 1 and 2 years. Upon completion, PAL designs should be ready for field deployment by the on-site contractor

Path Forward (cont.)

- Deploy PALs for new LLW trenches
- **Phase III-**Next step is to evaluate applications of PAL for MLLW and/or hazardous waste disposal
  - Evaluate the field-scale of testing of PAL for hazardous and/or MLLW at the future EPA test cell at DOD's Point Hueneme site which may take 3 or more years
  - Evaluate the application of installing reactive materials in a landfill barrier that can be mobilized to immobilize the underlying contaminant (e.g., nitrogen and organic material to significantly increase the Kd of I^{129})

Path Forward (cont.)

- Obtain approval from the regulators and stakeholders for deployment of PAL's at RL for mixed–low-level waste (MLLW) trenches
- Enlist the aid of the Interstate Technology Regulatory Council (ITRC) and the Western Governor's Association to expedite the approval process for disposal of hazardous waste utilizing a PAL system

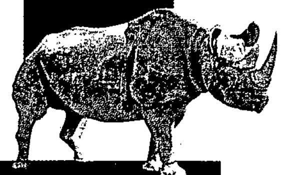
Conclusion

- Permeable reactive liners could be significantly cheaper to construct than the traditional double-lined system and may provide the ability to isolate waste for thousands of years
- Materials used in a RCRA compliant double-lined facility are expected to fail long before the radionuclides have decayed
- By optimizing the adsorption/attenuation processes via physical and chemical manipulation, the Permeable Adsorptive Liner could be a safe, viable, and cost-effective alternative for disposal of LLW, MLLW, and hazardous waste

TUFF STUFF® Polyurethane

DATA SHEET

Date Revised: 03/22/04



- Part A Isocyanate - Part number 60012
- Part B Resin – Part number 60021

■ GENERIC TYPE:

Elastomeric polyurethane. 100% solids (no VOCs, no solvents).
(Variations: pigmented, flame retardant, slow)

■ GENERAL PROPERTIES:

TUFF STUFF is a two-component, 100% solids (no VOCs, no solvents), exothermic, rapid curing, elastomeric polyurethane lining system.

- Minimum recommended thickness approximately 1/16" (62.5 mils), (1.6 mm)
- Maximum thickness – unlimited.
- Excellent abrasion resistance.
- Excellent impact resistance.
- High tensile strength, elongation and tear strength properties.
- Excellent weather resistance.
- Excellent corrosion resistance.
- Excellent casting material.
- Good chemical resistance.
- Good sound reduction.

■ RECOMMENDED USES:

Elastomeric properties allow for application to surfaces subject to:
vibration, expansion, contraction, movement, flexing, abrasion, chemical exposure, corrosion and impact.
Secondary containment - sprayed-on, impervious, monolithic area liner with a high level of protection and strength.
Bonds to virtually all substrates of any dimension.
Reduces noise transmission.
Stable from -40°F (-40° C) to 175° F (79.4° C).
Allows for vehicular and foot traffic.
Chemical processing equipment and tank coating.
Floor and wall protection - food handling, food processing, and commercial food storage.
Casting material for polyurethane component production.
Immersion service.

■ NOT RECOMMENDED FOR:

Hydrostatic barriers.
Sustained temperatures below -40°F (-40° C) or above 175° F (79.4° C).
Concrete substrates subject to high impact.
High density polyethylene or thermoplastics.
Immersion service in strong bases, acids or strong solvents.

■ CHEMICAL RESISTANCE GUIDE:

(Guidelines only: Fume, splash, spillage as noted. Individual testing required for immersion).

Acetic Acid to 10%	Excellent	Ammonia to 5%	Excellent
Formic Acid to 5%	Excellent	Caustic Soda Lye to 50%	Excellent
Nitric Acid to 10%	Excellent	Potash Lye to 20%	Excellent
Hydrogen Peroxide to 10%	Excellent	Oils	Excellent
Sulfuric Acid to 25%	Excellent	Solvents	Moderate
Tannic Acid to 20%	Excellent		

Properties were checked from polyurethane lining, 1/8" (125 mils), (3.18 mm) thick stock.

■ SUBSTRATES:

Metals, wood, concrete, fiberglass, geotextiles and most plastics.

■ VOLATILE ORGANIC CONTENT:

None. 100% solids.

■ DRY FILM THICKNESS RANGE:

Approximately 1/16" (62.5 mils), (1.6 mm) - unlimited.

■ SHELF LIFE:

Part A - Isocyanate: Six months, unopened
Part B - Resin: Six months, unopened

ANSI-RAB ACCREDITED QMS · BSI REGISTERED
ISO 9001:2000
FM62236

Rhino Linings®
INDUSTRIAL DIVISION
www.rhinoliningsindustrial.com

■ COLORS:

Base material: Isocyanate - yellow or light-straw color. Resin - opaque.

Full color range available.

Standard colors: black, indigo blue, graphite, emerald green and flame red.

Custom colors available by special order.

■ TYPICAL PHYSICAL PROPERTIES OF TUFF STUFF:

Hardness (Shore A)	85±5	ASTM D-2240
Tensile Strength (psi)*	1700 - 1900	ASTM D-412
Elongation (%)*	325 - 375	ASTM D-412
Compressive Strength (psi)	783	ASTM D-695-96
Flexural Modulus (psi)	5600 - 6400	ASTM D-790
Secant Modulus (psi)		
@ 200% Elongation	700 - 800	ASTM D-412
@ 400% Elongation	1200 - 1300	ASTM D-412
Taber Abrasion Resistance (mg of loss/1000 cycles)		
CS17 Wheel; 1000 grams weight	10 - 15	ASTM D-4060
Tear Resistance (pli)*		
Die C	140 - 150	ASTM D-624
Ross Flex (% crack growth/50,000 cycles)	0	ASTM F1A-308
Coefficient of Friction on Steel		
Static	.85	ASTM D-1894-95
Kinetic	.78	ASTM D-1894-95
Specific Gravity (grams/cc)	1.08 - 1.10	ASTM D-792
Water Absorption (%)	≤1.6	ASTM D-570
Dialectic Strength (volts/mil)	300	ASTM D-149
Volume Resistivity (ohm/inches)	6 x 10 (12)	ASTM D-257
Dialectic Constant (MHz)	5.4	ASTM D-150
Dissipation Factor (MHz)	0.058	ASTM D-150
Cathodic Disbonding	Pass	ASTM G-8

* Properties were checked from TUFF STUFF polyurethane lining, 1/8" (125 mils), (3.18 mm) thick stock.

■ SAFETY PRECAUTIONS:

Health Considerations:

Consult the Rhino Linings® Material Safety Data Sheets.

The uncured components of TUFF STUFF can cause irritation to the eyes, skin and mucous membranes and is harmful if swallowed. When handling, avoid contact with eyes and skin (especially open cuts). In case of contact, immediately wash off with plenty of water for at least fifteen (15) minutes. For eyes, obtain medical attention. Always wash hands before eating. Obtain immediate medical attention in case of ingestion.

TUFF STUFF contains isocyanates and may cause allergic skin or respiratory reactions. Do not use if you have chronic breathing problems (asthma) or if you have ever had reactions to isocyanates. When applying TUFF STUFF avoid breathing harmful vapors. Fresh air-supplied standard painter's hood and full face respirator must be worn by all personnel entering the area where TUFF STUFF is being applied until all vapors have been exhausted. In case of extreme exposure or adverse reaction, remove affected personnel to fresh air immediately and obtain medical help.

TUFF STUFF components are combustible liquids Class 111B. Store and transport according to regulation.

Important:

Consult the Rhino Linings Material Safety Data Sheets.

Read and follow warning labels on all components. For professional use only. Follow cautions and handling guidelines in Rhino Linings Technical Reference Manual.

The information herein is believed to be reliable, but unknown risks may be present. All warranties of any kind, expressed or implied, including warranties of fitness for a particular purpose, are specifically disclaimed.

For your Protection:

The information and recommendations in this publication are, to the best of our knowledge, reliable. Suggestions made concerning the products and their uses, applications, storage and handling are only the opinion of Rhino Linings USA, Inc. Users should make their own tests to determine the suitability of these products for their own particular purposes and of the storage and handling methods herein suggested. The toxicity and risk characteristics of products made by Rhino Linings USA, Inc. will necessarily differ from the toxicity and risk characteristics developed when such products are used with other materials during a manufacturing process. The resulting risk characteristics should be determined and made known to ultimate end-users and processors. Because of numerous factors affecting results, **Rhino Linings USA, Inc. makes no warranty of any kind, expressed or implied, including those of merchant ability and fitness for a particular purpose,** other than that the material conforms to its applicable current Standard Specifications. Statements made herein, therefore, should not be construed as representations or warranties. The responsibility of Rhino Linings USA, Inc. for claims arising out of breach of warranty, negligence, strict liability, or otherwise is limited to the purchase price of the material.

WTP Technical Issues Being Addressed

Pretreatment

- Increasing ultrafiltration throughput/effectiveness
- Changeover to resorcinol formaldehyde for Cs removal
- Caustic and oxidative leaching to remove Al and Cr
- H_2 controls/explosion resistance for vessels/large bore pipes
- Antifoam agent that does not accumulate H_2
- Mitigate criticality risk due to potential accumulation of trace fissile nuclides over time in cesium evaporator
- Mitigate long term erosion due to abrasive particles in waste
- Mitigate piping/component plugging risk
- Ensure effective waste mixing with fluidic pulse jet mixers

WTP Technical Issues Being Addressed

Melters

- Increase facility throughput capacity by upgrading electrical and cooling capacity
- Run tests to determine feasibility of increasing waste loading

Other

- Design all internal gypsum board walls to relieve standing water pressure on floors from fire header rupture

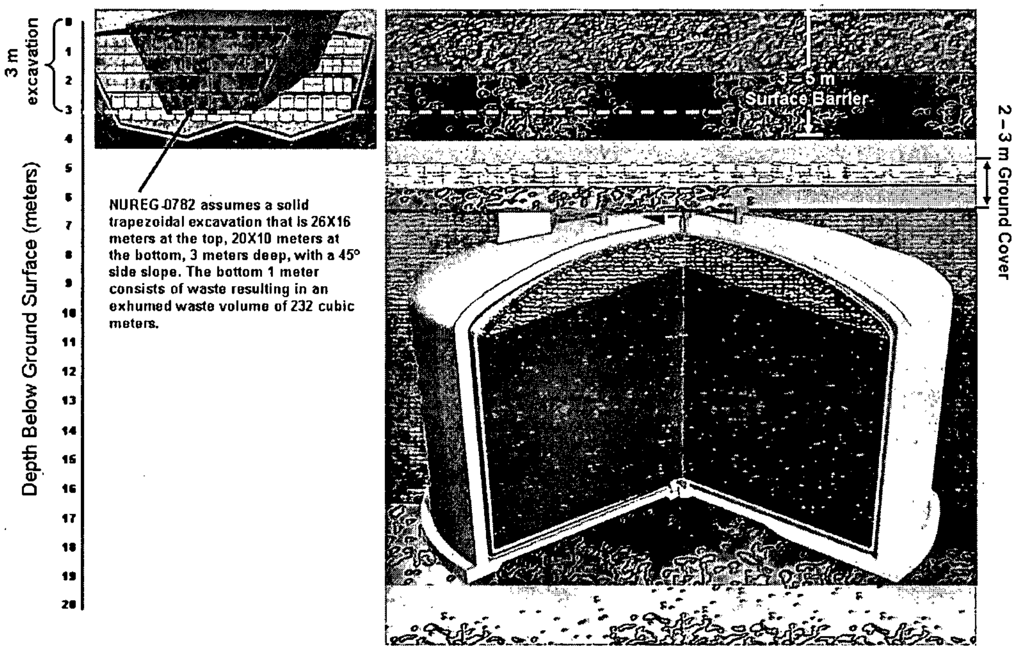
DRAFT
TECHNICAL BASIS FOR DISCUSSION
AT HANFORD ON OCTOBER 17 -19
ACNW VISIT

(1) <u>CONCENTRATION IN WELL DRILLING CUTTINGS</u>

The U.S. Nuclear Regulatory Commission (NRC) Draft Interim Concentration Averaging Guidance for Waste Determinations (Draft Guidance) (NRC 2005b) provides draft interim guidance to the U.S. Department of Energy (DOE) regarding concentration-averaging approaches for DOE tank waste residuals. In that guidance the NRC applies essentially identical concentration averaging principles to wastes that are retrieved, treated, and buried in containers and stabilized tank waste residuals remaining in DOE tanks following waste retrieval. For example, the NRC specifically notes (NRC 2005a) that the Draft Guidance "applies the principles already contained in the BTP," where the BTP refers to the NRC's Branch Technical Position on Concentration Averaging and Encapsulation (NRC 1995). DOE believes that applying the BTP approach to tank waste residuals in the manner set forth in the Draft Guidance is inconsistent with the logic that underpins the Class A, B, and C radionuclide concentration limits set forth in 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste. DOE recommends that concentration averaging for stabilized tanks/residuals should take into account the substantial differences between containerized LLW in shallow burial grounds and stabilized tanks which are essentially mammoth and monolithic underground vaults that are generally deeper and more difficult to intrude into than LLW analyzed by the NRC in establishing its BTP. The primary concern should be the risk to inadvertent intruders rather than placing an artificial constraint on a hypothetical portion of a stabilized monolith deep within the ground.

The Draft Guidance is Inappropriately Based on Excavation Intrusion Logic – The Table 1 and Table 2 radionuclide concentrations set forth in § 61.55 were derived based on risks associated with wastes being inadvertently brought to the surface as a result of excavating a basement for a residential dwelling. DOE's tank wastes require a different basis of analysis for potential inadvertent intruders due to numerous factors including the greater disposal depth. For example, Hanford tanks currently have 2-3 m of ground cover over the dome (Naiknimbalkar 2005, Appendix A) and that depth will be increased to 5 – 8 meters once the closure caps are put into place (Figure 1).

Figure 1. Relative Depths of Land Disposed Low-Level Waste, Tank Waste, and NUREG-0782 Construction Intruder Scenario



For tanks with domes, the depth to elevations where wastes were routinely stored (i.e., within the steel tank liner) adds an additional 4 m of reinforced concrete dome and low contamination grout between significantly contaminated grout and the ground surface resulting in 9 – 12 m total cover, 3-4 times the cover ultimately assumed in the excavation scenarios in NUREG-0782 (NRC 1981).

The excavation-based scenarios that the NRC used to derive the Class C limits are, therefore, generally not applicable to tank waste disposal geometries. For that reason, DOE developed inadvertent well driller scenarios to evaluate potential inadvertent intrusion[1]. While the inadvertent well driller scenario provides a hypothetical means to expose humans to the stabilized residuals, the key parameters associated with the well driller scenario are substantially different from those used in the BTP or NRC 1981 (e.g., lower source terms, less contaminated media).

As illustrated in Figure 1, even if the 500-year design life surface barrier were to degrade at some point, a 3-meter excavation would not provide a reasonable intruder pathway due to the distance through the grout inside the tank and the reinforced concrete dome/cover on the tank. Moreover, the massive monolithic structures comprised of the reinforced concrete tank shell, the steel liner, and the many thousands of cubic feet of grout in any

[1] Please note that the well driller scenario is not appropriate in some regions (such as Savannah River). This occurs when the geologic setting resulting in local practices and drilling equipment that generally do not penetrate high strength concrete caps.

given tank result in massive forms that should enhance recognition by the intruder. Such recognition should further mitigate risks associated with inadvertent intrusion.

The NRC's intrusion scenarios used to develop the § 61.55 Table 1 and Table 2 concentration limits generally assumed that while excavating a hole for a 3-meter deep basement the inadvertent intruder exhumes 232 m^3 of waste (the bottom meter of the excavation is assumed to be waste). For Class C waste the NRC assumed 500 years decay prior to excavation (NRC 1981, NRC 1982). The concentration-averaging BTP (NRC 1995) considered analogous scenarios[2]. The scenarios assumed in those documents would result in no dose to the public if rigorously applied to DOE tank waste.

Accordingly, the excavation-based logic that underpins the NRC's concentration-averaging approach for containerized waste is generally not applicable to stabilized tank waste. Similarly, the concentration averaging principles in the BTP (NRC 1995) that are based on NUREG-0782 (NRC 1981) and NUREG-0945 (NRC 1982) are not readily transferable to the Draft Guidance as was done in the examples presented in that document. Rather, the Draft Guidance should take into account the substantial differences that exist between tank residuals and containerized waste disposal grounds rather than add substantial further levels of conservatism to those already implicit in Class C concentration limits and assumed intrusion scenarios that are not required to protect members of the public.

Tank Residual Intrusion Scenarios Result in Greatly Reduced Source Terms Reaching the Surface Relative to those Assumed in Deriving Class C Concentration Limits – The risk presented to the public due to inadvertent intrusion is directly related to the inventory and mix of radionuclides brought to the surface that members of the public (including the inadvertent intruder) could be exposed to. NUREG-0728, Appendix G, Section 3.3, Waste Classification (NRC 1981), states:

> "In these scenarios, potential exposures to a potential inadvertent intruder are calculated considering <u>only the radionuclide concentration in the waste streams assumed to be actually contacted by the intruder.</u> The radionuclide concentrations and total activity in parts of the disposal facility not contacted by the potential inadvertent intruder do not enter into the calculations" [emphasis added].

In deriving the § 61.55 Table 1 and Table 2 concentration limits, the NRC assumed that substantial quantities of waste were exhumed during the intruder excavation activities. For example, NUREG-0782, Appendix G, Section 3.4.1, Intruder-Construction Scenario (NRC 1981), states, "This excavation would result in about <u>232 m^3 of waste being intruded into</u>" [emphasis added].

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[2] For example, the comment response section of the BTP states, "The assessment of radiological impacts in the EIS did indeed consider a broad range of scenarios, and the development of the technical position followed a similar approach in defining the concentration averaging and encapsulation positions for "discrete" wastes that were not addressed in detail in the EIS" (NRC 1995).

NUREG—0945 (NRC 1982) states:

> "It is also believed to be true that waste which has been disposed beneath a cover of at least 5 meters thick would be difficult to contact extensively even after 500 years. In the calculations for the draft EIS, it was assumed that at the end of 500 years the 5-meter intruder barrier was no longer effective. The scenario was taken to be <u>the same as that which was used to determine the Class A waste limits</u>. The only difference was that a 500-year radioactivity decay period was used instead of a 100-year decay period. This is believed to be very conservative since if Class C waste was brought to the surface it <u>would probably be considerably diluted with soil and lower activity waste</u>. The degree of dilution is difficult to estimate but <u>it is believed to be at least an order of magnitude</u>" [emphasis added].

From the above it can be concluded that the Class C levels were generally based on the exhumation of 232 m^3 of Class C waste at 500 years and a dilution ratio of 10:1 with non-Class C waste and cover soil.

In some locations (such as Hanford) regional drilling practices include using equipment designed to penetrate rock which could potentially result in tank penetration[3]. Air is generally used to carry away cuttings from the drill bit and transport the cuttings to the surface. Consequently, any waste cuttings brought to the surface during drilling should be well mixed[4]. An inadvertent driller is assumed to receive an acute dose due to his/her proximity to the cuttings (external dose) as well as inhalation and ingestion of waste cuttings suspended in air as dust. Subsequent to drilling, the contaminated drill cuttings are assumed to lead to chronic doses to people using land contaminated by the cuttings for a residential garden or other uses. The radionuclide inventory brought to the surface during the intrusion event and its spatial relationship to the intruder and subsequent land users affect the dose to the public. As discussed below, although drilling-based intrusion releases substantially less radioactivity to the ground surface than excavation-based intrusion and although the driller never comes into contact with waste in the form and concentrations that exist within a tank, the NRC has not provided any equitable credit in its concentration averaging guidance to reflect these major differences.

In the case of a driller penetrating an underground storage tank, the radionuclide inventory brought to the surface during drilling is determined by the diameter of the hole that is drilled. Figure 2 provides a schematic (not-to-scale) for a hypothetical drilling intrusion scenario where a 6.5-inch (0.165 m) drill is used to provide residential water[5].

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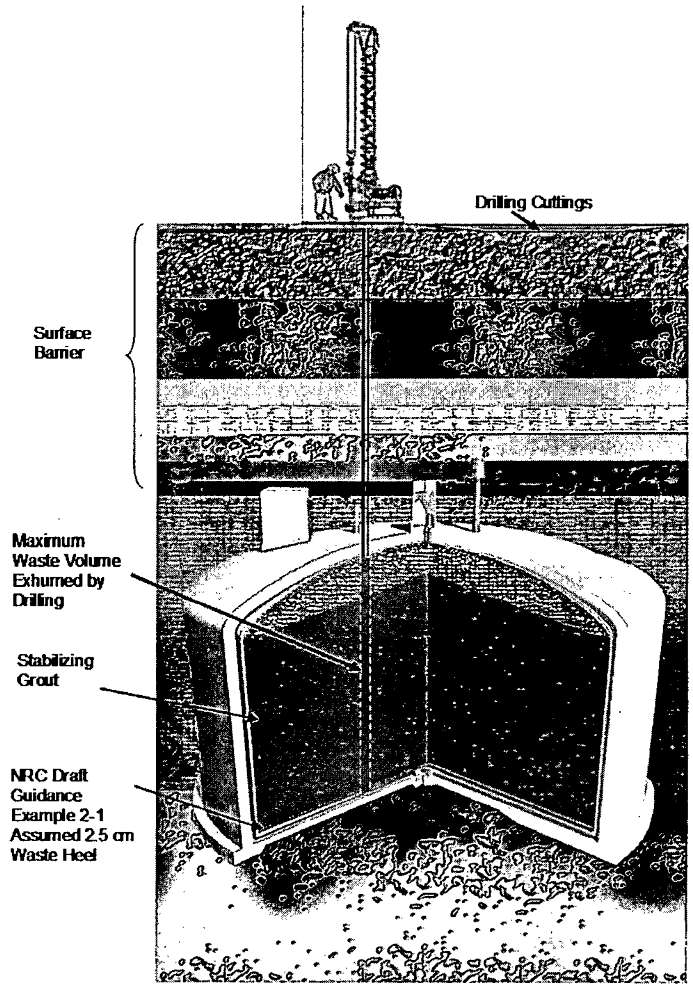
[3] Even where drilling practices may not lead to drilling through a tank, a concentration averaging approach that is based on a drilling scenario would be more representative of future potential intruder risks than the intruder construction and excavation scenario in NUREG-0782 (NRC 1981).

[4] The NRC recognized this in the Draft Guidance, i.e., "The average concentration of the waste used in the performance assessment calculations should be calculated by assuming mixing over the volume of well cuttings exhumed because the cuttings are expected to be well-mixed when spread on the land surface" (70 Fed Reg 74849 (December 16, 2005)).

[5] Note that larger diameter drill holes might be used for commercial purposes, however, the residential gardener (drill size assumed) results in the highest chronic dose.

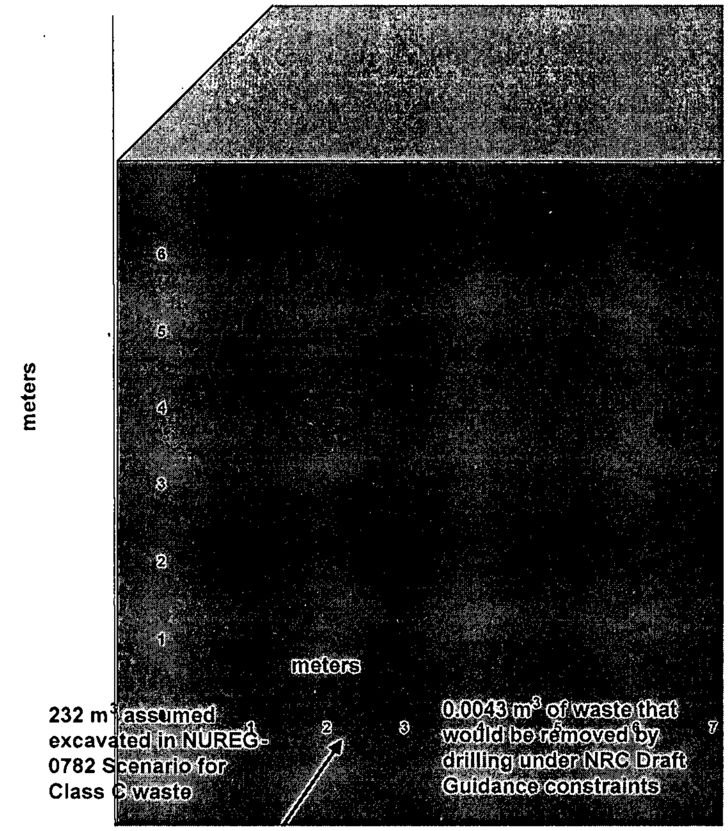
It should be noted that the radionuclide inventory (i.e., number of curies) brought to the surface by drilling is independent of whether all of the radioactivity remains in a thin layer dispersed across the bottom of a tank (e.g., the 2.5 cm layer assumed in Draft Guidance Example 2-1) or is mixed with all of the stabilizing grout in the tank. It is the area of the borehole that determines the inventory brought to the surface, not the extent of vertical mixing in the grout.

Figure 2. Conceptual Inadvertent Well Driller



For a 6.5 inch (0.165 m) diameter borehole and the waste and grout parameters used in Draft Guidance Example 2-1 (2.5 cm of residual dispersed within 20 cm of grout), the intruder would bring 0.0043 m^3 of contaminated waste to the surface. The volume of waste assumed to be excavated when the NRC derived the § 61.55 Table 1 and Table 2 concentration limits is 50,000 times higher (see Figure 3), i.e., NUREG-0782, Appendix G, Section 3.4.1, Intruder-Construction Scenario (NRC 1981), states, "This excavation would result in about 232 m^3 of waste being intruded into" [emphasis added]. Basing the Draft Guidance on buried drum waste intrusion scenario-based logic is inconsistent with the geometry for DOE's tanks and the source terms from tank residuals that could affect members of the public due to inadvertent intrusion.

Figure 3. NUREG-0782-Based Scenario Results in 50,000 Times As Much "Waste" Being Released to the Surface



While the Draft Guidance appears to be applicable to low-activity tank waste that is retrieved, treated, and containerized, it does not provide a reasonable concentration-averaging approach for tank waste residuals. Although the approaches set forth in the Draft Guidance appear to have been developed to be consistent with 10 CFR Part 61 and the BTP, the staff did not reasonably account for the substantial disposal differences between containerized waste and tank waste residuals. The Draft Guidance fails to recognize, for example:

- The NUREG-0782 excavation scenarios are not directly applicable to representative tank waste residual intrusion scenarios resulting in a very large discrepancy between waste volumes assumed to be excavated in deriving the § 61.55 Table 1 and Table 2 concentration limits (hundreds of cubic meters of waste) and the waste volume that could be exhumed via drilling through a closed tank (a fraction of a cubic meter) as depicted in Figure 3.
- No reasonable inadvertent intrusion scenario results in a member of the public being directly exposed to waste, as it exists in a tank.
- Drilling results in potential intruder exposure to cuttings which are a reasonably homogenous blend of the waste and contaminated grout throughout the tank.

- The entire tank structure including the stabilization grout is contaminated and would have to be managed and disposed of as radioactive waste if it were ever exhumed. It should be handled in an analogous fashion to a reactor vessel (e.g., Trojan reactor vessel), i.e., concentration averaging over the contaminated volume/mass of the waste that could be exhumed through intrusion.
- The factor of ten concentration averaging has no logical or risk basis for tank residuals buried deep within the ground that are only accessible by drilling.

The Draft Guidance places unreasonable and unrealistic constraints on tank waste residual concentration averaging. It can lead to classify waste that easily meets 10 CFR Part 61 Subpart C performance objects as greater than Class C due to an artificial constraint that is inconsistent with potential exposure scenarios.

Although the waste may not be homogeneously distributed throughout the grout column prior to drilling, the air (or other carrier) used to remove cuttings will result in mixing at the surface as will post-driller activities, e.g., gardening. Moreover it is likely that much of the grout within any given tank will be contaminated to some degree given that the entirety of the inside surfaces of the tank (walls, dome, internal equipment, risers, etc) will be highly contaminated prior to grout addition. In fact, NRC supports averaging the radionuclide inventory exhumed during drilling over the entire volume of drill cuttings brought to the surface for performance assessment purposes on the basis that the waste will be well mixed with the cuttings[6]. Averaging the residual radionuclide concentrations over the volume/mass of cuttings removed from the tank during drilling results in higher radionuclide concentrations than the driller would be exposed to and is significantly more representative of the risk posed by stabilized tank waste than the position taken by the NRC in the Draft Guidance (i.e., 10% waste loading). The NRC's intruder scenarios leading to 10 CFR Part 61 are already highly conservative[7]. Compounding that conservatism for tank residuals serves no purpose and fails to give credit to the added protection provided by massive monolithic tanks filled with grout[8], which should be considered in formulating the guidance.

Concentration-averaging guidance for tank waste residuals should reasonably account for such differences. This could be done, for example, by averaging the inventory of radioactive materials that would be intercepted by drilling through a tank over the volume/mass of the tank and stabilization grout that would be exhumed from the tank as a result of such drilling where the drilling is assumed to occur at a tank location where concentrations should be greatest, i.e., areas shown to have the deepest residuals by such means as post-retrieval topographic mapping (Figure 4). Even with this concentration averaging approach, the source terms exhumed by drilling will be orders of magnitude

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[6] See footnote 7.

[7] "Part 61 intruder scenarios are not risk-informed. They are based on bounding or extremely conservative assumptions and conditions...The assumptions used in the intruder scenario have a direct bearing on the Class A, B, and C concentration limits in Section 61.55." (NRC 2005c)

[8] "Credit for engineered barriers for waste form, waste packaging, disposal site design, and cover design were not explicitly included in Part 61. It would be an improvement to consider appropriate credit for the contribution of these engineered features to system performance." (NRC 2005c).

below those assumed via the scenarios used to derive the § 61.55 Table 1 and Table 2 concentration limits.

Figure 4. Recommended Concentration Averaging Volume/Mass for Tank Residuals

Basing the concentrations on the total borehole cutting volume and grout density within a tank would provide a concentration averaging approach that is more consistent with the logic used to develop the § 61.55 Table 1 and Table 2 concentration limits.

References

NRC 2005a. Letter from L. Camper, Director, Division of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C., to C. Anderson, Principal Deputy Assistant Secretary, Office of Environmental Management, U.S. Department of Energy, Washington, D.C., Re: Draft Interim Guidance on Concentration Averaging for Waste Determinations, December 5, 2005.

NRC 2005b. Draft Interim Concentration Averaging Guidance for Waste Determinations, Nuclear Regulatory Commission, 70 FR 74846 (December 16, 2005).

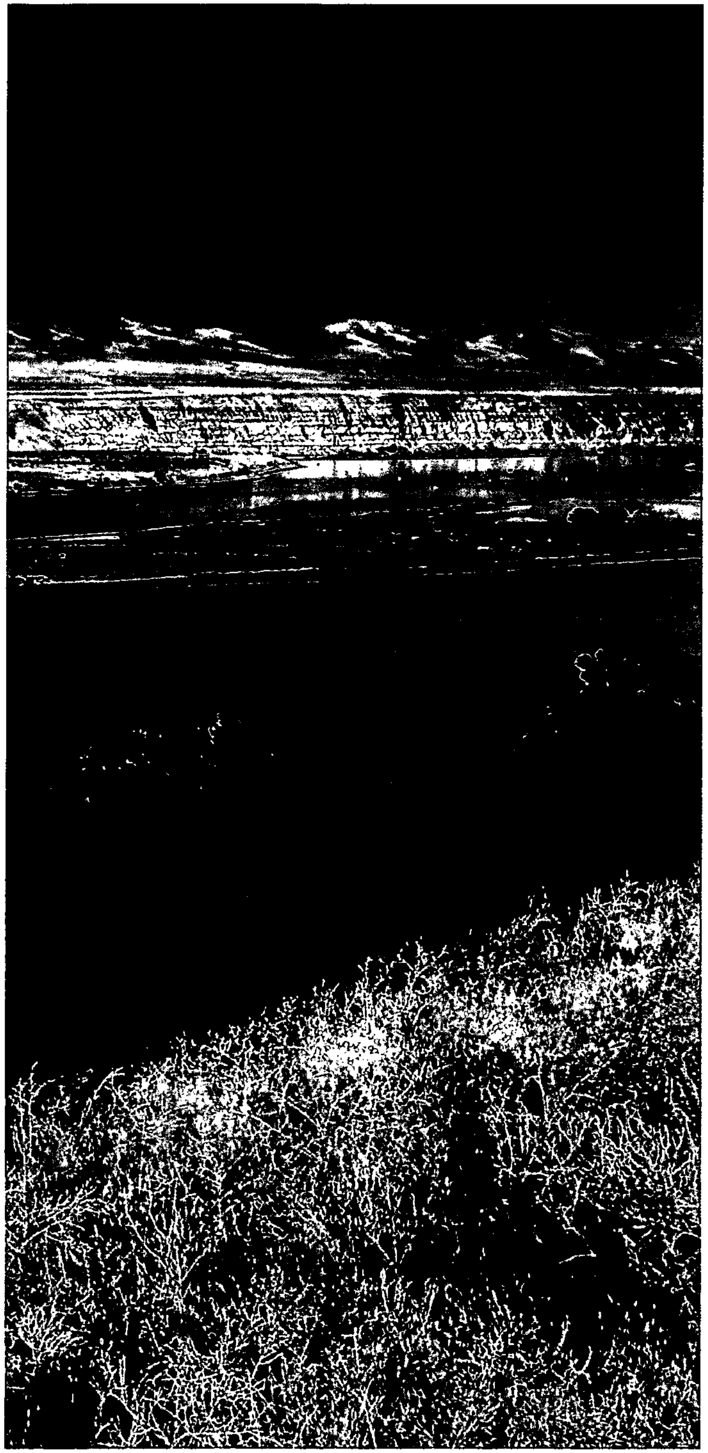
NRC 2005c. Letter to N. Diaz, Chairman, U.S. Nuclear Regulatory Commission, Washington, D.C. from M. Ryan, Chairman, NRC Advisory Committee on Nuclear Waste, Washington, D.C., Opportunities in the Area of Low-Level Radioactive Waste Management, ACNRW-0234, December 27, 2005.

Naiknimbalkar 2005. A. N. Naiknimbalkar, *Waste Tank Summary Report for Month Ending October 31, 2005*, HNF-EP-0182, Rev.211, CH2MHILL Hanford Group, Inc., Richland, WA, December 2005.

NRC 1995. Letter from M. Knapp, Director, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, to Commission Licensees, Issuance of Final Branch Technical Position on concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position, U.S. Nuclear Regulatory Commission, January 17, 1995 with enclosure.

NRC 1982. Final Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste, NUREG-0945, Appendix G, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, November 1982.

NRC 1981. Draft Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste, NUREG-0782, Appendix G, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, September 1981.



L/B/L Presentation

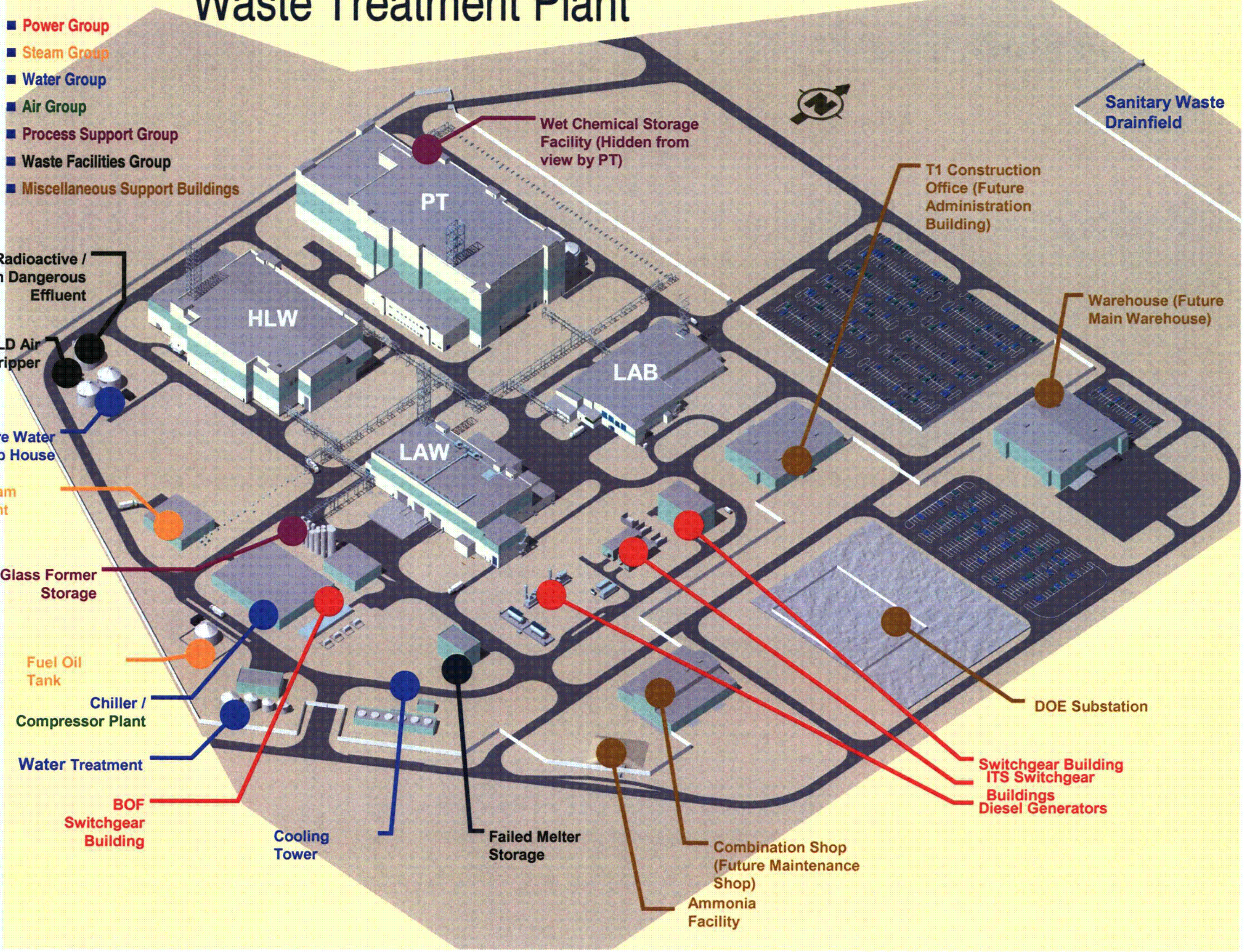
Janet Roth
L/B/L Project Engineering Manager

Presented to:
Comprehensive Flowsheet Review Team
October 17-20, 2005

U.S. Department of Energy
Office of River Protection

Bechtel National, Inc.

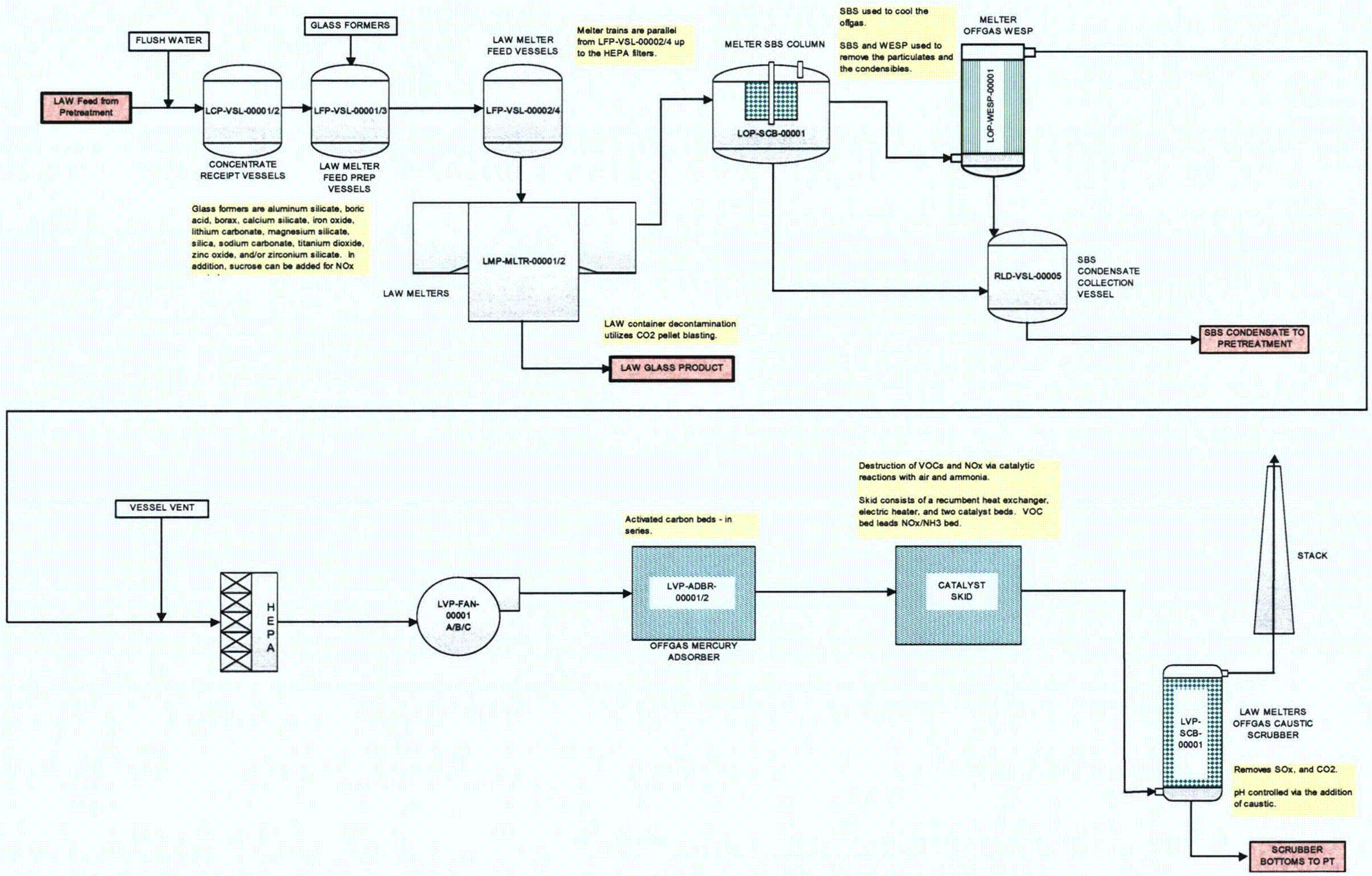
Waste Treatment Plant



LAW Function

- Process Low Active Waste into Immobilized Low Active Waste
- Process 30 Mtons/day
- The LAW Facility is designed for an average throughput of 733 units of waste per year based on the contract formula for calculating units of waste.

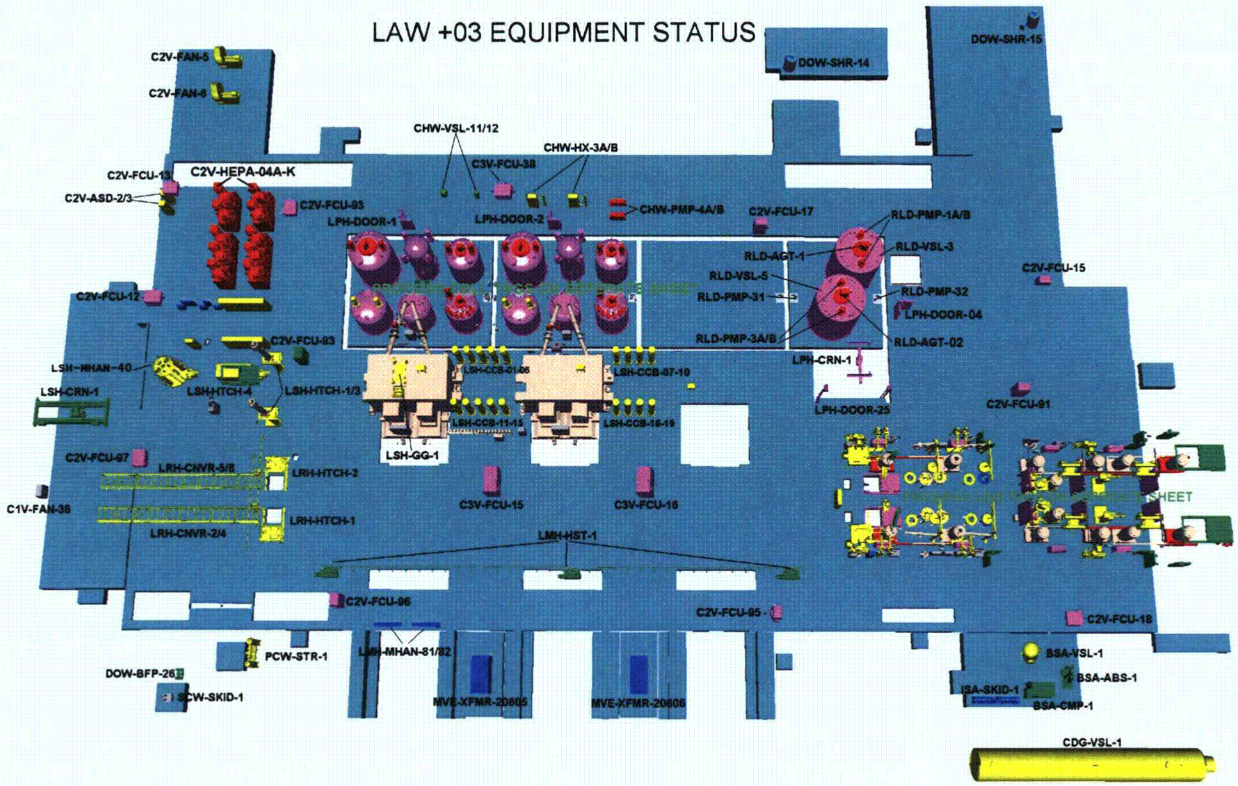
Simplified LAW Flow Diagram



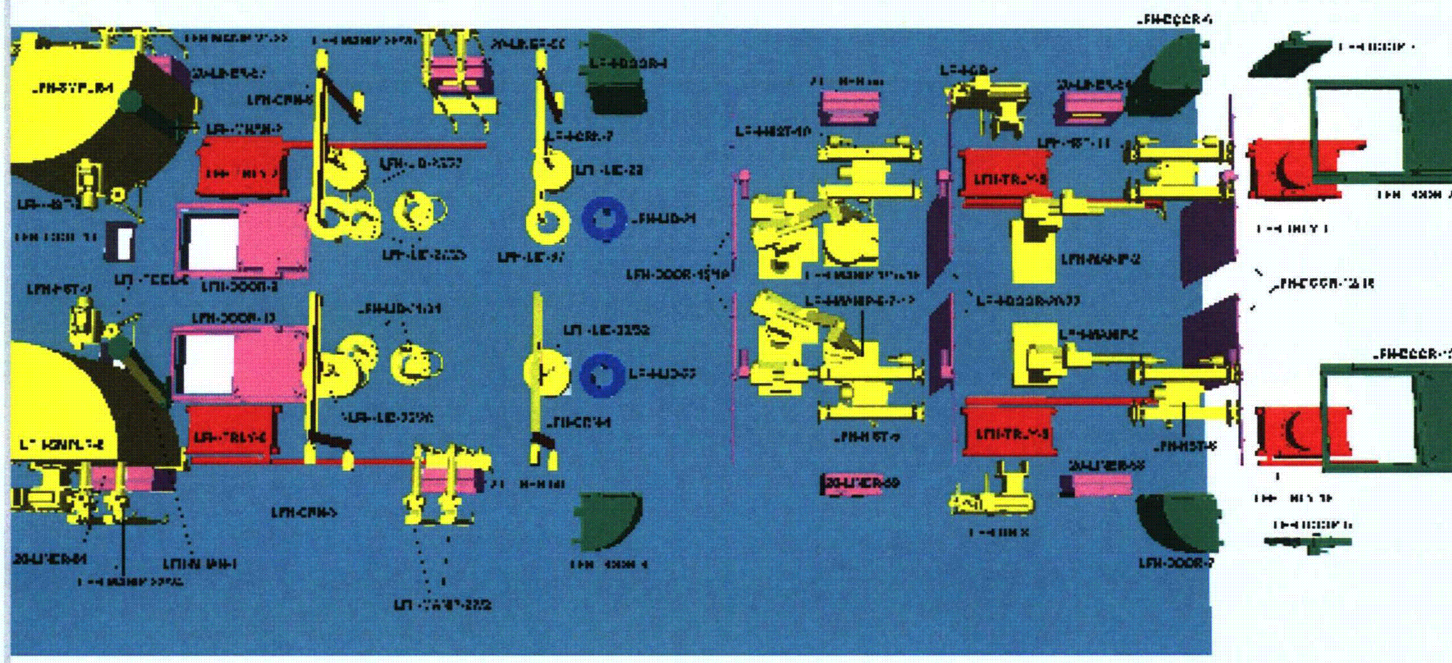
Engineering Release Quantities-Low Activity Waste

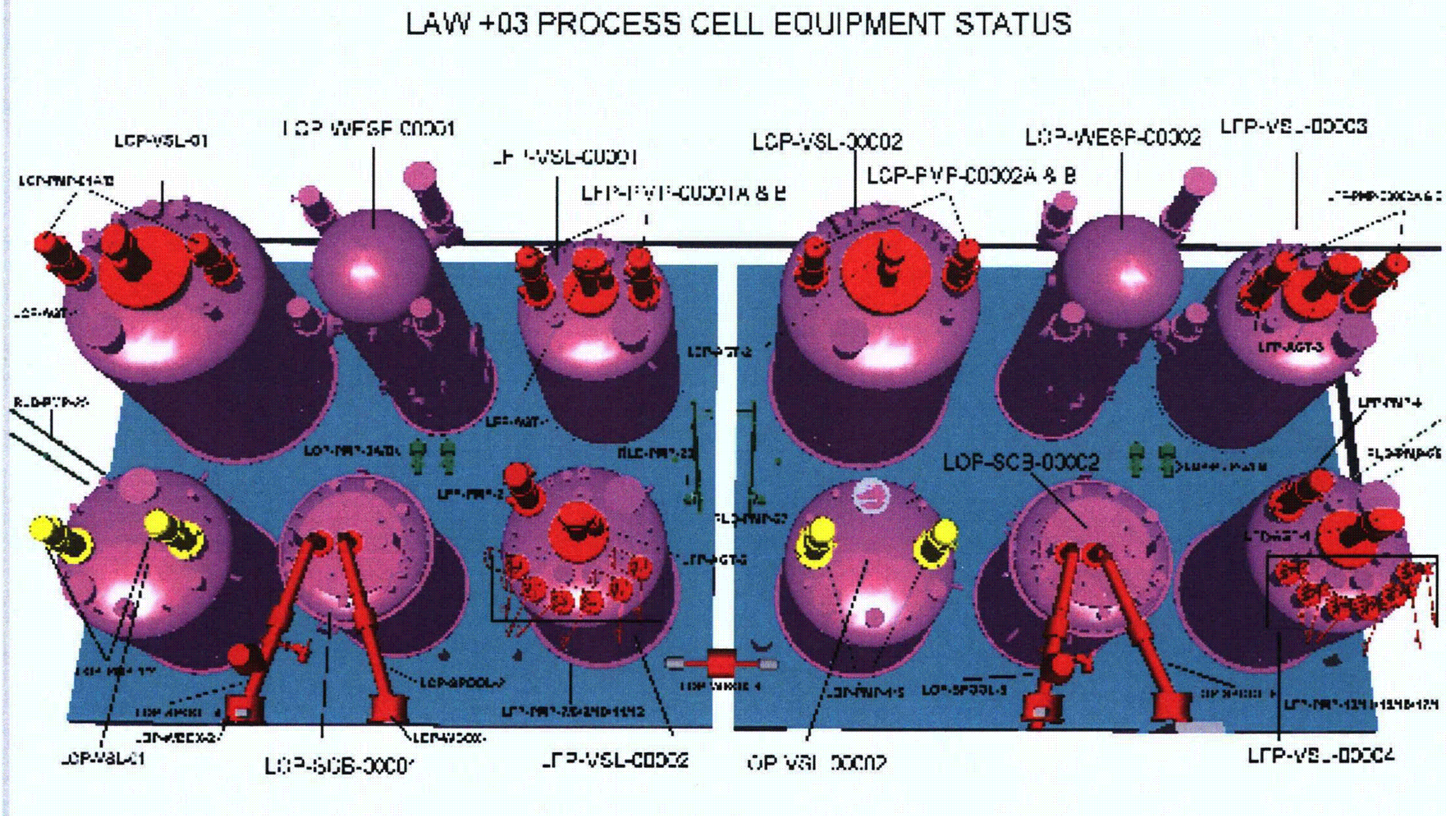
■ Concrete	27,500 cubic yards
■ Steel	6,000 ton
■ Duct	929,200 pounds
■ Pipe	99,500 feet
■ Cable Tray	16,900 feet
■ Conduit	160,000 feet
■ Cable	836,400 feet

LAW +03 EQUIPMENT STATUS

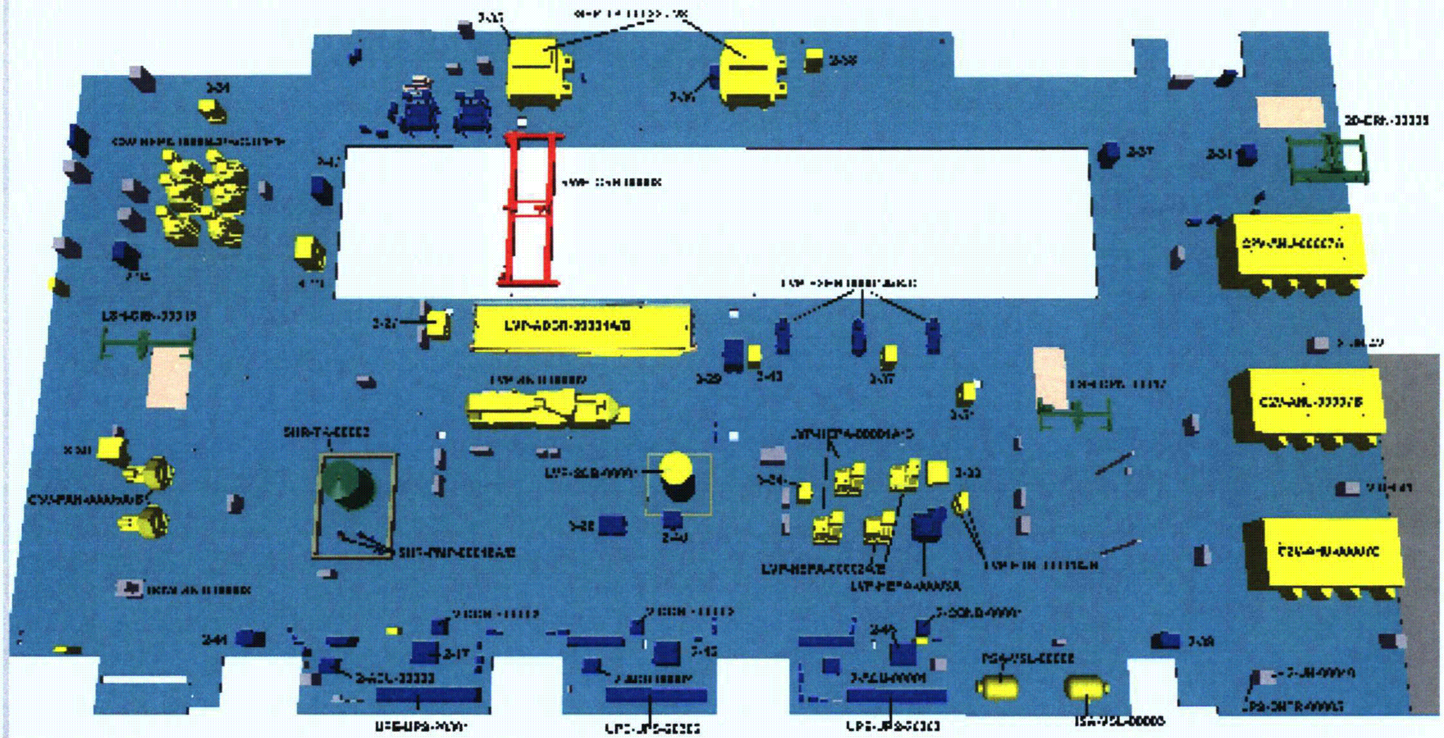


LAW +03 FINISHING LINE EQUIPMENT STATUS




LAW +03 PROCESS CELL EQUIPMENT STATUS
LOP-WESF-00002
LOP-SCB-00002
LCP-VSL-00002
LOP-SCB-00001

LAW +48 EQUIPMENT STATUS



Laboratory Function

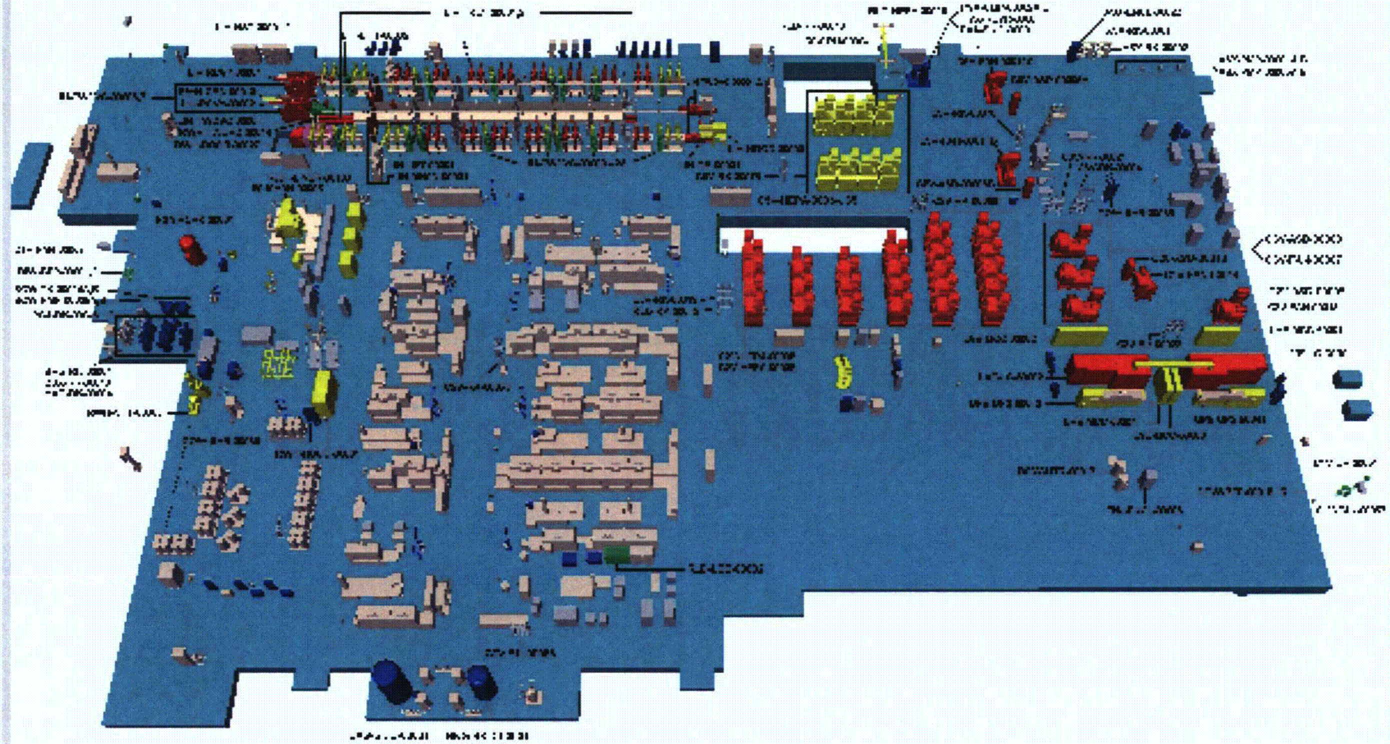
- The laboratory will perform chemical and radio-chemical analysis of samples to support the operation of the WTP.
- The laboratory has the capability of processing and analyzing samples to support the WTP glass forming operation.

Engineering Release Quantities-Analytical Laboratory

■ LAB	196 ft x 342 ft x 38 ft
■ Concrete	11,900 cubic yards
■ Steel	1,600 ton
■ Duct	326,600 pounds
■ Pipe	32,100 feet
■ Cable Tray	3,800 feet
■ Conduit	41,200 feet
■ Cable	149,500 feet

Scan

LAB +00 EQUIPMENT STATUS



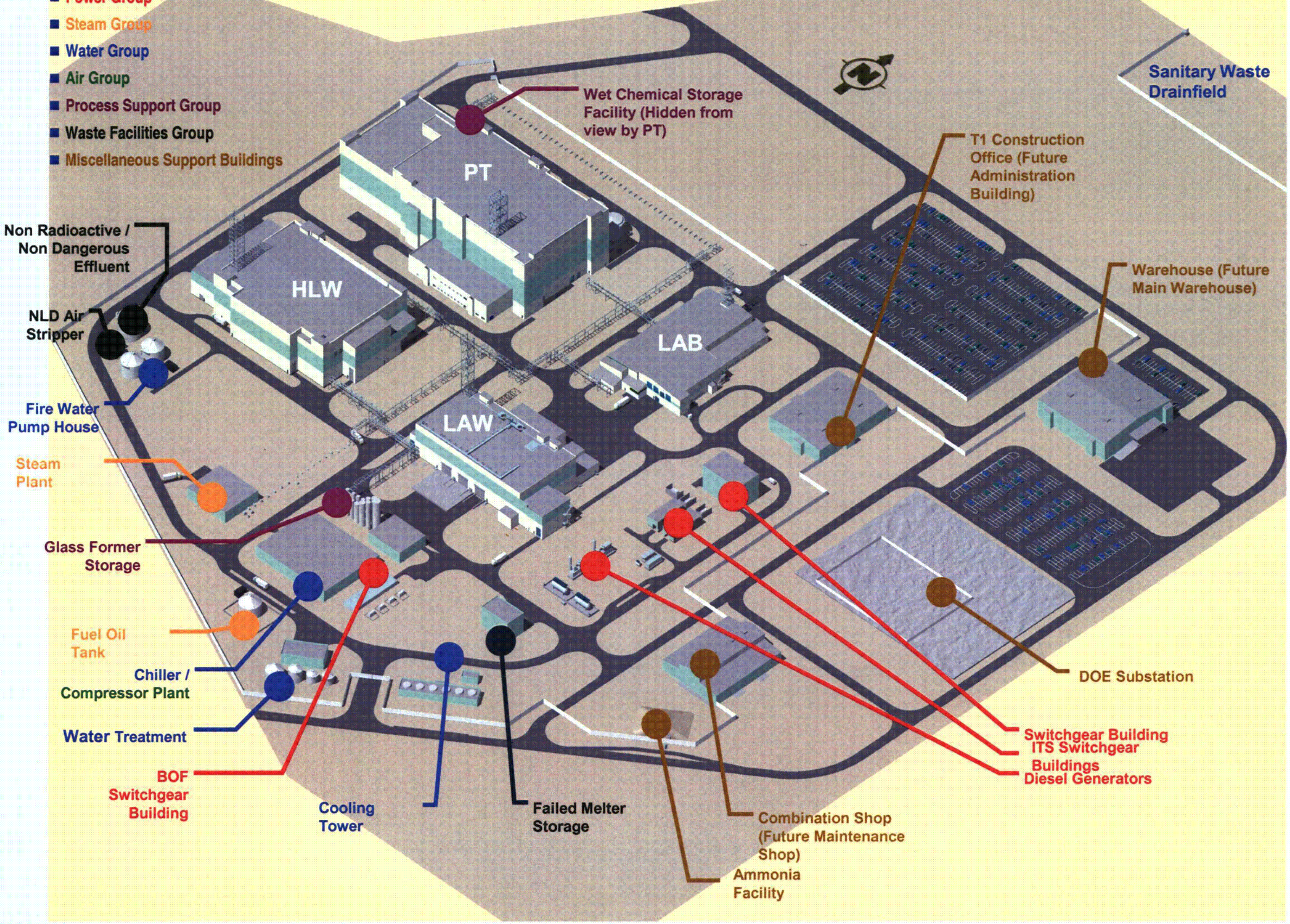
BOF Function

- Provide Process facilities with the utilities and services necessary to process waste
  - Steam
  - Process Water
  - Chilled Water
  - Cooling Water
  - Power
  - Compressed Air
  - Glass Formers
  - Wet Chemicals

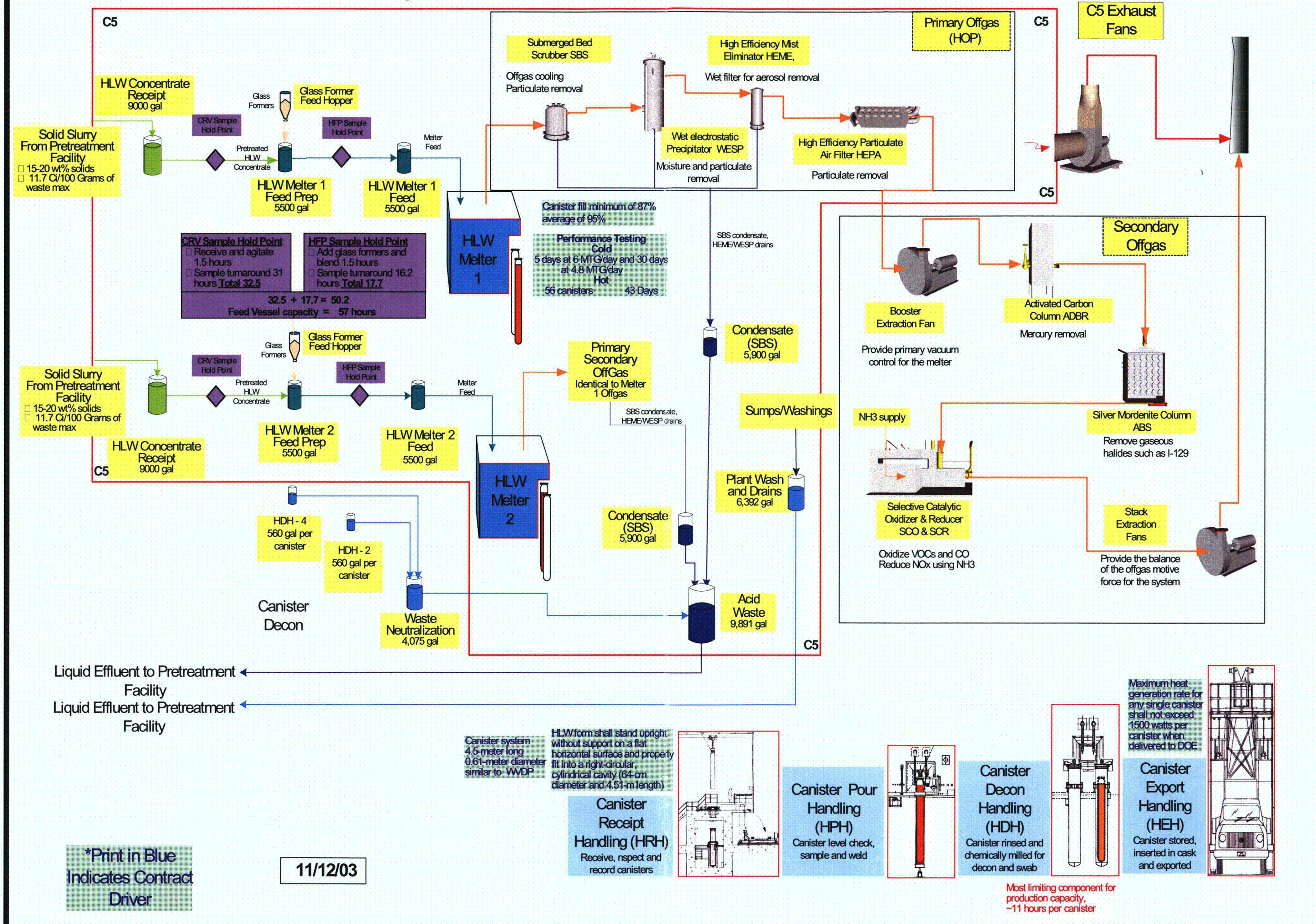
Engineering Release Quantities-Balance of Facilities

Concrete	16,500 cubic yards
Steel	900 ton
Pipe	40,500 feet
Cable Tray	8,800 feet
Conduit	266,700 feet
Cable	697,400 feet

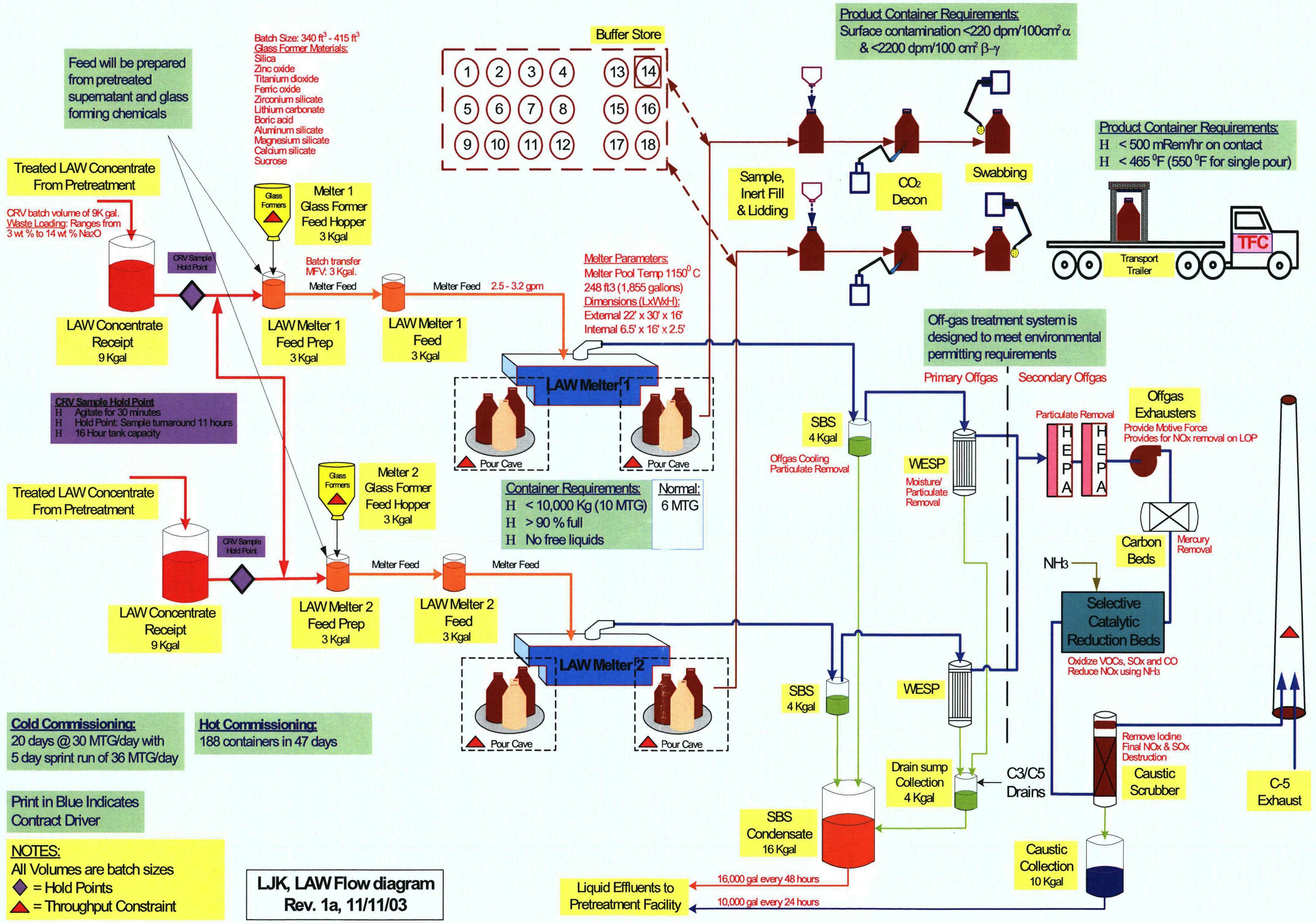
Waste Treatment Plant



WTP HLW Flow Diagram



WTP LAW Flow Diagram



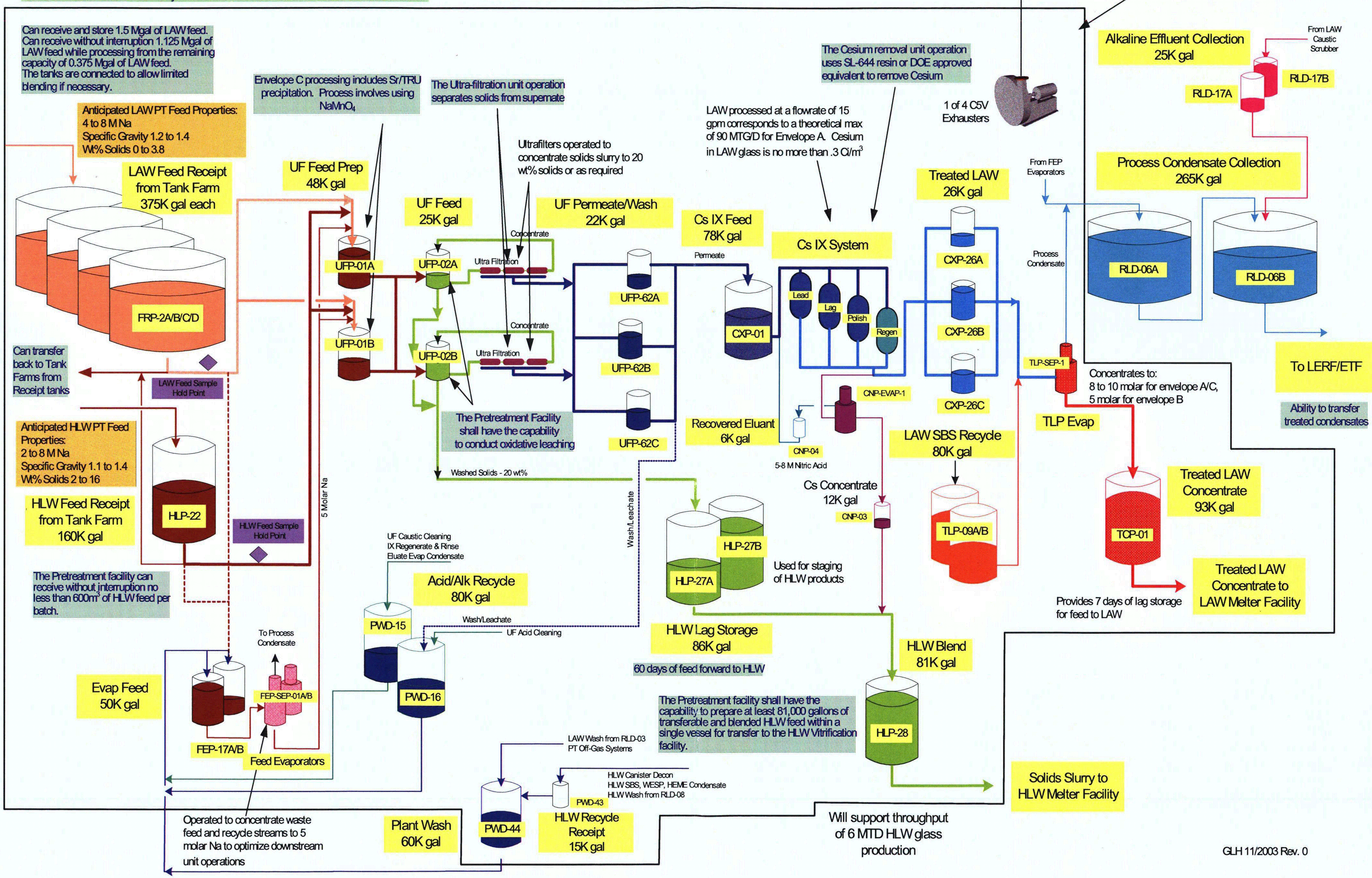
WTP Pretreatment Flow Diagram

Cold Commissioning Performance Testing

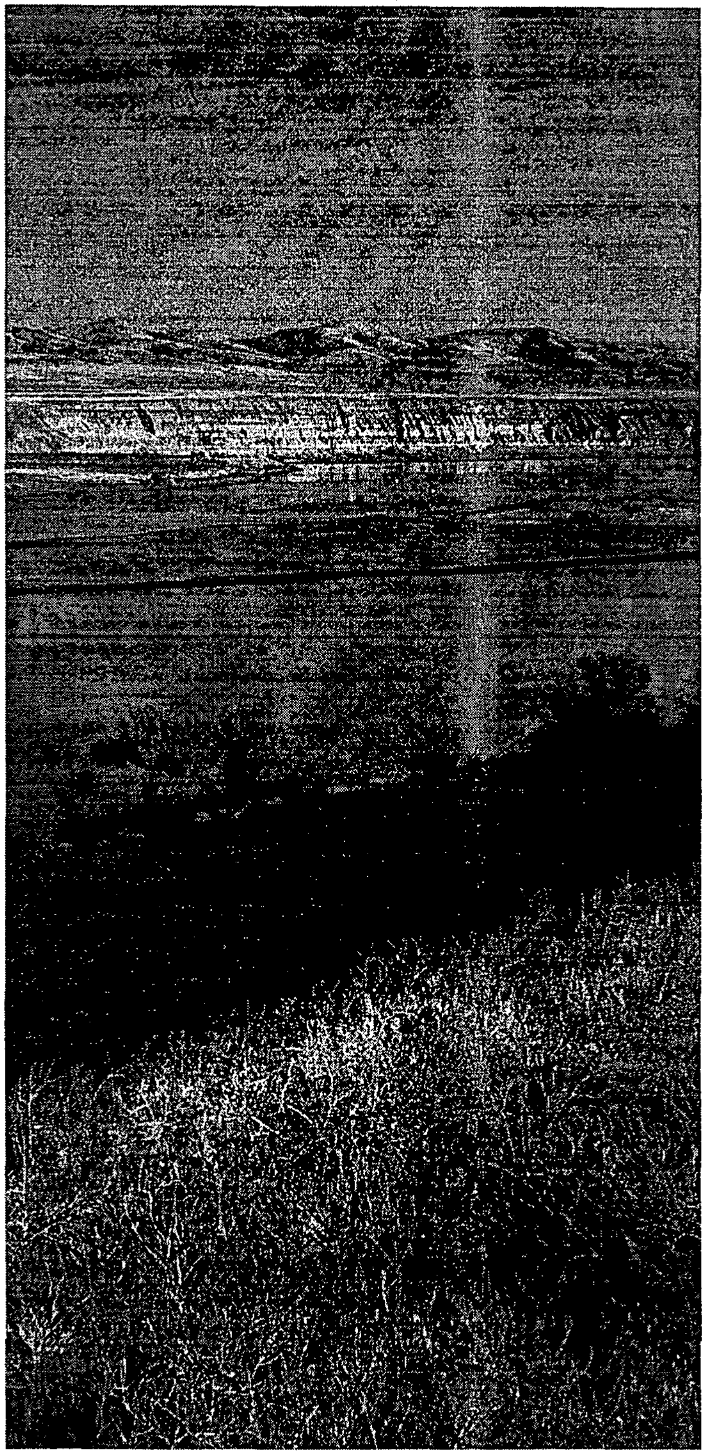
Minimum	Expected	Goal
5 days @ average of 4.2 MTG/ day and 20 days @ average of 3.2 MTG/day	5 days @ average of 5.4 MTG/ day and 20 days @ average of 4.2 MTG/ day	5 days @ average of 6 MTG/ day and 20 days @ average of 4.8 MTG/day
5 days @ average of 64 MTG/ day and 20 days @ average of 48 MTG/ day	5 days @ average of 80 MTG/day and 20 days @ average of 64 MTG/ day	5 days @ average of 90 MTG/ day and 20 days @ average of 84 MTG/day

Hot Commissioning Performance Testing

Facility	Production	Duration (Days) Minimum	Duration (Days) Expected
PT H	84 MTG Equivalent	27	20
PT L	1280 MTG Equivalent	27	20



GLH 11/2003 Rev. 0



Pretreatment Presentation

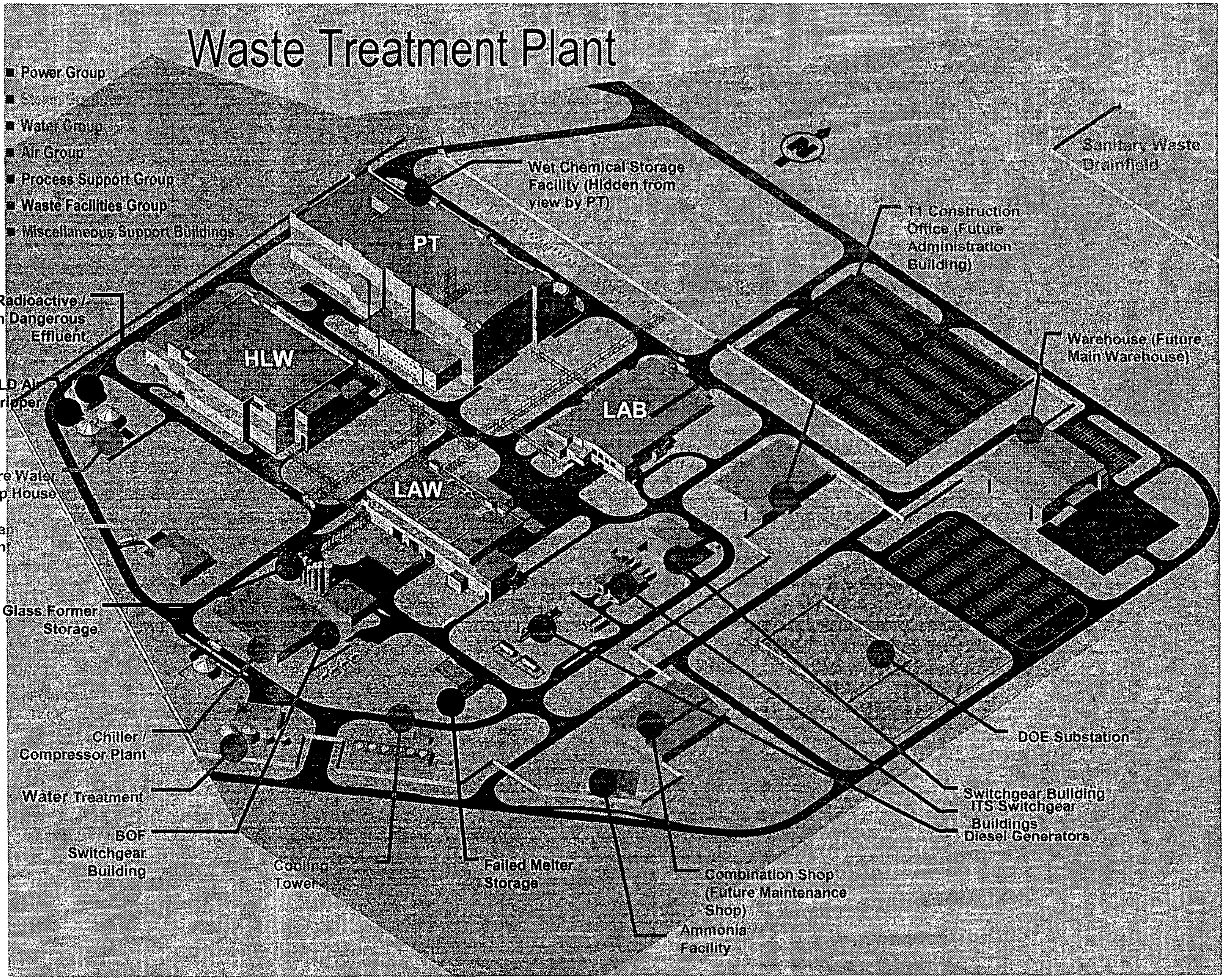
John Schneider
Pretreatment Project Engineering Manager

Presented to:
Comprehensive Flowsheet Review Team
October 17-20, 2005

U.S. Department of Energy

Office of River Protection

Bechtel National, Inc.

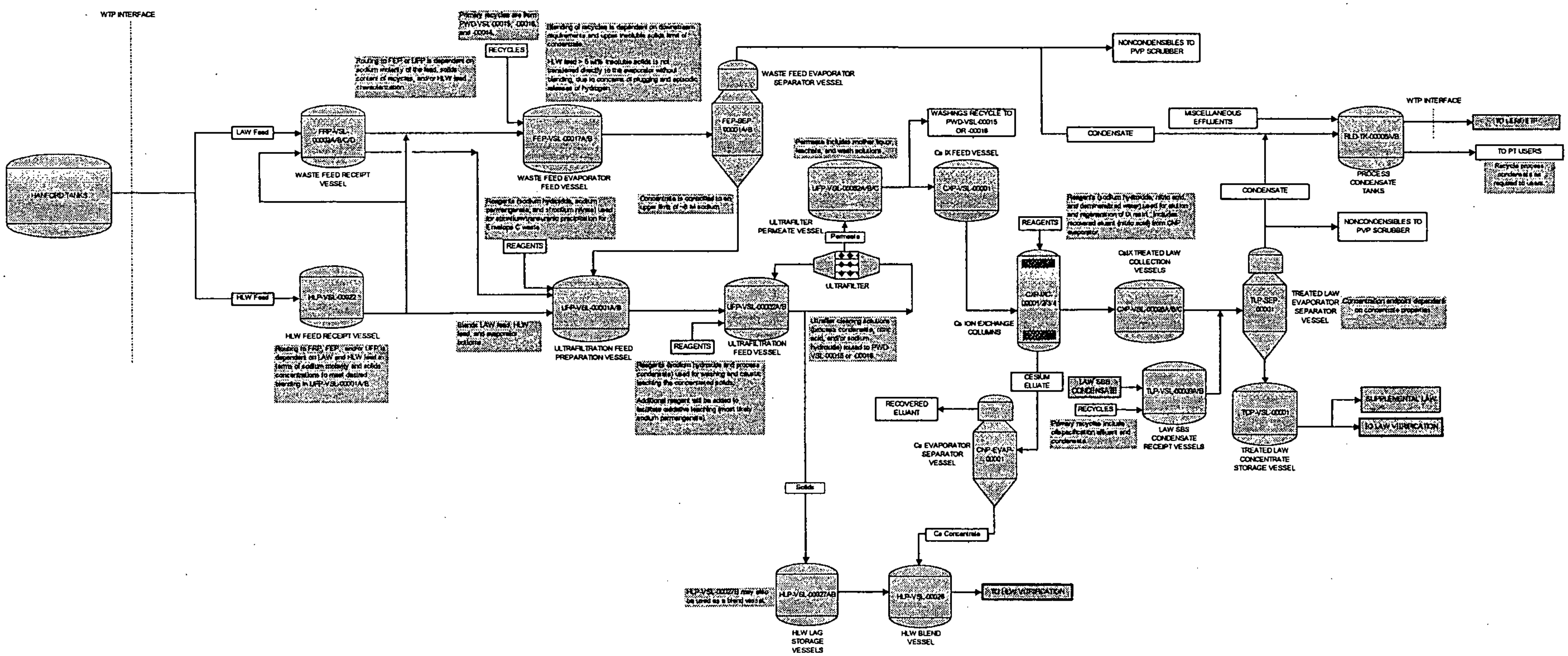


Waste Treatment Plant
Power Group
Water Group
Air Group
Process Support Group
Waste Facilities Group
Miscellaneous Support Buildings
Wet Chemical Storage Facility (Hidden from view by PT)
Sanitary Waste Drainfield
T1 Construction Office (Future Administration Building)
PT
HLW
LAB
LAW
Non Radioactive / Non Dangerous Effluent
NLD Air Stripper
Fire Water Pump House
Stea
Plan
Warehouse (Future Main Warehouse)
Glass Former Storage
Chiller / Compressor Plant
Water Treatment
BOF Switchgear Building
Cooling Towers
Failed Melter Storage
DOE Substation
Switchgear Building
ITS Switchgear Buildings
Diesel Generators
Combination Shop (Future Maintenance Shop)
Ammonia Facility

PT Function

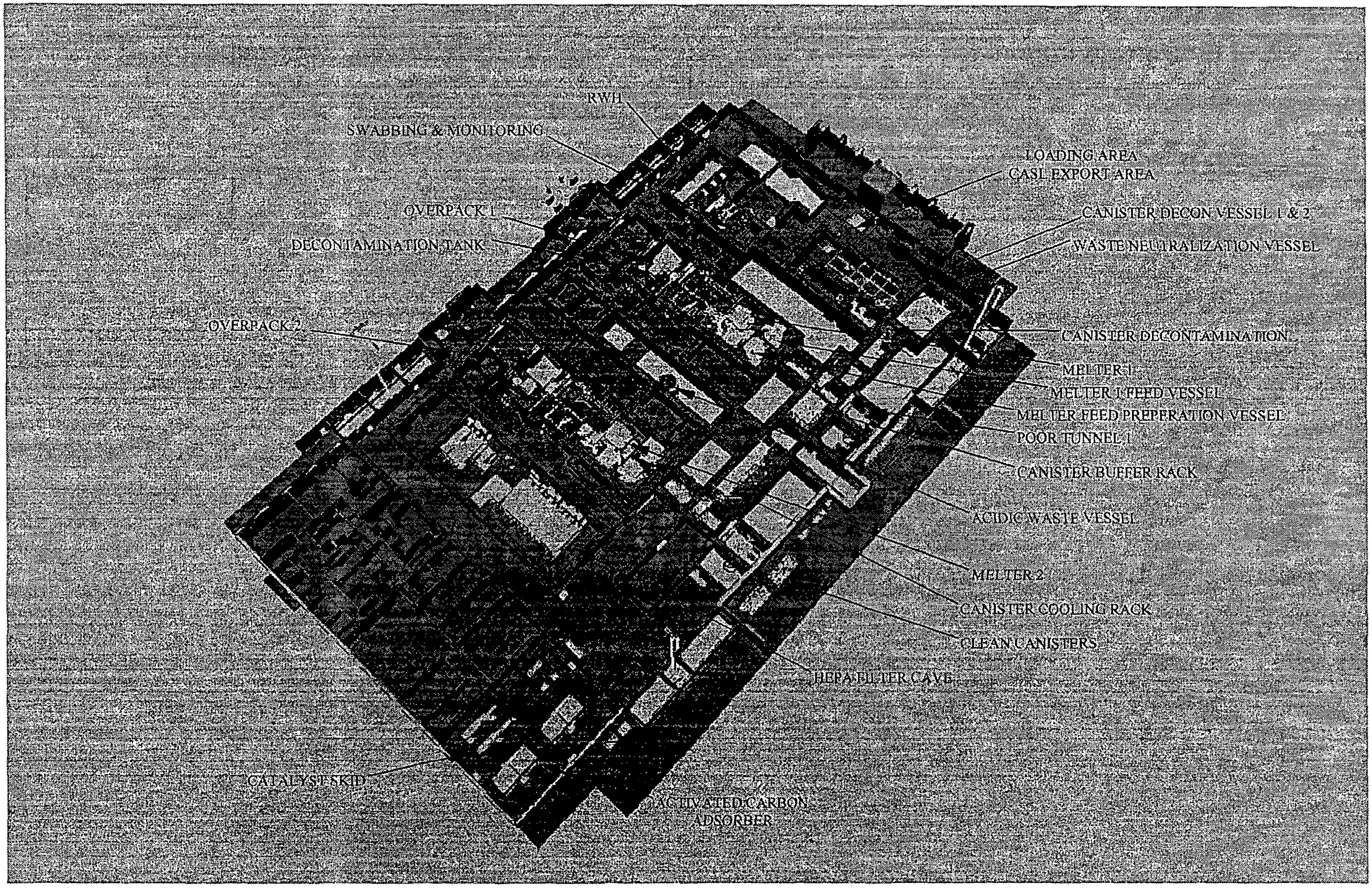
- Separate select radio nuclides and solids from Na and other soluble salts to process into HLW
- Process at a rate to support 480 canisters HLW
- Process LAW to provide 2200 units of waste Na on average

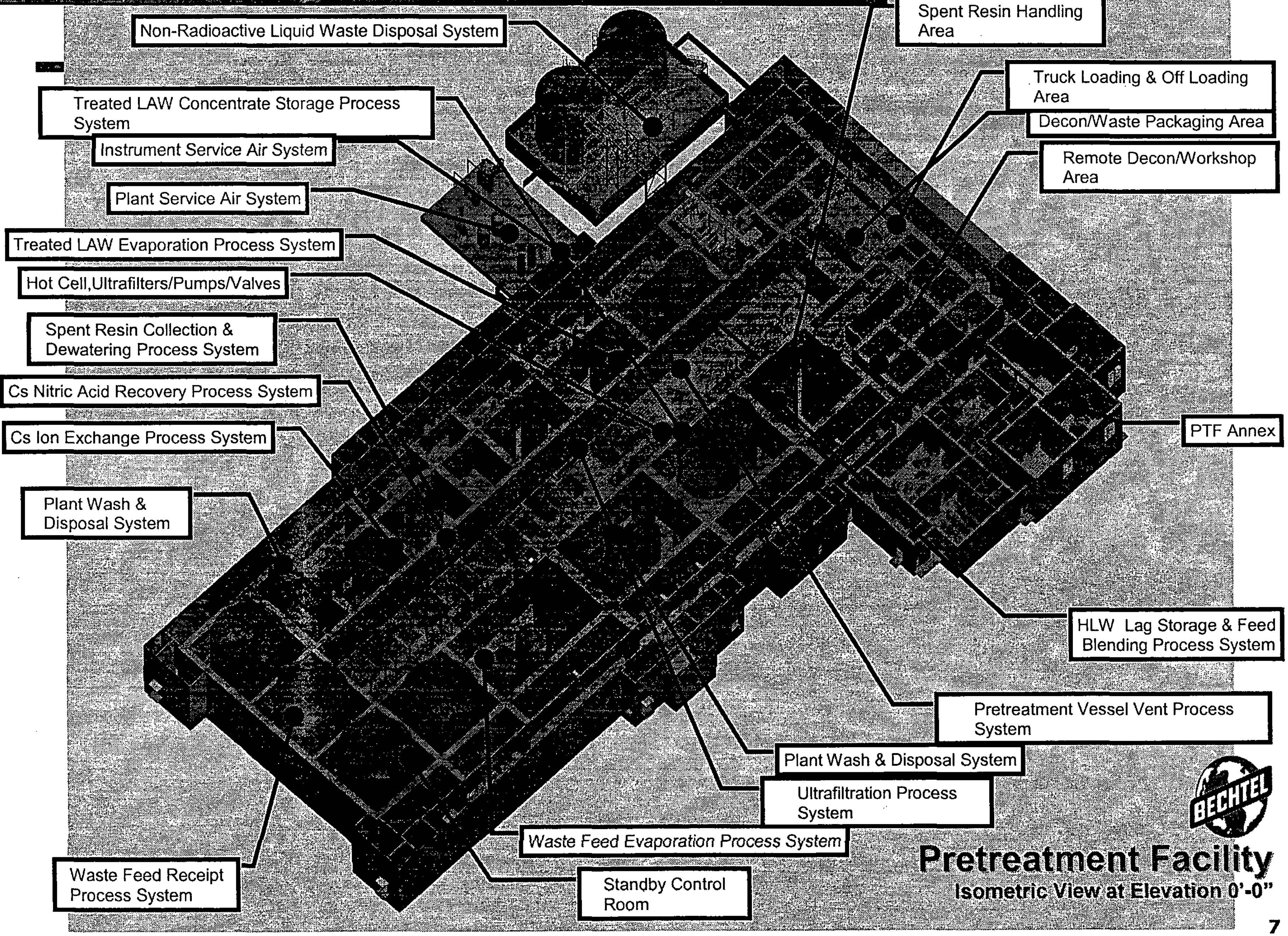
Simplified PT Flow Diagram



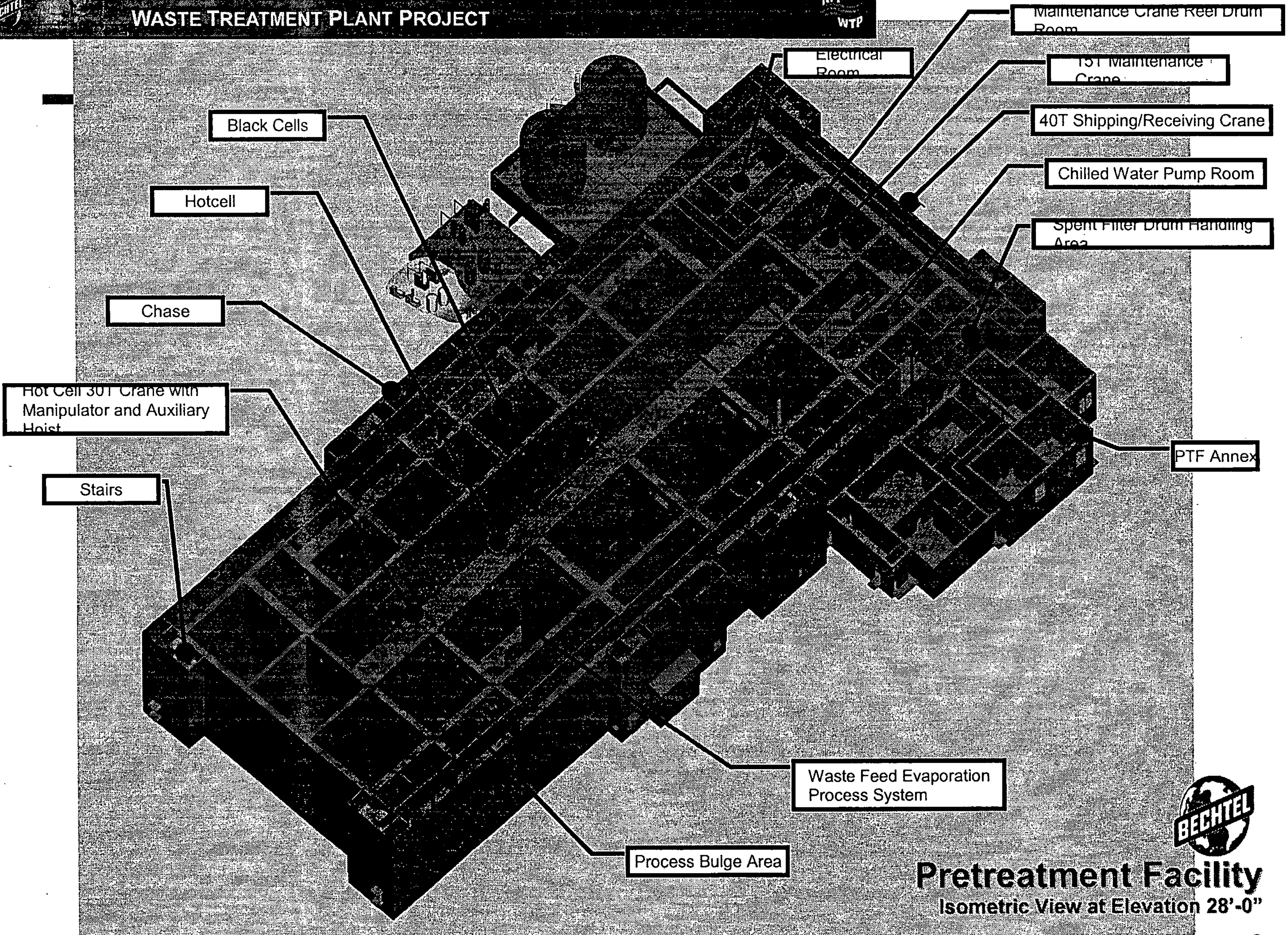
Engineering Release Quantities-Pretreatment

PT	565 ft l. x 216 ft w x 119 ft. h.
Concrete	111,800 cubic yards
Steel	16,000 tons
Duct	1,709,100 pounds
Pipe	540,700 feet
Cable Tray	36,700 feet
Conduit	464,700 feet
Cable	1,479,000 feet


RWH
SWABBING & MONITORING
LOADING AREA
CASL EXPORT AREA
OVERPACK 1
DECONTAMINATION TANK
CANISTER DECON VESSEL 1 & 2
WASTE NEUTRALIZATION VESSEL
OVERPACK 2
CANISTER DECONTAMINATION
MELTER 1
MELTER 1 FEED VESSEL
MELTER FEED PREPERATION VESSEL
POOR TUNNEL 1
CANISTER BUFFER RACK
ACIDIC WASTE VESSEL
MELTER 2
CANISTER COOLING RACK
CLEAN CANISTERS
HEPA FILTER CAVE
CATALYST SKID
ACTIVATED CARBON
ADSORBER

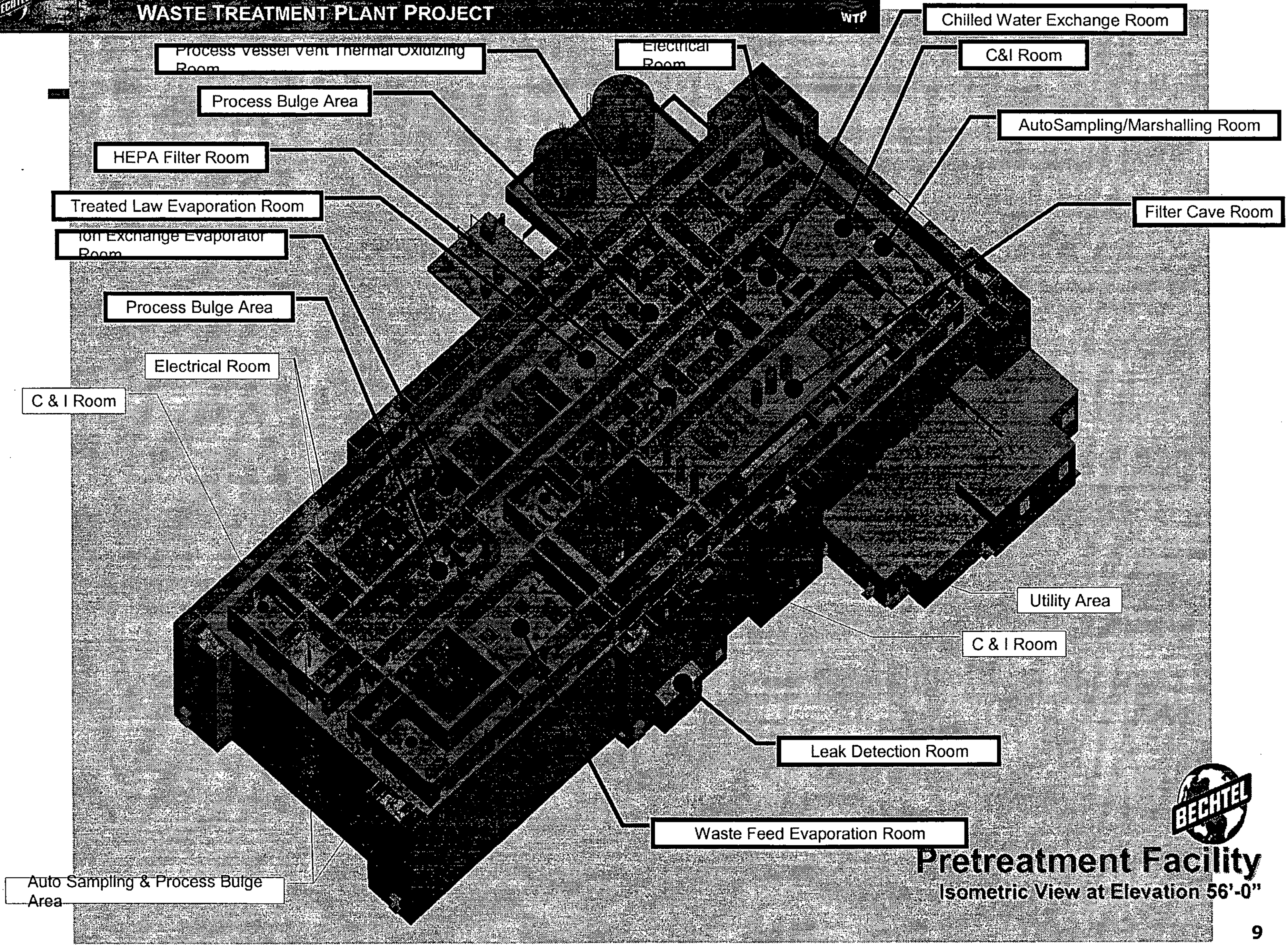


Pretreatment Facility
Isometric View at Elevation 0'-0"



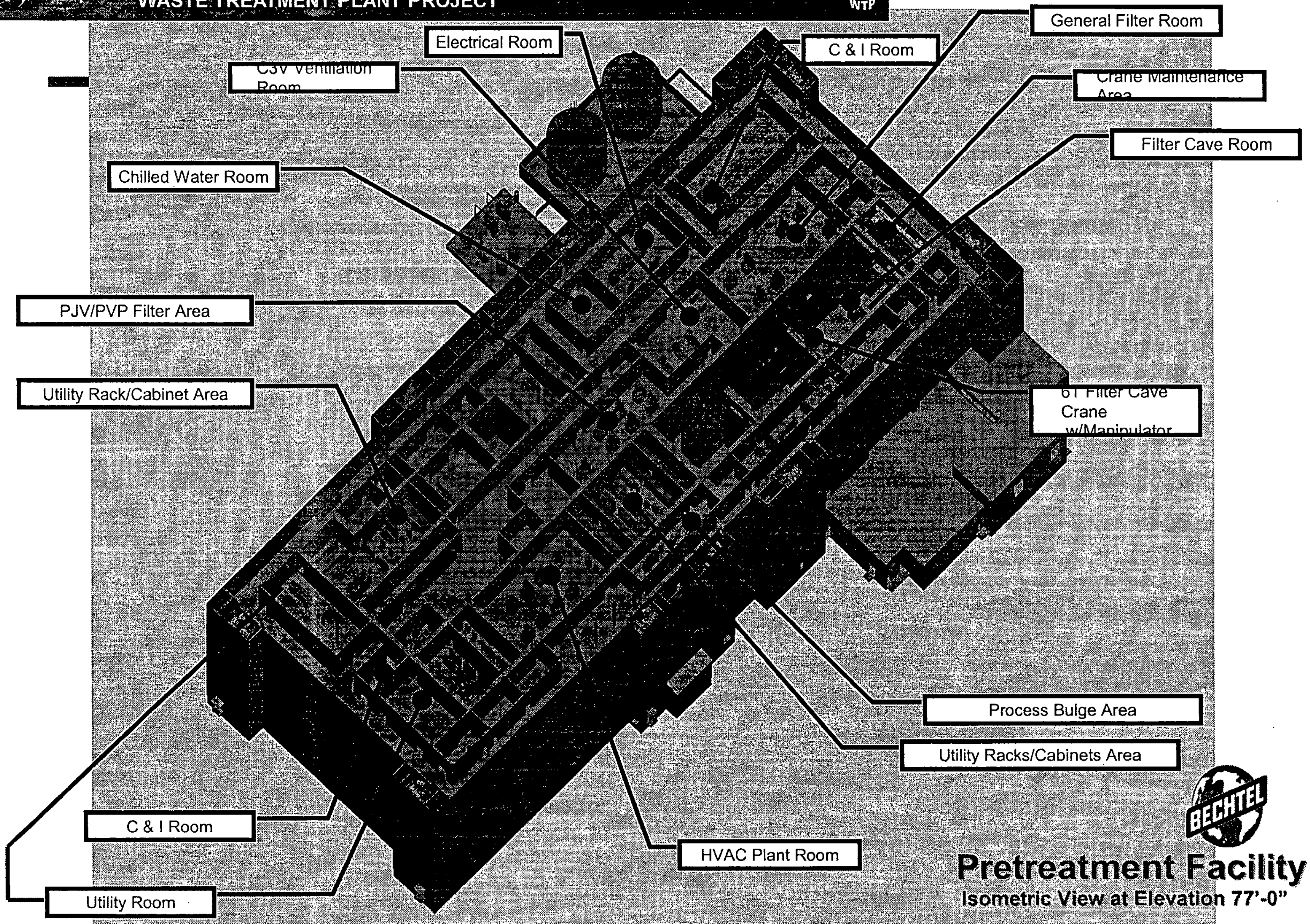
Pretreatment Facility

Isometric View at Elevation 28'-0"



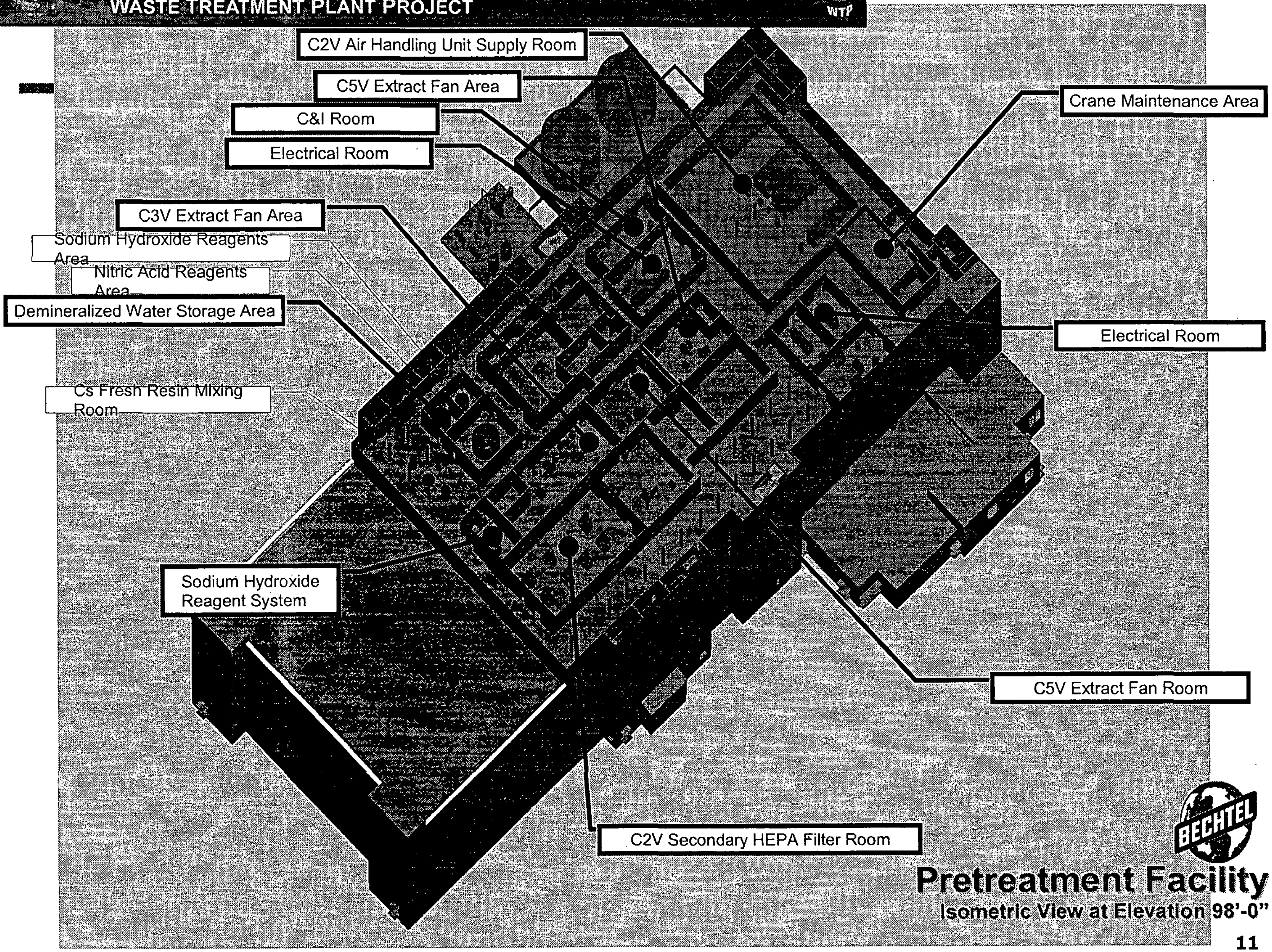
Pretreatment Facility

Isometric View at Elevation 56'-0"



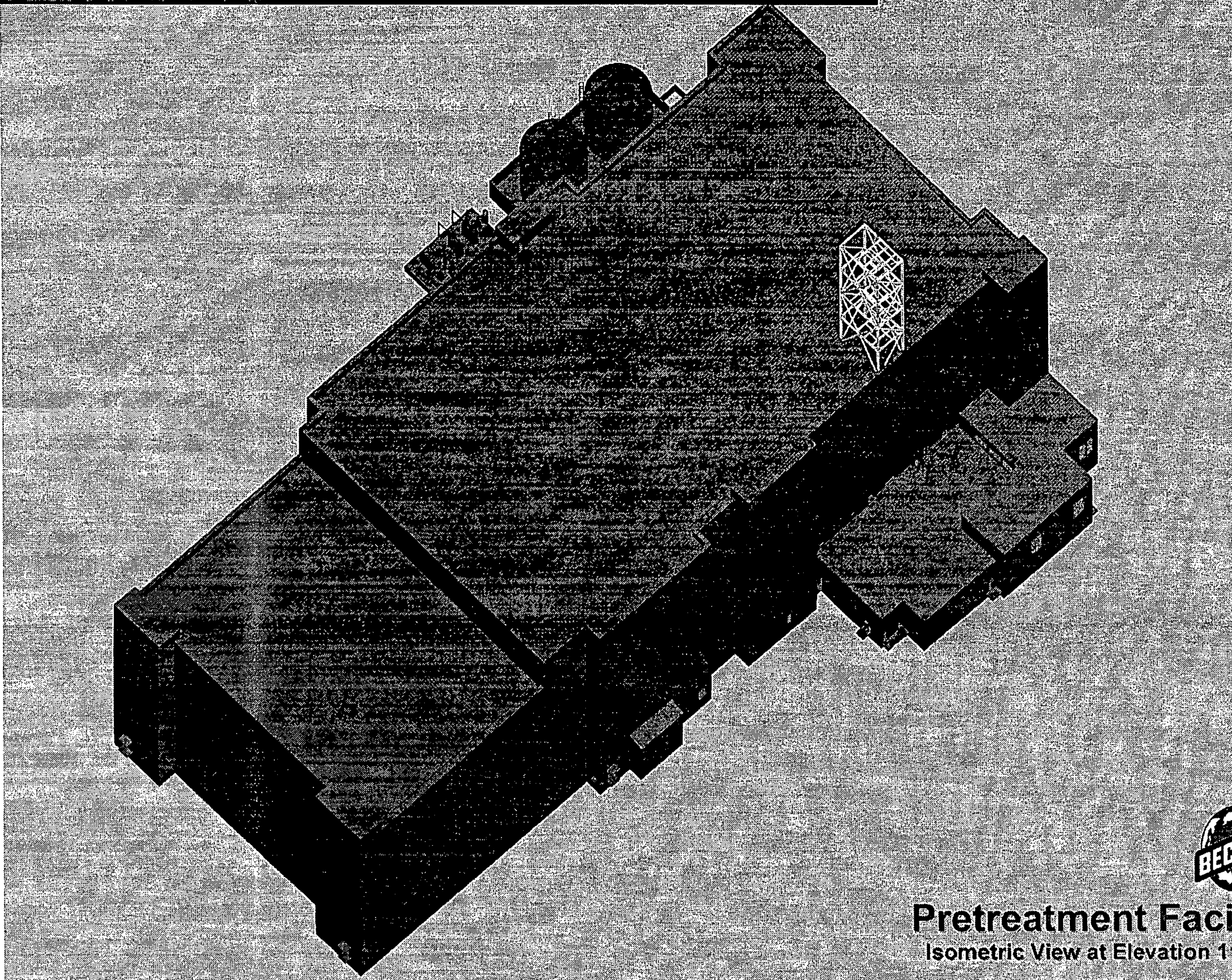
Pretreatment Facility

Isometric View at Elevation 77'-0"



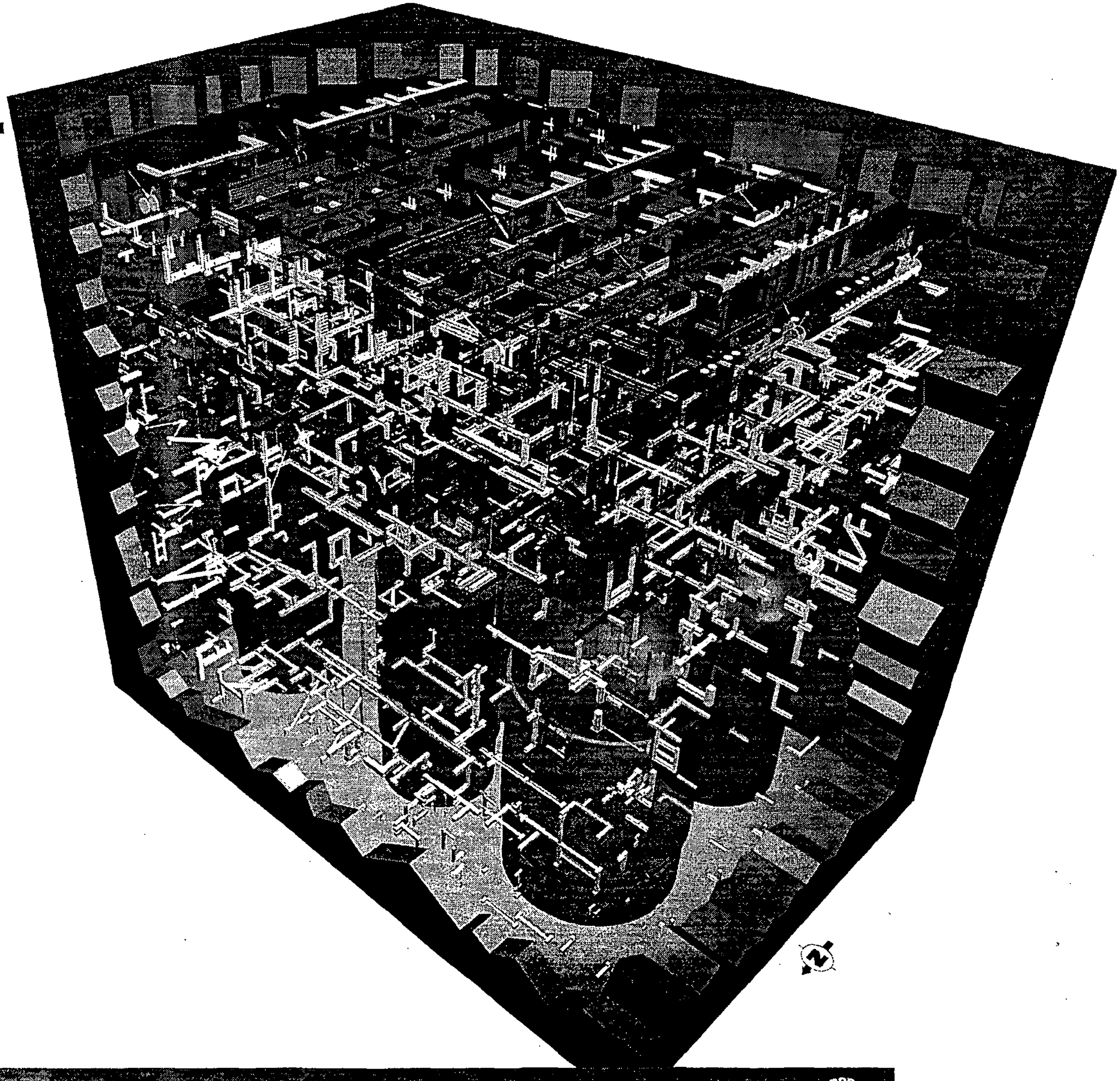
Pretreatment Facility

Isometric View at Elevation 98'-0"



Pretreatment Facility

Isometric View at Elevation 119'-0"



PLANNING AREA 3

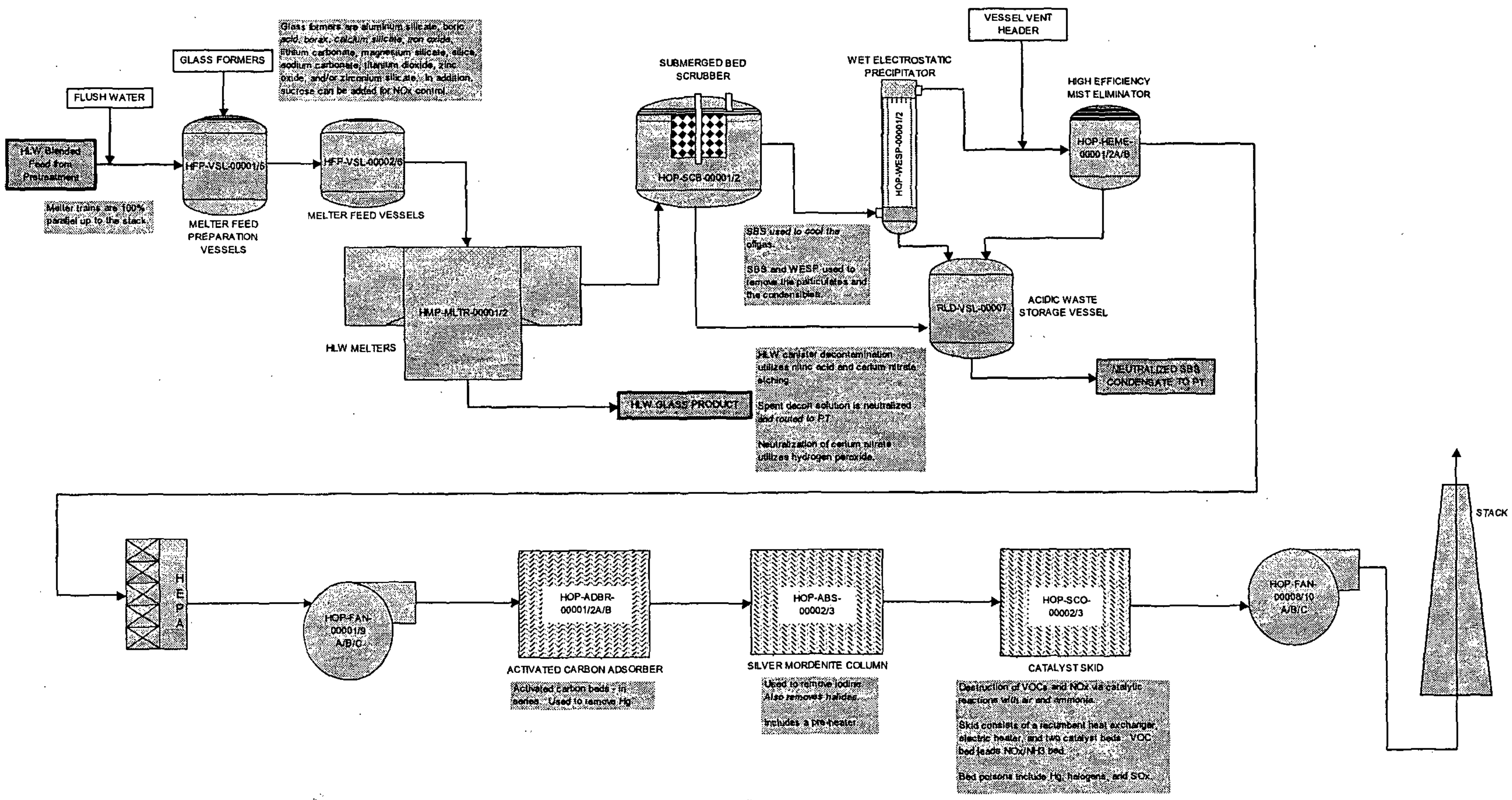
HLW Function

Process High Level Waste into Immobilized High Level Waste

Process 6 Mtons/day

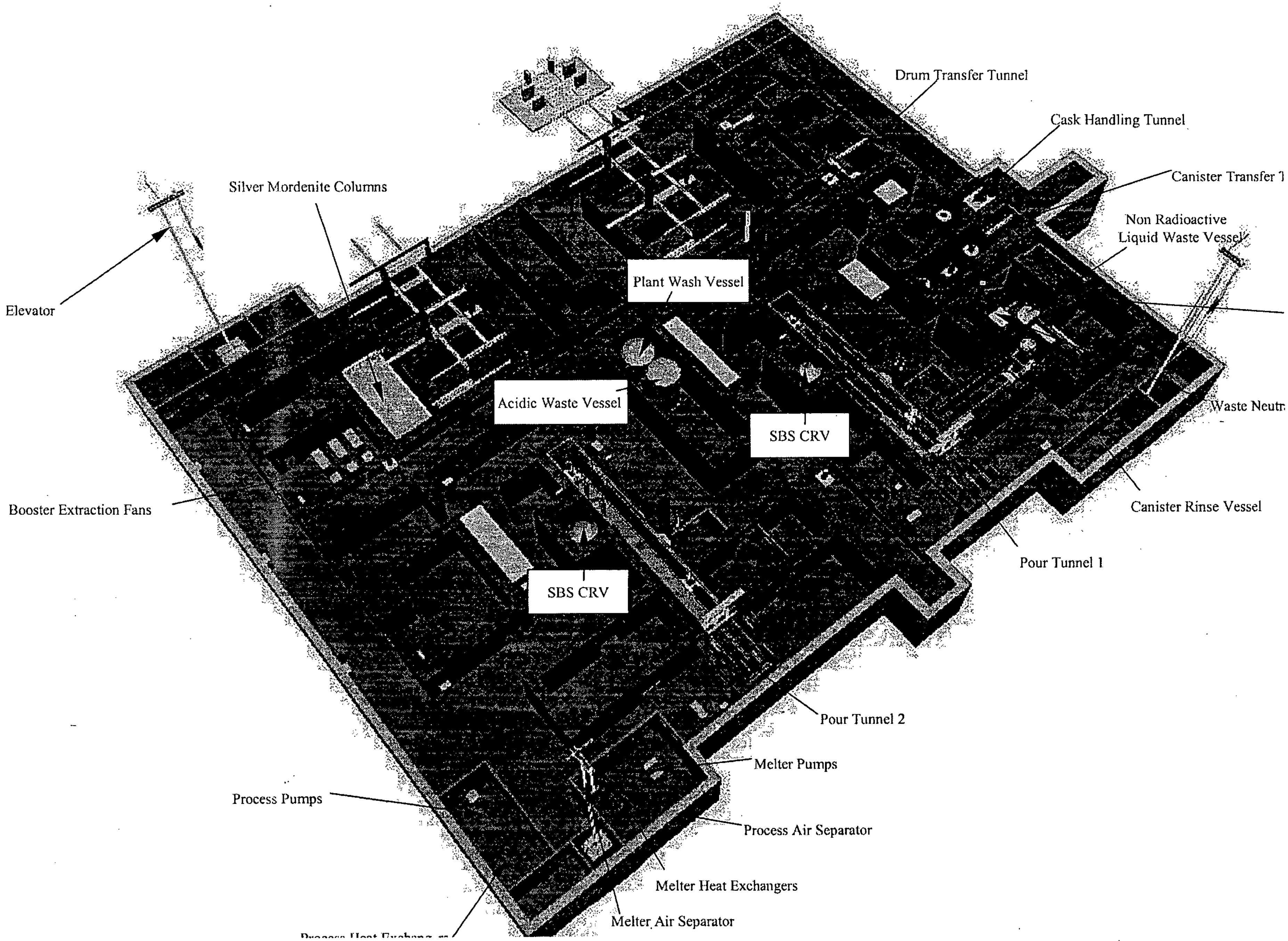
The HLW Facility is designed for an average throughput of 480 canisters of waste per year.

Simplified HLW Flow Diagram

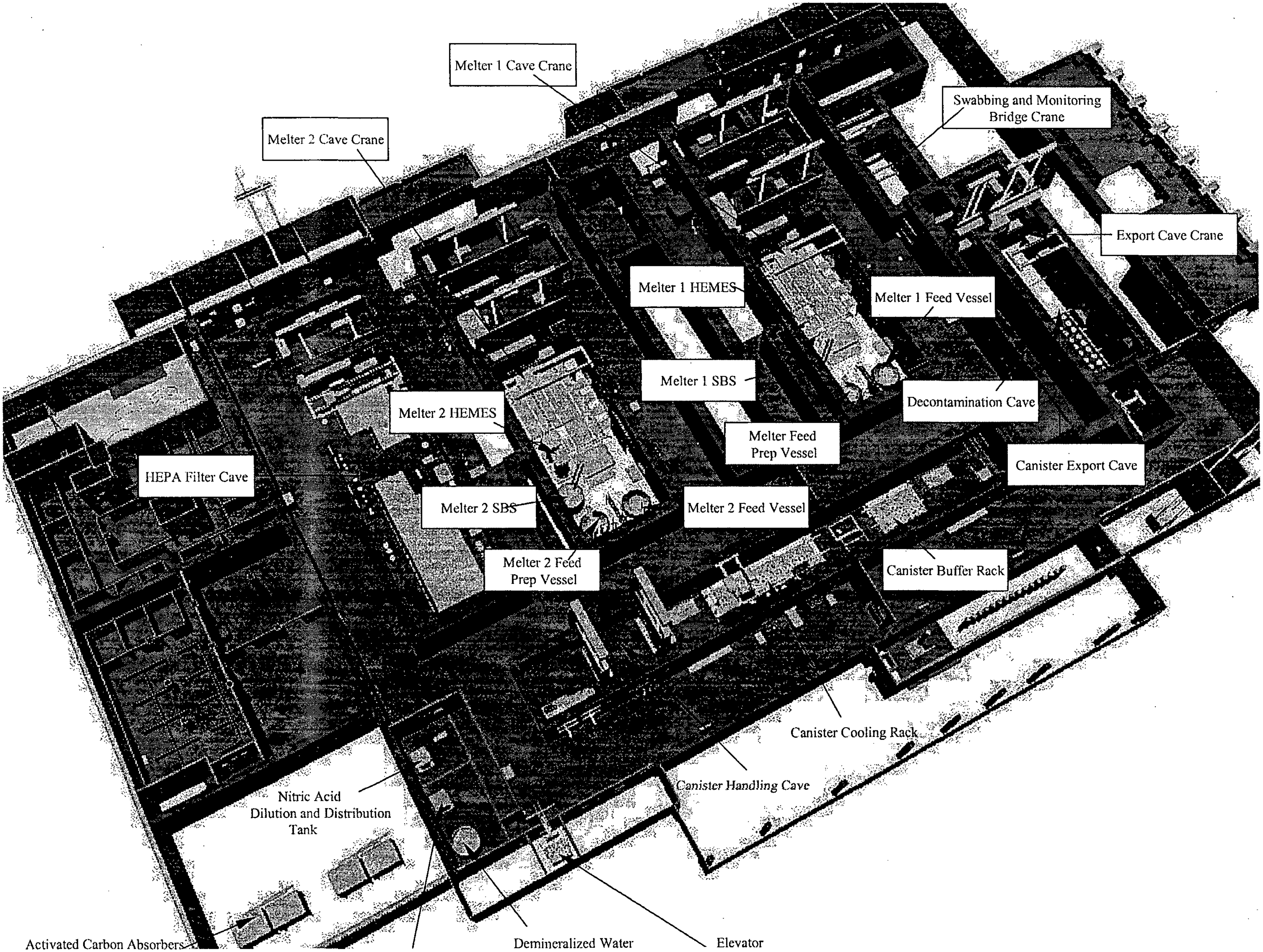


Engineering Release Quantities-High Level Waste

Concrete	87,600 cubic yards
HLW	448 ft l.x 275 ft w. x 98 ft h.
Steel	8,200 ton
Duct	1,148,900 pounds
Pipe	167,700 feet
Cable Tray	33,400 feet
Conduit	535,700 feet
Cable	3,312,500 feet



Drum Transfer Tunnel
Cask Handling Tunnel
Canister Transfer T
Silver Mordenite Columns
Non Radioactive
Liquid Waste Vessel
Plant Wash Vessel
Elevator
Acidic Waste Vessel
SBS CRV
Waste Neutr
Booster Extraction Fans
Canister Rinse Vessel
Pour Tunnel 1
SBS CRV
Pour Tunnel 2
Melter Pumps
Process Pumps
Process Air Separator
Melter Heat Exchangers
Melter Air Separator


Melter 1 Cave Crane
Melter 2 Cave Crane
Swabbing and Monitoring Bridge Crane
Export Cave Crane
Melter 1 HEMES
Melter 1 Feed Vessel
Melter 1 SBS
Decontamination Cave
Melter 2 HEMES
Melter Feed Prep Vessel
Canister Export Cave
HEPA Filter Cave
Melter 2 SBS
Melter 2 Feed Vessel
Melter 2 Feed Prep Vessel
Canister Buffer Rack
Canister Cooling Rack
Canister Handling Cave
Nitric Acid Dilution and Distribution Tank
Activated Carbon Absorbers
Demineralized Water
Elevator