ATTACHMENT 1b

Consumers Power Company
Palisades Plant
Docket 50-255

PROCESS CONTROL PROGRAM

August 29, 1985

13 Pages

Consumers Power Company
Palisades Plant - Docket 50-255

PROCESS CONTROL PROGRAM (PCP)

July 1, 1985

Approved ______________ 8/19/85
General Manager Date

______________ for WLB 8/19/85
Radiological Services Manager Date

______________ 8/19/85
Technical Review Date

______________ 8/26/85
Plant Review Committee Date
3137

PALISADES PROCESS CONTROL PROGRAM (PCP)

1.0 ALPHALT VOLUME REDUCTION SYSTEM

The Palisades Plant utilized a Waste Chem volume reduction and solidification system (VRS) to process various radioactive liquid waste streams.

The process utilizes thermal energy (heat) to evaporate water from the radioactive wastes thus reducing waste volume to anhydrous waste residue. This residue is then encapsulated in a thermoplastic matrix (asphalt).

The end product is a monolithic, freestanding solid with no free liquid. Fifty-five gallon drums are used to contain the encapsulated waste for temporary storage, transport and burial.

1.1 VARIABLES INFLUENCING SOLIDIFICATION

The purpose of this section is to identify and define those process variables which have a direct effect on the ability of the final product to form a freestanding monolith with no free liquid.

The following variables influence the properties and consistency of the final product:

a. Asphalt type

b. Waste chemical species used as feed

c. Ratio of waste-to-asphalt

d. Process temperature

e. pH

1.2 ASPHALT TYPE

Asphalt utilized in the system shall conform to ASTM-D-312-71, Type III. This is an oxidized petroleum-based asphalt, such as Witco Chemical Company's Pioneer 221. The specifications for this asphalt are provided in Appendix A.

This grade of asphalt has a low residual volatile content and a high molecular weight. At room temperature, and at all normal ambient temperature conditions, this material is a freestanding, monolithic, solid.

Utilization of an asphalt complying with ASTM-D-312-71, Type III, is the means by which process control of this variable is achieved.

1.3 WASTE CHEMICAL SPECIES

The type and relative quantity (waste-to-asphalt ratio) of waste chemicals being incorporated into the asphalt matrix has a direct influence on the properties of the final product. Encapsulation of inorganic salts and solids typically "stiffen" and harden the end product, whereas organic liquids have the opposite tendency. When the specified ratio of waste-to-asphalt is maintained, final product properties for typical power plant wastes are independent of the waste type.

However, certain chemical specifications are required as an outer bounds to limit end product tendencies to soften at lower temperatures.

A maximum limit of 1% oil by weight will be applied to the waste feed streams. Most oils found in power plants are low viscosity fluids, which are liquid at room temperature. Based on calculations for a typical waste stream with 20% solids by weight and 1% oil by weight, Waste Chem has found the total concentration of oil in the end product would be approximately 2.5%. This would then lower the end product softening point by approximately 5°F, or approximately 2°F lower per percent of oil. This is within an acceptable range and, therefore, is the basis for the limit of 1% oil in the feed stream. pH should be in the range of 7.5 to 8.5 for the best product.

Other chemical specifications on feed streams are specified below. These are required primarily for calculating waste-to-asphalt ratio which is important to end product, and equipment protection (which will have no discernable effect on the end product).

REQUIRED ANALYSIS

Concentrates	Resin/Powdex
pH (Equip Limit)	pH (Equip Limit)
% Solids	% Slurry
Sp Gravity	
Oil %	

1.4 WASTE-TO-ASPHALT RATIO

The ratio of waste-to-asphalt contained in the end product has the most significant effect on the viscosity and physical consistency of that product. Process control is achieved by placing limitations on the range of waste-to-asphalt ratios allowable for each waste type.

Waste-to-asphalt ratios (mass) and evaporative rates should not exceed the verification test values specified for the waste feeds as follows:

Feed		Ratio of Waste-to-Asphalt in the End Product
1.	Boric Acid Concentrates at 120 L/hr Evaporative Rate	$\leq$ 1.0/1.0
2.	Spent Resins at 80 L/hr Evaporative Rate	$\leq$ .67/1.0
3.	Powdex at 80 L/hr Evaporative Rate	$\leq$ .67/1.0

Should the ratio of waste-to-asphalt be increased above the range specified in the foregoing table, the end product viscosity will increase and may exhibit a grainy texture. This could lead to "pyramiding" in the steam domes. In all cases, the product will cool to form a freestanding monolith. If lower than specified waste loadings are realized, the end product properties will approach that of pure asphalt. Again, solidification is assured; however, toward this end of the spectrum, economical volume reduction may not be realized.

Maximum concentrate feed rate can be determined by the following formula:

$$\text{Conc Feed Rate} = \frac{0.528 \text{ GPM}}{(1.0 - \text{Solids Fraction})\ (\text{Sp Gravity})}$$

NOTE 0.528 gpm = 120 L/hr evaporative rate.

The corresponding asphalt feed is calculated by:

$$\text{Asphalt Feed (GPM)} = \frac{(\text{Conc Feed Rate GPM})\ (\text{Solids Fraction})\ (\text{Sp Gravity})}{(\text{Waste-to-Asphalt Ratio})}$$

where the recommended waste-to-asphalt ratio is 1.0.

NOTES: 1. The density of Type III asphalt is 1.0 so a density correction is not needed.

2. The minimum asphalt flow is 0.065 gpm because of lubrication requirements of the twin screws.

3. If either the concentrate or asphalt flows cannot be met, the calculated flows can be ratioed to new values to maintain the 1.0/1.0 waste-to-asphalt ratio as long as the maximum concentrate flow or the minimum asphalt flows is not exceeded.

Maximum bead resin or Powdex can be determined by the following formula:

$$\text{Resin Feed} = \frac{0.35 \text{ GPM}}{(1.0 - \text{Solid Fraction})}$$

NOTES: 1. Solid fraction = slurry fraction ÷ 2. Example is a 50% slurry = 25 weight %.

2. 0.35 gpm = 80 L/hr evaporative rate.

The corresponding asphalt feed is calculated by:

$$\text{Asphalt Feed (GPM)} = \frac{\text{(Resin Feed) (Solid Fraction)}}{\text{(Waste-to-Asphalt Ratio)}}$$

Where the recommended waste-to-asphalt ratio is 0.67, the notes on the preceding asphalt calculation apply.

The operator can also visually confirm that the quality of the end product is approximately being maintained. A CCTV camera "views" the discharge from the extruder-evaporator, and a TC monitor located in the Solid Radwaste Building Control Room allows the operator to observe the physical consistency of the product as it is discharged into the container. At evaporative rates higher than specified, there will be excessive steaming at discharge nozzle. At higher waste-to-asphalt loading the discharge will appear grainy and stringy.

1.5 PROCESS TEMPERATURES

A proper temperature profile along the length of the extruder-evaporator is required to provide adequate evaporative (process) capacity, and to assure that free water is not discharged from the machine.

Process temperature profiles for waste feeds should be maintained as recommended below:

Waste Type	Process Temperature (°F)					
Zones:	1	2	3	4	5/6	7
Boric Acid Concentrates LWS Concentrates Chemical/Laundry Waste	300°	280°	280°	300°	300°	*
Spent Resins/Powdex	300°	**	**	**	**	*

NOTE: No zone shall be maintained below 240°F.

* Cooling Zone - no specified temperature

** Steam supply control valves are fully open

Low temperature alarms are provided to alert the operator to a low temperature out-of-specification condition which could potentially lead to the discharge of free water. If the out-of-specification conditions persists for two (2) minutes, the extruder-evaporator is automatically tripped to prevent free water from being discharged into the container. Free water cannot be discharged in the interim, since the residual heat of the extruder-evaporator itself is sufficient to effect evaporation.

Verification of the absence of free water and product solidification will be made on a minimum of one container from every tenth batch or run. Verification is recommended to be done on every tenth drum shipped. The required container shall be examined through a removable lid bung or equivalent means for solidification by checking penetration with a solid tool and inverted for a minimum of eight hours to check for free water. Evidence of free water other than a few drops of condensation shall be cause for rejection and evaluation system product.

2.0 DEWATERING SOLIDS IN HIGH INTEGRITY CONTAINERS (HIC)

2.1 Solids such as bead resin, filter cartridges and powdered resin (Powdex) may be dewatered and shipped in HICs per approved vendor procedures and the HIC certificate of compliance.

2.2 High integrity containers are approved by the individual burial ground agreement states as meeting 10CFR61 waste form stability requirements.

2.3 Free water determination shall be verified by the successful completion and documentation of the vendors approved dewatering procedure.

3.0 DELAWARE CUSTOM MATERIAL (DCM) - SILICATE CEMENT

Liquid wastes can be solidified by the DCM method. The silicate solidifies and the cement gives structural strength.

3.1 For solidification, acquire a representative sample of waste. Before following the guidelines outlined below, determine the type of waste to be solidified, example, lab waste, laundry waste, decon solutions, boric acid, oil, etc. Sample for pH, boric acid, visible organics and radioactivity.

Use analysis to determine the proper laboratory procedure to test.

All batches shall be lab tested prior to solidification in a larger container unless sample analysis (pH ± 0.2 and Boron ± 20%) matches the analysis of a waste type which has previously passed lab test criteria.

For all oil waste, do not exceed 50% by volume. Oil must be emulsified with a detergent or boric acid in some type of neutral aqueous waste or tap water.

NOTE Oil cannot be shipped to Barnwell, South Carolina.

For spent resins, liquid absorbent, or other earthen-like material, dilute with an equal volume of concentrate or tap water to solidify.

All results must be recorded initially, at approximately 24 hours and approximately 48 hours after testing. Grade observations to evaluate sample mixes. The 48-hour test can be omitted if the 24-hour test is good.

The quantity of chemicals added to solidify radwaste shall be within 20% of the quantity as determined by the laboratory test of Step G.

3.2 SOLIDIFICATION AND FREE WATER DETERMINATION

Solidification shall be considered successful if, 48 hours after completion of Appendix A solidification, there is not standing water on the waste surface and the surface is not penetrated more than 2" with a 1" diameter rod. If deeper penetration is possible, then the drum can still be considered solid if the penetration hole remains open after the rod is withdrawn.

Silicate cement shall cure for a minimum of 28 days prior to shipment for disposal. For silicate cement drums, the following shall be done:

Each drum shall be inspected for absence of detectable freestanding liquid after curing at least 28 days. With the drum lid installed, invert each drum and allow drum to remain upside down for at least 24 hours.

After 24 hours, inspect each drum by placing upright and removing the lid. The RMC Supervisor or designate and a QC Inspector shall inspect each drum for presence of liquid. Drums which failed the 48-hour solidification evaluation should be capable of passing at this point. If no detectable freestanding liquid is present, the drum can be prepared for shipment. RMC Supervisor and QC Inspector document if no detectable freestanding liquid is present.

In the event liquid is observed, those drums with liquid shall be drained of all liquid. When no further liquid can be drained from the drum in a 24-hour period, the drum shall be core-bored or overpacked with two bags of approved absorbent and inspected by QC and RMC to verify that the drum is dry. After this verification (and documentation) the drum may be prepared for shipment.

Inspect the drum lid and gasket for defects prior to lid installation. Install lid. Use a different lid if defects are found which prevent a tight seal between drum and lid.

4.0 10 CFR 61 REQUIREMENTS

4.1 10 CFR 61 classification requirements will be met using Wastetrak computer software program using the scaling factor methodology of AIF/NESP-027, Methodologies for Classification of Low-Level Radioactive Waste from Nuclear Power Plants, 1983.

The scaling factors will be updated by an ongoing analysis program of actual waste streams. The program will initiate with semi-annual samples of available waste streams and may be modified to longer intervals if the data base warrants. Waste streams should include, if available; bead resin, concentrates, reactor coolant, clean waste, filter crud and compacted trash.

4.2 10 CFR 61 waste form stability requirements will be met by generic testing of the asphalt/waste stream product. The generic waste streams will be boric acid, bead resin and chemical regenerative wastes.

4.3 Documentation of the waste stream analysis, waste form stability and computer software scaling factor security shall be maintained by the Radiological Services Department.

APPENDIX A

Consumers Power Company
Palisades Plant

PROCESS CONTROL PROGRAM (PCP)

ASPHALT TECHNICAL DATA SUMMARY

WITCO CHEMICAL - PIONEER 221

1. Basic Constituent

Pioneer 221 is an oxidized petroleum base asphalt. Oxidation is accomplished by air blowing at temperatures ranging from 200°C (392°F) to 300°C (572°F). Air blowing results in a product with minimum volatile content (0.1%), greater inertness and higher molecular weight.

2. Flash Point

The Flash Point of Pioneer 221 is in excess of 288°C (549°F). The Flash Point is determined by the Cleveland Open Cup (ASTM D92-71) method. It is the lowest temperature at which surface vapors will momentarily ignite when a test flame is passed over the surface.

3. Fire Point

The Fire Point of Pioneer 221 is in excess of 300°C (572°F). The Fire Point, like the Flash Point, is determined by the Cleveland Open Cup (ASTM D92-72) method. It is the lowest temperature at which the surface vapors will burn for at least 5 seconds before going out, the vapors being ignited as in the test for Flash Point.

4. Ignition Point

The Ignition Point of Pioneer 221 is approximately 400°C (752°F).

The Ignition Point is the lowest temperature at which the heat loss from the combustible mixture is exceeded by the heat produced in the chemical reaction. It is thus the lowest temperature at which combustion begins and continues in an air environment.

5. Softening Point

The Softening Point of Pioneer 221 is in the temperature range of 88-94°C (190-201°F).

The Softening Point is determined by the Ring and Ball method (ASTM D-36-70).

6. Viscosity

The Viscosity of Pioneer 221 in the temperature range from 250°F to 400°F is presented in attached graph.

The graph is based on the following data from Witco Chemical:

Saybolt Furol Viscosity

at 205°C	54 sec
at 177°C	161 sec

7. Penetration

The Penetration of Pioneer 221 by ASTM Method D-5-73 for various temperatures is given below:

25°C (77°F)	22-30 dmm
46°C (115°F)	40-60 dmm
0°C (32°F)	13-18 dmm

The abbreviation "dmm" means one-tenth of a millimeter. The number of dmm's represents needle penetration under standard conditions of loading and time for a given temperature.

8. Specific Gravity

The Specific Gravity of Pioneer 221 is approximately 1.0 gram per cc.

Specific Gravity is determined by ASTM Method D-70-72, which employs a pyenometer. A pyenometer is a container of known volume which is weighed empty and filled with sample.

9. Solubility

Pioneer 221 may be considered to be entirely waterproof and insoluble in water. Pioneer 221 is soluble in petroleum solvents such as naphtha, mineral spirits and kerosene, in addition to carbon tetrachloride, carbon disulfide and trichlorethylene.

PIONEER 221 LAMINATING & INDUSTRIAL ASPHALT
PIONEER E-7465 FOR SALT CARTON MANUFACTURERS

Pioneer 221 in an all-purpose, tough, medium softening point asphalt for use in laminating paper, foil-to-paper, as a base pigment for paints and varnishes, or in the manufacture of sealers and adhesives.

Pioneer 221 complies with federal specifications set forth by the Food & Drug Administration for use in packaging and sealing food products and will not stain, or impart an odor or taste when used properly in connection with packaging products.

PHYSICAL CHARACTERISTICS

Softening Point	190-210°F
Penetration @ 77°F	20-30 dmm
Doctility @ 77°F	2.5 cms +
Solubility CCL	99.0% +
Flash Point (C.O.C.)	550°F +
Weight Per Gallon	8.3 lbs
Use Temperature	400°F ± 25°
Viscosity @ 400°F	.94 secs
Viscosity @ 375°F	.174 secs
Viscosity @ 350°F	.360 secs

Packaging: Bulk - Tankwagon (5000 gal), tank car (10,000 gal).
Packages - 100 lb cartons

TABLE 1 - COMPARISON OF ELEMENTAL ANALYSES AND OTHER CHEMICAL PROPERTIES OF ROAD TAR, COAL-TAR PITCH AND PETROLEUM ASPHALTS

MATERIAL GRADE	ASPHALT CEMENT AC-10	ROAD TAR RT-12	ROOFING ASPHALT TYPE III	ROOFERS PITCH TYPE A
ELEMENTAL ANALYSIS, percent:				
C	85.8	92.2	86.0	92.8
H	9.7	5.2	9.9	5.1
N	0.6	1.5	0.5	1.5
O	0.5	1.0	0.7	---
S	2.8	0.6	2.9	1.53
C/H atomic ratio	0.74	1.49	0.73	1.53
MOLECULAR WEIGHT, (Numbers Avg)	1030	420	1160	497
CARBON ATOM DISTRIBUTION: (percent of total carbon)				
AROMATIC CARBON	34	80	37	79
NAPHTHENE CARBON	23	15	23	18
PARAFFIN CARBON	43	5	40	3