A NOVEL CANADIAN SOLUTION FOR PROCESSING AND DISPOSAL OF MIXED LIQUID WASTES

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ABSTRACT

In 2009, Bruce Power contracted with Kinectrics for the disposal of its accumulated mixed liquid waste (MLW) inventory. The waste consists of solvent, PCB (Poly Chlorinated Biphenyls) and non-PCB contaminated oils and aqueous waste drums. The radioactivity in the wastes is principally due to cobalt-60, cesium-137 and tritium.

Historically, MLW drums originating from Canadian utilities were shipped to a licensed US facility for destruction via incineration. This option is relatively expensive considering the significant logistics and destruction costs involved. In addition, restrictions now apply on importation of PCB containing wastes in to the US. Because of this, Kinectrics developed a wholly Canadian solution for the disposal of the MLW.

Disposal of Bruce Power's MLW was conceived to be carried out in three phases.

Phase 1: Develop an overall plan for disposal of the accumulated wastes,
Phase 2: Dispose the PCB oil waste drums (highest priority), and
Phase 3: Dispose all other waste drums

Phases 1 & 2 have been completed and Phase 3 is currently underway with 17 drums having been disposed so far. A description of the key activities undertaken to date are described in this paper. This work sets the stage for the future management of MLW based exclusively or largely on disposal within Canada. All key technical, regulatory and logistical issues pertaining to the receipt, handling, processing and shipment of the wastes were addressed. Equipment was installed for basic processing of the incoming wastes. Based on Pathways methodology, it was shown that the wastes can be shipped to unlicensed facilities within Canada without exceeding the 10 μSv per annum exposure to the critical individual. Despite this and for compliance with ALARA, wastes exceeding self-imposed threshold levels of radioactivity will be solidified and shipped for storage as radioactive waste.

1. INTRODUCTION AND BACKGROUND

Bruce Power recently contracted with Kinectrics for the disposal of its accumulated mixed liquid waste (MLW) inventory. As shown in Table 1, the drums fall into three categories: aqueous, oils and solvent wastes. The solvents consist of Varsol and petroleum based distillates, aliphatic hydrocarbons and aromatic (benzene, toluene and xylene) based hydrocarbons. The oils consist of lubes and oily water emulsions; five of the oil drums are also contaminated with Poly Chlorinated Biphenyls (PCBs).

Table 1. Distribution of accumulated mixed liquid wastes

Type of mixed waste	Number of drums
Solvents	51
Oil	5
Aqueous	8
PCB Contaminated Oil	5
Total	69

Historically, MLW drums originating from Canadian utilities were shipped to a licensed US facility for destruction via incineration. This option is relatively expensive considering the significant logistics and destruction costs involved. In addition, restrictions now apply on importation of PCB containing wastes in to the US. Because of this, Kinectrics developed a wholly Canadian solution for the disposal of the MLW.

Disposal of Bruce Power's MLW was conceived to be carried out in three phases:

Phase 1: Develop an overall plan for disposal of the accumulated wastes,

- Sample waste drums and develop additional characterization data as required,
- Assess characterization data and identify preliminary disposal options,
- Perform Pathways Analyses to support conditional clearance of drums,
- Obtain approvals from Ontario Ministry of Environment (MOE) to receive and process waste drums,
- Assess treatment and solidification options for each drum, and
- Develop an overall waste disposal plan.

Phase 2: Dispose the PCB oil waste drums (highest priority), and

Phase 3: Dispose all other waste drums

Phases 1 & 2 have been completed and Phase 3 is currently underway. A description of the key activities undertaken to date are described in this paper.

2. CHARACTERIZATION OF MIXED LIQUID WASTE

2.1. Inventory and visual characteristics

The inventory of the various MLW drums, developed based on the use of Coliwasa samplers, was as follows:

- Less than 100 liters 9 drums
- 100-150 liters 10 drums
- Over 150 liters 50 drums

Of the 5 PCB contaminated oil drums, one drum contained essentially 100 % oil while the rest had an associated aqueous phase ranging from 10 to 50 % of the total waste volume. One of the 5 non-PCB oil drums contained mostly aqueous waste. The constitution of the 51 drums, designated as solvents, was as follows:

- 21 contained over 99 % solvent while 7 contained over 95 % aqueous waste,
- 12 contained two phases, both of which were solvents, and
- 9 contained a top solvent phase with the bottom aqueous phase comprising 30-90 % of the waste volume; one drum contained the two phases in reverse order.

Most of the MLW drums had visible suspended solids and/or sediments. All aqueous waste drums contained a minor (< 2 %) second phase (liquid and/or solid). Color of the waste generally ranged from clear to black with majority of the waste drums being brown/black/red.

2.2. Physico-chemical characteristics

- Flash points of the oils ranged between 90^0C and190^0C. Those for the solvents ranged between 41^0C and110^0C, with the majority (~80%) exceeding 60^0C. Overall, the data indicate limited flammability concerns for most of the MLW drums.
- The oil phase in the PCB contaminated oils contained between 99 and 9300 ppm PCBs; the corresponding aqueous phase generally contained less than 50 ppm PCBs. Other MLW generally contained less than 2 ppm PCBs.
- pH varied between 3.5 and 11.3

- Pb concentrations were generally higher than those of other toxic elements, namely, As, Be, Cr, Cd and Hg. Concentrations of Ag, Te, Sb and Se were lower than 2.3 ppm; those of other elements including B, Ba, Na, Ni, P and S ranged between 0.001 and 12,100 ppm.

2.3. Radiochemical characteristics

Typically, gamma spectrometry was performed on the entire 2 phase (where applicable) sample. Because tritium preferentially partitions into the aqueous phase[1], only the latter was generally analyzed for it. For selected samples, both gamma spectrometry and tritium analysis of the individual phases present were performed to assist in development of process options. Measured radiochemical characteristics indicated Co-60, Cs-134 and Cs-137 to be the principal gamma emitting radionuclides present. Compared with tritium, which was present in all samples, C-14 levels were generally much lower. Table 2 presents an overview of the results.

Table 2. Overall radiochemical characteristics of mixed liquid wastes

Type of MLW	No. of drums	H-3 activity (nCi/Kg)			(β,γ) activity (nCi/Kg)		
		Min.	Max.	LM*	Min.	Max.	LM*
PCB oil	5	127	17,000	1470	0.09	4.2	0.42
Non-PCB oil	5	20	1,490,000	7365	0.52	139.2	4.6
Aqueous	8	2270	344,000	15560	0.09	24.2	1.3
Solvent	51	<0.2	330,000,000	425	0.04	3110	1.0

* LM indicates Log or Geometric Mean.

Based on the sample characterization data, Table 3 indicates the number of drums of each type of waste which potentially met Bruce Power's free release criteria, namely, 2.7 nCi/Kg (β, γ) and 2000 nCi/Kg H-3 activity. Some of these drums, upon recounting using the barrel monitor at Bruce Power, however, failed to meet the (β, γ) activity free release criterion possibly because of the presence of sediments; the latter were likely not drawn into the Coliwasa tube during sampling. The last column in Table 3 shows the final drum inventory requiring disposal.

Table 3. Drum inventory requiring disposal

Type of MLW	Initial drum inventory requiring disposal	Number of drums potentially meeting free release criteria	Final drum inventory requiring disposal
PCB oil	5	1	4
Non-PCB oil	5	1	3
Aqueous	8	0	8
Solvent	51	28	36
All	69	30	51

[1] Preferential partitioning of tritium into the aqueous phase is generally expected when its concentration is relatively low. At elevated concentration, tritium may, with aging, increasingly incorporate into the associated organic phase.

3. OVERALL APPROACH FOR DISPOSAL OF MIXED LIQUID WASTES

Based on an assessment of the preliminary waste characterization data, Kinectrics developed an overall approach for treatment and final disposal of the MLW which consists of the following:

Conditional clearance

Currently, free or unconditional release limits for tritium and (β, γ) activity at Bruce Power are 2000 nCi/kg and 2.7 nCi/kg, respectively. Typically, one or both of these limits may be exceeded in the MLW. Such wastes, however, can still be conditionally cleared through the application of Pathways Analysis [1, 2]. This is the main underpinning of Kinectrics' disposal plan. Canadian Nuclear Safety Commission (CNSC) regulatory document R-85 requires that an application for conditional release of radioactive waste to unlicensed facilities be based on an assessment of the associated dose impacts to workers and members of the general public [3]. Based on Pathways Analysis, qualifying waste drums can potentially be shipped to unlicensed facilities for final disposal if the annual exposure to the critical individual does not exceed10 μSv.

Waste processing and ALARA

Consistent with CNSC's regulatory guide on ALARA [4], wastes in general undergo simple processing to reduce the radioactivity present prior to being shipped to unlicensed facilities. This is performed even though the Pathways Analyses may support conditional clearance of the unprocessed wastes. Separation of the aqueous phase associated with most oil and solvent wastes is expected to significantly lower the tritium content of the remaining wastes while filtration is expected to significantly lower (β, γ) activity.

Solidification

Although Pathways Analyses may support their conditional clearance, wastes which exceed self-imposed threshold levels of tritium and/or (β, γ) radioactivity are solidified and shipped back to Bruce Power for eventual transfer and storage at Ontario Power Generation (OPG)'s Western Waste Management Facility (WWMF).

Maximizing usage of existing drums

In order to minimize secondary waste generation, appropriate steps are undertaken to maximize use of existing drums. Several of the drums are reused for shipping conditionally cleared wastes to unlicensed facilities. Because the drums have integral tops (with two openings), they cannot be readily used for waste solidification.

4. REGULATORY APPROVALS AND ISSUES

This section presents a summary of various regulatory approvals and issues that were addressed during the course of the present work.

4.1. Approval from Ontario Ministry of the Environment (MOE)

Kinectrics' submitted two applications to the MOE in 2010:

- Application for a Provisional Certificate of Approval (C of A) for a Waste Disposal Site,
- Application for C of A (Air & Noise), and

These were subsequently approved [5, 6]. The Approval for Waste Disposal Site permits Kinectrics to receive up to 200 drums of wastes per year and treat/dispose them appropriately. Up to ten waste drums are allowed on-site at any time. All air emissions are required to be appropriately scrubbed prior to release.

An application to amend the Approval for Waste Disposal Site was filed in early 2011 to enable Kinectrics to receive liquids with a broader range of MOE classifications and also for receiving solid PCB contaminated mixed wastes containing up to 15,000 ppm PCBs. This amendment was recently granted [7]. Accordingly, Kinectrics can now receive, process and transfer liquid industrial waste and solid or liquid hazardous waste classes 112-4, 121-2, 131, 135, 145-6, 148, 150, 211-3, 222, 232, 241, 243, 251-4, 262-3, 267 and 270.

4.2. Conditional clearance of wastes

Pathways Analysis was carried out to establish the conditional clearance limits for disposal of:

- PCB waste via incineration at Swan Hills Treatment Facility in Alberta and
- Non PCB waste via incineration at Clean Harbors' incinerator in Corunna, Ontario.

Reports documenting the results from these analyses were submitted to CNSC for their review and concurrence [8, 9].

Additional vendor options are currently being developed to increase the flexibility for conditionally or unconditionally clearing wastes.

4.3. Shipment of PCB contaminated oils

The PCB contaminated wastes contained exempt levels of activity and were, therefore, transported from Bruce Power to Kinectrics as TDG (Transport of Dangerous Goods) Class 9 under a MOE waste manifest (as per Regulation 347) and MOE Director's Instructions (Regulation 362). Shipment of out-bound conditionally cleared wastes from Kinectrics was carried out directly by Aevitas (broker), under its blanket Director's Instruction.

5. PATHWAYS ANALYSIS

Pathways Analysis was performed to establish the conditional clearance limits for disposal of the MLW via incineration. The Pathways Analysis performed involved the following steps:

- Establish waste processing and final disposal path for each type of waste,
- Gather input information for dose calculations,
- Estimate dose associated with transportation of waste,
- Estimate dose associated with incineration/disposal of waste.

Transportation dose calculations were performed using MicroShield®. The required inputs included waste gamma activity, source-receptor distance and extent of shielding. The radiation dose to workers and the public during incineration were calculated using a modified Gaussian plume model to evaluate the time-integrated concentration at downwind distances from 100 m to 100 km from the point of release. Required inputs for these calculations included the total activity released during incineration, duration of release, mean wind speed, receptor distance from point of release, type of land and precipitation rate.

5.1. Conditional clearance of PCB contaminated wastes

The disposal scheme considered for PCB contaminated wastes is shown in Figure 1. Accordingly, wastes were initially transported from Bruce Power to Kinectrics for processing. The latter consisted of separating the aqueous phase from the oil phase because it contains less than 50 ppm PCBs and hence does not constitute PCB waste; the separated aqueous phase containing most of the tritium can be solidified if required and stored at OPG's Western Waste Management Facility. The PCB contaminated oil phase was transported first to Aevitas' facility in Ayr for temporary short-term storage, pending its final transfer to the Swan Hills Treatment Centre. The ash produced from incineration at Swan Hills is disposed off in a secure landfill located on-site.

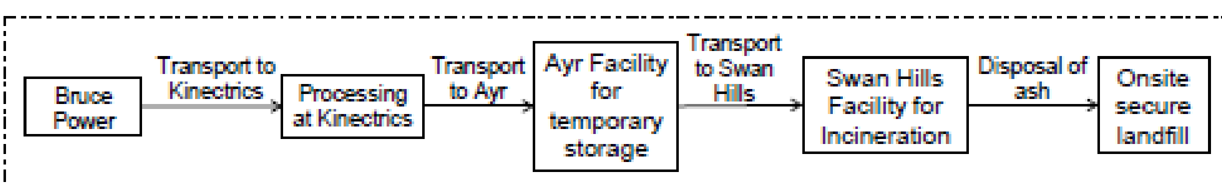

Figure 1. Disposal path for PCB wastes

Results from the Pathways Analysis based on the above disposal path [8] showed that:

- The dose received from transportation, namely, 0.022 μSv was substantially lower than the permissible annual dose limit of 10 μSv; in comparison, the dose received during incineration and disposal of the PCB waste residues was insignificant. The wastes, therefore, can be conditional cleared.

- The maximum allowable conditional clearance levels (i.e., the activity from each individual radionuclide which will result in a dose of 10 μSv/y) for the dominant radionuclides present in the waste were estimated to be $9.6x10^5$ Bq Co-60, $1.4x10^6$ Bq Cs-134, $4.2x10^6$ Bq Cs-137 and $1.6x10^{12}$ Bq H-3.

- Dose conversion factors for Co-60, Cs-134, Cs-137, and H-3 were estimated to be $1.1x10^{-11}$, $7.1x10^{-12}$, $2.4x10^{-12}$ and $6.3x10^{-18}$ Sv/Bq, respectively. These values can be generally used to assess the feasibility of conditionally clearing other similar wastes provided key parameters such as the mode of transportation, routing of the wastes etc. remain unchanged.

5.2. Conditional clearance of non-PCB contaminated wastes

The disposal scheme considered for non-PCB MLW is shown in Figure 2. Wastes are initially transported from Bruce Power to Kinectrics for processing to reduce the levels of tritium and beta/gamma emitters present; the processed wastes are then sent to the Clean Harbors facility in Mississauga for consolidation and fuel blending. Each shipment will contain a maximum of ten 200 L MLW drums. Drums received at the Mississauga facility will be consolidated with other non-radioactive hazardous waste, thus resulting in dilution of the activity. The bulk consolidated wastes will be transported in tankers to Clean Harbors in Corunna, Ontario for incineration and final disposal. Any combustion residue will be stabilized and disposed of in a secure on-site landfill.

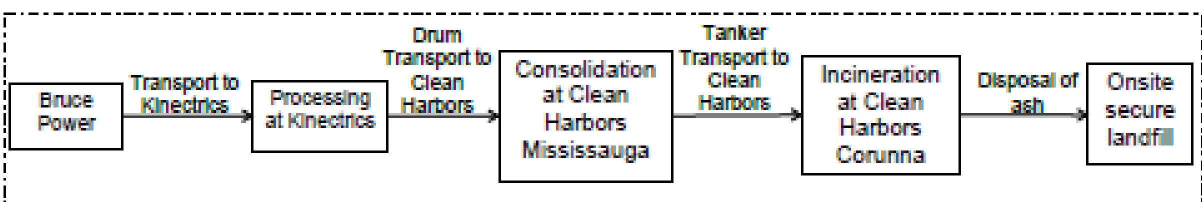

Figure 2. Disposal path for non-PCB mixed radioactive liquid waste

The Pathways Analysis conducted considered the disposal of 64 drums of non-PCB MLW (see Table 1). Dose calculations for drum transport were based on a compilation of the maximum specific activity for each observed radionuclide in the waste. Dose calculations during transport in a tanker were based on the activity contained in 10 drums diluted over the volume (approximately 27,000 L) of the tanker. Doses to the public and workers during incineration of the wastes were calculated based on the release of all the activity contained in 10 drums. Results of the pathways analysis based on the above disposal path [9] showed that:

- Overall, the estimated dose from transportation and disposal of the waste is about 1.75 μSv, a factor of about 6 lower than the yearly allowed dose of 10 μSv; the wastes, therefore, can be conditional cleared.

- The maximum allowable conditional clearance levels for the dominant radionuclides present in each waste shipment (10 drums) were 4.1×10^{7} Bq Co-60, 1.8×10^{8} Bq Cs-137, 2.2×10^{8} Bq Sb-125 and 1.3×10^{15} Bq H-3.

- Dose conversion factors for Co-60, Cs-137, Sb-125 and H-3 were estimated to be 2.4×10^{-13}, 5.6×10^{-14}, 4.6×10^{-14} and 7.8×10^{-21} Sv/Bq, respectively.

6. PROCESSING OPTIONS – A FEASABILITY ASSESSMENT

Although results from the Pathways Analysis indicated the feasibility of directly shipping all the wastes to unlicensed facilities for disposal, ALARA considerations and prudence dictated the need for simple processing to reduce the levels of radioactivity shipped. For wastes containing relatively higher levels of radioactivity, solidification was considered as an alternative to conditional clearance thus avoiding their shipment to unlicensed facilities.

Bench scale investigations were carried out to assess the feasibility of processing options, such as phase separation, particulate filtration, use of solid sorbents and waste solidification, in order to assemble a 'tool kit' which could be applied if and when required. Some of these investigations were of a scoping nature while others were more detailed. Selected results obtained are described below.

6.1. Phase separation

Unless incorporated into the matrix, tritium in PCB contaminated oil/aqueous wastes is expected to preferentially partition into the aqueous phase; on the other hand, the PCBs would preferentially partition into the oil phase. This offers the potential for improved management of the separated phases. Table 4 presents characterization data for the individual phases of the PCB contaminated wastes. They indicate the following:

- In the absence of phase separation, the overall tritium and (β, γ) activities in the waste significantly exceeded their unconditional release limits, namely, 2,000 nCi/kg for tritium and 2.7 nCi/kg for (β, γ) activity. However, both tritium and (β, γ) concentrations in the separated oil phase would clearly meet the unconditional release limits. Thus, shipment of the separated oil phase would significantly reduce the levels of radioactivity shipped to an unlicensed facility.

- The separated aqueous phase in all cases would have a PCB concentration lower than 50 ppm and thus could be classified as non-PCB waste.

The above results clearly indicate the possibility of using phase separation to meet ALARA requirements. If required, the separated non-PCB aqueous phase could potentially be solidified and shipped to OPG.

6.2. Solidification

OPG accepts solidified radioactive waste provided its PCB concentration is less than 50 ppm. Five solidification agents (modified natural clays) from Fluid Tech Inc., namely, Petroset II, Petroset, Petroset H, Aquaset H and Aquaset II, pre-approved for use by OPG, were chosen for bench scale testing. Petroset H and Aquaset H contain a cementitious additive that generally results in a hard waste form; the other waste forms typically have a putty-like consistency. Petroset II is an organophilic solidifier for non-aqueous liquids, such as oils and other hydrocarbons while Aquaset II, Aquaset H, Petroset and Petroset H are suitable for solidifying aqueous liquids.

Table 4. Characteristics of individual phases of PCB contaminated MLW

Drum ID	Aqueous phase (%)	PCB concentration (ppm)			Tritium concentration (nCi/kg)		Total (β, γ) concentration (nCi/kg)	
		Oil	Interface	Aqueous	Aqueous	Oil	Oil	Total
08-LO-065	50	1140	1720	18	7620	140	0.09	0.09
03-LOR-009	15	200	26	<2	17,000	613	0.34	4.2
10309	10	1950	183	2	7,300	503	0.09	0.17
10311	10	99	71	20	3,450	127	0.09	0.3

In general, because MLW contains both aqueous and organic phases, a combination of two solidification agents, one for each phase is required; Petroset II must be added first to aqueous wastes in order to solidify any small amount of oils/solvents present. The general procedure for solidification involves a pH adjustment step (desired pH range is 5-11) and the addition of a polar activator, such as methanol or iso-propanol[2] (if required), to accelerate curing.

A series of tests were carried out to evaluate the solidification of various MLW streams using the Fluidtech agents described above. The key findings were:

- In general, the Fluidtech agents were able to successfully solidify a range of MLW yielding a relatively homogeneous and non-slumping solidified waste form with no free liquid. Petroset, Petroset II and Petroset-H showed good solidification behavior at loadings of 3-6 lbs/gallon. Aquaset II was only effective at the higher loading of 6 lbs/gallon.

- Solidification resulted in a 6-33 % increase in volume.

[2] When using Petroset-II in combination with Aquaset, Aquaset-H, Petroset or Petroset-H, the materials are added in the sequence: (i) Waste, (ii) Petroset II, (iii) Petroset or Petroset-H or Aquaset or Aquaset-H and (iv) Alcohol activator (required only for organics).

- Presence of condensed moisture was observed on top of the solidified waste in several instances. Aquaset may be added on top of the solidified waste to mitigate this.

Test results were submitted to OPG for pre-approval of the solidified wastes.

7. OVERALL STRATEGY FOR TREATMENT AND DISPOSAL OF MLW

Based on the foregoing, the overall strategy for disposing the MLW drums is outlined below:

- Drums that meet the free release criteria, i.e. $(\beta, \gamma) < 2.7$ nCi/Kg and H-3 < 2000 nCi/Kg will be directly disposed by Bruce Power as conventional waste, thus significantly reducing overall disposal costs. Although several drums as listed in Table 3 met these criteria based on sample characterization results, further assessment using a barrel monitor at Bruce Power indicated that 12 of the drums did not meet the free clearance criteria. This is possibly because sediments present in the drums were not drawn into the Coliwasa tube used for sampling.

- Excluding the drums which met the free release criteria, all other wastes, in general, will first be filtered and then undergo phase separation if applicable. Filtration may reduce (β, γ) activity when particulates or sediments are present; it also ensures that no sediments would remain in emptied drums consigned for burial in a landfill. Phase separation is expected to simplify disposal by beneficially partitioning key contaminants between the phases.

- Although all the wastes in principal qualify 'as is' for disposal via incineration (as established using Pathways Analysis), the criteria $2.7 < (\beta, \gamma) < 27$ nCi/kg and 2000 < H-3 < 20,000 nCi/kg (i.e. upper limits selected to be 10 times the free clearance values) were adopted to determine if the wastes should be disposed via conditional clearance or instead solidified for storage at WWMF. Thus, if $(\beta, \gamma) > 27$ nCi/Kg and H-3 > 20,000 nCi/Kg, the waste was deemed, from ALARA perspective, to be more appropriately managed via solidification.

8. EQUIPMENT FOR PROCESSING MLW

A skid was designed and built for drum scale filtration and phase separation (see Figure 3). Its key features are:

- A filter housing, equipped with a bag micro-filter which can be easily removed and replaced,

- A conical bottom phase separation tank equipped with sight glasses for visual assessment of the individual phases and the total volume in the tank,

- A weighing station to determine quantity of liquid collected in empty drum placed under the phase separation tank,

- An air powered diaphragm pump capable of running dry to minimize liquid retention in spent filter bags,
- Ramps with rollers to facilitate handling and positioning of drums,
- A spill tray, and
- A spray ball located within the tank to permit cleaning of tank internals using a degreasing solution.

During operation of the Filtration/Phase Separation skid, solvent and water vapor emissions (containing low levels of tritium and C-14) will arise from the displacement of air out of the headspace within drums and the phase separation tank. To minimize emissions into the environment, dual granulated activated carbon (GAC) beds are used to scrub the air emissions before exhausting them through the fume-hood. Figure 4 shows the instrumented scrubber system containing two replaceable sorbent tanks.

A liquid waste solidification system, Model B 201 drum mixer (see Figure 5) was acquired from Beba Mischtechnik, Oldenburg, Germany. Its features include the following:

- An electrically operated, mobile heavy duty 45/55 gallon in-drum mixer,
- Rated power of single speed drive motor 6 kW,
- Drive shaft speeds of 104/208 rpm,
- Dual mixing blades which can be switched from clockwise to counter-clockwise rotation for more even mixing,
- Separately geared motor drives rotary table, causing impellers to move around the drum,
- Elevating mechanism to lift impellers out of the drum, and
- A vibratory cleaning system to dislodge binder from impeller surfaces.

9. CONCLUDING REMARKS

Based on an overall assessment of the Bruce MLW, profile of the disposed wastes is expected to be as shown in Table 5 where the exact number of drums to be conditionally cleared or solidified will depend on the extent of activity reduction achieved during waste processing. Because of the expected volume increase upon solidification, the number of solidified waste drums may exceed the numbers shown. In addition, one drum of solidified filter waste bags will also be produced as secondary waste.

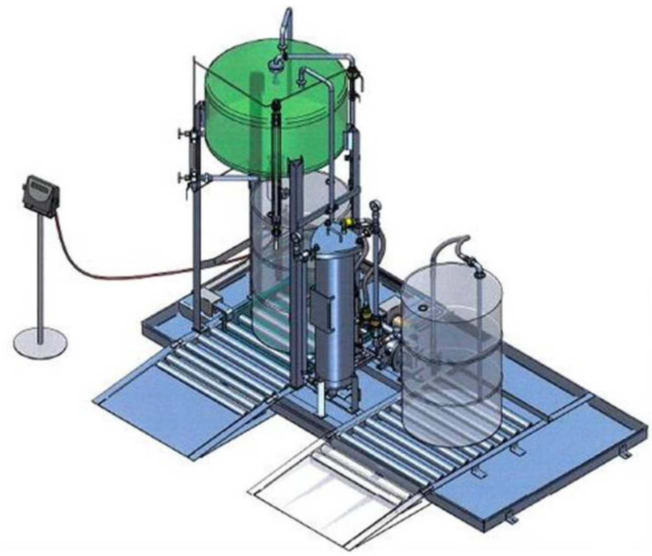

Figure 3. Skid for filtration and phase separation of MLW

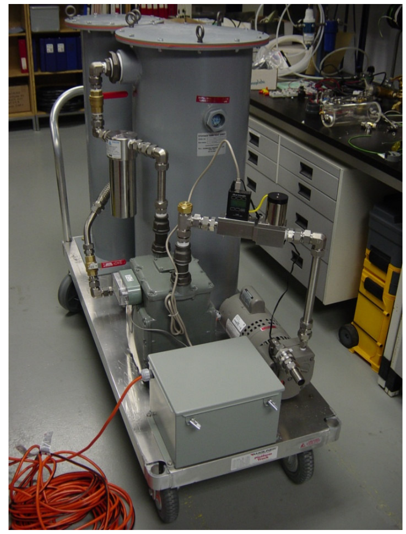

Figure 4. Dual bed air scrubbing system

Figure 5. Liquid waste solidification system

Table 5. Expected profile of disposed wastes

Type of mixed Waste	Processed wastes	Shipment destination
Solvent	Filtered Wastes	Conditionally cleared (max. 31 drums)
	Filtered/Separated Wastes	Conditionally cleared (max. 2 drums)
	Solidified Wastes	OPG (max. 3 drum)
Oil	Filtered Wastes	Conditionally cleared (max. 3 drums)
	Solidified Wastes	OPG (max. 2 drums)
Aqueous	Filtered Wastes	Conditionally cleared (max. 8 drums)
	Solidified Wastes	OPG (max. 2 drums)
PCB Contaminated Oil	Filtered/Separated Wastes	Conditionally cleared (4 drums)
	Solidified Wastes	OPG (1 drum)

The present status of Phase 3 is as follows:

- Of the 51 drums listed in Table 3, 4 drums of PCB contaminated oils, 1 drum of non-PCB contaminated oil and 20 drums of solvents have been processed to date.

- All four processed PCB waste drums, 10 solvent drums and 1 non-PCB contaminated oil drum have been conditionally cleared and destruction certificates obtained. Of the 10 recently processed solvent waste drums, 7 met unconditional clearance criteria and were free released to a hazardous waste vendor; the other 3 drums that did not meet unconditional clearance criteria will shortly be conditionally cleared.

- About 50 L of separated aqueous waste and 5-10 L of sludgy material were separated out and will shortly be solidified.

The work to date has set the stage for the future management of Bruce Power's mixed liquid wastes exclusively or largely based on disposal within Canada. All key technical, regulatory and logistical issues pertaining to the receipt, handling, processing and shipment of the wastes have been addressed. Kinectrics has the required MOE approvals for processing wastes within its Radioactive Facility. Equipment has been installed for basic processing of incoming wastes. Processing is designed to simplify disposal of wastes which typically exist as dual phases with tritium enriched in the aqueous phase, (β, γ) activity significantly associated with particulates and PCBs (when present) associated largely with the organic phase. Based on the Pathways methodology, it was shown that the wastes can be shipped to unlicensed facilities without exceeding the 10 μSv per annum exposure to the critical individual. Despite this and for compliance with ALARA, aqueous wastes, which contain relatively elevated levels of radioactivity will be solidified and shipped for storage and eventual disposal at OPG's WWMF.

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