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NWCF Facility Waste Streams

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ABSTRACT

This report addresses the issues of conducting debris treatment in the New Waste Calcine Facility (NWCF) decontamination area and the methods currently being used to decontaminate material at the NWCF.

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TABLES

ACROYMS

AMWTF	Advanced Mixed Waste Treatment Facility
BDATs	Best-Demonstrated Available Technologies
D&D	Decontamination and Decommissioning
EPA	Environmental Protection Agency
HEPA	High Efficiency Particulate Air
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LASGB	Liquid Abrasive Spray Glove Box
LDR	Land Disposal Restrictions
LLW	Low Level Waste
NWCF	New Waste Calcining Facility
RCRA	Resource Conservation and Recovery Act
RLWR	Radioactive Liquid Waste Reduction
TRU	Transuranic
WERF	Waste Experimental Reduction Facility

NWCF Facility Waste Streams

INTRODUCTION

Over the past two years the Radioactive Liquid Waste Reduction (RLWR) Group has actively investigated methods to reduce the amount of liquid waste generated at Idaho Nuclear Technology and Engineering Center (INTEC). During this investigation the RLWR group has implemented and investigated a number of techniques that have helped reduce the amount of liquid waste generated. This process of either eliminating or reducing the amount of liquid waste is an ongoing process. In some situations old liquid waste streams have been eliminated or new ways of decontaminating material, flushing lines and vessels have been improved by mechanical or new chemical methods.

Even with implementation of these new methods there is still a significant amount of liquid waste being generated. In some cases there is no other way of decontaminating or cleaning lines, vessels, or material without using chemicals. Over the past few years, conditions have improved with the introduction of new chemicals and decontaminating methods at the New Waste Calcine Facility decontamination area; which in turn has helped reduce the amount of secondary waste generated. The liquid waste streams generated during the day-to-day operations are mainly in support of operations. If this function was not performed, the amount of mixed and radioactive waste would increase and new equipment would constantly have to be purchased. The NWCF decon area operates as a decontamination service, to reduce radiation fields and allow repair of equipment, and as a debris treatment service, to reduce the volume of mixed waste.

DEBRIS TREATMENT

One of the major waste streams at the Idaho National Engineering and Environmental Laboratory (INEEL) is in the form of decontamination and decommissioning (D&D) debris and maintenance debris. This material is categorized as mixed waste and must be managed under the Resource Conservation and Recovery Act (RCRA). However, if the debris was to be treated at INTEC it could then be disposed of as low-level radioactive waste. This treatment of debris is a vitally important function for INTEC and the INEEL as a whole.

INTEC has approximately 700,000 gallons (93,590 ft^3) of mixed waste (debris) in storage awaiting treatment. This includes waste from the Tank Farm project (primarily wood and pipe, etc.), which was originally declared low-level waste (LLW) but was recently reclassified as mixed waste. The storage facility at INTEC is currently permitted to store 134,000 gallons (17,916 ft^3) of mixed waste; however, a permit was approved by the state to officially allow the storage capacity to be increased to 2.5 million gallons (334,250 ft^3). Over 90% of the current waste in storage at CPP-1617 was generated at INTEC (mostly Tank Farm and NWCF). CPP-1617 receives approximately 2000-4000 cubic feet of waste each year.

The INEEL has an agreement with the State of Idaho, under the Site Treatment Plan, to begin debris treatment by the 4^{th} quarter of the year 2000. At the present time, INTEC does not have an approved Part A or Part B permit to treat debris, which limits them to only being able to treat debris such as filters from filter leach or debris that is less than 90 days old. INTEC has received notice-of-deficiencies from the state on their Part B application for debris treatment. When the deficiencies are resolved and the permit is issued it will allow INTEC to treat 21,186 ft^3 of debris per year.

The current options for debris are limited if treatment does not occur in the decontamination shop at INTEC. The Waste Experimental Reduction Facility (WERF) can probably take some mixed waste, but it has to be segregated. The Advanced Mixed Waste Treatment Facility (AMWTF) may be able to handle some of the waste, but this is being built primarily to process transuranic (TRU) waste. Waste, which is mixed and cannot be burned or cleaned, may be able to go to the AMWTF.

In 1992 (57 FR 37194) the Environmental Protection Agency (EPA) published a ruling on the treatment standards for hazardous debris, including mixed debris (RCRA Land Disposal Restrictions (LDR) Guide page 8.10 – 8.15)[4]. This final ruling allows hazardous debris to be treated by specific technologies based on the type of debris and type of contaminants present. When the debris is treated with a specific technology, such as extraction or destruction, the debris is no longer subject to RCRA regulations. This ruling was very beneficial to the INEEL because the debris at the INEEL could then be treated and disposed of as low level radioactive waste.

Hazardous debris is generally defined as solid material having a size of 60mm or larger and intended for land disposal, exhibiting a prohibited characteristic of hazardous waste or contaminated with prohibited listed hazardous waste. (RCRA LDR Guide page 8.7-8.9)[4]. The debris must be treated by one of the treatment technologies for each contaminant. The choice of technology is left up to the generator or personnel in charge of managing the waste. To ensure effective treatment, the debris must meet the definition of "Clean Debris Surface" after it has been treated.

The term "Clean Debris Surface" means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discoloration's, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area (RCRA 268.45)[5].

The EPA has identified 17 Best-Demonstrated Available Technologies (BDATs) to treat the debris. Table 1 lists the types of treatment technologies under the three general categories of extraction, destruction or immobilization (RCRA 268.45 page 748-749)[5]. These specified technologies are generic in nature and therefore applicable to all contaminates.

Table 1. Alternative treatment standards for hazardous debris.

Extraction Technologies	Destruction Technologies
Physical Extraction	Chemical oxidation
Abrasive Blasting	Chemical reduction
Scarification, grinding	Thermal destruction
Spalling	<u>Immobilization Technologies</u>
Vibratory finishing	Macroencapsulation
High pressure steams and water	Microencapsulation
Chemical extraction	Sealing
Thermal extraction	

During the past several years, technologies such as CO_2 pellet blasting and liquid abrasive blasting have been incorporated into the decon area to aid personnel treating debris or performing general decontamination. With these new technologies, debris can be treated or material can be decontaminated while generating smaller amounts of secondary waste. The NWCF also has the availability of all the technologies mentioned in Table 1 with the exception of immobilization. During testing and installation of these systems, modifications were made to the steam spray booth so that debris could be treated. The ventilation system was upgraded and secondary containment floor was installed.

The CO_2 pellet blasting system in the NWCF decontamination area is a non-destructive cleaning system that uses dry ice as a blasting media. The system is designed to remove loosely adhered contamination on all types of substrates. The system shaves blocks (1' x 1' x 1') of dry ice to create dry ice granules which are then propelled by air onto the surface being cleaned. When the granules hit the surface they instantly sublime causing the contamination (i.e. paint, oxide, dirt) to be lifted off the substrate. The CO_2 gas then returns to the atmosphere and the contamination falls to the floor or is collected on high efficiency particulate air (HEPA) filters. The only waste generated during this process is the contamination being removed from the surface being cleaned. The majority of the contamination is collected on HEPA filters, which are subsequently treated via the filter leach process.

A liquid abrasive spray glove box (LASGB) has been installed in the decontamination area and is attached to the existing steam spray booth located in CPP-659. The LASGB is 4' deep x 4' high x 8' long and has two exterior glove box operating stations. The media delivery system is a recirculating system, which means that the media can be reused. The system has a solid separator cyclone, located inside the cabinet, and is used to separate the blasting media from the water. The system is capable of operating with a variety of media (glass beads, plastic beads, etc.) and different amounts of water. The LASGB also has a high-pressure hot water system, which can be used to remove smearable contamination.

The LASGB system can be operated in destructive or non-destructive modes, depending on the type of abrasive and the amount of water used. While this system is in operation the type of abrasive can be changed depending on the type of debris being treated. The proposed plan of operation for the LASGB is to segregate the material or debris prior to operation and determine if the LASGB is the best method to treat or decontaminate the material. If the material or debris can be treated with the LASGB, an appropriate abrasive is selected depending on the nature of contamination, to be removed, and the debris.

After the treatment or general decontamination is complete, the abrasive is removed and stored in containers for reuse. The life of the abrasive will depend on how often it is used and the type of debris being treated. By using this system, abrasives can be reused until the operator has determined that it is no longer effective. The water is cleaned with filters that are located within the system and is reused, as long as the system is being used to decontaminate material and not to treat debris. If the system is used to treat debris, the water and filters will carry the same waste codes as the debris being treated. This may necessitate a change out of the water and filters when treatment is done. However, the quantities of water will be small (5 to 10 gallons) and will greatly reduces the volume of secondary waste that would other wise be generated with chemical decontamination; potentially savings hundreds of gallons of chemicals to decontaminate one item.

DECONTAMINATION FACILITY

The CPP-659 decontamination area has additional methods to treat debris or decontaminate material other than liquid abrasive or CO_2. The traditional methods are as follows:

1. Chemical soaking and scrubbing.
2. Steam Cleaning.
3. Water washing.
4. Spray on / wipe off chemicals.

One new technique available at the decontamination facility is the VAC-PAC Scabbling System. This system is used to scabble contaminated paint from steel or concrete and to remove thin layers of concrete. The system has a self-contained collection system for the material removed during the process. As the material is removed it is transported through a hose and placed in 55 or 35 gallon drum. This system has been used to remove paint from charger casks that were previously cleaned using chemical paint removers and scrubbing.

Before general decontamination occurs, each box, bag, or drum of material is segregated to determine which method or treatment process will be used. Radiation levels, size, and type of material (i.e. piping, valves, wood, plastic, etc.) determine the technique used to decontaminate each item. During this segregation process waste codes are determined for each piece. All debris is recorded and tracked to identify the debris and to determine where and when the debris was treated.

Chemicals commonly used at the NWCF decon area are nitric acid, oxalic and, TURCO 4502, TURCO Alkaline Rust Remover, Butchers speedball, and Radiac wash. The average monthly and yearly volumes of the chemicals consumed is given in Table 2.

Table 2. Chemical volumes.

Chemical	Concentrated Volume/month	Water Dilution Factor	Diluted Volume/ month	Volume/ Year
+Nitric Acid	*200 gallons	.50 gal. water	300 gallons	3,600 gallons
Oxalic Acid	*15 lbs.	.50 lbs./1 gal. water	30 gallons	360 gallons
Speedball	*5 quarts	None	None	15 gallons
Radiac Wash	*2 quarts	None	None	6 gallons
Turco 4502	*15 lbs.	.50 lbs./1 gal. water	30 gallons	360 gallons
Turco ARR	*125 lbs.	.50 lbs./1 gal. Water	250 gallons	3,000 gallons

*These estimates were obtained using ICMS.

+The nitric acid dilution factor is based on .50 gallon rinse water to 1-gallon nitric acid.

Butchers Speedball is a detergent solution that is generally used as a spray on / wipe off chemical. It can be used on all types of material that have low levels of surface contamination. It can also be used in the sink hoods area, steam booth, decon cubicles, or any other areas were light decon efforts are needed.

Radiac Wash is a detergent solution that is generally used as a spray on / wipe off chemical. It can be used on all types of material that have low levels of surface contamination. It can also be used in the sink hood area, steam booth, decon cubicles, or any other areas were light decon efforts are needed.

Nitric Acid 3*M*-6*M* is used to decontaminate items that are highly contaminated in the sink hoods, or decon cell. Nitric Acid 1*M*-3*M* is used as a leachant in the filter leaching process, which is performed in the filter-handling cell.

Turco 4502 and Oxalic acid are two chemicals used together in a two step process. The first step in this process is to treat the item with Turco 4502 ($KOH+KMnO_4$). The Turco converts the oxide layer on the surface of the item being cleaned. The second part of this process is then apply oxalic acid which removes the converted oxide layer. These chemicals are normally used in the sink hood area and the decon cell.

Turco ARR (Alkaline Rust Remover) is a chemical ($NaOH$) normally used to decontaminate items in the sink hood area or decon cell by boiling or hand scrubbing the item.

The primary reason these chemicals are and have been used at the NWCF decontamination area is because they are listed in the Technical Information Manual that was issued in1982. This manual is used to determine which types of chemicals are to be used to decontaminate material.

Large quantities of nitric acid are used during operation of the filter leach process. The nitric acid is made up (diluted for use) in large makeup vessels each having a capacity of 550 gallons. However, the standard practice when treating filters is to fill only one vessel to 400 gallons, which can last for several days. These vessels are also used to transfer chemicals to the hot cell. The amount of concentrated (13M) nitric acid used to leach one filter is approximately 27.70 gallons.

Alternative methods of leaching filters are currently being investigated. One method is to use water in place of nitric acid. This process would involve separating the filter media from the housing and treating only the fiber. Other chemicals are also being investigated to help reduce the amount of leaching time and the amount of chemical necessary.

New chemicals and decontamination techniques have been introduced and are currently being substituted at the NWCF decon area to help reduce the amount of secondary liquid waste. They are as follows:

Strippable Coatings – These coatings are used to remove smearable contamination on materials and help reduce the amount of Butchers Speedball and Radiac wash used. These coatings generate only solid waste.

a. Bartlett – Stripcoat TLC is a one-component, water-based, decontamination coating. This coating can be used to decontaminate floor/wall areas and equipment. The coating can be applied to metal, wood, concrete and painted surfaces. The coating can be applied with industrial spray equipment, paint rollers or brushes. After the coating has dried it can be pulled off the surface. The average drying time for this coating is 4 hours and can cover 50 sq. ft. /gal if applied at 25 mils thick.

b. Pentek – 604 is a "self-stripping" coating that is normally applied with a brush or roller. The coating can be used on all types of material (i.e., plastic, glass, and rubber) and all kinds of metal except carbon steel. The strippable coating is a water-based polymer, which is non -toxic, non-hazardous and non-flammable. One gallon covers approximately 120 ft^2. After the coating has been applied to the surface, it will dry and fall off. The average drying time is between 3 to 4 hours; however, drying time will vary depending on the temperature and humidity of the area being treated. This coating is designed to remove loose contamination.

Nitric Acid / Potassium Permanganate (NP) - This is a newer method that has been used in the NWCF decontamination area several times. It is similar to the TURCO 4502 but makes much less waste when calcined because it uses nitric acid in place of potassium hydroxide.

EET Chemicals are used to remove fixed and lose contamination. These chemicals have been proven to remove fixed contamination that nitric and ARR do not remove. These chemicals can be used in small quantities and could help reduce the amount of nitric or ARR consumption by half.

Corpex 918 is a low foam industrial cleaner and oil emulsifier concentrate (basic degreaser) that removes grime, oil, and the contaminants they entrap. The chemical is used primarily as a degreaser and to remove stains from stainless steel floors that other wise would have required large amounts of other chemicals.

Corpex Smearaway is a low foam-decontaminating agent (detergent) that removes smearable contamination affixed to surfaces by oil, grease, dirt, soil and grime. This chemical is used in place of speedball and radiac wash and will give the same results while producing about half as much secondary waste.

Corpex 921 is a new proprietary decontamination chemical that can be reused until it is spent. This chemical is used in an ultra-sonic bath, which will be connected to a recycling system. Each item that is being decontaminated will be placed in the ultra-sonic bath and left to soak until the item is clean. This new chemical is to be tested within a few months to determine efficacy and applicability as a decontamination chemical.

Siemens HP/CORD is a new decontamination method, which involves using their chemicals (permanganic acid/oxalic acid) in an ultra-sonic bath. The ultra-sonic bath will be used in conjunction with ion-exchange resins and an ultra-violet light to treat the chemicals after they have been used to clean items. The secondary waste generated from this system should consist of low-level contaminated water and a small amount of resin. This chemical can also be reused until spent. This method is going to be tested within the next year.

There are more studies being conducted with new decontamination chemicals and methods in an effort to reduce the generation of secondary waste.

COST ADVANTAGE

The life cycle disposal costs of using the current chemicals at the NWCF decontamination shop can be seen in Tables 3 and 4. These costs are based on processing the secondary waste through the calciner process.

Table 3. Life cycle disposal cost of current chemicals.

Current Chemicals	Gal Calcine/Gal Chemical[1,2]	Life Cycle Disposal Cost, $/gal[3]	* Life Cycle Annual Cost
Nitric Acid	0	$0	$2,915
Oxalic Acid (0.5M)	0.18	$342	$123,780
ARR	0.35	$665	$1,497,250
Turco 4502	0.34	$646	$1,454,600

* Assume 5,000 gallons of each chemical per year. This cost includes the PEW evaporation cost.

Table 4. Life cycle disposal cost of new chemicals.

New Chemicals	Gal Calcine/Gal Chemical [1,2]	Life Cycle Disposal Cost, $/gal [3]	*Life Cycle Annual Cost
NP	0.019	$35	$176,974
Techxtract	0.018	$34	$171,940
Corpex 918	0.08	$152	$761,940
Corpex Smearaway	0.02	$38	$191,940
Pentek 604	0	$0	$0
#Siemens	0	$0	$0
Stripcoat TLC	0	$0	$0
Corpex 921	2.1	$3,990	$19,951,800
+Corpex 921	0	$0	$0

* Assume 5,000 gallons of each chemical per year. This cost includes the PEW evaporation cost.
+ If this chemical can be treated through the U.V. system that Siemens has invented the Life Cycle Disposal Cost would be $0 or if the spent chemical can be grouted and sent off site the cost for disposal would decrease, but not as dramatically.
# This chemical will be caught in an ion exchange system and destroyed by a U.V. system, which will create low-level contaminated water. Solid waste (resin) that would be generated will be burned at WERF.

The life cycle disposal cost is much less for the new chemicals than the current chemicals. It is important to remember that all the chemicals are being used in combination and to totally eliminate the current chemicals may not be feasible. However, by implementing new chemicals and reducing the amount of current chemicals being used the amount of liquid waste generated can be reduced.

During this fiscal year a study is going to be conducted to determine how beneficial Corpex 921 will be to use at the NWCF. The chemical is going to be used in an ultrasonic bath, which is connected to a recycling system. This chemical has an advantage in that it can be recycled until it is completely spent. This means that it would not have to be disposed of each time that it is used. The study will look at the decontamination factors and how long does it takes before the chemical is no longer effective. The life cycle disposal cost for this chemical can be seen in Table 4. Although the cost may seem extremely high, one thing to remember is that this chemical may be used for months before it has to be disposed of and the cost is based on sending it through the calciner. Other options for disposal (including almost "wasteless" destruction with U.V. light) of this chemical are also going to be investigated during this study.

CONCLUSIONS/RECOMMENDATIONS

It is clear that there are changes that need to be made to the way items are decontaminated. One of these changes is to revise the Technical Information Manual, which would help in the introduction of new ways of decontaminating items. The reductions in the amount of Turco products that are used needs to be addressed along with alternatives to the amount and types of chemicals that are used to decontaminate items. Also, the importance of using alternative methods of decontamination and reducing waste streams needs to be presented to the personnel that are actually performing the work. The importance and cost benefit of debris treatment needs to be brought to the attention of management. The investigations and introduction of new chemicals needs to be continued.

The RLWR group is continuing to address the generation of secondary liquid waste streams. Even with many new techniques being incorporated into the decon area at CPP-659, waste generation is still a large issue. These new techniques and chemicals have helped in managing the amount of chemicals used and have also reduced the volume of liquid waste that is generated.

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