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Project Title/Work Order Safety Evaluation for Adding Water to Tank 101-SY		Date 12/09/94
		EDT No. N/A
		ECN No. 614154

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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XE 12/9/94

COMPLETE

ENGINEERING CHANGE NOTICE

Page 1 of 4

1. ECN 614154

Proj.
ECN

2. ECN Category (mark one) Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐		3. Originator's Name, Organization, MSIN, and Telephone No. Richard Clinton, 7E310, R2-11, 373-6162		4. Date October 19, 1994	
		5. Project Title/No./Work Order No. 101-SY WATER ADDITION	6. Bldg./Sys./Fac. No. 241-SY	7. Approval Designator SQ	
		8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-SAD-016 REV 1	9. Related ECN No(s). N/A	10. Related PO No. N/A	
11a. Modification Work [] Yes (fill out Blk. 11b) [x] No (NA Blks. 11b, 11c, 11d)		11b. Work Package No. N/A	11c. Modification Work Complete N/A		11d. Restored to Original Condition (Temp. or Standby ECN only) N/A
		Cog. Engineer Signature & Date		Cog. Engineer Signature & Date	
12. Description of Change Changed the water addition limit.					
13a. Justification (mark one) Criteria Change ☒ Design Improvement ☐ Environmental ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐					
13b. Justification Details This change is required to establish a new water addition limit for future planned activities for SY-101.					
14. Distribution (include name, MSIN, and no. of copies) See attached distribution list.					
<div style="border: 1px solid black; padding: 5px; text-align: center;"> RELEASE STAMP OFFICIAL RELEASE BY WHC DATE DEC 09 1994 STA 4 </div>					

A-7900-013-2 (06/94) GEF095

MASTER

A-7900-013-1 (04/94)

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614154

18. **Change Impact Review:** Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NONE		

A-7900-013-3 (06/94) GEF096

UNREVIEWED SAFETY QUESTION SAFETY REVIEW FORM

(Per WHC-IP-0842, 15.9)

Page 1 of 2

REFERENCE DOCUMENT(S):

ECN No. 614154

PCA No. N/A

Work Pkg No. N/A

Other (Specify) N/A

Authorization Basis: WHC-SD-WM-ISB-001 Rev. 0

TITLE: NEW WATER ADDITION LIMIT FOR TANK 241-SY-101

Tank 241-SY-101 is on the Flammable Gas Watch List. Several activities planned for this tank will require the addition of water to the waste. These activities include removing the present mixer pump, installing a replacement pump, installing the viscometer and the void fraction meter, and flushing the FIC and manual tape. The amount of water required for these activities is estimated to be 15,380 gallons (see ECN, page 1). The new limit proposed for the amount of water that can be added to the tank is 20,000 gallons (see ECN, page 2). The old limit was 9600 gallons. Adding 20,000 gallons of water to the tank would increase its surface level by 7.37 inches. The current waste level in the tank is 400 inches, and it would increase to over 407 inches if 20,000 gallons of water were added.

Does the PROPOSED CHANGE:

A. Represent a change to the facility as described in the AUTHORIZATION BASIS documentation?

☐ N/A ☒ No ☐ Yes/Maybe

Basis: Water has been added to tank 241-SY-101 in the past to flush the waste level measuring instruments and to install the mixer pump. According to WHC-SD-WM-ISB-001 Vol. 1 Rev. 0, Sec. 3.4, the maximum surface level allowable is 422 inches. However, additional controls are in place for tank 241-SY-101 due to its mitigation with the mixer pump. In the mitigation mixer pump safety assessment, LA-UR-92-3196 Rev. 12, waste level limits are set for specific activities, based on the amount of slurry gas that may be in the waste at different heights. These limits range from 401.5 to 404.9 inches. However, the Test Review Group (TRG) has the authority to raise the maximum waste level based on the amount of water that has been added. Limits on the amount of water that can be added for each activity are set in the safety assessment to limit the amount of gas that could be released.

B. Represent a change to procedures as described in the AUTHORIZATION BASIS?

☐ N/A ☒ No ☐ Yes/Maybe

Basis: The addition of water follows procedures already established.

C. Represent a test or experiment not described in the AUTHORIZATION BASIS documentation?

☐ N/A ☒ No ☐ Yes/Maybe

Basis: This is not a test or experiment.

UNREVIEWED SAFETY QUESTION SAFETY REVIEW FORM
(Continued)

Page 2 of 2

D. Does the change impact:

- Implemented OSRs or IOSRs? ☐ N/A ☒ No ☐ Yes/Maybe
- Approved IOSR Compliance Implementation Plans? ☐ N/A ☒ No ☐ Yes/Maybe

Basis: None of the OSRs or IOSRs place any limits on water additions or maximum waste levels in flammable watch list tanks.

Based on the above, a Safety Evaluation ☐ DOES ☒ DOES NOT
need to be performed for this change

USQE No. 1

N. E. Wilkins
Print Name

USQE No. 2

G. J. Gauck
Print Name

N. E. Wilkins
Signature

11/21/94
Date

G. J. Gauck
Signature

11-28-94
Date

RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-SAD-016, REV 2

Document Title: Safety Evaluation for Adding Water to Tank 101-SY

Release Date: 12/9/94

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz

December 9, 1994

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SUPPORTING DOCUMENT		1. Total Pages <i>19</i>
2. Title Safety Evaluation for Adding Water to Tank 101-SY	3. Number WHC-SD-WM-SAD-016	4. Rev No. 2
5. Key Words Tank 214-SY-101; liquid level; gas release event; pump removal; ventilation flow rate.	6. Author Name: Richard Clinton <i>Richard Clinton</i> Signature Organization/Charge Code 7E310/N2B11	
<p><i>KMB 12/9/94</i> APPROVED FOR PUBLIC RELEASE</p>		
<p>7. Abstract</p> <p>This document provides a new water limit for Tank 241-SY-101. The original limit was set at 9600 gallons. The new limit is now 20,000 gallons. There are various activities that require the use of additional water to the tank. The main activity is the removal of the temporary mixer pump. This requires a large amount of water which will exceed the original limit. Also, other activities such as flushing, adding a viscometer, and adding a void fraction meter requires additional water. The new limit safely incorporates these activities and allows room for more future activities.</p>		
<p>8. RELEASE STAMP</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>OFFICIAL RELEASE </p> <p>BY WHC</p> <p>DATE DEC 09 1994</p> <p><i>SIA 4</i></p> </div>		

[illegible]

WHC-SD-WM-SAD-016 Rev. 2

SAFETY EVALUATION FOR ADDING WATER TO TANK 101-SY

R. Clinton

August 1994

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1.0 PURPOSE

The objective of this document is to evaluate the liquid level limit set for 241-SY-101 in October of 1992 and establish a new limit for future planned 241-SY-101 activities. This evaluation is based upon the behavior of SY-101 since the implementation of mixer pump operations. The new liquid level limit is also based upon the future activities planned for tank SY-101. The new limit includes contingencies for other activities that may be needed besides pump removal and installation.

2.0 INTRODUCTION

The water addition of tank 241-SY-101 is required for several operations within the tank. These operations include the removal of the present mixer pump, the installation of a newly fabricated mixer pump, the additions of the viscometer and void fraction meter, and flushing.

The newly fabricated mixer pump is going to replace the temporary mixer pump on a permanent basis. The removal of the present mixer pump involves pre-wash activities, which include adding water through the burrowing ring, internal flushing, and external washing. This gives a total for the pre-wash activities of approximately 2286 gallons. The actual pump removal includes internal flushing, adding water through water wands, and adding water through spray ring. This gives a total for the actual pump removal of approximately 7034 gallons. Also, another 300 gallons must be added for the dilution and the flushing of contaminated material that might drop from the pump into the pump pit during removal.

The values were derived under the assumption that the lifting rate of the pump is approximately 1 ft/min or less, a combined water wand flow rate of 60 GPM, a spray ring flow rate of 120 GPM, and a washed length of 600 inches.

Estimated water addition for pump removal totals approximately 12,320 gallons. This includes the pre-wash activities. This will increase the tank level by approximately 4.48 inches. The Safety Condition for Operation (SCO) is given in LANL 1994 as 8900 gallons. Any amount over that must be approved by the Test Review Group (TRG).

The installation of the new mixer pump, the viscometer, and the void meter will need a minimal amount of water addition. The new mixer pump will need approximately 1000 gallons. The viscometer and the void meter is estimated to need approximately 1000 gallons each.

Regular periodic flushing of the FIC and the manual tape is going to need approximately 30 gallons of water each.

The total amount of water additions for these operations should equal approximately 15,380 gallons. This would increase the tank level to approximately by 5.59 inches.

In order to prepare for any more contingencies, a limit of 20,000 gallons is established. This would increase the tank level by 7.27 inches. The added volumes of water will be tracked and surface level monitored to implement compliance with the water addition limits.

3.0 BACKGROUND

In the past couple of years, there have been several operations that have been done that required the monitoring of water addition to tank 241-SY-101. The limit of 9600 gallons was based on activities such as water lancing operations, pump installation, MIT installations, flushing, and VDTT installations (see Appendix for actual amounts). Also, the limit was based on the level of the tank before any pump was installed. The tank level was approximately 416 inches. In an effort to avoid the maximum liquid level of 422 inches, the 9600 gallon limit was set. This limit would have only increase the liquid level by 3.5 inches, which would have made the liquid level roughly 419.5 inches. This would have been very close to the maximum allowable of 422 inches.

Another concern was that the water addition might induce a roll-over. There has been no evidence of a roll-over being induced since the water addition, during or after the installation of the mixer pump. This is consistent with previous conclusions, i.e. that water addition would not induce roll-overs (Reynolds, 1992).

4.0 LIQUID LEVEL

The current liquid level of 400 inches should allow the addition of 20,000 gallons (7.27 inches) to the tank. The liquid level increase by 7.27 inches fall well within compliance with OSD-T-151-00007. This specifies that the maximum liquid level in the tank would be 416 inches.

The maximum liquid level allowable of 416 inches is supported by an analysis performed by URS/Blume Engineers (RHO-C-59, July, 1981).

Considering that the former tank level was 416 inches, the present liquid level of 400 inches is well below the maximum allowable. This should allow a substantial amount of water addition to the tank.

5.0 WASTE CHEMISTRY

Water will be added during various operations such as pump removal and installation, flushing, and void fraction meter and viscometer installation. For the pump removal, a large amount of water will be added prior to and during the operation. Pressurized water will be used for softening the waste, pre-flushing, pre-washing, and actual pump removal. For the void fraction meter and the viscometer, 2000 gallons of water will be used for installation.

The addition of water will create fluidized sludge and will dilute the waste. Adding water through the burrowing ring, the crust will soften. In the pre-wash and pre-flushing operations, fluidized sludge and water will be created deep within the waste and on the surface of the waste.

The viscometer and void fraction meter will add to the further dilution and softening of the crust.

Crust analysis indicate that it is predominately sodium nitrate and sodium nitrite. Sodium aluminates and sodium carbonates are also present in large quantities. The sodium carbonate is present in hydrated form, so it helps to prevent the crust from drying out.

Analysis of core samples from tank SY-101 obtained during Window C (May, 1991) indicate that the moisture content of the crust ranges from 10 to 26 percent.

The tank is presently at about 1.1 million gallons. The addition of 20,000 gallons, in comparison to the total volume of waste, is very small (less than 2% of the total volume). The addition of this amount of water should not affect the overall pH of the waste.

6.0 EFFECTS ON GAS RELEASE EVENT (GRE)

This section examines the potential hydrogen gas concentration in the event that there is a major gas release after the addition of water and the removal of the mixer pump. The estimation of the hydrogen concentration can be obtained with some preliminary calculations. There are a couple of assumptions that must be made in order to complete the calculations. First, it is assumed that the amount of water injected into the sludge layer is 2100 gallons. This total is for 3 minutes of internal flushing at a flow of 200 gallons per minute and 18.7 minutes at approximately 80 gallons per minute for the burrowing ring. Secondly, it will be assumed that any additional water used during the pump removal and other operations will be deposited on the crust or in the convective layer.

The first calculation that must be done is the volume of the tank head space of tank SY-101. It is assumed that the dome of the tank is ellipsoidal. This means that the formula $\pi D_i^2 h / 6$ (from Perry's Chemical Engineer's Handbook 6th Edition) where $D_i = 75$ ft. and $h = 11.7$ ft (distance from crown to the primary tangent line of the tank).

$$\pi D_i^2 h / 6 = 34,500 \text{ cubic feet}$$

Considering that the tangent line of tank is located at 422.3 inches, the remaining volume can be calculated by subtracting the current level of 400 inches and multiplying by 2750 gallons/in. (368 cubic feet/in).

$$V = (422.3 - 400) 368 \text{ cubic ft./in} = 8206 \text{ cubic ft.}$$

where V is equal to the volume between the tangent line and the level of the waste.

Hence, the total head volume available for the dilution of the gas released is:

$$34,500 + 8206 = 42,706 \text{ cubic ft.}$$

Next, the gas concentration trapped within the sludge must be estimated. According to studies done by R.T. Allemann of Battelle, the non-convective layer (sludge layer) holds a volumetric fraction of gases equal to 24% (when most buoyant). The gas would be under approximately 2 atmospheres of pressure. It is estimated by Allemann that one half of the gas could be released to the tank head space.

The next calculation is to estimate the amount of gas release to the tank head space. It is assumed that the waste affected is 20 times the volume of the flush water used. For example, if 2100 gallons is injected into the sludge layer, the amount of waste affected will be 42000 gallons. In accordance with Allemann, 12% percent of the gas (1358 cubic ft., at 1 atm.) can potentially be released to the dome.

The composition of the gas released consist of about 40 volume % hydrogen (Ashby, et al, 1992). The amount of hydrogen would then be 543.5 cubic ft.

If minimal ventilation is assumed, the hydrogen concentration due to the pump removal can be calculated by dividing the volume of hydrogen by the total head space volume. Therefore, the volume percent of hydrogen is:

$$543.5 \text{ cu.ft.} / 42,706 \text{ cu.ft.} = 1.27 \% \text{ (by volume)}$$

Since a minimum of 400 cfm ventilation is required through 101-SY (LANL 1994), the additional hydrogen will dissipate and will not adversely affect the safety of the tank.

7.0 CONTROL OF WATER ADDED TO 101-SY

The addition of water to tank 101-SY will be controlled in several ways. The water used in the tank farm must be in compliance with the standard operating procedure, "Raw Water Surveillance and Usage", TO-040-540, Rev. C-13. This procedure requires written logs to be maintained to record water meter readings when loading water in preparation for usage.

It is assumed that the highest temperature of the transported water is at dome temperature, and the generation of gas will increase as much as 32 times in a local area (only for the time taken for the water to cool down to the average temperature of the waste in the tank). The temperature of the water may lower the viscosity of the waste in a local area, which may cause the release of gas.

The water addition system includes meters to control the application of the water. The water from the tank truck passes through a three way fixture that includes a check valve, a blank, and a meter. The water wands and the spray ring for the removal of the pump will have flow rates of 60 GPM and 120 GPM, respectively. The spray nozzles are in a fixed configuration. This should prevent the misdirection or the spreading of any contaminated material outside of the tank.

In order to ensure safety, the temperature of the water used must be at or 20 degrees below dome temperature, unless otherwise approved by Safety. The solids expected within the tank are sodium nitrate, sodium nitrite, and sodium carbonate. These solids dissolve in cold water, but better results are obtained when using hot water. The water should remain in the area of the injection unless the buoyancy forces move it. The dissolved solids from the pump will become indistinguishable from the rest of the waste.

8.0 WYDEN BILL CONSIDERATIONS

Public Law 101-510, Section 3137, entitled " Safety Measures for Waste Tanks at Hanford Nuclear Reservation". Section 3137, commonly referred to as the "Wyden Bill", enacted a prohibition effective on March 5, 1991, which provides that no additional high-level nuclear waste (except for small amounts removed and returned to the tank for analysis) may be added to a tank identified under subsection (a) (of the bill), unless the Secretary of the Department of Energy determines that no safer alternative than adding such waste to the tank currently exists or that the tank does not pose a serious potential for release of high-level waste.

101-SY Waste Tank falls under subsection (a) definition. However, the hot water to be added to 101-SY serves a variety of beneficial purposes including:

- * reducing radiation exposures to the operating personnel, consistent with ALARA guidelines.
- * potentially reducing contamination of the mixer pump and other equipment to category 3 low level waste instead of TRU (transuranic waste) which requires additional certifications and costs in order to transport and dispose.

Furthermore, since water does not meet the definition of high level radioactive waste, water additions to the 101-SY tank should be exempt from the Wyden Bill prohibition, providing other safety considerations as previously discussed in this supporting document are met.

9.0 REFERENCES

Ashby, E.C., et. al., 1992. "Gas Generation and Retention in Tank 101-SY: A Summary of Laboratory Studies Tank Data, and Information Needs" PNL-8124, Battelle Pacific Northwest Laboratory, Richland, Washington.

Carlson, T.A., "Compilation of Basis Letters Referenced in 241-AN, AP, AW, AY and SY Process Specifications", SD-RE-TI-008, Rev. 4, January 6, 1988.

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Ginn, S., 1973, "Tank Cross Section 241-SY Tank Farm" Drawing No. H-2-37772, Rev. 2, Hanford Engineering Services, Division of Vitro Corporation of America, Richland, Washington.

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Los Alamos National Laboratory, "A Safety Assessment for Proposed Pump Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101: Hanford Site, Richland, Washington", LA-UR-92-3196, Rev. 12, September 8, 1994.

Marusich, R.M., "Safety Evaluation for adding Moisture to Tank 101-SY," WHC-SD-WM-TI-425, Rev. 1, July, 1990.

Public Law 101-510, Section 3137 "Safety Measures for Waste Tanks at Hanford Nuclear Reservation", March, 1991.

Reynolds, D.A., "Reply to Concerns on Water Additions to 101-SY", Westinghouse Hanford Company Internal Memo, 72100-92-050, March 24, 1992, Richland, Washington.

URS/John A. Blume and Associates, "Analysis of Underground Waste Storage Tanks 241-SY at Hanford Washington", ARH-R-172 for Atlantic Richfield Hanford Company, Richland, Washington, October, 1974.

URS/John A. Blume and Associates, "Additional Analysis of Underground Waste Storage Tanks 241-SY at Hanford Washington", RHO-C-59 for Vitro Engineering, Richland, Washington, July, 1981.

10.0 APPENDIX A

TANK 241-SY-101 WATER ADDITIONS

Window G Additions:

o MIT Installation	36 gallons
o Air Lance Removal (3)	1,173 gallons
o Manual Tape Removal	61 gallons
o VDTT Installation (2)	253 gallons
o Thermocouple Tree Removal	1,089 gallons

Window H Additions:

o Slurry Distributor Removal	30 gallons
------------------------------	------------

Window I Additions:

o Water Lancing Operation	500 gallons
o Water Lancing Decontamination	300 gallons
o Pump Installation	253 gallons
o Multifunctional Instrument Tree (MIT) #2 Installation	32 gallons
o Manual Tape Flush	31 gallons
o FIC Flush	44 gallons

Water Additions Since Window I:

o Pump Internals Flush	27 gallons
o FIC	90 gallons
o Manual Tape	15 gallons

[25] From: Kenneth D Fowler 8/24/92 10:35AM (2387 bytes: 38 ln)
 To: Erik H Neilsen
 Subject: VDTT Water addition basis.

----- Forwarded -----

From: Troy I Stokes at -WHC207 8/20/92 3:40PM (2186 bytes: 38 ln)
 To: Kenneth D Fowler at -WHC140
 cc: Nicholas W (Nick) Kirch at -WHC140, Troy I Stokes, Tony R Benegas at
 -WHC208, Carl E Hanson, Jack W Lentsch at -WHC129, George F Vargo Jr at
 -WHC35
 Subject: VDTT Water addition basis.

----- Message Contents -----

Text item 1:

Nick;
 Glen Rust believes it best to lance all the way down if the lance is used. Upon further review, this position makes pretty good sense to me, and the work plan has adopted this position.

So, the estimated 200 gallons for lancing only will have to increase. At 11 gpm, descent speed of 1 ft/min, and waste depth of 422", we'll put out about 387 gallons minimum per lancing operation.

Please make sure the water limiting document adequately covers this expected operation.

Troy Stokes

Text item 2:

Ken,

As per our telephone conversation, here's some justification for water addition requests.

The lance must be lowered in at about 1 ft/min, a safety control. It flows about 11 gpm at 100 psi, conditions expected from the tank truck. The lance will be turned on just above the waste surface. The waste is about 35 feet deep. So, 35 minutes req'd at 11 gpm ———>385 gallons

Then, the external decon piece flows about 3 gpm. We need at least 30 gallons to meet some regulations to wash it off. A removal rate of 1 to 5 ft/min leads us to (assuming 55 feet of lance is in the tank) 165 gallons to 33 gallons. The VDTT must be internally flushed with about 22 gallons to meet some regulations once the lance is clear of the waste.

So, it looks like we may need about 600 gallons per VDTT, and 2 VDTTs are going to be installed.

Please call with any questions,
Troy

15: From: Peter A. Tichler at -WEC108 5/5/92 1:13PM (914 bytes: 14 ln)
cc: Dennis E. Cole at -WEC11

Receipt Requested

cc: Roy E. Russell at -WEC131, Thomas L. Moore at -WEC131, Gordon J. Funnell,

Donald E. DeGare

Subject: Water Quantity Required for SY-101 Lance Removal

Message Contents

The information below is the expected water use for the SY-101 Lance Removal Program. Water will be used for three operations; ID flush, OD spray wash, and caking ball removal.

ID Flush — 10 gals for one fill x 10 to flush nozzles clear = 100 gals
OD Spray Wash — 0.5 gal/min x 6 nozzles x 120 min = 360 gals
Caking Ball Removal — 1 gal/min x 120 min = 120 gals

Total = 320 gals per lance
= say 300 gals

Total = 3200 gals (four lances)

From

D.E. Cole

Tank Farm Projects

PREWASH ACTIVITIES:

ITEM	FLOW (GPM)	TIME (min)	TOTAL (gal)
Burrowing Ring	80	18.75	1500
Internal Flush	200	3	600
Heel Flush	2	3	6
Spraywands	60	3	180
TOTAL			2286

DURING PUMP REMOVAL:

Pump Length Below Riser: 32 feet
Pump Raised 4 feet prior to decon.

Total Washed Length: 28 feet

Planned Rate of Withdrawal: 2 ft/min
Assume actual withdrawal rate of 1 ft/min to allow for logging of gamma data.

Plenum (Internal) Flush Duration: 3 min
Burrowing Ring Flush Duration: 3 min
Assume Spray Ring and Wands left on during Plenum and Burrowing Ring Flush.
Heel flush left on during entire procedure.

So, for the total water addition during pump removal:

ITEM	FLOW (GPM)	TIME (min)	TOTAL (gal)
Burrowing Ring	80	3	240
Internal Flush	200	3	600
Heel Flush	2	28+3+3	68
Barton Flush	2	3	6
Spray Ring	120	28+3+3	4080
Spraywands	60	28+3+3	2040
TOTAL			7034

TOTAL REQUIRED FOR DECON: 9,320 GAL