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1.0 DISCUSSION

The purpose of the Process Control Program (PCP) for incontainer solidification is to provide a program which will assure a solidified product with no free standing liquid prior to transportation for disposal and which meets the requirements of 10 CFR 61.56, Waste Characteristics.

The PCP's for each waste stream included in this procedure are based on laboratory testing, the results of which are included in "Topical Report Cement Solidified Waste to Meet the Stability Requirements of 10 CFR 61" prepared by Westinghouse - Hittman. These PCP's are valid for all liner types using electric or hydraulic mixing heads provided by Hittman.

The appropriate portions of this document shall be considered complete only when used with the operating procedures (OP 1104-28A for borated and oily wastes or OP 1104-28C for resin, for full scale solidification. This document describes the methodology for determining the acceptable ratio of waste, cement and additive that will result in an acceptable product for transportation and ultimately burial. The Solidification Data/Calculation Sheets convert these ratios into the recommended quantity of cement and additive that should be mixed with Class A unstable waste and the recommended quantity of cement and additive which must be mixed with Class A Stable and Class B or C wastes.

2.0 REFERENCES

- 2.1 Westinghouse Hittman F421-P-004, Process Control Program for Incontainer Solidification of 4 to 20 wt% Boric Acid
- 2.2 Westinghouse Hittman STD-P-05-002, Process Control Program for Incontainer Solidification of Oily Waste
- 2.3 Westinghouse Hittman F421-P-005, Process Control Program for Incontainer Solidification of Powdered Resins
- 2.4 Westinghouse Hittman F421-P-005, Process Control Program for Incontainer Solidification of Class A Unstable or Stable, Class B and C Resin at Maximum Packaging Efficiency
- 2.5 Westinghouse Hittman STD-R-05-007, Topical Report Cement Solidified Waste to Meet the Stability Requirements of 10 CFR 61
- 2.6 Westinghouse Hittman STD-R-05-011, Topical Report Mobile Incontainer Dewatering and Solidification System (MDSS)
- 2.7 NRC Letter from Charles E. Rossi, Assistant Director, Division of PWR Licensing-A to R.J. Leduc, Director of Engineering Westinghouse Hittman -"Acceptance of Referencing of Licensing Topical Report STD-R-05-011, Hittman Mobile Incontainer Dewatering and Solidification System (MDSS)", Dated Oct. 31, 1986.

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2.8 Tech. Spec. Section 3.22.3, Solid Radioactive Waste

2.9 GPUN Radiation Protection Plan

3.0 LIMITS AND PRECAUTIONS

- 3.1 As required by Tech Spec 4.22.3.1.2, the PCP shall be used to verify the solidification of at least one representative test specimen from at least every tenth batch of each type of wet radioactive waste (e.g., evaporator bottoms, o ly waste, resin and precoat sludge).
- 3.2 For the purpose of the PCP a batch is defined as that quantity of waste required to fill a disposable liner to the appropriate level on the waste level indicator.
- 3.3 If any test specimen fails to solidify, solidification of the batch under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with the Process Control Program, and a subsequent test verifies solidification Solidification of the batch may then be resumed using the alternate solidification parameters determined.
- 3.4 If the initial test specimen from a batch of waste fails to verify solidification then representative test specimens shall be collected from each consecutive batch of the same type of waste until the three (3) consecutive initial test specimens demonstrate solidification. The Process Control Program shall be modified as required to assure solidification of subsequent batches of waste.
- 3.5 For high activity wastes, such as spent resin or used precoat, where handling of samples could result in personnel radiation exposures which are inconsistent with the ALARA principle, representative non-radioactive samples will be tested. These samples should be as close to the actual waste physical and chemical properties as possible. Typical expended mixed bed resin shall be used to simulate the spent bead resin and the appropriate mix of anion to cation powdered resin shall be used to simulate used precoat.
- 3.6 All Chemicals used to condition or solidify waste or simulated waste in solidification tests shall be the actual chemicals used in full scale solidification.
- 3.7 A Test Solidification Data Sheet will be maintained for each test sample solidified. Each Data Sheet will contain pertinent information of the test sample and the liner numbers solidified based on the test sample.

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- 3.8 Samples should be drawn at least six hours prior to the planned full scale waste solidification to allow adequate time to complete the required testing and verification of solidification for Class A unstable waste. 28 hours should be allowed, if practical, for Class A stable, Class B and C wastes.
- 3.9 The tank containing the waste to be solidified should be mixed by recirculating the tank contents for at least three volume changes prior to sampling to assure a representative sample.
- 3.10 An RWP must be obtained and used for performing test solidifications of radioactive samples.

4.0 TEST SOLIDIFICATION OF 4 TO 10 WT% BORIC ACID (CONCENTRATED WASTE)

4.1 Prerequisites

NOTE: This PCP Test Solidification Procedure is applicable to Class A Unstable, Class A Stable, Class B and C Waste Forms.

- 4.1.1 A sufficient size sample of concentrated waste (approx. 1 liter) has been drawn and the following parameters analyzed for by Plant Chemistry:
 - Boron
 - pH
 - Total Solids
 - Gamma Scan

NOTE: The total solids and gamma scan are used for information purposes only to track waste characteristics and are not to be used in the Process Control Program calculations.

4.1.2 The Ops Quality Assurance Group has been contacted to inform them of the pending Test Solidification to see if they care to witness the test.

OOA Monitor Contacted

Name / Date / Time

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4.1.3 The appropriate portions of Attachment 1 have been completed including waste classification, chemistry information, balance calibration data and the sequential sample number.

4.2 Procedure

NOTE: Tare weights of waste, cement, additives, etc. should be obtained during performance of the following procedure. Round off to the nearest gram.

- 4.2.1 Calculate the weight percent of Boric Acid on Attachment 1.
- 4.2.2 MEASURE 500 gms of untreated concentrated waste into a container.
- 4.2.3 RECORD the weight and volume on Attachment 1.
- 4.2.4 ADD 50 wt% sodium hydroxide (NaOH) to raise the pH between 8 to 8.5 for Class A unstable, Class A stable, B and C solidification. If pH is >8.5 then reduce to a range of 8 and 8.5 with sulfuric acid.
- 4.2.5 RECORD the weight of NaOH used and the adjusted pH on Attachment 1.
- 4.2.6 If large (i.e., foam causing) quantities of detergents are present, TREAT the sample with an anti-foaming agent until the foam disappears.
- 4.2.7 RECORD the weight of anti-foaming agent used on Attachment 1.
- 4.2.8 Determine if oil is present by looking for an oil film on the surface of the sample. If oil is present perform the following:

m1 (011) ÷ m1 (total sample) x 100 = % 0.1

- a. If oil is present in stable waste in a quantity greater than 1% by volume, reduce the quantity of oil to less than 1% by skimming.
- b. For unstable waste if oil is present and the volume is between 3 and 12% of the volume of waste, TREAT with an emulsifying agent such as Maysol 776 (20% of the volume of oil). Oil in concentrations > 12% by volume may not be solidified by this procedure. (Refer to Section 6.0 Test Solidification of Waste Oil).

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	NOTE :	The de equal	ensity of Maysol 77 to the weight in g	6 is 1.0 g/ml; th rams.	e volume in ml is	
	4.2.9	RECORD 1 on Attac	the % oil and the q	uantity of any em	ulsifying agent used	
	4.2.10		the volume and calc thment 1.	ulate the weight	of the treated Sample	
•	4.2.11		te the percent soli)), (11) and (12) i		by completing items ittachment 1.	
	4.2.12	For the into a r	test solidificatio mixing vessel 400 m	n of the concentr 1 of pretreated w	ated waste, measure vaste.	
	NOTE :		olidifications sho able beaker or sim			
	4.2.13	RECORD 1 Attachme	the volume AND weig ent l.	ht of the treated	sample on	
	4.2.14		te the water in the in Section III of		ting items (15), (16)	
	4.2.15	tion Dat	CULATE and WEIGH O	, DETERMINE the w	the Test Solidifica- ater/cement ratio juantity of Portland	
	4.2.16	RECORD	the weight of cemen	t on Attachment 1		
	4.2.17	CALCULAT 1.e., an vessel.	E and WEIGH out the	e required quanti asilicate (ASMS),	ty of metso beads, into a separate	
	4.2.18	RECORD 1	the weight of ASMS	on Attachment 1.		
	4.2.19	Slowly A	DD the cement to t	he test sample wh	ile it is being mixed.	
1	NOTE :	mixing	should be accompl motor with blade a homogeneous mixt	or manually with	a rigid stirrer	

minute.

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		and the second se		an and a survey of the analysis of	nana kasangkana nakakana ing Pala nagaraka kanana dan dan
4.2.20	After all the sample while	e cement is a it is being	dded, slowly mixed.	ADD the A	SMS to the test
4.2.21	so that a hor	mogeneous mix ± 5°F for 24	ture is obtained the hours for C	lass A Stat	e ASMS is added) the sample and le, Class B or C
NOTE :	the accepta proceed.	time during t ance criteria However, no t ed without at	the liner test solidif	solidifica cation sha	ition may
4.2.22	Verify the Ad sign and date			ion 10) has	been met and
4.2.23	the full scal this waste ty	e required qu le solidifica ype (as deter Solidificati	uantities of ution using a mined by Rad on Calculat	cement and liner typ dwaste Oper	ection 10 additives for e applicable for ations Engineer- for 4 to 10 wt%
NOTE :		shall be soli te Solidifica			28A, Radio
4.2.24	Complete Sect solidificatio				
0 TEST SOLIDIFICA	TION OF > 10 1	TO 20 wt% BOR	NIC ACID (CO	CENTRATED	WASTE)
5.1 Prerequis	ites				
NOTE :	This PCP Te Class A Uni				licable to C Waste Forms.

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	5.1.1	A suff has be	icient size sample of concentrated wast en drawn and the following parameters a Chemistry:	
		• B	oron	
		• pi		
		• To	otal Sollds	
		• Gi	amma Scan	
	NOTE :	purp	total solids and gamma scan are used fo oses only to track waste characteristic e used in the Process Control Program o	cs and are not .
	5.1.2	them of	s Quality Assurance Group has been cont f the pending Test Solidification to se s the test.	tacted to inform se if they care to
		0	QA Monitor Contacted	
			Name	/ Date / Time
	5.1.3	includ	propriate portions of Attachment 3 have ing waste classification, chemistry inf ation data and the sequential sample no	formation, balance
5.2	Procedure			
Ī	<u>NOTE</u> :	obta	weights of waste, cement, additives, e ined during performance of the foilowin d off to the nearest gram.	
	5.2.1	Calcul	ate the weight percent of Boric Acid or	n Attachment 3.
	5.2.2	MEASUR	E 500 gms of untreated concentrated was	ste into a container
	5.2.3	RECORD	the weight and volume on Attachment 3	
	5.2.4	12 and	wt% sodium hydroxide (NaOH) to raise 12.5. If pH is > 12.5 then reduce to ith sulfuric acid.	

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5.2.5	RECORD the weight of NaOH used and 3.	the adjusted pH on Attachment
5.2.6	If large (i.e., foam causing) quant present, TREAT the sample with an a	
5.2.7	RECORD the weight of anti-foaming a	gent used on Attachment 3.
5.2.8	Determine if oil is present by look surface of the sample. If oil is p	
	ml (Oll) ÷ml (total sam	ple) x 100 =% 0.1
	 a. If oil is present in stable wa than 1% by volume, reduce the 1% by skimming. 	
	b. For unstable waste if oil is p between 3 and 12% of the volum emulsifying agent such as Mays oil). Oil in concentrations > solidified by this procedure. Solidification of Waste Oil).	e of waste, TREAT with an ol 776 (20% of the volume of 12% by volume may not 'a
NOTE :	The density of Maysol 776 is 1.0 equal to the weight in grams.	g/ml; the volume in ml is
5.2.9	RECORD the % oil and the quantity o on Attachment 3.	f any emulsifying agent used
5.2.10	Record the volume and calculate the on Attachment 3.	weight of the treated sample
5.2.11	Calculate the percent solids in the (9) , (10) , (11) and (12) in Section	sample by completing items II of Attachment 3.
5.2.12	For the test solidification of the into a mixing vessel 400 ml of trea	
NOTE :	Test solidifications should be co disposable beaker or similar size	
5.2.13	RECORD the volume AND weight of the	sample on Attachment 3.

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5.2.14		the water in the sample by con n Section III of Attachment 3.	
5.2.15	tion Data	re 1 and the percent solids for Sheet, Item (12), DETERMINE the LATE and WEIGH out the require ent.	he water/cement ratio
5.2.16	RECORD the	weight of cement on Attachmen	nt 3.
5.2.17	CALCULATE sodium met	and WEIGH out the required qui asilicate (ASMS) into a separa	antity of anhydrous ate vessel.
5.2.18	RECORD the	weight of ASMS on Attachment	3.
5.2.19	Slowly ADD	the cement to the test sample	e while it is being mixed
N <u>CTE</u> :	mixing a	hould be accomplished by stir otor with blade or manually w homogeneous mixture is obtain	ith a rigid stirrer
5.2.20		the cement is added, slowly A le it is being mixed.	DD the ASMS to the test
5.2.21	so that a CURE at 12	iclent mixing (2 minutes afte homogeneous mixture is obtain 10 ± 5°F for 24 hours for Clas n temperature for Class A Unst	ed, SEAL the sample and s A Stable, Class B or C
NOTE :	the acce proceed.	y time during the 24 hour cur ptance criteria, the liner so However, no test solidifica d without at least 24 hours o	lidification may tion shall be dis-
5.2.22		Acceptance Criteria (Section late Attachment 3.	10.0) has been met and
5.2.23	calculate the full s this waste ing) and t	Acceptance Criteria has been m the required quantities of ce scale solidification using a 1 e type (as determined by Radwa the Solidification Calculation d (Attachment 4).	ement and additives for liner type applicable for iste Operations Engineer-

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	1	Waste Solidification - Hittman.	104-28A, Radioactive
	5.2.24	Complete Section VII of Attachment 4 upon	completion of the
.0 <u>TES</u>		Waste Solidification - Hittman.	completion of the
.0 <u>TES</u> 6.1		Waste Solidification - Hittman. Complete Section VII of Attachment 4 upon solidification if cement remains in the ho ION OF WASTE OIL (12 - 40% 011)	completion of the

5.1.1	A sufficient	size sample (approx. 500	m1.)	each of	pH adjusted
	concentrated	waste and waste oil have	been	drawn.	

NOTE :	The pH of the concentrated waste will be adjusted in the tank before the test solidification.	1
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6.1.2 The Ops Quality Assurance Group has been contacted to inform them of the pending Test Solidification to see if they care to witness the test.

Name

OQA Monitor Contacted

/ Date / Time

- 6.1.3 A sequential sample number has been assigned to the test and included on Attachment 5.
- 6.1.4 A determination has been made as to the waste class of the pending full scale solidification by Radwaste Ops. Engineering.
- 6.1.5 The balance calibration data has been included on Attachment 5.
- 6.2 Procedure

NOTE: Tare weights of waste, cement, additives, etc. should be obtained during performance of the following procedure. Round off to the nearest gram.

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6.2.1	Measure 140 ml d	into a mixing vessel 210 ml of oil.	concentrated waste and
NOTE :		solidifications should be conduc sable beaker or similar size con	
6.2.2		the waste volumes added and calc on Attachment 5.	ulate the percent oil by
6.2.3	MEASURE	out 28.0 ml (28.0 gms) of Mayso	1 776.
6.2.4	RECORD	the quantity of the emulsifier o	on Attachment 5.
6.2.5		Maysol 776 to the waste and mix is obtained, at least five (5)	
NOTE :	mixer signs is bro	g should be accomplithed by stir with blade or manually with a r of pure oil may be an indicatio eaking down. Should this occur, Engineering for further instruct	igid stirrer. Any on that the amulsion contact Radwaste
6.2.6	present	e (i.e., foam causing) quantitie , treat, the sample with anti-fo sappears.	es of detergents are baming agent until the
6.2.7	Record	the amount of anti-foaming agent	used on Attachment 5.
6.2.8		out 447.3 gms of Portland Type us sodium metasilicate (ASMS).	I cement and 51.8 gms of
6.2.9	RECORD	the quantities of cement and ASM	4S on Attachment 5.
6.2.10	and mix	ADD the cement to the test sampl until a homogeneous mixture is an one (1) minute.	
6.2.11		11 the cement is added, slowly A while it is being mixed.	ADD the ASMS to the test
6.2.12		two (2) minutes after all the A mixture is obtained.	ASMS is added and homo-

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ste Solidi	fication Proce	ess Control Program	
6.2.		e sample and cure at 120 + 5°F Class B or C or at room tempera	for 24 hours for Class A ature for Class A Unstabi
NO	meets	anytime during the 24-hour cure the acceptance criteria, the 1 ed. However, no test solidifica alified without at least 24 hour	iner solidification may ation shall be
6.2.1		the Acceptance Criteria (Section d date Attachment 5.	n 10.0) has been met and
6.2.1	calculat the full this was	Acceptance Criteria has been rete the required quantities of constant of the solidification using a steep type (as determined by Radward the Solidification Calculation ment 6).	ement and additives for. liner type applicable for aste Operations Engineer-
NOT		ner shall be solidified using (Solidification - Hittman.	09 1104-28A, Radioactive
TEST SOLIDI	FICATION OF U	ISED PRECOAT	
ALL OF CONTRACTORS OF CARDING STATES	quisites	n Tantin, Tenensian in Annahim Inne 19 de	

- 7.1.1 A sufficient size sample of used precoat (approx. 500 ml) has been drawn and the following parameters analyzed for by Plant Chemistry:
 - pH (of sluice water)
 - Gamma Scan

NOTE. Where high activity waste could pose personnel radiation exposure problems when performing the test solidification, expended powdex with an appropriate anion/cation ratio shall be substituted. The ratio shall be determined by Radwaste Operations Engineering. A small sample of use precoat (≈ 20 mis) shall be taken for isotopic analysis.

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ī	NOTE :	The o	amma scan is t	o he used fo	r informatio	n purposes only
	HOTE.	to tr				o be used in the
-	7.1.2	The sam	ple has set to	verify < 1	oil by volu	me.
	7.1.3	them of	Quality Assur the pending T the test.	ance Group H est Solidifi	as been cont cation to se	acted to inform e if they care to
		00	A Monitor Cont	acted		
					Name	/ Date / Time
	7.1.4	The app includi number.	ng the balance	ons of Attac calibration	chment 7 have data and th	been completed e sequential sampl
7.2	Procedure					
1	NOTE -	obtai	weights of was ned during per loff to the ne	formance of		
	7.2.3		out 381.1 gms er and place in			esin and 151.5 gms
Ī	NOTE:		solidification sable beaker o			ng a 1,000 ml
	7.2.2	RECORD 7.	the volume and	d weight of	the powered r	esin on Attachment
	7.2.3	water a	water to the added and the t on Attachment	total volume	in and RECORD of waste slu) the weight of urry (water plus
	7.2.4	If any agent.	foam is presen	nt, TREAT th	e sample with	n an anti-foaming
	7.2.5	RECORD	the quantity c	of anti-foam	ing agent use	ed on Attachment 7

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7.2.6	ml () a. If oi the vo as Maj conce this p	if oil is present by looking the sample. If oil is pres Oll) =ml (total sample 1 is present and the volume olume of waste, TREAT with a ysol 776 (20% of the volume ntrations > 12% by volume ma procedure. Contact Radwaste uidance.	ent perform the following:) x 100 =% 0.1 is between 3 and 12% of n emulsifying agent such of oil). Oil in y not be solidified by
NOTE:		ity of Maysol 776 is 1.0 gm/ ual to the weight in gms.	m]; the volume in
7.2.7		quantity of oil present and he sample on Attachment 7.	the amount of Maysol
7.2.8	RECORD the	initial pH of the sample on	Attachment 7.
7.2.9		t approximately 10 grams of Iso known as hydrated lime.	calcium hydroxide
7.2.10	tws (2) gri idditions three (3)	the calcium hydroxide to th ams at a time. MIX for thre until the pH is at least 11 grams of calcium hydroxide. alter the pH of the slurry.	e (3) minutes between 5. ADD an additional This final addition may
<u>NOTE</u> :	mixing m		with a rigid stirrer
7.2.11		quantity of calcium hydroxi pH on Attachment 7.	de added to the slurry and
7.2.12	MEASURE OU	t 444 gms of Portland Type 1	cement.
7.2.13	RECORD the	amount of cement on Attacha	ment 7.

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	7.2.15		two (2) minutes after all the ceme eneous mixture.	ent is added to obtain
	7.2.16	RECORD	the final sample volume on Attachme	ent 7.
	7.2.17	Seal an	d allow the sample to CURE for 24 H	hours at 120 ± 5°F.
	NOTE :	meets	anytime during the 24-hour cure to the acceptance criteria, the line ed. However, no test solidification fied without at least 24 hours of o	r solidification may on shall be dis-
	7.2.18		the acceptance criteria (Section 10 te Attachment 7.	0.0) has been met, sign
	7.2.19	calcula a liner Radwast	he Acceptance Criteria has been met ate the required quantities of cemer type applicable for this waste typ te Operations Engineering) and the meet for Used Precoat (Attachment 8	nt and additives using pe (as determined by Solidification Calcula-
	NOTE :		liner shall be solidified using OP n and Precoat Processing - Hittman.	
0 TES	T SOLIDIFIC	ATION OF	BEAD RESIN	
8.1	Prerequi	sites		
	NOTE :	This Class	PCP Test Solidification Procedure s A Stable, Class B and C Waste For	is applicable to ms.
	8.1.1		icient size sample of bead resin (a and the following parameters analyz	

- pH (of sluice water)
- Gamma Scan

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aste	Solidificat	tion Proce	ss Control Program	9
	<u>NOTE</u> :	exposu expende source Operat	high activity waste could pose re problems when performing the ed non-radioactive resin shall of this resin shall be determi ions Engineering. A small samp mls) shall be taken for isotopi	e test solidification, be substituted. The ned by Radwaste ble of spent resin
Ī	<u>NOTE</u> :	to trac	mma scan is to be used for info ck waste characteristics and is lculations.	prmation purposes only not to be used in the
	8.1.2	The samp	le has set to verify < 1% oil b	y volume.
1		The Ops Quality Assurance Group has been contacted to inform them of the pending Test Solidification to see if they care to witness the test.		
		AQO	Monitor Contacted	
			Name	/ Date / Time
	8.1.4	The appro including number.	opriate portions of Attachment g the balance calibration data	9 have been completed and sequential sample
8.2	Procedure			
	<u>NOTE</u> :	obtaine	eights of waste, cement, addili ed during performance of the fo off to the nearest gram.	ves, etc. should be llowing procedure.
	8.2.1	MEASURE 1	nto a mixing vessel 240 gm of	dewatered resin.
	<u>NOTE</u> :		blidification should be conduct able beaker or similar size con	

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	tion Process Control Program	11
8.2.2	RECORD the weight and volume of th Attachment 9.	e sample (resin and water) on
8.2.3	WEIGH out 2.1 gms of EC-3 into a s	eparate vessel.
8.2.4	RECORD the weight of EC-3 on Attac	hment 9.
8.2.5	WE GH out 84.3 gms of water and re Attachment 9.	cord the weight on
8.2.6	ADD the water to the vessel contai thoroughly.	ning the EC-3 and mix
8.2.7	ADD the water/EC-3 mixture to the	bead resin and mix thorougly.
8.2.8	If any foam is present, TREAT the agent.	sample with an anti-foaming
8.2.9	RECORD the quantity of anti-foamin	g agent used on Attachment 9.
8.2.10	Determine if oil is present by loo surface of the sample. If oil is	
	m1 (011) ÷m1 (total sa	mple) x 100 =% 0.1
	a. If oil is present and the vol the volume of waste, TREAT wi as Maysol 776 (20% of the vol concentrations > 12% by volum this procedure. Contact Radw for guidance.	th an emulsifying agent such ume of oil). Oil in he may not be solidified by
NOTE :	The density of Maysol 776 is 1.0 is equal to the weight in gms.) gm/m1; the volume in m1
8.2.11	RECORD the quantity of oil and the Attachment 9.	volume of emulsifier used on
8.2.12	RECORD the initial sample pH on At	ttachment 9.
8.2.13	MEASURE out approximately 11.5 gms Ca(OH) ₂ , also known as hydrated 11	

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8.2.14 Slowly ADD the Ca(OH)₂ to the resin sample two (2) grams at a time. Mix for three (3) minutes between additions until the pH of the slurry is at least 11.5. ADD three (3) additional gms of Ca(OH)₂. This final additional may or may not alter the pH of the slurry.

- 8.2.15 RECORD the quantity of calcium hydroxide added to the slurry and the final pH on Attachment 9.
- 8.2.16 MEASURE out 178.2 gms of Portland Type I cement into a separate vessel.
- 8.2.17 RECORD the weight of the cement on Attachment 9.
- 8.2.18 Slowly ADD the cement to the test sample while it is being mixed.
- 8.2.19 MIX for two (2) minutes after all the cement is added to obtain a homogeneous mix.
- 8.2.20 RECORD the final sample volume on Attachment 9.
- 8.2.21 SEAL the sample and allow the sample to CURE for 24 hours at 120 \pm 5°F.

NOTE: If at anytime during the 24-hour cure time, the sample meets the acceptance criteria, the liner solidification may proceed. However, no test solidification shall be disqualified without at least 24 hours of cure.

8.2.22 VERIFY the acceptance criteria (Section 10.0) has been met, sign and date Attachment 9.

8.2.23 When the Acceptance Criteria has been met per Section 10.0, CALCULATE the required quantities of cement and additives using a liner type applicable for this waste type (as determined by Radwaste Operations Engineering) and the Solidification Calculation Sheet for Bead Resin (Attachment 10).

NOTE: The liner shall be solidified using OP 1104-28C, Primary Resin and Precoat Processing - Hittman.

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9.0 ALTERNATE TEST SOLIDIFICATION PROGRAMS

NOTE: The PCP Test Solidification presented in this procedure should cover the majority of the waste processing requirements of TMI-1. In the event a different waste stream requires processing or a waste stream covered by this procedure but not having the appropriate waste form or liner type, a PCP Test Solidification can be performed using a current procedure provided by Westinghouse -Hittman.

9.1 Prerequisites

- 9.1.1 A procedure is available for the particular waste stream to be processed.
- 9.1.2 This procedure has been verified current by the Radwaste Ops. Manager or his designee and will be reviewed by the Radwaste Engineer prior to its use.
- 9.1.3 The sample required by this procedure has been obtained and applicable chemistry parameters analyzed for by Plant Chemistry.
- 9.1.4 The Ops Quality Assurance Group has been contacted to inform them of the pending Test Solidification to see if they care to witness the test.

Name

OQA Monitor Contacted

/ Date / Time

- 9.1.5 Balance calibration data has been included on Attachment 11.
- 9.1.6 Attachment 11 has been completed.
- 9.2 Procedure

9.2.1 Performed the applicable portions of the Westinghouse - Hittman procedure.

10.0 ACCEPTANCE CRITERIA

- 10.1 Solidification Acceptability
 - 10.1.1 The sample solidification is considered acceptable if there is not visual or drainable free water.

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10.1.2 The sample solidification is considered acceptable if it resists genetration.

 NOTE:
 Physical examination shall be for resistance to a ten (10) pound load applied to the surface of the solidified product using a 1/2 inch diameter metal rod. The solidification shall be considered acceptable if the metal probe cannot break the surface and penetrate to the sample core. Normal denting of the surface is acceptable.

 The rod tolerances are as follows:
 +1 lb

 Weight
 10 lbs
 -0 lb

 +0
 in

 Diameter
 1/2 inch
 -1/4 in

- 10.2 Solidification Unacceptability
 - 10.2.1 If the waste fails any of the criteria set forth in Section 10.1 the solidification will be termed unacceptable and a new set of solidification parameters will need to be established under the procedures in Section 10.3.
 - 10.2.2 If the test solidification is unacceptable then the same test procedure must be followed on each subsequent batch of the same type of waste until three consecutive test samples are solidified.
- 10.3 Alternate Solidification Parameters
 - 10.3.1 If a test sample for <u>Class A unstable waste</u> fails to provide acceptable solidification of waste the following procedures should be followed.
 - a. Mix 454.5 gms of cement and 45.5 gms of ASMS with 400 mls of water to ensure that the problem is not a bad batch of cement.
 - b. Add additional 50 wt.% NaOH to raise the pH above B but less than 9.2 for borated wastes.
 - c. If the waste (other than waste oil) is only partially solidified, use lower waste to cement and Metso ratios. Using the recommended quantities of cement and Metso Beads, reduce the waste sample to 375 ml and continue reducing the sample volume by 25 ml. until the acceptability criteria of Section 10.1 are met.

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- d. If the waste oil mixture is only partially solidified try using lower waste to cement ratios. Reduce the quantity of waste by 25 ml. and the emulsifier by 1 ml., (This will result in a slightly higher concentration of emulsifier in the waste) and proceed with the test solidification. Continue with similar reductions until a satisfactory product is achieved.
- 10.3.2 For <u>Class A stable</u>, <u>Class B and C waste</u> test samples that fail to solidify, Contact Radwaste Operations Enginegring for resolution.

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Waste Solidification Proce	ss Control Program	8	
	ATTACHMENT 1	Page 1 of 4	
CLASS A UNSTABLE	AND STABLE, CLASS & AND	C TEST SOLIDIFICATION	
DATA	SHEET FOR 4 TO 10 WT% B	DRIC ACID	
hemistry Parameters	Balance Cal. Info.	Liner No.:	
ample Date	CMTE No	Sample No.:	
oron ppm	Serial No	Date:	
otal Solids ppm	Cal. Due Date	Waste Class	
H			
otal ActmCi/cc			
. PRECONDITIONING:			
	Acid (in decimal form):		
	Weight Percent of Boric Acid (in decimal form):		
Boron (ppm) x .01 (1748 = 1	748 =	(1)	
Weight of Untreated Samp	le:	gms (2)	
Volume of Untreated Samp	le:	mls (3)	
Weight of 50% NaOH Added	to Adjust pH	gms (4)	
within range per Section	4.2.4.		
pH of treated sample:		And and a second s	
Weight of Anti-foam Adde	d :	gms (5)	
% 011 ¹ :		%	
Weight of Emulsifier Add	led:	gms (6)	
Volume of treated sample		mls (7)	
Weight of treated sample	:		
(2) + (4) + (5) + (6) =		gms (B)	
		account of the second	

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Waste Solidification Process	Control Program		8
	ATTACHMENT 1 (Cont'd)	Page	2 of 4
I. DETERMINATION OF PERCENT S	OLIDS OF SAMPLE:		
Weight of Boric Acid in Un	treated Sample:		
(2) x (1) = () x () =	gms	(9)
Weight of 50% NaOH:			
(4) x 0.5 = () x 0.	5 =	gms	(10)
Weight of Solids in Treater	d Sample:		
(5) + (6) + (9) + (10) = () + () + () + ()		gms	(11)
Percent Solids in Treated !	Sample:		
100 x (11) ÷ [(8)] = 100 x () ÷ [()] =		%	(12)
II. DETERMINATION OF WATER IN S	SAMPLE FOR SOLIDIFICATION:		
Volume of Treated Sample to	o be Solidified:	ml	(13)
Weight of Treated Sample to	be Solidified:	gms	(14)
Weight of Water in Sample (Contributed by Waste:		
$\left[\frac{(2)}{(8)} \times (14)\right] \times [1 - (1)]$			
$\left[\frac{(\cdot)}{(\cdot)} \times (\cdot)\right] \times [1 - (\cdot)]$] =	gms	(15)
Weight of Water in Sample (Contributed By 50% NaOH:		
$\left[\frac{(4)}{(8)} \times (14)\right] \times 0.5 =$			
$\left[\frac{()}{()} \times ()\right] \times 0.5 =$		gms	(16)
Total Weight of Water in Sa	ample:		
(15) + (16) = () + () =		gms	(17)

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Na	aste Solidification Proce	ess Control Program	
		ATTACHMENT 1 (Cont'd)	Page 3 of 4
۱.	DETERMINATION OF QUANTIT SAMPLE SOLIDIFICATION:	Y OF PORTLAND TYPE I CEMENT AND ME	TSO BEADS TO USE FO
	Using Figure I, find the the Water/Cement Ratio:	% solids in sample (12), and DETE	RMINE (18)
	Weight of Cement to Use:		
	$\frac{(17)}{(18)} = \frac{()}{()} =$		gms (19)
	Weight of Metso Beads to	use:	
	(19) x 0.15 = () x 0	0.15 =	gms (20)
	Test Solidification Perf	ormed By:	
	Name	Date	Time
	SAMPLE INSPECTION		
	Sample cured for:		
	Hours Cured		
	Temp. Cured	******	
	Verified By	Date	
	Sample contains "No Free	Liquid":	
	Verified By	Date	
	Sample "Resists Penetrat	ion":	
	Verified By	Date	

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Waste Solidification Proces	s Control Program	9	
Additional batches solidi	ATTACHMENT 1 (Cont'd) fied based on this sample	Page 4 o	of 4
Liner Waste No. Vol. Date	Liner Waste No. Vol. Date	Liner Waste	ate
2.	5.	8.	
3.	6.	9.	
4.	7.	10.	
DOTNOTES:			
1. Maximum allowable of	il content for stable waste	e is 1% by volume.	
. INDEPENDENT VERIFICATION E			-
Test Sample Meets Acceptar Criteria (Section 10)	Name	/ Date / Time	
Test Solidification Data Sheets (Calculations) Revi	ewed		
	Name	/ Date / Time	

Nuclear	TMI-1 Operating Procedure	Number 1104-281 Revision No.
Waste Solidification Proc	cess Control Program	
	ATTACHMENT 2	Page 1 of 3
SOLIDIFICATION	CALCULATION SHEET FOR 4 TO 10 WT% BO	DRIC ACID
Line	r Type to be used	
. Volume of Untreated Was	ste to Add to Liner ^{1,3} :	
a landa and	ed Waste Vol. fication Data Tables 📼	
(<u>)</u> x	ft ³	(21)
I. Volume of Additives to	Add to Liner:	
NaOH: (4) x 4.80 (3)	<u>6 x (21) = () x 4.86</u> x () = ()	gals (22)
Anti-foam: (5) x 7.41 (3)	<u>8</u> x (21) = <u>() x 7.48</u> x () = ()	gals (23)
Emulsifier: (6) x 7.4	8_x(21) = () x 7.48 x () = ()	gals (24)
II. Volume of Treated Waste	e to be Solidified ¹ :	
$(21) + \frac{(22) + (23) + (23)}{7.48}$	() + () + () + ()	ft ³ (25)
V. Cement Quantity for Fu	11 Scale Solidification:	
$\frac{(19)}{(13)} \times 62.4 \times (25) = \frac{(}{(}$	<u>)</u> x 62.4 x () =	1bs (26)
(26) ÷ 94 = () + 94		bags ²
. ASMS Quantity for Full	Scale Solidification:	
(26) x .15 = () x .	15 =	1bs (27)
(27) + 100 = () + 1	00 =	bags ²

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	iste Solidification Proc	cess Control Program	9
		ATTACHMENT 2	Page 2 of 3
Ι.	INDEP. NDENT VERIFICATIO	ON BY GPUN MANAGEMENT	
	SOLID/FICATION CALCULATION SHEETS REV	IEWEDName	/ Date / Time
NTOO	OTES		
	The volume of <u>treated</u> maximum treated waste	waste to be solidified in a sin volume listed on the attached S	gle liner cannot exceed the olidification Data Tables.
	Round off up to the nea	arest whole bag.	
		olume added to the liner in Ste ded to the liner is less than t	
II.	DETERMINATION OF THE QU	UANTITY OF CEMENT ADDED TO WAST	Έ:
	Quantity of Cement Add	ed to Hopper:	1bs (28)
	Quantity of Cement Lef	t in Hopper:	1bs (29)
	Quantity of Cement Add	ed per ft. ³ Waste:	
	$\frac{(28) - (29)}{(25)} = \frac{()}{(}$	<u>- ()</u> =	lbs_cement/ ft ³ _waste
	Bori For	mum Quantity of Cement Allowab c Acid Class A Unstable Waste Stable waste solidifications a d to the liner.	is 62 lbs./ft. ³ .
	Quantity of Cement Add	ed Meets Minimum Requirements	for unstable waste forms:
	Verified By	D	ate

Verified By

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Waste Solidification Pro	cess Control Pr	ogram	7
	ATTACHMENT	2 (Cont'd)	Page 3 of 3
		ON DATA TABLES WT% BORIC ACID	
	HN-100 Series 3	HN-100 LVM <u>Series 3</u> 1	
Usable Liner Vol. (cu. ft.)	141.1	157.5	
Max. Treated Waste Vol. (cu. ft.)	104.4	116.6	
Max. Solidified Waste Vol. (cu. ft.)	141.1	157.5	
Recommended Min. Treated Waste Vol.	98.1	103.8	

(cu. ft) ²		
Min. Solidified Waste Vol. (cu. ft) ²	132.6	140.2
Max. Rad. Level	12	12

R/hr Contact

- For less than A₂ quantities of LSA waste. For greater than A₂ quantities of LSA waste, the maximum treated waste volume is 112.4 cu. ft. due to weight limitations.
- These minimums are required when shipping to Barnwell, to comply with the 15% maximum void space criteria for liners containing solidified stable waste forms.

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	ATTACHMENT 3		Page 1 of
	D STABLE, CLASS B AND C T HEET > 10 TO 20 WT% BORIC		
hemistry Parameters	Balance Cal. Info.	Liner No.:	
ample Date	CMTE NO	_ Sample No.	:
oron ppm	Serial No	Date:	
otal Solids ppm	Cal. Due Date	Waste Class	s
Η			
otal ActµCi/cc			
. PRECONDITIONING			
Weight Percent of Boric Aci	d (in decimal form):		
Boron (ppm) x .01 (1748 = 1748) x .01 =	-	(1
Weight of Untreated Sample:			gms (2
Volume of Untreated Sample:			mls (3
Weight of 50% NaOH Added to Section 5.2.4:	o Adjust pH per		gms (4
pH of treated sample:		_	
Weight of Anti-foam Added:			gms (5
% 011 ¹ :			%
Weight of Emulsifier Added:			gms (6
Volume of treated sample:			mls (7
Weight of treated sample:			
(2) + (4) + (5) + (6) = () + () + () + () =		gms (8

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Title			Revision No.	
Waste Solidification Process	Control Program	l	8	
	ATTACHMENT 3 (Cont'd)	Page	2 of 4	
II. DETERMINATION OF PERCENT S	OLIDS OF SAMPLE			
Weight of Boric Acid in Un	treated Sample			
(2) x (1) = () x () =	gms	(9)	
Weight of 50% NaOH:				
(4) x 0.5 ∞ () x 0.	5 *	gms	(10)	
Weight of Solids in Treate	d Sample:			
(5) + (6) + (9) + (10) =				
()+()+()+()		gms	(11) ·	
Percent Solids in Treated	Sample:			
100 x (11) ÷ [(8)] = 100 x () ÷ [()] =		%	(12)	
III. DETERMINATION OF WATER IN	SAMPLE FOR SOLIDIFICATION:			
Volume of Treated Sample t	o be Solidified:	m1	(13)	
Weight of Treated Sample t	o be Solidified:	gms	(14)	
Weight of Water in Sample	Contributed by Waste:			
$\left[\frac{(2)}{(8)} \times (14)\right] \times [1 - (1)]$				
$\begin{bmatrix} () \\ \hline () \end{bmatrix} \times () \end{bmatrix} \times \begin{bmatrix} 1 \\ - () \end{bmatrix} $] =	gms	(15)	
Weight of Water in Sample	Contributed by 50% NaOH:			
$\left[\frac{(4)}{(8)} \times (14)\right] \times 0.5 = \left[\frac{(4)}{(4)}\right]$	$\frac{1}{2}$ x () x 0.5 =	gms	(16)	!
Total Weight of Water in S	iample:			
(15) + (16) = () + ()	E	gms	(17)	

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Waste Solidification Proc	cess Control Program	8
	ATTACHMENT 3 (Cont'd)	Page 3 of 4
V. DETERMINATION OF QUANTI SAMPLE SOLIDIFICATION:	ITY OF PORTLAND TYPE I CEMENT AND	METSO BEADS TO USE FOR
Using Figure I. find the Water/Cement Ratio:	ne % solids in sample (12), and [:	DETERMINE (18)
Weight of Cement to Use	Ð:	
$\frac{(17)}{(18)} = \frac{()}{()} = $		gms (19)
Weight of Metso Beads 1	to use:	
(19) x 0.15 = () x	0.15 =	gms (20)
Test Solidification Per	rformed By:	
Name	Date	Time
SAMPLE INSPECTION		
Sample cured for:		
Hours Cured		
Temp. Cured		
Verified By		Date
Sample contains "No Fre	ee Liquid":	
Verified By		Date
Sample "Resists Penetra	ation":	
Verified By		Date

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	ATTACHMENT 3 (Cor	nt'd) Page 4 of 4
Additional batches so	olidified based on this	sample solidification:
Liner Waste No. Vol. I	Date No. Vol.	Date No. Vol. Date
2.	5.	8.
3.	6.	9.
4.	7.	10.
DOTNOTES :		
1. Maximum allowat	le oil content for Stab	le Waste is 1% by volume.
V. INDEPENDENT VERIFICAT	TION BY GPUN MANAGEMENT	
Test Sample Meets Acc Criteria (Section 10)		/ Date / Time
Test Solidification [Sheets (Calculations)		
	Name	/ Date / Time

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Title	P. Nuclear	TMI-1 Operating Procedure	of the location states of the strength in some of the strength	1104-281
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Was	te Solidification Proc	ess Control Progrum		8
		ATTACHMENT 4	Pag	e 1 of 3
	SOLIDIFICATION C	ALCULATION SHEET FOR > 10 TO 20 WT% E	SORIC ACID	
	Liner	type to be used		
. V	olume of Untreated Was	te to Add to Liner ^{1,3} :		
<u>(</u>	3) Max. Treated 7) x from Solidif	d Waste Vol. ication Data Tables ∞		
(() x	ft ³		(21)
I. Vo	olume of Additives to A	Add to Liner:		
Na	aOH: (4) x 4.86 (3)	x (21) = () x 4.86 x () =	gals	(22)
Ar	nti-foam: <u>(5) x 7.48</u> (3)	$x (21) = () \times 7.48 \times () = $	gals	(23)
Er	mulsifier: <u>(6) x 7.48</u> (3)	x (21) = () x 7.48 x () =	gals	(24)
II. Vo	olume of Treated Waste	to be Solidified ¹ :		
(2	$\frac{(22) + (23) + (24)}{7.48}$	<u>4)</u> = () + () + () + () 7.48 =	ft ³	(25)
V. Ce	ement Quantity for Full	1 Scale Solidification:		
(1)	$\frac{19}{13} \times 62.4 \times (25) = \frac{(}{(}$) x 62.4 x () =	1bs	(26)
(2	26) ÷ 94 = () 94 =		bags2	
. AS	SMS Quantity for Full S	Scale Solidification:		
(2	26) x .15 = () x .15	5 =	lbs	(27)
(2	27) + 100 = () 100	0 =	bags ²	

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* / A A		Operating Procedure	1104-281
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		ATTACHMENT 4	Page 2 of 3
SOL	DIFICATION CALCU	JLATION SHEET FOR > 10 TO 20	WT% BORIC ACID
I. INDEPENDENT	VERIFICATION BY	GPUN MANAGEMENT	
SOLIDIFICAT			
CALCULATION	SHEETS REVIEWED	Name	Contra de Tria
OOTNOTEC		Name /	Date / Time
OOTNOTES			
The volume maximum tre	of treated waste volum	to be solidified in a sing le listed on the attached So	le liner cannot exceed th
	p to the nearest		indiffication Data Tables.
Mac THE DET	e volume added t	added to the liner in step o the liner is less than th	e value obtained in
II. DETERMINATI	ON OF THE QUANTI	TY OF CEMENT ADDED TO WASTE	:
Quantity of	Cement Added to	Hopper:	1bs (28)
Quantity of	Cement Left in i	Hopper:	1bs (29)
Quantity of	Cement Added pe	r ft. ³ Waste:	artenantingge.
(28) - (2	9) = () = (1 -	14
(25)	$\frac{9}{2} = \frac{() - ()}{()}$		lbs_cement/ ft3_waste

NOT		uantity of Cement Allowable cid Class A Unstable Waste	for >10 to 20 Wt.
	For STABLE	E waste solidifications all	the cement must be
	added to 1	the liner.	
Quantity of	Cement Added Mor	ets the Minimum Requirement	e for unstable and a
QUENTIN D	Semente Noveo net	ers the Minimum Requirement	s for unstable waste form
Ve	rified By	Dat	6
The recomme	nded minimum tros	ated waste volume and minim	
meet the re	quirements of the	e Solidification Data Table	s for STABLE waste forms.
Ve	rified By	Da+.	0

AD Nuclear		TMI-1 ating Procedure	Number 1104-281
Title	all and a second se	niinteenaveettiin moonaan puissen oonaan aanaan aanaan aanaan aanaa aanaa	Revision No
Waste Solidification Pro	cess Control Pr	ogram	77
	ATTACHMENT	4 (Cont'd)	Page 3 of 3
		ON DATA TABLES O WT% BORIC ACID	
	HN-100 Series 3	HN-100 LVM Series 31	
Usable Liner Vol. (cu. ft.)	141.1	157.5	
Max. Treated Waste Vol. (cu. ft.)	101.3	113.1	
Max. Solidified Waste Vol. (cu. ft.)	141.1	157.5	
Recommended Min. Treated Waste Vol. (cu. ft) ²	95.2	100.7	
Min. Solidified Waste Vol. (cu. ft) ²	132.6	140.2	
Max. Rad. Level	12	12	
R/hr Contact			
 For less than A₂ quant LSA waste, the maximum limitations. 			
 These minimums are req maximum void space cri 	uired when ship teria for liner	ping to Barnwell, to s containing solidifi	comply with the 15% ed stable waste for

API Nuclear	TMI-1	Number
	Operating Procedur	e 1104-281
Title		Revision No.
Waste Solidification Proc	ess Control Program	11
,	ATTACHMENT 5	Page 1 of 2
CLASS & UNSTABLE AND	STABLE, CLASS B AND C TEST SO FOR WASTE OIL	DLIDIFICATION DATA SHEET
hem. Parameters (Conc. Wast	e) Balance Cal. Info	Liner No.:
ample Date	CMTE No.:	Sample No.:
oronppm	Serial No.:	Date:
otal Solidsppm	Cal. Due Date:	Waste Class:
н		
otal ActµCi/	cc	
. SAMPLE PREPARATION		
Volume of Oil to be Sol	idified:	mls (1)
Volume of Concentrated	Waste added to the oil:	m1s (2)
Total Volume of Sample:		mls
% Oil by Volume:		
$\frac{(1)}{(1) + (2)}$ x 100 = $\frac{(1)}{(1)}$	() × 100 =	% (3)
Weight of 50 wt% NaOH a	added to sample to raise pH >	5gms (4)
Quantity of Emulsifier	to Add to Sample:	mls (5)
Quantity of Anti Foam A	Added to Sample:	mls (6)
Quantity of Portland Ty	ype 1 Cement Added to Sample:	gms (7)
Quantity of Anhydrous S to Sample:	Sodium Metasilicate Added	gms (8)
Test Solidification Per	rformed By:	

GPU N	uclear		TMI-1 perating Proc	redure	Number
Title			crating FIO		Revision No.
Waste Solid	ification P	rocess Control	Program		9
		ATTACHME	NT 5 (Cont'	(d)	Page 2 of 2
I. SAMPLE IN	ISPECTION				
Sample cu	red for:				
Hours Cur	ed				
Temp. Cur	ed				
Veri	fied By	-		Date	1000
Sample co	ntains "No i	Free Liquid":			
Veri	fied By			Date	
Sample "R	esists Pene	tration":			
Veri	fied By	-		Date	
Additiona	1 batches so	olidified pased	or this sam	nple solidificat	ion:
Liner No.		Date No.	Waste Vol. D		Waste Vol. Date
2.		5.		8.	
3.		6.		9.	
4.		7.		10.	
II. INDEPENDE	NT VERIFICAT	TION BY GPUN MA	NAGEMENT		
	le Meets Acc (Section 10)		Naca	/ Dat	e / Time
	dification [Name	/ Dat	e / TTINE
	alculations		Name	/ Dat	e / Time

	TMI-1 Operating Procedure	Number 1104-231
TI	tie	Revision No.
	Waste Solidification Process Control Program	9
	ATTACHMENT 6	Page 1 of 3
	SOLIDIFICATION CALCULATION SHEET FOR WASTE OF	IL
	Liner type to be used	
Ι.	PARAMETERS FOR FULL SCALE SOLIDIFICATION	
	Emulsifier:	
	(5) x 7.48 ÷ (1) = () x 7.48 ÷ () =	gal/ (9) ft ³
	Anti-foam (6) x 7.48 x $(1) + (2) = () x 7.48 x () + ()$	gal/ (10) ft3
	Cement: (7) x 62.43 x $(1) + (2) = (2) \times 62.43 \times (2) + (2) \times 62.43 \times (2) + (2) \times 62.43 \times (2) \times $	1bs/ (11) ft3
п.	ASMS: (8) x 62.43 x $\overline{(1) + (2)} = ($) x 62.43 x $\overline{() + ()}$ QUANTITIES TO BE ADDED FOR FULL SCALE SOLIDIFICATION	1bs/ (12) ft3
	Volume of untreated waste to add to liner (Max Treated Waste Vol from Solidification Data Tables): ³ Concentrated Waste to be added:	(13)
	60% x (13) x 7.48 = 0.60 x () x 7.48 =	gals (14)
	Waste Oil to be added: $40\% \times (13) = 0.40 \times () =$	ft ³ (15)
	$40\% \times (13) \times 7.48 = 0.40 \times () \times 7.48 =$	gals

고만 Nuclear	TMI-1 Operating Procedure	Number 1104-281
itle		Revision No.
Waste Solidification Proces	s Control Program	9
	ATTACHMENT 6 (Cont'd)	Page 2 of 3
Emulsifier to be added:		
(15) x (9) = () x () =	gals
Anti-foam to be Added:		
(13) x (10) = () x ()		gals
ASMS to be added:		
(13) x (12) = () x () =	1bs (16)
(16) * 100 = () * 100	-	bags1
Volume of cement to add t	o liner:	
(13) x (11) = () x () =	1bs (17)
(17) * 94 = () * 94 =		bags1

FOOTNOTES:

1 Round off up to the nearest whole bag.

- 2 Reduce the quantity of total waste in the liner by 1 ft³ for every 10 gallons of anti-foam added to the liner. No adjustment is necessary for the first 10 gallons.
- 3 Use actual waste volume added to the liner in step/equations used in Section II if waste volume added to the liner is less than the value obtained in Step/Equation 13.
- III. INDEPENDENT VERIFICATION BY GPUN MANAGEMENT

SOLIDIFICATION CALCULATION SHEETS REVIEWED_____

Name

/ Date / Time

DD Nuclear	TMI-1 Operating Pro	cedure	Number 1104-281			
Title	a non a second the space we can be a second as a second second second second second second second second second		Revision No.			
Waste Solidification Proce	Waste Solidification Process Control Program					
	ATTACHMENT 6 (Cont	'ď)	Page 3 of 3			
SOLIDI	FICATION DATA TABLES F	OR WASTE CEL				
	HN-100 Series 3	HN-100 LVM				
Usable Liner Volume, (ft ³)	141.1	157.5				
Max. Waste Volume (oil and conc. waste), ft ³	93.7	104.6				
Max. Solidified Volume, ft ³	141.1	157.5				
Maximum Rad Level R/hr Contact	12	12				

E6-3

GPU Nuclear	1				
	TMI-1 Operating Procedure				1104-28
Title				Revi	sion No.
Waste Solidification Pro	ocess Control Pro	ogram			8
	ATTAC	MENT 7		Pa	ge 1 of 1
CLASS A STABL	E, CLASS B AND C FOR USED	TEST SOLIDIF	ICATION D	ATA SHEET	
alance Cal. Info.	Chemistry Parame	eters	Liner No	o.:	montradict sector gener-
MTE NO	рН		Sample H	No.:	
erial No	Gamma Scan	mC1/m1	Date:	-	
al. Due Date	% Oil	1	Waste C	ass	
SAMPLE PREPARATION					
Weight of Dewatered Po	owered Resin		_	gms	(1)
Volume of Dewatered Po	owered Resin			m]	(2)
Weight of Water Added	to Powdered Resi	In:	_	gms	(3)
Total of Volume of Po	wered Resin Slurr	·y:	_	m1	(4)
Quantity of Anti-foam	Agent Added to S	Sample:		gms	(5)
Quantity of oil in Sam	mple		_	%	(6)
Quantity of Emulsifyir	ng Agent Added to	Sample:		gms	(7)
Initial pH of Sample:					(8)
I. SOLIDIFICATION					
Quantity of Ca(OH)2 ne	ecessary to raise	pH > 11.5:		gms	(9)
Final pH of Sample:			_		(10)
Quantity of Portland (Cement Added to S	Sample	_	gms	(11)
Final Sample Volume:			_	m]s	(12)
Test Solidification Pe	erformed By:				
Name		Date		Time	

GPU Nucle	ar	TMI Operating		6	Number 1104-281
Title		SPECE CON	100000		Revision No.
Waste Solidificatio	n Process Contro	Program			9
	ATTACH	MENT 7 (C	ont'd)		Page 2 of 2
CLASS A S	TABLE, CLASS B A FOR	ND C TEST S		CATION DATA	SHEET
1. SAMPLE INSPECTION					
Sample cured for:					
Hours Cured					
Temp. Cured	efectes in chalanchers are some normalismen				
Verified By				Date	
Sample contains "!	No Free Liquid"				
Verified By				Date	
Sample "Resists Pe	enetration":				
Verified By			******	Date	
Additional batches	s solidified bas	ed on this	sample :	solidificati	ion:
Liner Waste No. Vol.	Date No.		Date	Liner No.	Waste Vol. Date
2,	5.			8.	
3.	6.			9.	
4.	7.			10.	
. INDEPENDENT VERIFI	ICATION BY GPUN	MANAGEMENT			
Test Sample Meets Criteria (Section		Name		/ Date	e / Time
Test Solidification Sheets (Calculation		harr		1 5-1-1	/ Time
		Name		/ Date	e / Time
		E7-2			1372c

· GPU Nucle	Der TMI-1 Operating Froced	ure Number
Title	and the second s	Revision No.
Waste Solioificatio	on Process Control Program	
	ATTACHMENT 8	Page 1 of 3
SOL	IDIFICATION CALCULATION SHEET FOR	NUSED PRECOAT
	Liner Type to be used	
PARAMETERS FOR FL	ULL SCALE SOLIDIFICATION:	
Quantity of Water	r:	
$\frac{(3) \times 7.48}{(2)} = ()$	$\frac{1}{()} \times \frac{7.48}{()} =$	gal/ (13) ft ³ of waste
Quantity of Anti-	-Foam Agent:	
$\frac{(5) \times 7.48}{(2)} = ($	$\frac{x 7.48}{()} =$	gal/ (14) ft ³ of waste
Quantity of Emuls	sifier:	
$\frac{(7) \times 7.48}{(2)} = (-)$) <u>x 7.48</u>	gal/ (15) ft ³ of waste
Quantity of Ca(O	H) ₂ :	
$\frac{(9) \times 62.43}{(2)} = ($	$\frac{) \times 62.43}{()} =$	1bs/ (16) ft ³ of waste
Quantity of Porti	land Type 1 Cement:	
$\frac{(11) \times 62.43}{(2)} = ($	<u>) x 62.43</u> =	1bs/ (17) ft ³ of waste
I. QUANTITIES TO BE	ADDED FOR FULL SCALE SOLIDIFICAT	ION
Volume of Dewater	red Powdered Resin to be Solidifi	ed:ft ³ (18)
Quantity of Water	r:	
(18) x (13) = () x () =	gal (19)
Quantity of Anti-	-Foam Agent:	
(18) x (14) = () x () =	gal (20)
Quantity of Emul:	sifier:	
(18) x (15) = () x () =	ga1 (21)

E8-1

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GI ^D Nuclear	TMI-1 Operating Procedure	Number 1104-281
Title		Revision No.
Waste Solidification Pr	ocess Control Program	9
	ATTACHMENT 8 (Cont'd)	Page 2 of 3
SOLIDIFI	CATION CALCULATION SHEET FOR USED	PRECOAT
Quantity of Ca(OH)2:		
(18) x (16) = () x (22) ÷ (100) = () ÷		1bs (22) bags ²
Quantity of Portland	Type Cement:	
(18) x (17) = () x (23) + (94) = () +		1bs (23) bags ²
The volume of waste, settled and treated wa Table for used precoa	to be solidified in a liner cannot aste volume listed on the Class B # t.	exceed the maximum Waste Solidification Data
Round up to the neare:	st whole bag.	
II. INDEPENDENT VERIFICATI	ION BY GPUN MANAGEMENT	
SOLIDIFICATION CALCULATION SHEETS REV	VIEWED	

데만 Nuclear		MI-1 g Procedure	Number 1104-281
itle		Barrowski, and a second se	Revision No.
Waste Solidification Proce	8		
	ATTACHMENT 8	(Cont'd)	Page 3 of 1
SOLIDIF	ICATION DATA TABL	E FOR USED PRECOAT	
		HN-600 MUS	HN-200 MU
Usable Liner Volume, ft ³		59.3	59.4
Max. Solidified Waste Vo	1. ft ³	59.3	59.4
Max. Dewatered Waste Vol	., ft ³	33.3	33.3
Min. Waste Vol. ft3		32.9	32.0
Min. Solidified Waste Vo	1, ft ³	58.6	57.0
Max. Radiation Level R/hr Contact of Liner		100	800

API Nuclear	-	TMI-1		Numb	er
A REPORT OF A REPORT OF A REPORT OF A		ating Procedu	ire		1104-283
Title				Revi	sion No.
Waste Solidification Pr	ocess Control Pr	ogram	and Control of the opposite serve the opposite serve		8
CLASS A STABL	E, CLASS B AND C	HMENT 9 TEST SOLIDIF AD RESIN	ICATION DATA		ge 1 of 2
Balance Cal. Info.	Chemistry Param	eters	Liner No.:		6. See
MTE NO.	рН		Sample No.	:	and an and a second second
Serial No	Gamma Scan	mCi/ml	Date:		
Cal. Due Date	% Oi1	2	Waste Clas	s :	
SAMPLE PREPARATION					
Sample Weight:				gms	(1)
Sample Volume:				ml	(2)
Weight of EC-3:				gms	(3)
Weight of water:				gms	(4)
Weight of Anti-foamin	g agent added to	sample:		_ gms	(5)
Quantity of oil in sa	mple:			_ %	(6)
Weight of Emulsifier	added to sample:			gms	(7)
Initial pH of sample:				_	(8)
I. SAMPLE SOLIDIFICATION					
Weight of Ca(OH)2 add		raise			
the pH > 11.5:				gms	(9)
Final pH of sample:					(10)
Weight of Portland Ty	pe 1 cement adde	d to sample:		gms	(11)
Final Sample Volume:				m1	(12)
Test Solidification P	erformed By:				
Name		Date	Generation	ime	

E9-1

· CIP Nuclear			Number
Title	Operating F	rocedure	Revision No.
Waste Solidification Pr	ocess Control Program		
Haste Softerine action in	ocess control Program		9
	ATTACHMENT 9 (Co	ont'd)	Page 2 of 2
CLASS A STABL	E, CLASS B AND C TEST S FOR BEAD RESI	OLIDIFICATION DATA	SHEET
II. SAMPLE INSPECTION			
Sample cured for:			
Hours Cured			
Temp. Cured			
Verified By		Date	
Sample contains "No F	ree liquid".		
Jumpre concurns no r			
Verified By		Date	
Sample "Resists Penet	ration":		
Verified By		Date	
Additional batches so	lidified based on this	sample solidificat	ion:
Liner Waste No. Vol. D	ate No. Vol.	Date No.	Waste Vol. Date
2.	5.	8.	
3.	6.	9.	
4.	7.	10.	
. INDEPENDENT VERIFICAT	ION BY GPUN MANAGEMENT		
Test Sample Meets Acc	eptance		
Criteria (Section 10)	Name	/ Date	e / Time
Test Solidification Di Sneets (Calculations)			
	Name	/ Date	e / Time
	E9-2		131

· III Nuclear	TMI-1 Operating Procedure	Number 1104-281
Title		Revision No.
Waste Solidification Proc	ess Control Program	
	ATTACHMENT 10	Page 1 of 3
SOLIDIFIC	CATION CALCULATION SHEET FOR BEAD	RESIN
Li	ner Type to be used:	
II. PARAMETERS FOR FULL SCA	LE SOLIDIFICATION	
Quantity of EC-3:		
$\frac{(3) \times 6.3}{(2)} = \frac{() \times 6.3}{()}$		gal/ (13) ft ³ of waste
Quantity of Water:		
$\frac{(4) \times 7.48}{(2)} = \frac{() \times 7.48}{()}$	8	gal/ (14) ft ³ of waste
Quantity of Anti-Foam Ag	gent:	
$\frac{(5) \times 7.48}{(2)} = \frac{() \times 7.48}{()}$	8 =	gal/ (15) ft ³ of waste
Quantity of Emulsifier:		
$\frac{(7) \times 7.48}{(2)} = \frac{() \times 7.48}{()}$	8 =	gal/ (16) ft ³ of waste
Quantity of Calcium Hydr	roxide Ca(OH) ₂ :	
$\frac{(9) \times 62.43}{(2)} = \frac{() \times 62}{()}$.43 =	1bs/ (17) ft ³ of waste
Quantity of Portland Typ	pe 1 Cement:	
$\frac{(11) \times 62.63}{(2)} = \frac{() \times 62}{()}$	2.43 =	1bs/ (18) ft ³ of waste
II. QUANTITIES TO BE ADDED F	FOR FULL SCALE SOLIDIFICATION	
Waste Volume of to be Sc	plidified ¹ .3:	ft ³ (19)
Quantity of EC-3:		
(19) x (13) = () x () =	gal (20)

E10-1

13720

G만 Nuclear	TMI-1 Operating Procedure	Numbe	
Title	operating Procedure	Revis	1104-281 ion No.
Waste Solidification Proc	ess Control Program		9
	ATTACHMENT 10 (Cont'd)		Page 2 of 3
SOLIDIFIC	ATION CALCULATION SHEET FOR BEAD	RESIN	
Quantity of Water:			
(19) x (14) = () x () =	gal	(21)
Quantity of Anti-Foam Ag	gent:		
(19) x (15) = () x () =	gal	(22)
Quantity of Emulsifier:			
(19) x (16) = () x () =	gal	(23)
Quantity of Calcium Hydr	oxide Ca(OH) ₂ :	anna anna anna anna anna anna anna ann	
$(19) \times (17) = () \times ($ $(24) \div (100) = () \div 10$) =	1bs bags2	(24)
Quantity of Portland Typ	e Cement:		
(19) x (18) = () x ((25) ÷ (94) = () ÷ 94		1bs bags2	(25)
The volume of dewatered treated waste volume lis Solidification Data Shee	bead resin to be solidified canno ted on the Class A Stable, Class t for Bead Resin.	ot exceed the B and C Test	maximum
Round up to the rearest	whole bag.		
Reduce the quantity of w anti-foam agent plus emu	aste in liner by 1 ft ³ for every lsifier added to liner.	10 gallons of	f
I. INDEPENDENT VERIFICATION	BY GPUN MANAGEMENT		
SOLIDIFICATION CALCULATION SHEETS REVIE	WED		

ित्र Nucle	ar	TM1 Operating			1104-281
Title				Revis	ion No.
Waste Solidification	Process Cor	trol Program			8
	TTA	ACHMENT 10 (Cont'd)		Page 3 of 3
1	SOLIDIFICATI	ON DATA TABLE	S FOR BEAD RES	IN	
	HN-100 LVMU	HN-200	HN-600 MU	HN-600 LVMVGS	
Usable Liner Volume (cu. ft.)	148.8	59.4	64.0	61.7	
Max. Dewatered Waste Volume (cu. ft.)	120.0	47.9	51.6	49.8	
Max. Solidified Waste Volume (cu. ft.)	148.8	59.4	64.1	61.7	
Max. Rad. Level R/hr Contact	12	800	100	100	•
Min. Recommended ⁽¹⁾ Waste Vol (ft ³)	106.9	46.0	-	47.3	
Min Solidified ⁽¹⁾	132.6	57.0	-	58.6	

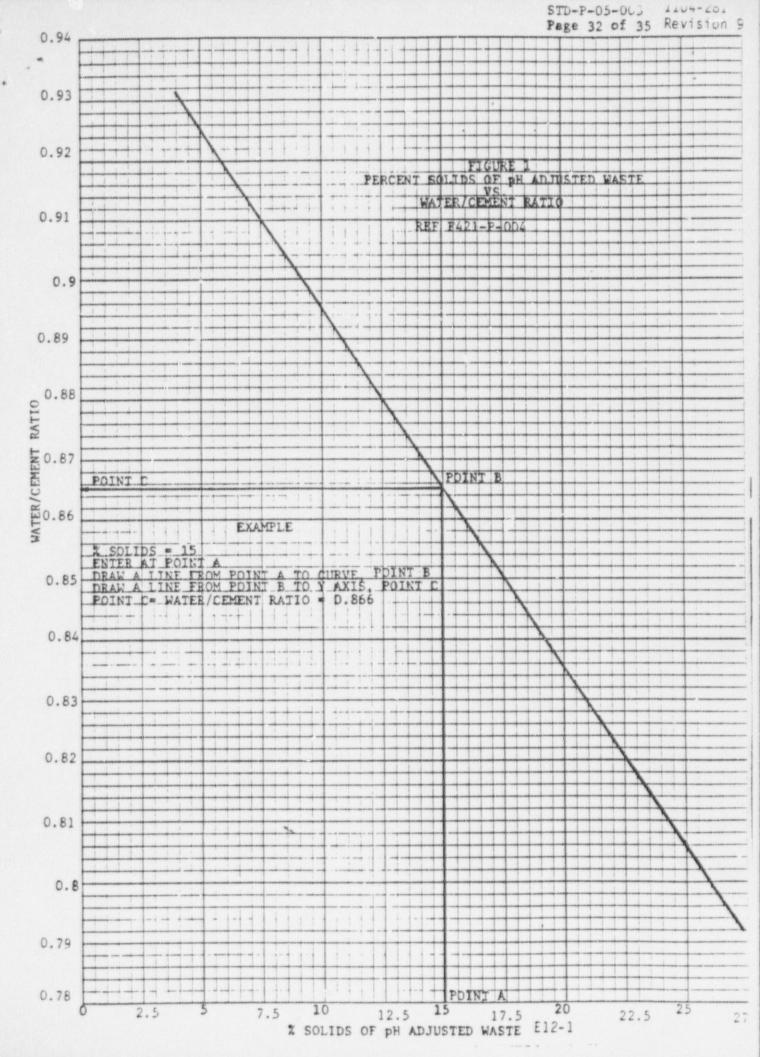
(1)

Grout will have to be added to the HN600 MU to increase the solidified waste volume to meet the 15% maximum void space criteria for shipment to Barnwell.

리만 Nuclear	TMI-1	Number
tle	Operating Procedure	1104-283
		Revision No.
Maste Solidification Process	Control Program	7
	ATTACHMENT 11	Page 1 of
TEST SOLIDIFICATIO	DN USING WESTINGHOUSE - HITTMAN F	PROCEDURE
Waste to be Processed:		****
Westinghouse - Hittman Proc	edure No	_
Procedure - Title		
Current Revision		_
Justification to use this alternate test procedure:		
		tinty, in chapter of the low of the second second second
Liner Type		
Liner Type Waste Class		
Waste Class		
Waste Class Balance Cal Info.		
Waste Class Balance Cal Info. CMTE No.		
Waste Class Balance Cal Info. CMTE No. Serial No.		

NOTE :

Form should be attached to valid Westinghouse - Hittman Procedure used for the Test Solidification



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