EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

1-January/30-June 1982

Supplemental Information

Facility TMI-Unit 1 License DPR 50-289

1. Regulatory Limits

   a. Fission and activation gases:
   b. Iodines:
   c. Particulates, half-lives > 8days:
   d. Liquid effluents:

   TMI-Unit 1 Tech Specs, Amendment No. 72 based on 10 CFR 20 and 10 CFR 50 Limits.

2. Maximum Permissible Concentrations

   Provide the MPCs used in determining allowable release rates or concentrations.

   a. Fission and activation gases:
   b. Iodines:
   c. Particulates, half-lives > 8 days:
   d. Liquid effluents:

   10 CFR 20, Appendix B, Table II

3. Average Energy

   Provide the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases, if applicable. $\bar{E} = 3.82E-1$

4. Measurements and Approximations of Total Radioactivity

   Provide the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.

   a. Fission and activation gases: GE(LI) spectrometry, Liquid Scintillation
   b. Iodines: GE(LI) spectrometry
   c. Particulates: GE(LI) spectrometry, Gas Flow Proportional, β spectrometry
   d. Liquid effluents: GE(LI) Spectrometry, Liquid Scintillation

5. Batch Releases

   Provide the following information relating to batch releases of radioactive materials in liquid and gaseous effluents.

	1st Q	2nd Q
a. Liquid		
1. Number of batch releases:	26	34
2. Total time period for batch releases: (min.)	19,028	15,061
3. Maximum time period for a batch release: (min.)	2,300	1,128
4. Average time period for batch releases: (min.)	732	443
5. Minimum time period for a batch release: (min.)	205	145
6. Average stream flow during periods of release of effluent into a flowing stream: (CFM)	3.43E6	2.91E6
b. Gaseous		
1. Number of batch releases:	16	23
2. Total time period for batch releases: (min.)	96,097	125,488
3. Maximum time period for a batch release: (min.)	30,905	39,886
4. Average time period for batch releases: (min.)	6,006	5,456
5. Minimum time period for a batch release: (min.)	510	508

6. Abnormal Releases

	1st Q	2nd Q
a. Liquid		
1. Number of releases	-0-	-0-
2. Total activity releases:	-none-	-none-
b. Gaseous		
1. Number of releases:	-0-	-0-
2. Total activity released:	-none-	-none-

TABLE 1A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1st	Quarter 2nd	Est.Total Error,%
A. Fission & activation gases				
1. Total release	Ci	7.56 E-3	<1.00E-8	2.50 E1
2. Average release rate for period	µCi/sec	9.51 E-4	N/A	
3. Percent of technical specification limit	%	*	-0-	
B. Iodines				
1. Total iodine - 131	Ci	<1.00 E-8	<1.00 E-8	N/A
2. Average release rate for period	µCi/sec	N/A	N/A	
3. Percent of technical specification limit	%	-0-	-0-	
C. Particulates				
1. Particulates with half-lives > 8 days	Ci	7.53 E-5	3.72 E-5	2.50 E1
2. Average release rate for period	µCi/sec	9.47 E-6	4.68 E-6	
3. Percent of technical specification limit	%	*	*	
4. Gross alpha radioactivity	Ci	5.52 E-8	2.18 E-6	
D. Tritium				
1. Total release	Ci	1.04 E-4	6.78 E-5	2.50 E1
2. Average release rate for period	µCi/sec	1.33 E-5	8.53 E-6	
3. Percent of technical specification limit	%	*	*	

Note: All less than (<) values are in µCi/cc.

*% Tech Spec limits: Listed on Dose Summary Table

TABLE 1C

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
GASEOUS EFFLUENTS - GROUND-LEVEL RELEASES

Nuclides Released	Unit	Continuous Mode Quarter 1st	Continuous Mode Quarter 2nd	Batch Mode Quarter 1st	Batch Mode Quarter 2nd

1. Fission gases

Nuclides Released	Unit	Continuous Quarter 1st	Continuous Quarter 2nd	Batch Quarter 1st	Batch Quarter 2nd
krypton-85	Ci	<1.00 E-8	<1.00 E-8	7.56 E-3	<1.00 E-8
krypton-85m	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
krypton-87	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
krypton-88	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
xenon-133	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
xenon-135	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
xenon-135m	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
xenon-138	Ci	<1.00 E-8	<1.00 E-8	<1.00 E-8	<1.00 E-8
Others (specify)	Ci				
	Ci				
	Ci				
unidentified	Ci				
Total for period	Ci	N/A	N/A	7.56 E-3	N/A

2. Iodines

Nuclides Released	Unit	Continuous Quarter 1st	Continuous Quarter 2nd	Batch Quarter 1st	Batch Quarter 2nd
iodine-131	Ci	<1.00 E-12	<1.00 E-12	<1.00 E-8	<1.00 E-8
iodine-133	Ci	<1.00 E-10	<1.00 E-10	<1.00 E-8	<1.00 E-8
iodine-135	Ci	<1.00 E-10	<1.00 E-10	<1.00 E-8	<1.00 E-8
Total for period	Ci	N/A	N/A	N/A	N/A

3. Particulates

Nuclides Released	Unit	Continuous Quarter 1st	Continuous Quarter 2nd	Batch Quarter 1st	Batch Quarter 2nd
strontium-89	Ci	2.34 E-5	1.31 E-7		
strontium-90	Ci	6.20 E-6	<1.00 E-11		
cesium-134	Ci	<1.00 E-11	<1.00 E-11	<1.00 E-8	<1.00 E-8
cesium-137	Ci	<1.00 E-11	<1.00 E-11	4.58 E-5	3.49 E-5
barium-lanthanum-140	Ci	<1.00 E-11	<1.00 E-11	<1.00 E-8	<1.00 E-8

Note: All less than values (<) are in µCi/cc.

TABLE 2A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	Quarter 1st	Quarter 2nd	Est. Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, gases, alpha)	Ci	9.98 E-3	4.73 E-3	2.50 E1
2. Average diluted concentration during period	μCi/ml	7.62 E-10	2.99 E-10	
3. Percent of applicable limit	%	*	*	
B. Tritium				
1. Total release	Ci	4.22 E-1	1.94 E0	2.50 E1
2. Average diluted concentration during period	μCi/ml	3.22 E-8	1.23 E-7	
3. Percent of applicable limit	%	*	*	
C. Dissolved and entrained gases				
1. Total release	Ci	<1.00 E-4	<1.00 E-4	N/A
2. Average diluted concentration during period	μCi/ml	N/A	N/A	
3. Percent of applicable limit	%	N/A	N/A	
D. Gross alpha radioactivity				
1. Total Release	Ci	<1.00 E-7	1.46 E-6	2.50 E1
E. Volume of waste released (prior to dilution)	liters	5.09 E6	4.58 E6	1.00 E1
F. Volume of dilution water used during period.	liters	1.31 E10	1.58 E10	1.00 E1

Note: All less than values (<) are in μCi/ml.

*% Tech. Spec. Limits: Listed on Dose Summary Table.

TABLE 2B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
LIQUID EFFLUENTS

Nuclides Released	Unit	CONTINUOUS MODE Quarter 1st	CONTINUOUS MODE Quarter 2nd	BATCH MODE Quarter 1st	BATCH MODE Quarter 2nd	
strontium-89	Ci	<5.00 E-8	<5.00 E-8	3.10 E-6	<5.00 E-8	*
strontium-90	Ci	<5.00 E-8	<5.00 E-8	7.52 E-6	2.09 E-5	
cesium-134	Ci	<5.00 E-7	<5.00 E-7	1.24 E-3	6.32 E-4	
cesium-137	Ci	<5.00 E-7	<5.00 E-7	7.23 E-3	3.21 E-3	
iodine-131	Ci	<1.00 E-6	<1.00 E-6	<1.00 E-6	<1.00 E-6	
cobalt-58	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
cobalt-60	Ci	<5.00 E-7	<5.00 E-7	1.16 E-3	6.31 E-4	
iron-59	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
zinc-65	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
manganese-54	Ci	<5.00 E-7	<5.00 E-7	1.21 E-5	<5.00 E-7	
chromium-51	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
zirconium-niobium-95	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
molybdenum-99	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
technetium-99m	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
barium-lanthanum-140	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
cerium-141	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
Other (specify)	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	<5.00 E-7	
Iron-55	Ci	<1.00 E-6	<1.00 E-6	3.32 E-4	2.32 E-8	*
Antimony-125	Ci	<5.00 E-7	<5.00 E-7	<5.00 E-7	2.39 E-4	
Phosphorus-32	Ci	<1.00 E-6	<1.00 E-6	<1.00 E-6	<1.00 E-6	
Total for period (above)	Ci	N/A	N/A	9.98 E-3	4.73 E-3	
xenon-133	Ci	<1.00 E-5	<1.00 E-5	<1.00 E-4	<1.00 E-4	
xenon-135	Ci	<1.00 E-5	<1.00 E-5	<1.00 E-4	<1.00 E-4	

Note: All less than (<) values are in µCi/ml.

* All results of analyses by offsite vendors were not available in time for this report. Results will be supplied as soon as they are available and this table updated (if applicable) for Sr-89, Sr-90, P-32 and Fe-55 in the 2nd quarter of 1982.

TABLE 3A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. Solid waste shipped off-site for burial or disposal (not irradiated fuel)

1. Type of waste	UNIT	6 MONTH PERIOD	EST. TOTAL ERROR, %
a. Spent resins, filter sludges, evaporator bottoms, etc. *	m^3 Ci	4.248 .927	5%
b. Dry compressible waste, containinated equipment, etc. **	m^3 Ci	219.984 1.221	5%
c. Irradiated components, control rods, etc.	m^3 Ci	N/A	
d. Other (describe)	m^3 Ci	N/A	

2. Estimate of major nuclide composition (by type of waste)		
a. Co-60	4.47%	
Cs-134	16.91%	
Cs-137	77.25%	
Sr-90/Y-90	0.63% each	
b. Cs-137	32.17%	
Ba-137m	30.46%	
Cs-134	3.9%	
Sr-90/Y-90	3.12% ea.	
Co-60	24.64%	
c. N/A		
d. N/A		

3. Solid Waste Disposition Number of Shipments	Mode of Transportation	Destination
1	Tractor/Trailer (van)	Richland, Washington
3	Tractor/Flatbed	Richland, Washington
5	Tractor/Trailer (van)	Barnwell, South Carolina
1	Tractor/Flatbed	Barnwell, South Carolina

B. Irradiated Fuel Shipments (Disposition)

Number of Shipments	Mode of Transportation	Destination
None		

* Shipped in 3 LSA liners, 172.3 cu. ft. each; solidified with cement

** Shipped in 227 LSA (Type A) steel drums, 7.5 ft^3/each and 62 LSA(Type A) steel boxes, 98 ft^3/each

TABLE 1

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: A

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	2	3	2	1	0	10
NNE	1	0	0	0	0	0	1
NE	0	2	1	0	0	0	3
ENE	0	0	0	0	0	0	0
E	0	0	2	0	0	0	2
ESE	1	3	2	2	0	0	8
SE	2	6	2	0	0	0	10
SSE	2	3	1	0	0	0	6
S	3	3	5	0	0	0	11
SSW	2	9	4	1	0	0	16
SW	1	4	6	0	0	0	11
WSW	4	4	4	0	0	0	12
W	5	3	13	8	12	0	41
WNW	3	4	15	7	7	1	37
NW	3	4	15	19	5	0	46
NNW	4	10	17	6	5	0	42
VARIABLE	6	0	0	1	0	0	7

TOTAL 256
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 26

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: B

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	2	0	0	0	2
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	2	1	0	0	0	3
ESE	1	4	1	1	0	0	7
SE	0	2	1	0	0	0	3
SSE	0	2	1	0	0	0	3
S	0	4	1	0	0	0	5
SSW	2	3	0	0	0	0	5
SW	0	0	0	0	0	0	0
WSW	3	0	0	2	0	0	5
W	0	2	2	3	3	0	10
WNW	0	1	5	6	0	0	12
NW	2	1	3	1	3	0	10
NNW	2	4	0	2	0	0	8
VARIABLE	2	0	1	0	0	0	3

TOTAL 73
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 26

TABLE 1 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS, C

ELEVATION, SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	1	2	1	0	0	5
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	3	0	0	0	0	3
E	4	4	2	0	0	0	10
ESE	1	3	3	0	0	0	7
SE	1	5	0	0	0	0	6
SSE	2	1	0	0	0	0	3
S	0	2	2	0	0	0	4
SSW	0	0	0	0	0	0	0
SW	0	1	0	2	0	0	3
WSW	0	2	0	1	0	0	3
W	0	3	3	3	6	0	15
WNW	0	0	3	9	2	0	14
NW	0	4	2	8	2	0	16
NNW	2	2	2	4	1	0	11
VARIABLE	5	0	1	1	0	0	7

TOTAL 102
PERIODS OF CALM(HOURS), 0
HOURS OF MISSING DATA, 26

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS, D

ELEVATION, SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	12	14	4	1	0	0	31
NNE	14	14	0	0	0	0	28
NE	15	24	7	0	0	0	46
ENE	20	33	8	0	0	0	61
E	27	34	6	0	0	0	67
ESE	17	55	15	0	0	0	87
SE	14	31	19	0	0	0	64
SSE	7	22	0	1	0	0	30
S	3	23	8	0	0	0	34
SSW	4	5	3	2	0	0	14
SW	6	7	3	0	0	0	16
WSW	5	6	6	6	0	0	23
W	12	14	20	17	10	1	74
WNW	6	10	33	60	11	0	120
NW	6	16	50	54	9	0	135
NNW	13	12	20	18	6	0	69
VARIABLE	73	1	1	1	0	0	76

TOTAL 908
PERIODS OF CALM(HOURS), 0
HOURS OF MISSING DATA, 26

TABLE 1 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: E

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	12	24	1	1	0	0	41
NNE	15	4	0	0	0	0	19
NE	11	5	0	0	0	0	16
ENE	11	5	0	0	0	0	16
E	13	18	0	0	0	0	31
ESE	14	16	1	1	0	0	32
SE	8	12	1	0	0	0	21
SSE	6	11	1	0	0	0	18
S	11	13	6	2	0	0	32
SSW	10	3	1	1	0	0	15
SW	7	8	7	0	0	0	22
WSW	6	12	4	1	3	0	26
W	4	15	11	12	0	1	43
WNW	6	10	21	3	1	0	43
NW	11	13	17	7	0	0	48
NNW	14	18	12	7	1	0	52
VARIABLE	53	0	0	0	0	0	53

TOTAL 475
PERIODS OF CALM(HOURS): 3
HOURS OF MISSING DATA: 26

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: F

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	6	14	1	0	0	0	21
NNE	8	1	0	0	0	0	9
NE	10	1	0	0	0	0	11
ENE	6	1	0	0	0	0	7
E	14	3	0	0	0	0	17
ESE	6	3	0	0	0	0	9
SE	15	1	1	0	0	0	17
SSE	9	1	0	0	0	0	10
S	6	1	0	0	0	0	7
SSW	7	0	0	0	0	0	7
SW	0	2	0	1	0	0	3
WSW	3	3	0	0	0	0	6
W	7	5	0	0	0	0	12
WNW	6	5	0	1	0	0	12
NW	5	4	4	0	0	0	13
NNW	8	7	1	1	0	0	17
VARIABLE	37	0	0	0	0	0	37

TOTAL 178
PERIODS OF CALM(HOURS): 8
HOURS OF MISSING DATA: 26

TABLE 1 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: G

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	6	0	0	0	0	10
NNE	4	1	0	0	0	0	5
NE	1	0	0	0	0	0	1
ENE	7	0	0	0	0	0	7
E	8	3	0	0	0	0	11
ESE	8	5	0	0	0	0	13
SE	10	4	0	0	0	0	14
SSE	9	1	0	0	0	0	10
S	12	1	0	0	0	0	13
SSW	13	1	0	0	0	0	14
SW	8	0	0	0	0	0	8
WSW	6	2	1	0	0	0	9
W	4	2	1	0	0	0	7
WNW	5	1	0	0	0	0	6
NW	5	1	2	0	0	0	8
NNW	3	2	1	0	0	0	6
VARIABLE	25	0	0	0	0	0	25

TOTAL 142
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 26

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: ALL

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	37	61	13	5	1	0	120
NNE	42	21	0	0	0	0	63
NE	37	33	8	0	0	0	78
ENE	44	42	8	0	0	0	94
E	66	64	11	0	0	0	141
ESE	48	89	22	4	0	0	163
SE	50	61	24	0	0	0	135
SSE	35	41	12	1	0	0	89
S	35	47	22	2	0	0	106
SSW	38	21	8	4	0	0	71
SW	22	22	16	3	0	0	63
WSW	27	29	15	10	3	0	84
W	32	44	50	43	31	2	202
WNW	26	31	77	88	21	1	244
NW	32	43	93	89	19	0	276
NNW	46	55	53	38	13	0	205
VARIABLE	201	1	3	3	0	0	208

TOTAL 2134
PERIODS OF CALM(HOURS): 3
HOURS OF MISSING DATA: 26

TABLE 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: A

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	11	10	10	5	3	0	39
NNE	4	7	0	0	0	0	11
NE	2	1	1	1	0	0	5
ENE	0	5	0	0	0	0	5
E	3	7	0	0	0	0	10
ESE	3	11	2	0	0	0	16
SE	3	3	5	2	0	0	13
SSE	1	7	3	0	0	0	11
S	3	2	7	1	0	0	13
SSW	4	6	9	0	0	0	19
SW	3	6	5	0	0	0	14
WSW	5	2	2	0	0	0	9
W	9	9	11	3	0	0	32
WNW	11	11	15	4	1	0	42
NW	15	17	44	18	3	6	103
NNW	17	23	19	21	7	0	87
VARIABLE	24	0	0	0	0	0	24

TOTAL 429
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: B

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	0	0	0	0	0
NNE	0	1	0	0	0	0	1
NE	1	0	0	0	0	0	1
ENE	0	1	0	0	0	0	1
E	1	0	0	0	0	0	1
ESE	3	2	1	0	0	0	6
SE	0	1	1	0	0	0	2
SSE	1	0	1	0	0	0	2
S	3	3	2	0	0	0	8
SSW	0	1	6	1	0	0	8
SW	1	0	0	0	0	0	1
WSW	1	0	1	0	0	0	2
W	1	0	3	3	0	0	7
WNW	1	1	3	7	5	1	18
NW	0	2	3	5	7	3	20
NNW	2	2	1	1	0	0	6
VARIABLE	0	0	0	0	0	0	0

TOTAL 84
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

TABLE 2 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: C

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	3	1	0	0	0	0	4
NNE	0	0	0	0	0	0	0
NE	1	1	0	0	0	0	2
ENE	0	1	0	0	0	0	1
E	0	2	2	0	0	0	4
ESE	2	1	1	0	0	0	4
SE	1	6	1	0	0	0	8
SSE	0	1	1	0	0	0	2
S	0	3	3	2	0	0	8
SSW	2	3	0	1	0	0	6
SW	0	1	0	0	0	0	1
WSW	0	1	0	0	0	0	1
W	0	0	2	0	0	0	2
WNW	0	2	3	2	1	0	8
NW	1	0	0	1	1	0	3
NNW	7	0	0	4	0	0	11
VARIABLE	7	0	0	0	0	0	7

TOTAL 68
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: D

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	12	11	3	6	0	0	32
NNE	10	9	0	0	0	0	19
NE	6	21	6	0	0	0	33
ENE	16	34	13	0	0	0	63
E	8	51	23	1	0	0	83
ESE	9	36	13	0	0	0	58
SE	6	16	5	1	0	0	28
SSE	7	11	17	0	0	0	35
S	7	10	13	2	0	0	32
SSW	3	9	8	6	1	0	27
SW	2	2	4	0	0	0	8
WSW	5	2	1	0	0	0	8
W	13	11	9	2	0	0	35
WNW	9	17	28	19	0	0	73
NW	4	12	21	16	5	1	59
NNW	14	13	6	6	2	0	41
VARIABLE	50	0	0	0	0	0	50

TOTAL 634
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

TABLE 2 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: E

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	9	18	6	2	0	0	35
NNE	10	8	3	0	0	0	21
NE	12	8	1	0	0	0	21
ENE	12	14	0	0	0	0	26
E	18	15	0	0	0	0	33
ESE	17	11	1	0	0	0	29
SE	10	17	4	0	0	0	31
SSE	8	17	8	0	0	0	33
S	15	17	11	0	0	0	43
SSW	18	18	5	4	2	0	47
SW	11	10	2	2	0	0	25
WSW	10	8	4	0	0	0	22
W	14	12	16	6	0	0	48
WNW	16	18	21	4	1	0	60
NW	7	21	18	8	2	0	56
NNW	17	25	6	5	0	0	53
VARIABLE	54	0	0	0	0	0	54

TOTAL 583
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS: F

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	9	2	2	0	0	0	13
NNE	6	4	0	0	0	0	10
NE	1	5	0	0	0	0	6
ENE	1	1	0	0	0	0	2
E	11	5	0	0	0	0	16
ESE	12	8	0	0	0	0	20
SE	10	3	0	0	0	0	13
SSE	13	3	0	0	0	0	16
S	16	2	0	0	0	0	18
SSW	11	1	0	0	0	0	12
SW	2	0	1	0	0	0	3
WSW	12	3	1	0	0	0	16
W	9	6	2	0	0	0	17
WNW	9	6	2	0	0	0	17
NW	11	4	1	0	0	0	16
NNW	16	5	7	0	0	0	28
VARIABLE	26	0	0	0	0	0	26

TOTAL 223
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 23

TABLE 2 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS, C

ELEVATION, SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	1	0	0	0	0	5
NNE	2	0	0	0	0	0	2
NE	1	1	0	0	0	0	2
ENE	1	1	0	0	0	0	2
E	8	1	0	0	0	0	9
ESE	12	3	0	0	0	0	15
SE	13	3	0	0	0	0	16
SSE	9	1	0	0	0	0	10
S	16	1	0	0	0	0	17
SSW	12	1	0	0	0	0	13
SW	10	0	0	0	0	0	10
WSW	7	2	0	0	0	0	9
W	8	0	1	0	0	0	9
WNW	5	1	0	0	0	0	6
NW	10	1	1	0	0	0	12
NNW	5	1	0	0	0	0	6
VARIABLE	10	0	0	0	0	0	10

TOTAL 143
PERIODS OF CALM(HOURS), 0
HOURS OF MISSING DATA, 23

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82063024

STABILITY CLASS, ALL

ELEVATION, SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	48	43	21	13	3	0	128
NNE	32	29	3	0	0	0	64
NE	24	37	8	1	0	0	70
ENE	30	57	13	0	0	0	100
E	49	81	25	1	0	0	156
ESE	58	72	18	0	0	0	148
SE	43	49	16	3	0	0	111
SSE	39	40	30	0	0	0	109
S	60	38	36	5	0	0	139
SSW	50	39	28	12	3	0	132
SW	29	19	12	2	0	0	62
WSW	40	18	9	0	0	0	67
W	54	38	44	14	0	0	150
WNW	51	36	72	36	8	1	224
NW	48	57	88	40	19	10	260
NNW	78	60	30	37	0	0	232
VARIABLE	190	0	0	0	0	0	190

TOTAL 2161
PERIODS OF CALM(HOURS), 0
HOURS OF MISSING DATA, 23

TABLE 3

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: A

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	2	3	1	1	0	9
NNE	1	0	0	0	0	0	1
NE	0	2	1	0	0	0	3
ENE	0	0	0	0	0	0	0
E	0	0	2	0	0	0	2
ESE	1	2	2	2	0	0	7
SE	2	5	2	0	0	0	9
SSE	2	2	1	0	0	0	5
S	3	3	5	0	0	0	11
SSW	2	7	4	1	0	0	14
SW	1	2	5	0	0	0	8
WSW	4	3	4	0	0	0	11
W	4	3	10	8	12	0	37
WNW	3	4	11	6	7	1	32
NW	2	3	12	13	5	0	35
NNW	3	10	17	5	4	0	39
VARIABLE	5	0	0	1	0	0	6

TOTAL 223
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010121-82033124

STABILITY CLASS: B

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	2	0	0	0	2
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	2	1	0	0	0	3
ESE	0	4	0	1	0	0	5
SE	0	2	1	0	0	0	3
SSE	0	1	1	0	0	0	2
S	0	3	1	0	0	0	4
SSW	1	2	0	0	0	0	3
SW	0	0	0	0	0	0	0
WSW	3	0	0	2	0	0	5
W	0	1	2	3	3	0	9
WNW	0	1	4	5	0	0	10
NW	2	1	1	1	1	0	6
NNW	2	3	0	1	0	0	6
VARIABLE	1	0	1	0	0	0	2

TOTAL 58
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

TABLE 3 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: C

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	1	2	1	0	0	5
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	3	0	0	0	0	3
E	4	3	2	0	0	0	9
ESE	1	3	2	0	0	0	6
SE	0	4	0	0	0	0	4
SSE	1	0	0	0	0	0	1
S	0	0	2	0	0	0	2
SSW	0	0	0	0	0	0	0
SW	0	1	0	2	0	0	3
WSW	0	2	0	1	0	0	3
W	0	2	2	3	6	0	13
WNW	0	0	2	7	2	0	11
NW	0	3	1	4	1	0	9
NNW	2	2	2	3	1	0	10
VARIABLE	5	0	1	1	0	0	7

TOTAL 81
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: D

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	11	12	3	1	0	0	27
NNE	13	9	0	0	0	0	22
NE	8	20	7	0	0	0	35
ENE	16	29	8	0	0	0	53
E	24	28	5	0	0	0	57
ESE	16	48	15	0	0	0	79
SE	12	29	20	0	0	0	61
SSE	6	10	9	1	0	0	26
S	1	12	6	0	0	0	19
SSW	2	4	0	1	0	0	7
SW	5	4	2	0	0	0	11
WSW	4	6	5	6	0	0	21
W	10	13	16	11	5	0	55
WNW	6	8	23	48	7	0	92
NW	6	16	46	46	8	0	122
NNW	10	18	19	16	5	0	68
VARIABLE	59	1	1	1	0	0	62

TOTAL 747
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

TABLE 3 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: E

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	7	18	1	0	0	0	26
NNE	11	2	0	0	0	0	13
NE	9	4	0	0	0	0	13
ENE	7	5	0	0	0	0	12
E	13	18	0	0	0	0	31
ESE	11	16	1	0	0	0	28
SE	7	10	1	0	0	0	18
SSE	5	10	1	0	0	0	16
S	11	12	5	2	0	0	30
SSW	9	2	0	1	0	0	12
SW	6	7	3	0	0	0	16
WSW	4	8	3	1	1	0	17
W	2	14	11	11	0	1	39
WNW	4	4	14	5	1	0	28
NW	6	10	16	7	0	0	39
NNW	6	13	10	5	1	0	35
VARIABLE	33	0	0	0	0	0	33

TOTAL 373
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: F

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	5	6	1	0	0	0	12
NNE	8	1	0	0	0	0	9
NE	8	1	0	0	0	0	9
ENE	6	1	0	0	0	0	7
E	13	2	0	0	0	0	15
ESE	6	3	0	0	0	0	9
SE	14	0	1	0	0	0	15
SSE	9	1	0	0	0	0	10
S	5	1	0	0	0	0	6
SSW	5	0	0	0	0	0	5
SW	0	2	0	1	0	0	3
WSW	3	3	0	0	0	0	6
W	3	3	0	0	0	0	6
WNW	4	3	0	0	0	0	7
NW	4	4	1	0	0	0	9
NNW	6	5	1	1	0	0	13
VARIABLE	33	0	0	0	0	0	33

TOTAL 141
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 17

TABLE 3 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS. G

ELEVATION. SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	3	4	0	0	0	0	7
NNE	4	1	0	0	0	0	5
NE	0	0	0	0	0	0	0
ENE	3	0	0	0	0	0	3
E	1	3	0	0	0	0	4
ESE	6	0	0	0	0	0	6
SE	6	2	0	0	0	0	8
SSE	5	1	0	0	0	0	6
S	8	1	0	0	0	0	9
SSW	5	0	0	0	0	0	5
SW	5	0	0	0	0	0	5
WSW	2	2	1	0	0	0	5
W	3	2	1	0	0	0	6
WNW	2	0	0	0	0	0	2
NW	4	1	1	0	0	0	6
NNW	2	0	1	0	0	0	3
VARIABLE	14	0	0	0	0	0	14

TOTAL 80
PERIODS OF CALM(HOURS). 0
HOURS OF MISSING DATA. 17

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82010101-82033124

STABILITY CLASS: ALL

ELEVATION. SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	29	43	12	3	1	0	88
NNE	37	14	0	0	0	0	51
NE	25	28	8	0	0	0	61
ENE	32	38	8	0	0	0	78
E	55	56	10	0	0	0	121
ESE	41	76	20	3	0	0	140
SE	41	52	25	0	0	0	118
SSE	28	25	12	1	0	0	66
S	28	32	19	2	0	0	81
SSW	24	15	4	3	0	0	46
SW	17	16	10	3	0	0	46
WSW	20	24	13	10	1	0	68
W	22	38	42	36	26	1	165
WNW	19	20	54	71	17	1	182
NW	24	38	78	71	15	0	226
NNW	31	43	50	31	11	0	166
VARIABLE	150	1	3	3	0	0	157

TOTAL 1703
PERIODS OF CALM(HOURS). 0
HOURS OF MISSING DATA. 17

TABLE 4

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: A

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	8	6	10	5	3	0	32
NNE	4	7	0	0	0	0	11
NE	2	1	1	1	0	0	5
ENE	0	5	0	0	0	0	5
E	2	7	0	0	0	0	9
ESE	3	11	2	0	0	0	16
SE	2	3	5	2	0	0	12
SSE	1	6	3	0	0	0	10
S	3	2	4	1	0	0	10
SSW	4	4	5	0	0	0	13
SW	3	4	3	0	0	0	10
WSW	5	1	2	0	0	0	8
W	8	8	11	3	0	0	30
WNW	9	8	14	4	0	0	35
NW	13	9	35	12	2	2	73
NNW	13	20	18	19	7	0	77
VARIABLE	20	0	0	0	0	0	20

TOTAL 356
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: B

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	0	0	0	0	0
NNE	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	3	2	1	0	0	0	6
SE	0	1	1	0	0	0	2
SSE	1	0	1	0	0	0	2
S	2	2	1	0	0	0	5
SSW	0	0	2	1	0	0	3
SW	1	0	0	0	0	0	1
WSW	1	0	0	0	0	0	1
W	0	0	3	2	0	0	5
WNW	1	0	3	7	5	1	17
NW	0	2	3	4	6	2	17
NNW	2	2	1	1	0	0	6
VARIABLE	6	0	0	0	0	0	6

TOTAL 67
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

TABLE 4 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062002

STABILITY CLASS: C

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	3	0	0	0	0	0	3
NNE	0	0	0	0	0	0	0
NE	1	1	0	0	0	0	2
ENE	0	1	0	0	0	0	1
E	0	2	2	0	0	0	4
ESE	2	1	1	0	0	0	4
SE	1	5	1	0	0	0	7
SSE	0	1	1	0	0	0	2
S	0	3	1	2	0	0	6
SSW	2	2	0	1	0	0	5
SW	0	1	0	0	0	0	1
WSW	0	1	0	0	0	0	1
W	0	0	0	0	0	0	0
WNW	0	1	3	2	1	0	7
NW	1	0	0	1	1	0	3
NNW	2	0	0	4	0	0	6
VARIABLE	5	0	0	0	0	0	5

TOTAL 52
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062002

STABILITY CLASS: D

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	10	3	6	0	0	28
NNE	8	6	0	0	0	0	14
NE	6	18	6	0	0	0	30
ENE	15	29	12	0	0	0	56
E	5	47	22	1	0	0	75
ESE	5	23	13	0	0	0	41
SE	5	11	4	1	0	0	21
SSE	5	10	16	0	0	0	31
S	6	4	12	2	0	0	24
SSW	3	6	2	6	1	0	18
SW	2	1	3	0	0	0	6
WSW	4	2	0	0	0	0	6
W	0	0	5	2	0	0	25
WNW	6	17	22	13	0	0	58
NW	4	10	16	11	5	1	47
NNW	13	11	5	6	2	0	37
VARIABLE	35	0	0	0	0	0	35

TOTAL 517
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

TABLE 4 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: E

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	7	14	6	2	0	0	29
NNE	10	7	3	0	0	0	20
NE	7	8	1	0	0	0	16
ENE	8	11	0	0	0	0	19
E	11	14	0	0	0	0	25
ESE	11	8	1	0	0	0	20
SE	8	14	3	0	0	0	25
SSE	3	12	8	0	0	0	23
S	13	14	6	0	0	0	33
SSW	10	12	2	1	2	0	27
SW	9	7	2	2	0	0	20
WSW	8	7	4	0	0	0	19
W	11	12	17	6	0	0	46
WNW	13	16	25	4	1	0	59
NW	7	15	14	10	2	0	48
NNW	13	18	6	5	0	0	42
VARIABLE	41	0	0	0	0	0	41

TOTAL 471
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: F

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	8	2	2	0	0	0	12
NNE	5	4	0	0	0	0	9
NE	1	5	0	0	0	0	6
ENE	0	0	0	0	0	0	0
E	6	3	0	0	0	0	9
ESE	8	7	0	0	0	0	15
SE	6	3	0	0	0	0	9
SSE	10	3	0	0	0	0	13
S	14	1	0	0	0	0	15
SSW	9	1	0	0	0	0	10
SW	1	0	0	0	0	0	1
WSW	9	3	1	0	0	0	13
W	5	4	2	0	0	0	11
WNW	5	0	2	0	0	0	7
NW	8	1	1	0	0	0	10
NNW	12	3	7	0	0	0	22
VARIABLE	20	0	0	0	0	0	20

TOTAL 162
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

TABLE 4 (CONT'D)

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: G

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	1	0	0	0	0	5
NNE	2	0	0	0	0	0	2
NE	1	1	0	0	0	0	2
ENE	1	1	0	0	0	0	2
E	5	1	0	0	0	0	6
ESE	8	3	0	0	0	0	11
SE	9	3	0	0	0	0	12
SSE	5	1	0	0	0	0	6
S	8	1	0	0	0	0	9
SSW	7	1	0	0	0	0	8
SW	7	0	0	0	0	0	7
WSW	6	2	0	0	0	0	8
W	7	0	1	0	0	0	8
WNW	3	1	0	0	0	0	4
NW	8	0	1	0	0	0	9
NNW	5	1	0	0	0	0	6
VARIABLE	18	0	0	0	0	0	18

TOTAL 105
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD= 82040101-82062902

STABILITY CLASS: ALL

ELEVATION: SPEED:SP100A DIRECTION:DI100A LAPSE:DT150A

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	30	33	21	13	3	0	100
NNE	29	25	3	0	0	0	57
NE	18	34	8	1	0	0	61
ENE	24	48	12	0	0	0	84
E	29	74	24	1	0	0	128
ESE	40	55	18	0	0	0	113
SE	31	40	14	3	0	0	88
SSE	25	33	29	0	0	0	87
S	46	27	24	5	0	0	102
SSW	35	26	11	9	3	0	84
SW	23	13	8	2	0	0	46
WSW	33	16	7	0	0	0	56
W	40	33	39	13	0	0	125
WNW	37	43	69	30	7	1	187
NW	41	37	70	38	16	5	207
NNW	69	55	37	35	0	0	196
VARIABLE	145	0	0	0	0	0	145

TOTAL 1730
PERIODS OF CALM(HOURS): 0
HOURS OF MISSING DATA: 18

SUMMARY OF MAXIMUM INDIVIDUAL DOSES

LAST ACCUMULATIONS FOR PERIODS

Liquid January 1, 1982 to March 31, 1982
Gaseous January 1, 1982 to March 31, 1982
Air January 1, 1982 to March 31, 1982

	Effluent	Applicable Organ	Estimated Dose (mrem)	Age Group	Location Dist (M)	Location Dir (Toward)	% of Applicable Limit	Limit (mR)
1.	Liquid	Total Body	8.49E-02	Adult	Receptor 1		2.8E 00	3.0
2.	Liquid	Liver	1.29E-01	Teen	Receptor 1		1.3E 00	10.0
3.	Noble Gas	Air Dose (Gamma-mrad)	7.79E-09		363	ESE	7.8E-08	10.0
4.	Noble Gas	Air Dose (Beta-mrad)	8.84E-07		363	ESE	4.4E-06	20.0
5.	Noble Gas	T. Body	5.84E-09	All	630	ESE	1.2E-07	5.0
6.	Noble Gas	Skin	7.02E-07	All	630	ESE	4.7E-06	15.0
7.	Iodine & Particulates	Skin	3.10E-04	Teen	630	ESE	2.1E-03	15.0

SUMMARY OF POPULATION DOSES

LAST ACCUMULATIONS FOR PERIODS

Liquid January 1, 1982 to March 31, 1982
Gaseous January 1, 1982 to March 31, 1982

	Effluent	Applicable Organ	Estimated Population Dose (Person-rem)
8.	Liquid	Total Body	3.7E-02
9.	Liquid	Thyroid	2.5E-03
10.	Gaseous	Total Body	3.9E-04
11.	Gaseous	Bone, Lung	5.8E-04

Unit 1 - 2nd Quarter 1982

SUMMARY OF MAXIMUM INDIVIDUAL DOSES

LAST ACCUMULATIONS FOR PERIODS

Liquid April 1, 1982 to June 30, 1982
Gaseous April 1, 1982 to June 30, 1982
Air April 1, 1982 to June 30, 1982

	Effluent	Applicable Organ	Estimated Dose (mrem)	Age Group	Location Dist (M)	Location Dir (Toward)	% of Applicable Limit	Limit (mR)
1.	Liquid	Total Body	3.35E-02	Adult	Receptor 1		1.1E 00	3.0
2.	Liquid	Liver	5.03E-02	Teen	Receptor 1		5.0E-01	10.0
3.	Noble Gas	Air Dose (Gamma-mrad)	0.00		0		0	0
4.	Noble Gas	Air Dose (Beta-mrad)	0.00		0		0	0
5.	Noble Gas	T. Body	0.00		0		0	0
6.	Noble Gas	Skin	0.00		0		0	0
7.	Iodine & Particulates	Bone	1.58E-04	Child	630	ESE	1.1E-03	15.0

SUMMARY OF POPULATION DOSES

LAST ACCUMULATIONS FOR PERIODS

Liquid April 1, 1982 to June 30, 1982
Gaseous April 1, 1982 to June 30, 1982

	Effluent	Applicable Organ	Estimated Population Dose (Person-rem)
8.	Liquid	Total Body	2.5E-02
9.	Liquid	Thyroid	1.0E-02
10.	Gaseous	Total Body	1.8E-03
11.	Gaseous	Liver, Skin	4.1E-03

CHANGES TO THE PROCESS CONTROL PROGRAM FOR RADIOACTIVE WASTE SOLIDIFICATION

Background:

Originally, the TMI-1 Process Control Program (PCP) was included as part of the procedure for incontainer solidification (OP 1104-28A). As of May, 1982, the PCP has been separated from this solidification procedure, re-written, and issued as its own procedure (OP 1104-28I).

The following provides the explanation for the changes in the content of the procedure for any applicable sections.

Procedure Changes and Explanations:

a. Section 2.1.1 Concentrated Waste (Evaporator Bottom)

This change reflects modifications in the method used to convey waste from the storage locations to the Hittman liner. Hard piping and use of the permanent waste recirculation pumps are now utilized instead of a progressive cavity pump and temporary line.

b. Section 2.2.1 Emulsifier Feed (Oily Waste Only)

Additional words have been added to indicate at which time emulsifiers will be added to a liner for oily waste solidifications. Since the emulsifier is locally added, it is necessary for this addition to take place prior to the transfer of concentrated waste to eliminate the potential for airborne releases.

c. Section 2.4 Vent Air Filter Subsystem

Changes in this section reflect the modifications to the liner off gas system. Previously, the liner was vented directly to a bag/filter house located in the solidification building. Incorporation of a larger bag house with HEPA filter and the venting discharge to the TMI-1 Auxiliary Building, provides the mechanism to ensure that all off gas is contained within a filtered system and not released to the environment.

d. Note (Following Section 3.2.3.1)

The statement included in this note provides for testing of evaporator bottoms at ambient temperatures if the waste has been previously neutralized. Neutralization of the waste is required for conditioning waste prior to the addition of the cement and to prevent boric acid precipitation. TMI-1 does make it a practice to neutralize waste while contained in the storage tanks. It is therefore possible that the sample of waste has an acceptable pH and is properly conditioned for the solidification test.

CHANGES TO THE PROCESS CONTROL PROGRAM FOR
RADIOACTIVE WASTE SOLIDIFICATION
(continued)

e. Section 3.2.3.2 (Collection of Samples)

The first sentence of this section has been reworded for clarification.

f. Section 4.1.1 (Waste Conditioning)

The content of Sections 4.1.1 and 4.1.2. have been exchanged. The new 4.1.1 provided additional guidance for neutralization of concentrated waste for conditioning of the waste prior to testing.

g. Section 4.1.2 (Waste Conditioning)

This revised item provided the required quidance for neutralization of bead and powdered resins prior to testing.

h. Section 4.1.4 (Waste Conditioning)

The specific information in this section has been modified to incorporate improvements to the Hittman procedures. The Hittman procedures developed for incontainer solidification provides the basis for this PCP.

i. Section 4.1.5 (Waste Conditioning)

This section replaces 4.1.4.1 and subsequent sections. These sections are renumbered after restructuring. Additional information has also been included in this section for additional guidance of oily waste to ensure proper ratios are used and consistent with burial requirements. The intent of the section is not changed.

j. Section 4.2.3 (Test Solidification)

The changes in the section incorporate changes to the Hittman procedures for test solidification. Two verification samples are now performed using different quantities of solidification agents (i.e. cement and metso). The two samples provide an upper and lower range of the ad mixtures and are used as a basis for determination of the ratios to be used for solidification.

k. Section 4.2.4 (Test Solidification)

See 4.2.3, (Item j. above)

l. Section 4.2.5 (Test Solidification)

See 4.2.3, (Item j. above)

CHANGES TO THE PROCESS CONTROL PROGRAM FOR
RADIOACTIVE WASTE SOLIDIFICATION
(continued)

m. Section 4.2.6 (Test Solidification)

See 4.2.3, (Item j. above)

n. Section 4.2.8 (Test Solidification)

The amount of time allowed for the samples to harden have been changed from 30 minutes to 4 hours. This change is required to be consistent with the Hittman procedures and provides additional time for hardening of the verification samples.

o. Section 4.5.2 (Alternate Solidification Parameters)

This section has been added to provide further guidance for determination of the cause if a sample(s) fails to solidify.

p. Attachments (Data Sheets)

All of the previous data and calculation sheets have been changed to reflect the methodology for the dual sample test verifications. The new data sheets (again consistent with existing Hittman procedures) are used for documentation of test verification. The intent of these sheets has not been changed.

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1104-28I
Revision 0
07/20/82

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IMPORTANT TO SAFETY
ENVIRONMENTAL IMPACT RELATED

THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 OPERATING PROCEDURE 1104-28I
HITTMAN NUCLEAR AND DEVELOPMENTAL CORPORATION PROCESS CONTROL PROGRAM

Incontainer Solidification

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6.0	0	31.0	0				
7.0	0	32.0	0				
8.0	0	33.0	0				
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(PORC) M A Nelson
Signature

7/19/82
Date

R J Toole
Signature

7-20-82
Date

Document ID: 0212T

THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 OPERATING PROCEDURE 1104-28I
HITTMAN NUCLEAR AND DEVELOPMENT CORPORATION PROCESS CONTROL PROGRAM

Incontainer Solidification

1.0 PURPOSE

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 liquid prior to transportation for disposal.

The program consists of three major steps, which are:

a. Procedures for collecting and analyzing samples;

b. Procedures for solidifying samples;

c. Criteria for process parameters for acceptance or rejection as solidified waste.

2.0 SYSTEM DESCRIPTION

The systems described herein are designed to handle the solidification of liquids, evaporator bottoms, other concentrated liquids, contaminated oil spent resin, filter sludge and other miscellaneous waste. Concentrated liquids are processed at elevated temperatures as required to keep the salts in solution. The various operations are as described below.

2.1 Waste Feed System

2.1.1 Concentrated Waste (Evaporator Bottoms)

The waste feed system consists of permanent plant pumps and piping for the recirculation of concentrated evaporator bottoms from the concentrated waste storage tanks and permanent transfer piping terminating at the Hittman Building. The concentrated waste being recirculated with the CWST transfer pumps (WDL-P-12 A/B) is diverted to pump waste to the Hittman disposal liner.

The pumps and the valve lineup is manually controlled and flow is discontinued when a predetermined level is reached in the liner.

2.1.2 Bead Resin and Powdered Resin

The waste feed system consists of TMI-1 resin recirculation hoses attached to the resin disposal and dewater return connections on the outside wall of the Auxiliary Building. Resin may be directed either to the disposal liner or back to the resin tank via the dewater return connection. The resin flow the liner is stopped when the resin slurry reaches a predetermined level. A dewatering pump operating during the fill cycle dewaters the liner until loss of flow is detected. The dewater pump, a positive displacement air operated diaphragm pump, is stopped. The resin flow is restarted and continued until the predetermined level is reached. The dewater pump is restarted. The fill and dewater procedure is repeated until the dewatering cycle no longer brings the resin level down below the predetermined level. Based on liner size used, a predetermined quantity of water is added back into the liner through the dewatering element to fluff the bed to relieve any bed packing.

Liners used for powederd resin have special bottom designs to preclude plugging of the dewatering elements.

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2.1.3 Oily Waste

Due to the low activity levels associated with oil wastes, the liners in which the oil is to be solidified can be filled by hand or with a small pump. The liner is filled to a preset level (determined visually). The quantity of evaporator bottoms determined by the verification test is added as described in section 2.1.1.

2.2 Cement Feed Subsystem

Cement and chemical additives are batch loaded into the shipping container, where the actual mixing occurs, by means of a screw conveyor. This subsystem consists of:

a. Cement hopper with discharge adaptor

b. Screw feeder and drive motor

c. Container inlet valve

As a function of waste volume and container size, the appropriate amount of cement and additives for a single batch are pre-loaded into the cement hopper which, through the discharge adaptor, meters the cement to the screw feeder. Cement is conveyed through the flexible screw feeder to the top of the container, where it passes through the container inlet valve and falls by gravity into the radwaste while the mixing blades are turning.

Dusting is minimized by pre-loading the cement hopper with a known volume of cement, as determined by the Waste Solidification Data Sheet, and by the use of a dust collector as a feature of the vent air filter subsystem (see 2.4).

The cement container inlet valve and the vent line are in integral part of the container fill head assembly.

2.2.1 Emulsifier Feed (Oily Waste Only)

Liquid emulsifier is added using a small positive displacement pump prior to the addition of other liquid waste. The quantity of emulsifier required is determined through verification testing.

2.3 Mixing

Each liner is supplied with an internal mixing device designed to provide thorough mixing of the entire liner contents. A mixing motor mounted on the top of the liner prior to the filling operation is started prior to the addition of cement. Mixing continues for approximately twenty minutes or until the motor automatically trips off due to high resistance to mixing. The mixture will be completely firm within 4 hours and be suitable for transport.

2.4 Vent Air Filter Subsystem

The fill head also includes an elbowed vent line. The vent line is hard piped to the edge of the cask where hoses can be connected to allow the air being vented from the cask to be conveyed to the ventilation system. The vent line on the fill head is connected with flexible hose to a sealed 55 gallon drum used to detect an inadvertent over flow of the liner. A liquid level sensor in the drum will activate an audible alarm in the event that liquid enters the drum. The drum prevents moisture intrusion into the air filtration system. The filtration system consists of flat fabric filters to remove particulates (especially cement dust) from the

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vent air. The vent air then goes through a HEPA and a charcoal filter before being discharged to the TMI-1 Auxiliary Building. An auxiliary blower in the TMI-1 Auxiliary Buiding installed at the discharge of the vent line is installed to allow the vent line to be operated under a slight negative pressure.

3.0 COLLECTION AND ANALYSIS OF SAMPLES

3.1 General Requirements

3.1.1 As required by the Radiological Effluent Technical Specifications for PWR's and BWR's the PCP shall be used to verify the solifidication of at least one representative test specimen from at least every tenth batch of each type of wet radioactive waste (e.g., evaporator bottoms, boric acid solution, sodium sulfate solutions, resin and precoat sludge).

3.1.2 For the purpose of the PCP a batch is defined as that quantity of waste required to fill a disposable liner to the waste level indicator.

3.1.3 If any test specimen fails to solidify, 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.

3.1.4 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 solidifications. The Process Control Program shall be modified as requires to assure solifidication of subsequent batches of waste.

3.1.5 For high activity wastes, such as spent resin or used precoat, where handling of samples could result in personnel radiation exposures which are inconsisent with the ALARA principle, representative non-radioactive samples will be tested. These samples should be as close to the actual waste and chemical properties as possible. Typical unexpended 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.

3.1.6 All Chemicals used to condition or solidify waste or simulated waste in solidification tests shall be representative of the actual chemicals to be used in full scale solidification. If chemicals of a different type or from a different manufacturer are used, the new material shall be tested to verify it produces a solid product prior to full scale solidification.

3.2 Collection of Samples

3.2.1 Radiological Protection

3.2.1.1 Comply with applicable Radiation Work Permits.

3.2.1.2 Test samples which use actual waste shall be disposed of by solidification in the disposal liner.

3.2.1.3 A Waste Solidification Data Sheet will be maintained for each test sample solidified. Each Data Sheet will contain pertinent information on the test sample and the batch numbers of wastes solidified based on each test sample.

3.2.2 Waste Solidification Data Sheet

The Waste Solidification Data Sheet will contain pertinent information on the characteristics of the test sample solidified so as to verify solidification of subsequent batches of similar wastes without retesting.

3.2.2.1 a. The test sample data for concentrated waste will include, but not necessarily be limited to, the type of waste solidified, major constituents, percent solids, pH, volume of sample, amount of oil in sample and the ratio of the sample volume to the final volume of the solidification product.

b. The test sample data for spent resin and used precoat will include, but not necessarily be limied to, the type of waste solidified, volume of sample and ratio of sample volume to the final volume of the solidified product.

3.2.2.2 The Waste Solidification Data Sheet will include the Batch Number, Batch Volume, and Data Solidified, for each batch solidified based on sample described.

3.2.3 Collection of Samples

3.2.3.1 Evaporator bottoms shall be kept heated or reheated to 130°F prior to testing.

> NOTE: If the evaporator bottoms had previously been neutralized prior to solidification to prevent boric acid precipitation the sample may be tested at ambient temperatures.

3.2.3.2 Two samples shall be taken for analysis. One sample shall be compatible with the standard size sample used for the radioactivity analysis and the second for the chemical analysis. If the radioactivity levels are too high to permit full size samples to be taken then smaller samples shall be taken with the results corrected accordingly. Sample sizes shall be determined by the plant Radiological Controls staff.

3.2.3.3 Samples should be drawn at least six hours prior to the planned waste solidification procedure to allow adequate time to complete the required testing and verification of solidification.

3.2.3.4 The tank containing the waste to be solidified should be mixed by recirculating the tank contents for at least one volume change prior to sampling to assure a representative sample.

3.2.3.5 If the contents of more than one tank are to be solidified in the same liner then representative samples of each tank should be drawn. These samples should be of such size that when mixed together they form samples of standard size as prescribed in Section 3.2.3.2. If the contents of a particular tank represents X percent of the total waste quantity to be solidified then the sample of that tank should be of such size to represent X percent of the composite samples.

4.0 TEST SOLIDIFICATION AND ACCEPTANCE CRITERIA

4.1 Waste Conditioning

4.1.1 For boric acid (up to 14 weight percent) prior to solidification, the pH of the sample should be adjusted to a range of 7.4 to 9.0 or greater than 11.5 with sodium hydroxide (NaOH). The quantity of sodium hydroxide added shall be recorded.

4.1.2 For bead or powdered resin, prior to solidification the pH of the sample should be adjusted to a range of 5 to 8 if Metro Beads are used or to a range of 8 to 10 if they are not used. The quantity of sodium hydroxide used shall be recorded.

4.1.3 If foaming is apparent during the solidification testing the sample should be treated with an anti-foaming agent. The quantity of anti-foaming agent required shall be recorded.

4.1.4 If a floating oil film is present in quantities greater than 1 percent by volume, the oil should be broken up with Maysol or other emulsification agent. The quantity of emulsification agent added shall be recorded.

4.1.5 If oily waste is to be solidified, an emulsifier shall be added to pretreat the waste sample as follows:

1. Allow one sample to stand undisturbed until the water/oil interface is clearly discernible and determine the percent by volume of the oil. If this volume is greater than 40 percent add a sufficient quantity of waste (or other aqueous liquid to be solidified) to reduce the percent of oil by volume to less than 40 percent. Use the Waste Calculation Data Sheet to determine the quantity of liquid to add. When the correct oil to water ratio is reached, measure and record the pH (pH paper may be used if a measurement cannot be made with a meter because of oil fouling).

2. Prior to the test sample solidification, the oily waste is treated with a predetermined quantity of emulsifier. For this application, Maysol 776 is used at a ratio of 1 part emulsifier to 5.1 parts oil by volume. The emulsifier has a density of one.

3. After the emulsifier is thoroughly mixed into the sample, a quantity of Metso Beads the weight of which is twice the weight of the emulsifier used, is mixed in thoroughly until the Metso Beads have completely dissolved.

4.2 Test Solidification

4.2.1 Any sample to be solidified shall be pretreated as specified in Section 4.1.

4.2.2 Test solidification should be conducted using a 1000 ml. disposal beaker or similar size container. Mixing should be accomplished by stirring with a rigid stirrer until a homogenous mixture is obtained, but in no case for less than five (5) minutes.

4.2.3 For the test solidification of resin, measure into two mixing vessels 90 ml of water each and add a sufficient quantity of dewatered resin to yield a 390 mixture. The degree of compaction of the resin will determine the volume of resin required.

4.2.4 For the test solidification of precoat sludge, measure into two mixing vessels 300 gms of dewatered powdered resin each and add 100 gms of water.

4.2.5 For the test solidification of Concentrated Waste (Evaporator Bottoms), measure into two mixing vessels 400 ml of pH adjusted waste each.

4.2.6 For the test solidification of Concentrated Waste and Oily Waste measure 320 ml of the waste to be solidified including the oily waste and pretreatment chemicals into the beaker. Measure out the required quantities of cement and Metso Beads as shown below. Volumes are for loose, uncompacted material.

Waste	Cement (grams) Sample A	Cement (grams) Sample B	Metso Beads (grams) Sample A	Metso Beads (grams) Sample B
Bead Resin	189	236	19	24
Filters Sludge	230	260	46	52
Evaporator Bottoms	440	505	63	84.2

> NOTE: Omit the following step if Metso Beads were previously added.

4.2.7 Mix the cement and Metso Beads together and slowly add this mixture to the test sample while it is being stirred.

4.2.8 After ten (10) minutes of mixing and a homogeneous mixture is obtained allow the waste to stand for a minimum of 4 hours.

4.3 Solidification Acceptability

The following criteria define an acceptable solidification process and process parameters.

4.3.1 The sample solidification is considered acceptable if there is not visual or drainable free water.

4.3.2 The sample solidification is considered acceptable if upon visual inspection the waste appears that it would hold its shape if removed from the beaker and it resists penetration by a rigid stick.

4.4 Solidification Unacceptability

4.4.1 If the waste fails any of the criteria set forth in Section 4.3 the solidification will be termed unacceptable and a new set of solidification parameters will need to be established under the procedures in Section 4.5.

4.4.2 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.

4.5 Alternate Solidification Parameters

4.5.1 If a test sample fails to provide acceptable solidification of waste the following procedures should be followed.

1. Mix equal volumes of dry cement and water to ensure that the problem if not a bad batch of cement.
2. Add additional caustic solution to raise the pH above 8.
3. 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 volume 25 ml until the acceptability criteria of Section 4.3 are met.

4. If the waste oil mixture is only partially solidified try using lower waste to cement ratios. Reduce the quantity of waste by 20 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.

4.5.2 If the test sample fails to provide acceptable solidification of waste following the actions of Section 4.5.1 the following sample analysis should be performed. The waste should fall within the acceptable range.

SAMPLE ANALYSIS

For Boric Acid $\leq$ 14 Weight Percent (24000 ppm as B)

pH	7.4 to 9.0 or > 11.5
Percent Boric Acid	$\leq$ 14
ppm as Boron	$\leq$ 24000
Detergents	No appreciable foaming during agitation
Oil (floating)	< 1 percent by volume

For Bead and Powdered Resin

pH	> 5
Detergents	No appreciable foaming during agitation
Oil (floating)	< 1 percent by volume

Oily Waste Mixed with Evaporator Bottoms

pH	> 5
Percent Boric Acid	$\leq$ 14 (prior to mixing)
ppm as Boron	$\leq$ 24000 (prior to mixing)
Oil	$\leq$ 40 percent by volume
Detergents	No appreciable foaming during agitation

FOR USE IN UNIT I ONLY

Batch No.: ________________

Sample No.: ________________

Date: ________________

WASTE SOLIDIFICATION DATA SHEET
for Boric Acid

Sample Volume, ml: Sample A ________ Sample B ________ (1)

pH[1]:

Quantity of Oil percent:

Quantity of Cement Added: Cement Ratio[2] ________: (No./ft³ Waste)

Sample A ________gms Sample A ________ (2)

Sample B ________gms Sample B ________ (3)

Quantity of Additive[3] Added: Additive Ratio[4] ______: (No./ft³ Waste)

Sample A ________gms Sample A ________ (4)

Sample B ________gms Sample B ________ (5)

Final Waste to Product Ratio: Sample A ________ Sample B ________ (6)

Product Acceptable: Sample A ____Yes ____No (If no, refer to Section 4.5 and proceed as directed)

Sample B ____Yes ____No

Radionuclides Present: (Isotopes and Concentrations)

Additional batches solidified based on this simple solidification:

Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date
2			5			8		
3			6			9		
4			7			10		

Test Solidifications Performed by: ____________________ Date: ________

PCP Samples Approved by: ____________________ Date: ________

FOR USE IN UNIT I ONLY

NOTES

1 If pH adjustment is required, note chemical used, quantity used and pH after adjustment.

2 For the ratios given in Section 4.2.4, cement-to-waste ratios are 70.9 to 81 pounds cement per cubic foot of boric acid.

3 The additive used in this process is anhydrous sodium metasilicate as referenced in the text.

4 For the ratios giving in Section 4.2.4, additive-to-waste ratios are 10.1 to 13.5 pounds additive per cubic foot of boric acid.

FOR USE IN UNIT I ONLY

SOLIDIFICATION CALCULATION SHEET

Waste Volume[1], ft^3:______________________________ (1)

Cement Ratio, No./ft^3: Sample A______________________ (2A)

Sample B______________________ (2B)

Additive:______________________________

Additive Ratio, No./ft^3: Sample A:______________________ (3A)

Sample B:______________________ (3B)

Cement Quantity[2]

__________(1)[1] x __________(2A) = __________lbs. (4A)

__________(1)[1] x __________(2B) = __________lbs. (4B)

Additive Quantity[2]

__________(1) x __________(3A) = __________lbs. (5A)

__________(1) x __________(3B) = __________lbs. (5B)

[1] The quantity of waste to be solidified in a single liner cannot exceed the maximum waste volume listed on the attached Solidification Data Tables.

[2] 4A and 5A define the minimum quantity of cement and additive respectively that must be mixed with the waste to assure solidification. When these quantities of materials are mixed, additional cement and additive are to be mixed until further mixing is not possible or the values in 4B and 5B are reached.

FOR USE IN UNIT I ONLY

Batch No.: ________________

Sample No.: ________________

Date: ________________

WASTE SOLIDIFICATION DATA SHEET

FOR OILY WASTE

Volume percent Oils: ____________ percent
(Maximum of 40 percent by volume)

Sample Volume, ml: ____________

Major Composition of Non-oil Component: ____________

Quantity of Emulsifier Added, ml: ____________

pH: ____________

Quantity of Cement Added, gm: ____________

Quantity of Anhydrous Sodium Metasilicate Added, gm: ________________

Final Product to Waste Ratio (Volumetric) ____________ percent

Product Acceptability: ______ Acceptable ______ Unacceptable
If unacceptable note why:

Radionuclides Present.
Isotopes and Concentrations

1. If the percent of oil in the sample exceeds the maximum allowable quantity the sample shall be diluted as required (See the Waste Calculation Data Sheet). This new mixture will be thoroughly mixed, tested for percent oil and a new sample taken from this mixture as per Section 4.2.3. The volume of dilutant required will be recorded.

FOR USE IN UNIT I ONLY

WASTE SOLIDIFICATION DATA SHEET

FOR OILY WASTE

Complete Section A only if the initial samples shows oil in excess of 40 percent by volume, otherwise go to Section B.

SECTION A

Step 1 Original samples volume ________ml. (1)

Volume percent oil in sample 0.______ (as decimal fraction) (2)

Step 2 Sample volume (ml) multiplied by (2): =

________(ml) X 0.______ = ________(ml) (3)

Step 3 Divide (3) by 0.4: ________ ÷ 0.4 = ________ (4)

Step 4 Subtract original sample volume (1) from (4) to get quantity of liquid needed to dilute sample to 40 percent oil by volume:

________(4) - ________(1) = ________ml (5)

SECTION B

Step 1 Volume of waste in liner, gallons: ________ (6)

(HN-100 liner contains 17.62 gallons/inch). The maximum allowable waste depth is 42 inches.

Step 2 If the volume percent oil is greater than 40 percent it is necessary to determine the amount of liquid (i.e. water) that must be added to the liner to reduce the percent oil to less than 40 percent (If the fluid level in the liner is close to 42 inches such that the addition of any liquid would raise the fluid level above the 42 inches level proceed to Step 3). Take the quantity of liquid (5), added to the test sample in Section A and divide it by the original sample volume (1). Multiply this decimal fraction increase by the volume of fluid in the liner to obtain the quantity of liquid needed to dilute the contents of the liner to less than 40 percent oil by volume.

________(5)ml / (1)ml = 0.______ X (6)________gal = ________gal (7)

FOR USE IN UNIT I ONLY

Calculate new fluid level in liner. Add (7) to (6) and divide by 17.62 gallons/inch and add this increased depth to the original fluid depth.

$\frac{(6)+(7) \quad \text{gallons}}{17.62 \text{ gallons/inch}}$ = ________ inches (8)

(8)must not exceed 42 inches. If it does do not add any liquid to the liner but proceed to Step 3. If the fluid level (8) is less than or equal to 42" add the quantity of liquid calculated in (7) to the liner and proceed to Step 4.

Step 3 This step is to be completed only when the quantity of oil in the liner exceeds 40 percent by volume and diluting with water would raise the fluid level above 42 inches.

Multiply the original samples volume (1) by 0.4:

________ (1)(ml) X 0.4 = ________ (9)

Subtract (9) from (3) above:

________ (3) - ________ (9) = ________ ml (10)

Divide (10) by the original sample volume (1) to obtain the decimal fractional decrease in sample oil volume to bring the percent oil down to 40 by volume.

$\frac{\_\_\_\_\_\_ (10)}{(1)}$ = 0.________ (11)

Multiply the volume of waste in the liner (6) by this decimal fraction (11).

________ (6) X ________ (11) = ________ gallons (12)

This represents the quantity of oil that must be removed from the liner, and replaced by an equal volume of liquid waste, to bring the percent oil down below 40 percent by volume. To do this first allow the fluid in the liner to stand undisturbed for a period of 15 minutes and then pump oil out using a rubber hose extended into the liner to a level just below the top of the oil layer.

Step 4 If the lab sample showed less than 40 percent oil by volume proceed without an additional sample and enter below the volume percent oil in the liner.

Vol. percent oil 0.________ (13)

FOR USE IN UNIT I ONLY

If liquid was added to dilute the oil (Step 2) or oil was removed (Step 3) mix the contents of the liner for 15 minutes and resample to confirm the volume percent oil in the liner and enter below. (If not applicable enter N/A).

Resample Vol. percent oil 0.__________ (14)

Measure the fluid level in the liner. Again this level must not exceed 42 inches.

Fluid level __________ inches (15)

Calculate the quantity of oil in the liner by multiplying the fluid level (in inches) by the gallons per inch (17.62 gallons per inch) by the percent oil by volume from either (13) or (14).

__________ inches(15) X 17.62 $\frac{\text{gallons}}{\text{inch}}$ X 0.__________ (13 or 14) =

__________ gallons (16)

Step 5 With the mixing motor "ON" add the emulsifier Maysol 776 at 1 part emulsifier to 5.1 parts oil by volume. To obtain the quantity of Maysol 776 required, divide the gallons of oil (16) by 5.1.

$$\frac{\_\_\_\_\_\_\_\_ \text{(16) gallons}}{\frac{\text{5.1 gallons oil}}{\text{gallon emulsifier}}} = \_\_\_\_\_\_\_\_ \text{gallons of emulsifier} \quad (17)$$

Continue mixing until the oil is completely mixed and the contents of the liner is a uniform milky white in appearance. Record the mixing time.

__________ minutes mixing

Note that mixing times of up to 120 minutes may be required to completely emulsify some oils.

Step 6 For every gallon of fluid in the liner add 11.2 pounds of uncompacted cement. This is equivalent to 83.3 pounds of cement for every cubic foot of waste.

To calculate the quantity of cement required multiply the fluid level (15) by 17.62 gallons per inch by 11.2 pounds cement per gallon of fluid.

__________ (15) X 17.62 X 11.2 = __________ pounds of cement (19)

Convert this to cubic feet of loose cement by dividing (19) by 94 pounds per cubic foot.

$$\frac{\_\_\_\_\_\_\_\_\_\_ (19) \text{ pounds}}{94 \text{ pounds per ft}^3} = \_\_\_\_\_\_\_\_\_\_ \text{ft}^3$$

This is equivalent to the number of one ft^3 bags required.

Add the cement slowly while mixing continually until all the cement is added.

Step 7 Calculate the quantity of anhydrous sodium metasilicate to be added to the liner. From Section 4.1.3, the weight of the anhydrous sodium metasilicate is twice the weight of the emulsifier. The density of the emulsifier is approximately equal to that of water, 62.4 pounds per cubic foot, (8.34 pounds per gallon). Therefore the anhydrous sodium metasilicate will weigh twice as much as the emulsifier.

$$2 \times 8.34 \frac{\text{pounds}}{\text{gallon}} \times \_\_\_\_\_\_\_\_\_\_ (17) = \_\_\_\_\_\_\_\_\_\_ \text{pounds} \qquad (18)$$

Add the Metso Beads slowly and continue mixing the contents of the liner until all the anhydrous sodium metasilicate has been added and the motor trips due to high resistance to mixing or for 20 minutes after the last bag is added.

FOR USE IN UNIT I ONLY

1104-28I
Revision 0

Batch No.: ________ ________

Sample No.: ______________

Date: ____________________

WASTE SOLIDIFICATION DATA SHEET
for Powdered Resin

Sample Volume, ml: Sample A ________ Sample B ________ (1)

pH[1]: ________ Quantity of Oil percent: ________

Other Major Constituents:

Quantity of Cement Added: | Cement Ratio[2] (No./ft^3 Waste)

Sample A ________gms | Sample A ________ (2)

Sample B ________gms | Sample B ________ (3)

Quantity of Additive[3] Added: | Additive Ratio[4] (No./ft^3 Waste)

Sample A ________gms | Sample A ________ (4)

Sample B ________gms | Sample B ________ (5)

Product Acceptable: Sample A ___Yes ___No (If no, refer to Section 4.5 and proceed as directed).

Sample B ___Yes ___No

Radionuclides Present: (Isotopes and Concentrations)

Additional batches solidified based on this simple solidification:

Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date
2			5			8		
3			6			9		
4			7			10		

FOOTNOTES

[1] If pH adjust is required, note chemical used, quantity used and pH after adjustment.

[2] For the ratios given in Section 4.2.4, cement-to-waste ratios are 37.39 and 42.26 pounds per cubic foot of powdered resin. Note that the cement ratio for powdered resin is per cubic foot of waste; i.e., powdered resin plus water.

[3] The additive used in this process is anhydrous sodium metasilicate as referenced in the text.

[4] For the ratios given in Section 4.2.4, the additive-to-waste ratios are 7.47 and 8.45 pounds per cubic foot of powdered resin waste.

[5] The following table shows the minimum and recommended mix ratios for a 300 gms sample size of 5 to 27 dry weight percent powdered resin:

Slurry Concentration, Dry Weight Percent	Minimum				Recommended			
	Cement (gms)	Additive (gms)	Cement (lb/ft^3)	Additive (lb/ft^3)	Cement (gms)	Additive (gms)	Cement (lb/ft^3)	Additive (lb/ft^3)
5-12	330	33.0	68.7	6.9	390	39.0	81.2	8.1
13-21	270	27.0	56.2	5.6	330	33.0	68.7	6.8
22-27	180	18.0	37.5	3.8	270	27.0	56.2	5.6

SOLIDIFICATION CALCULATION SHEET

Waste Volume to be Solidified[1]: ________________

Cement Ratio, No./ft^3: Sample A ________________ (2A)

Sample B ________________ (2B)

Additive Ratio, No./ft^3: Sample A ________________ (3A)

Sample B ________________ (3B)

Cement Quantity[2]

__________(1) X __________(2A) = __________lbs. (6A)

__________(1) X __________(2B) = __________lbs. (6B)

Additive Quantity[2]

__________(1) X __________(3A) = __________lbs. (7A)

__________(1) X __________(3B) = __________lbs. (7B)

Quantity of Water to be added:

__________(1) X 2.36 = __________gallons (8)

Divide the Quantity of Water to be added (8) by the supply flowrate (9) to determine how long water should be pumped to the disposal liner or use a premeasured quantity of water.

__________(8) ÷ __________gal/min (9) = __________minutes (10)

1 The quantity of waste to be solidifed in a single liner can not exceed the maximum waste volume listed on the attahed Solidification Data Table.

2 6A and 7A define the minimum quantity of cement and additive respectively that must be mixed with the waste to assure solidification. When these quantities of materials are mixed, additional cement and additive are to be mixed until further mixing is not possible or the values in 6B and 7B are reached.

SOLIDIFICATION DATA TABLE

POWDERED RESINS

	HN-600*	HN-200**
Usable Liner Volume, ft^3	65	57.
Max. Solidified Waste Vol. ft^3	55.75	55.75
Max. Waste Vol., ft^3	42.4	42.4
Cement added at Max. Waste Vol.: Pounds	2532	2532
1 ft^3 bags	26.9	26.9
Anhydrous Sodium Metasilicate Added at Max. Waste Vol.: Pounds	253	253
100 bags	2.5	2.5
Max. Radiation Level R/hr Contact	100	800

* Based on 18" maximum depth of filter sludge in the liner and maximum cement and additive quantities.

** Based on 34" maximum depth of filter sludge in the liner and maximum cement and additive quantities.

FOR USE IN UNIT I ONLY

APPENDIX A

CONCENTRATION OF POWDERED RESIN SLURRIES
FOR PCP SOLIDIFICATION

In order for powdered resin slurry samples to be solidified in accordance with this PCP, these samples must be concentrated to a higher weight percent solids. The simplest, easiest, and most accurate procedure to use is decanting, i.e. pouring off excess liquid until only a thin layer of liquid remains on the settled solids layer. Decanting is to be performed after the sample has been allowed to sit undisturbed for two hours. The excess water is then poured off, being careful not to lose any solids. If there is not enough sample to perform the PCP, the procedure is to be repeated until the required quantity is obtained.

If the radiation level of the sample is too high for such handling, a decanting apparatus may be assembled much like that shown in Figure 1. The materials used depend upon availability and H.P. requirements. This set up would allow for less physical handling of the sample by the person performing the test. The decant beaker should have the tube located at the 400 ml. mark. A two hour settling time is required. At that time, the stopcock (or clamp) is opened to allow the liquid to drain off of the solids layer. If more than a thin layer of water remains on the settled layer, the sample will have to be decanted as described above. Also, if less than the required slurry quantity results, additional waste must be decanted in the same manner to the prescribed amount.

Following this procedure will result in the proper weight percent slurry as required by the PCP. H.P. requirements will govern which of the two procedures should be used.

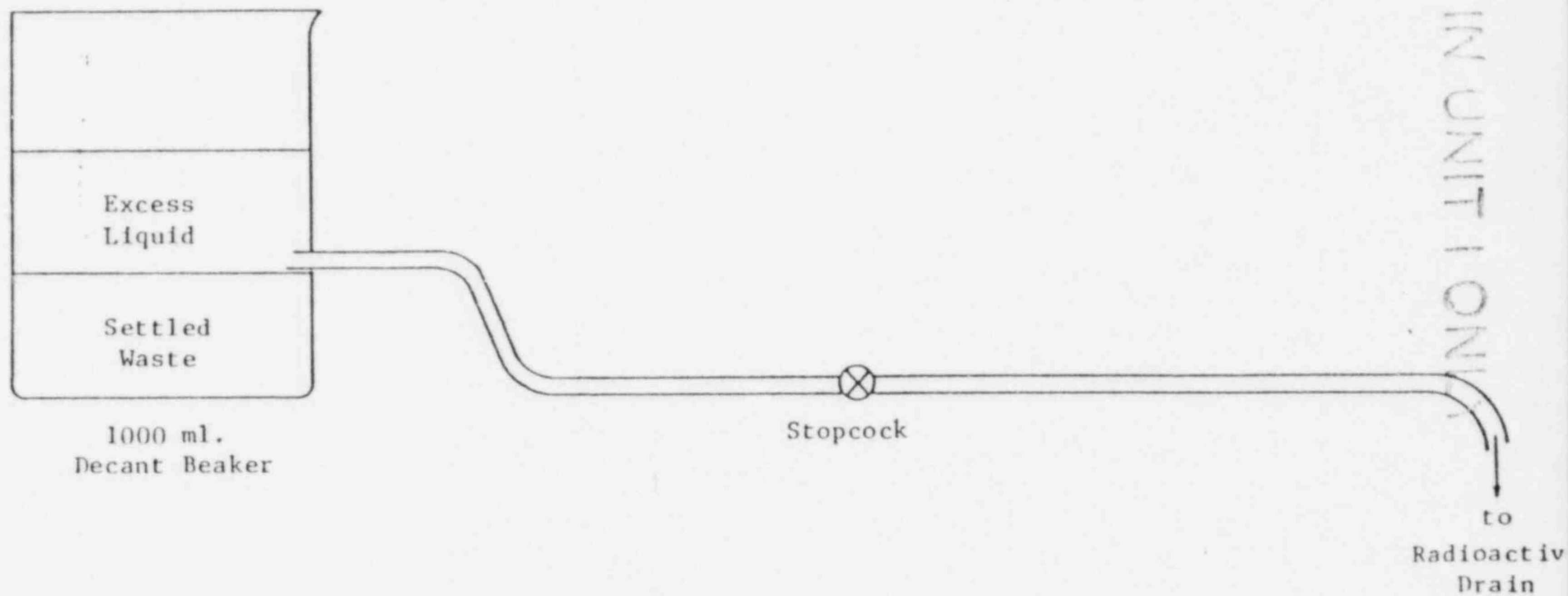

Figure 1. Decanting Apparatus Schematic

FOR USE IN UNIT I ONLY

Batch No.: ____________

Sample No.: ____________

Date: ____________

WASTE SOLIDIFICATION DATA SHEET
for Bead Resin

Sample Volume, ml: Sample A ________ Sample B ________ (1)

pH(1):

Quantity of Oil Percent:

Quantity of Cement Added: Cement Ratio2 ________: (No./ft^3 Waste)

Sample A ________gms Sample A ________ (2A)

Sample B ________gms Sample B ________ (2B)

Quantity of Additive Added: Additive Ratio3 ______: (No./ft^3 Waste)

Sample A ________gms Sample A ________ (3A)

Sample B ________gms Sample B ________ (3B)

Final Waste to Product Ratio: Sample A ________ Sample B ________ (4)

Product Acceptable: Sample A ___Yes ___No (If no, refer to Section 4.5 and proceed as directed).

Sample B ___Yes ___No

Radionuclides Present: (Isotopes and Concentrations)

Additional batches solidified based on this sample solidification:

Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date	Batch No.	Batch Vol.	Date
2			5			8		
3			6			9		
4			7			10		

PCP Performed by: ______________________ Date: ________

Approved by: ______________________ Date: ________

FOR USE IN UNIT I ONLY

NOTES:

1 pH is taken for information only. This may be useful in determining additional steps to be taken in the event the sample solidification is unacceptable.

2 For the ratios given is Section 4.2.4, cement-to-dewatered resin ratios are 38 to 47.6 pounds of cement per cubic foot of dewatered resin for samples A and B respectively.

3 The weight of anhydrous sodium metasilicate is 10 percent of the cement weight.

FOR USE IN UNIT I ONLY

SOLIDIFICATION CALCULATION SHEET

Resin Volume[1],: ______________________________ (1)

Cement Ratio, lbs./ft^3: Sample A ______________________ (2A)

Sample B ______________________ (2B)

Additive: ______________________________

Additive Ratio, lbs./ft^3: Sample A: ______________________ (3A)

Sample B: ______________________ (3B)

Cement Quantity[2]

________(1)[1] x ________(2A) = ________lbs. (4A)

________(1)[1] x ________(2B) = ________lbs. (4B)

Additive Quantity[2]

________(1)[1] x ________(3A) = ________lbs. (5A)

________(1)[1] x ________(3B) = ________lbs. (5B)

Quantity of Water to be added - gallons (Resin only):

________(1) x 2.25 = ________ (6)

Divide the Quantity of Water to be added (6) by the supply flowrate to determine how long water should be pumped to the disposal liner. (7)

________(6) ÷ ________gal/min (7) = ________minutes (8)

1 The quantity of waste to be solidified in single liner cannot exceed the maximum resin volume listed on the attached Solidification Data Tables.

2 (4A) and (5A) define the minimum quantity of cement and additive respectively that must be mixed with the waste to assure solidification. When these quantities of materials are mixed, additional cement and additive are to be mixed until further mixing is not possible or the values in (4B) and (5B) are reached.