50-320 THREE MILE ISLAND #2

NONRADIOLOGICAL PROCEDURES DOCUMENT
Environmental Tech Specs
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THREE MILE ISLAND NUCLEAR STATION

UNIT 2

NON RADIOLOGIAL

PROCEDURES DOCUMENT

9/16/77
Rev. 0

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MECHANICAL DRAFT COOLING TOWER OPERATION

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THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-3.8

MECHANICAL DRAFT COOLING TOWER OPERATION

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2.0 LIMITS AND PRECAUTIONS

2.1 Equipment.

2.1.1 Do not operate a cooling fan in reverse for longer than 15 to 20 minutes at a time for deicing towers.

2.1.2 Do not operate fans manually at air temperatures of $4^{o}F$ or less (YM-TR-1923 PNL 10 or SR-T1-3868 thru PNL331 3873). HOWEVER, Invinronmental temperature limits of 2.2.5 must not be exceeded.

2.1.3 Do not stop and than restart fans until a 30 minute off period elapses. EXCESSIVE MOTOR TEMPERATURES MAY RESULT. FANS MAY BE CHANGED FROM SLOW TO FAST OR FAST TO SLOW SPEED OPERATION WITHOUT WAITING 30 MINUTES.

2.1.4 When shifting fans from fast to slow speed, allow a minimum of 30 seconds before energizing the slow speed winding.

2.1.5 Bypass operation of MDCT may cause environmental Tech. Spec. Limits 2.2.5 too be exceeded.

2.1.6 Bypass operation of the MDCT will defeat the cooling Twr H_2O inlet low alarm (SR-TAL-3880) and indication SR-TI-3880 PNL 8, SR-TR-3880 (G) PNL 331.

TABLE 1

AUTOMATIC EQUIPMENT SAFEGUARDS

2.1.7 MDCT Fan/Deluge System Interlock, stops all MDCT fans if MDCT Deluge System actuates (FS-FS-).

2.1.8 Forward/reverse control relays are interlocked, such that both cannot be energized simultaneously.

2.1.9 < 4^{o}F fan shutdown, stops all fans if they are in auto when MDCT dry bulb temperature is < 4^{o}F.

2.2 Administrative.

2.2.1 A minimum MDCT effluent flow rate of 5000 GPM or 7.2 MGD (SR-FI-4360, PNL 8) must be maintained to ensure adequate dilution of radioactive liquid waste during their release.

2.2.2 Maximum mixed water temperature (blue pen, SR-TR-3880, PNL 331) shall not exceed 87^{o}F, except as noted in paragraph 2.2.4.6 (3).

NOTE: SR-TE-3880 does not measure NSRW Emergency Flow into MDCT.

2.2.3 Monitor the ΔT recorder (SR-DTR-3882, PNL 8) closely during and after fan/pump switching or speed changes to assure that the rate of change in mixed river water temperature does not exceed the ± 2% hour limit.

2.2.4 During the period 1 April thru 30 September, the following temperature limits must not be exceeded:

a. During normal operation, maintain cooling tower outlet temperature.

1. Not greater than 7°F above river inlet temp.
2. Not more than 3°F below river inlet temp.

NOTE: River inlet and cooling twr outlet water temperatures are indicated as follows:

River Inlet	SR-TI-3880 on PNL 8
	SR-TR-3882 (R) ON PNL 311
	Computer Point 1031
Tower Outlet	SR-TI-3881 ON PNL 8
	SR-TR-3882 (G) ON PNL 331

b. During Reactor cooldown operations, maintain cooling tower outlet temperature.

1. Not greater than 12°F above river water inlet temperature.
2. The differential between river water inlet and cooling tower outlet. Temperature shall not change at a rate greater than ± 2°F/hour (SR-TR-3882, PNL 8).

3. If river water inlet temp is 87°F or higher, the tower outlet temperature shall be maintained at or below the river ambient temperature. This insures compilance with both Tech. Specs. and NPDES permit restrictions.

2.2.5 During the period 10 October thru 31 March, the following temperature limits must bot be exceeded.

a. During normal operation, maintain cooling tower outlet temperature.

1. Not greater than 12°F above river water inlet temp.
2. Not more than 3°F below river water inlet temp.

b. During Reactor cooldown operations, maintain cooling tower outlet temperature.

1. Not greater than 20°F above river inlet temperature.
2. The differential between river water inlet and cooling tower outlet temp. shall not change at a rate exceeding ± 2°F/hour.

2.2.6 If any of the instrumentation required to assure compliance with environmental Tech Specs is inoperable; alternate methods of surveillance must be immediately made available per section 4.3.5.

2.2.7 In preparation for automatic fan operation, the fans should be stopped when the MDCT inlet water temperature decreases to (41°F) or less, as indicated on SR-T1-3880, PNL 8.

2.2.8 Insure that the access doors between cells are kept closed.

2.2.9 Close observance of MDCT operation during sudden rainstorms, or rapid temp. changes is necessary to insure the ΔT is maintained within environmental Tech. Spec. limits.

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2.2.10 Prior to initiating changes in the MDCT inlet flow (including CW blowdown), the CRO should be notified of the change. CW blowdown must be initiated/secured at a very slow rate to minimize ΔT changes.

2.2.11 Operation of the MDCT in the automatic mode does not assure compilance with the environment Tech. Spec. limits.

3.0 PREREQUISITES FOR STARTUP

3.1 Place control switches on PNL 8 in the following positions.

MDCT Pump (cw-p-2A)	PULL-TO-LOCK
MDCT Pump (cw-p-2B)	PULL-TO-LOCK
MCDT Fan 2-1 speed select	OFF
MDCT Fan 2-2 speed select	OFF
MDCT Fan 2-3 speed select	OFF
MDCT Fan location/mode select	PANEL

3.2 The following power sources are energized with the breakers in the following positions.

2-7 Voltage	ENERGIZED
2-8 Voltage	ENERGIZED
2-71 White Power lights	ON
2-81 White Power lights	ON

3.3 AT MDCT electrical distribution panels 2-71/2-8 and 2-71/2-81, position breakers as follows:

CW-P-2A	2-7 (Unit 7-3)	RACKED IN
CW-P-2B	2-8 (Unit 8-3)	RACKED IN
FAN 2-1	2-71 (Unit BL1)	CLOSED
	2-71 (Unit CL1)	CLOSED

	SPACE HEATER SWITCH	ON
FAN-2-3	2-71 (Unit DL1)	CLOSED
	2-71 (Unit EL1)	CLOSED
	SPACE HEATER SWITCH	ON
SR-V56	2-71 (Unit AL1)	CLOSED
	SPACE HEATER SWITCH	ON
SR-V56	2-71 (Unit AL1)	ON
SR-V26A	2-71 (Unit AL4)	CLOSED
	SPACE HEATER SWITCH	ON
FAN 2-2	2-81 (Unit AM 1)	CLOSED
	2-81 (Unit BM1)	CLOSED
	SPACE HEATER SWITCH	ON
SR-V26B	2-81 (Unit DM4)	CLOSED
	SPACE HEATER SWITCH	ON

_____3.4 AT MDCT elect, distribution PNL MP2-81 position breakers as follows

PNL 331A PWR	SWITCH 13LB	CLOSED
PNL 331 PWR	SWITCH 14LB	CLOSED

_____3.5 AT MDCT control PNL area, position switches as follows:

FAN 2-1	Direction Select	FWD
	Speed Select	LOW
FAN 2-2	Direction Select	FWD
	Speed Select	LOW
FAN 2-3	Direction Select	FWD
	Speed Select	LOW

_____3.6 Startup valve lineup Appendix A is completed.

_____3.7 Ensure that the MDCT circulating water pump sump is filled with water.

_____3.8 Ensure that the MDCT fire protection system is in operation by verifying:

FS-V544B	Open
F545B	Open
FS-V546B	Open

Fire service pressure of $\lesssim$ 100# is indicated at deluge valves.

_____3.9 Determine mode of fan operation based on operating environmental and ambient conditions automatic mode (4.3.2).

Ambient air temperature is less than 34°F dry bulb and cooldown operation is not required.

Manual mode-panel (4.2)

Ambient air temperature is greater than 34°F dry bulb or if cooldown operation is required.

Manual Mode-Local (4.3.4)

Ambient air temperature is less than 34°F and MDCT de-icing operation is required.

4.0 PROCEDURE

_____4.1 Startup procedure (manual).

4.1.1 Establish flow to hotwater distribution basins by placing CW-P2A or CW-P-2B control switch to start position and releasing.

4.1.2 Observe that pump red run light engenerizes, discharge valve SR-V26A or 26B opens and header pressure low alarm (8-F-2) clears.

4.1.3 Determine desired fan operating combination based on the following parameters.

1. River water temperature

   SR-T1-3880 on PNL 8

   Computer Point 1031

2. MDCT Air Temperatures

   YM-TR-1923 on PNL10

   SR-T1-3868 thru 3873 on PNL 331

3. Difference between river supply and cooling tower outlet water temperature; indicated by

   SR-DTR-3880 ON PNL 8

   SR-T1-3880 and T1-3881 ON PNL 8

   SR-TR-3882 (R) and (6) ON PNL 331

4.1.4 Place the first MDCT fan (2-1 or 2-3) in operation by placing its speed selector switch on PNL 8 to either the slow or fast speed position. Observe approp. red running light energizes.

4.1.5 Observe MDCT ΔT (SR-DTR-3880) indication & MDCT outlet temperature (SR-T1-3881) on PNL 8 are decreasing. Sequentially start additional MDCT fans, as necessary until the MDCT ΔT is within environmental Tech. Spec. limits.

4.2 Normal Operation (Manual).

4.2.1 In this mode of operation, the control room operator must be alert to limits/preacutions and the effects of changes in ambient conditions.

4.2.2 Temperatures must be controlled within limits set forth in section 2.2.4 or 2.2.5 (environmental Tech Specs.) by selecting number and speed of the operating fans.

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4.2.3 Fan speed may be changed as follows.

1. Stop fan by placing appropriate fan speed selector on PNL 8 to OFF.
2. Fast to slow; place appropriate fan speed selector on PNL 8 to Off, wait 30 seconds than move switch to the slow position.

4.2.4 Should a condition occur where unseansonable high ambient air temperatures combined with low river water temperatures causes the MDCT ΔT to go to zero or less, refer to section 4.3.3. for continued operation.

4.2.5 Periodically clean the hot water distribution meter in orfices. (This can be performed while Twr is in operation.

4.2.6 Cooldown operation.

A. When primary cooldown in in progress the following tech spec limits are applicable.

1 April to 30 Sepbember - Sect. 2.2.4.b.

1 Oct. to 31 March - Sect. 2.2.5.b.

B. During period March thru December the inboard flow control valves should be opened to their summer positions, if not, open them.

C. The MDCT is in manual operation IAW section 4.2 of this procedure, if not place it in operation.

D. During summer months, prior to primary system cooldown, secure CW system blowdown until the cooldown has been completed.

E. When initiating DH removal cooldown of the primary system, do so at a slow rate in order to limit the resulting river water ΔT excursion to within controllable limits.

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F. Monitor river water ΔT recorder, (on PNL 8) closely during cooldown operations.

4.3 Winter Operations (Manual).

4.3.1 Duing the months of December, January and February the MDCT should be set up for winter operation.

A. Throttle close the inboard flow distribution valves, SR-V unit1 the water level in the outer hot water distribution basins approaches ≈ L of the Overflow point.

NOTE: Do not allow the hot water basins to overflow.

B. During night time winter operation, the number or speed of running fans should be reduced in order to minimize icing/maintain ΔT and the rate of change ΔT within Tech. Spec. limits.

Example: Initial condition, 3 fans FHST.

a. 2-1 fan to slow @ 30 minute or more intervals.

b. 22 fan to slow.

c. 2-3 fan to slow.

d. 2-1 fan off.

e. 2-2 fan off.

f. 2-3 fan off.

C. If air temperature is 28°F to 24°F utilize fans 2-1 and 2-3 for de-ice operations IAW section 4.3.4. In this temperature range the aux operator should monitor the MDCT for icing ≈ every two hours on the lower windward regions of the tower.

D. De-ice the tower as necessary IAW Section 4.3.3. Normally a 10 minute run of fans 2-1 and 2-2 in low speed reverse is sufficient to de-ice the tower.

E. When the ambient air temperature is less than 24°F, utilize fan 2-2 for de-icing operation also.

4.3.2 Winter Operations (Automatic).

A. The automatic control system is designed to prevent tower icing without continous operator attendance.

NOTE: Automatic operation will not insure compliance with environmental Tech. Spec. limits on river water ΔT.

B. The MDCT is in operation per section 411 of this procedure. If not place in operation.

C. Gradually obtain the operating condition which will be assumed by the automatic control system (refer to Appendix "C"). If ambient air temperature is > 34°F, place all three fans in high speed.

D. Energize the G.E. logic panel by closing its circuit breaker on PNL 331A MDCT pump house.

NOTE: The following step should be performed immediately after completing step D above, because of timer settings in the auto control logic.

E. Place the fan local/auto/panel selector switch on panel 8, to the auto position. Fans should operate automaticlly as described in logic diagram (Appednix C).

1. The control logic determines the required fan operating combination based on MDCT dry bulb temperature input data.

2. Correct fan combinations are then started and rotation of operating fans is accomplished.

3. Should temperatures change, the control logic will immediately modify the operating fan combinations as necessary.

F. Operator action in this mode consists of monitoring the following.

1. Cooling tower inlet water temperature, (SR-T1-3880 on PNL 8).
2. Cooling tower outlet water temperature (SR-T1-3881 on PNL 8).
3. Difference between river water supply temperature and cooling tower outlet water temperature (SR-DTR-3882 on PNL 8).
4. Correct fan combination operating, indicated by illumination of red and green fan status lights on PNL 8.

G. Insure all alarms listed in Table 2, are clear on PNL 331, MDCT pumphouse.

H. Monitor the MDCT for icing every 3-4 hours, if icing conditions exist, place fans in manual and deice IAW Section 4.3.4.

4.3.3 MDCT operation at high ambient air temperatures combined with low river water temperatures.

NOTE: When this condition exists, the ΔT across the MDCT will go to zero or less, as a result of the ambient wet bulb temperature being at or higher than MDCT inlet water temperature.

A. When the ΔT across the MDCT is zero or less, bypass the MDCT by securing all MDCT fans and pumps cw-p-2A/2B.

B. Do not alter CW de-ice flow rate, during these operating conditions.

C. If river water ΔT is increasing, secure NDCT blowdown slowly by closing CW-V17A/17B.

NOTE: Notify chemistry Dept. when Cw sys. blowdown is secured for extended period of time (> 8 hours). CW system's langler index must be maintained at 0 ± .5. If blowdown is required, blowdown intermittently, during the evenings if possible.

D. If river water ΔT continues to increase, place the idle nuclear water header in service to decrease ΔT.

E. If river water Δ continues to increase and the Tech. Spec. limit is exceeded; notify supervisor of operations and the PORC Chairman.

NOTE: The river water ΔT chart recorder in the control RM (PNL 8) has a mechanical stop at ≈ 11.6°F ΔT. Operation with this recorder at or greater than 11.6°F ΔT is unreliable; moniotr river water ΔT at the MDCT recorder SR-TR-3882 as per ETS.

F. When the wet bulb temperature decreases to less than MDCT inlet water temperature sufficiently to insure a positive ΔT across the MDCT; return the MDCT to normal operation.

4.3.4 MDCT De-ice operation.

A. Inboard flow distribution valves SR V have been adjusted for winter operation IAW 4.3.1.A.

B. Station Aux. Operator at Local MDCT panel 331.

C. On local control stations for fan 2-1,2-2 & 2-3, position speed selector switches to match current fan operating status.

D. Check local fan direction control switches in the forward position.

NOTE: Local fan controls switches must match actual fan operating stauts prior to shifting location/mode selector (on panel 8) to the local position. This prevents inadvertent speed/direction changes when fan control is shifted to the MDCT area.

E. Place fan location/mode selector switch on PNL 8 to the "Local" position.

F. At the MDCT.

1. Locally, stop operating fan (in the tower section which is to be de-iced) by placing its direction control switch to the OFF position.

2. Wait 2 minutes, than position its speed selector switch to "Slow".

3. Start the fan by placing its direction control switch to the "Reverse' position. Observe that its low speed and reverse red lights energize.

CAUTION: Do not operate fans in reverse for more than 20-30 minutes at a time. Prolonged

reverse operation may allow ice to build up on fan blades, on the inside of fan cylinder, on mist eliminators and also, on the fill behind the mist eliminators

4. When tower section has been adequatley de-iced, stop the fan by placing its direction control switch to the OFF position.

5. Wait 2 minutes, then return this fan to normal operation (desired by CR operator) by positioning its direction and speed control switches as required.

6. Repeat steps F. (1) thru F (4) for the other MDCT sections requiring de-icing.

7. Return fan control to PNL 8 as follows.

   a. Verify that local speed switches for the 3 fans agree with PNL 8, speed switch positions.

   b. Verify local fan direction selector switches (3) are in the forward position.

G. At panel 8, in the control room, place the panel/auto local switch to the "Panel" position.

4.3.5 Operation when Normal Temperature Indication not available. (To avoid violation of Environmental Tech. Specs.).

a. Loss of ΔT Indication (SR-TR-3880 on PNL 8).

Calculate ΔT at least every 2 hours using the available indication of river water inlet temperature and MDCT outlet temperature. Enter the calculated value in the CRO log.

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b. Loss of MDCT Effluent Temperature Indication (SR-TR-3881).

Take necessary readings on SR-TR-3882 (green pen) on the MDCT local panel. If neither the normal or alternate instruments are operable then use SR-TR-3880 (blue pen) on MDCT local panel and enter the readings in the CRO log every 2 hours.

c. Loss of River Water Inlet Temperature Indication (Computer point 1031).

Take necessary readings on temperature recorder SR-TR-3882 (red pen) on the MDCT local. If neither the normal or the alternate instruments are operable, monitor river water inlet temperature on computer Point 1031.

4.4 Normal system Shutdown.

A. Stop operating MDCT fans as follows.

1. Automatic Mode.

a. If operating in automatic mode, place the local/auto/panel switch (ON PNL 8) to Panel.

b. Place high/off/low switch on PNL 8 each fan to OFF position.

c. De-energize G.E. Logic panel by opening its breaker.

2. Manual Mode.

a. Place fan high/off/low switch on PNL 8) for each fan to OFF position.

B. Stop operating MDCT pump, by placing its control switch on PNL 8 to the stop position and releasing.

C. Open SR-V58A and SR-V58B, MDCT header drains, to prevent freezing of lines on Tower, during shutdown when temps may be less than $32^{o}F$.

TABLE 2

ALARMS ASSOCIATED WITH MECHANICAL DRAFT COOLING TOWER

ALARM	LOCATION	ACTUATING DEVICE	SETPOINT
H_2o Temp at lower Louvers LO	MDCT Local PNL 331	?	33°F
Cooling tower H_2O inlet temp LO	MDCT Local PNL 331	SR-TS-3880	44 F
Cooling Tower H_2O Outlet temp. LO	MDCT Local PNL 331	SR-TS-3881A	37°F
Mixed River Water Disch Temp Hi	MDCT Local PNL 331	?	87°F
Cooling Tower H_2O Disch. Temp HI	MDCT Local PNL 331	SD-TS-3881B	87°F
Cooling Tower H_2O Outlet Temp HI	MDCT Local PNL 331	SR-T	
River Water Supply Temp. LO	MDCT Local PNL 331	SR-TS-3882	32.5°F
2-1 Fan ½ speed Control Logic Trouble	MDCT Local PNL 331		(See Appendix)
2-2 ½ speed Control Logic Trouble	MDCT Local PNL 331		(See Appendix) (See Appendix)
2-3 Fan ½ spee- Control Logic trouble	MDCT Local PNL 331		(See Appendix)
Insturment Power Supply failure	MDCT Local PNL 331		Loss of AC power from Dist. PNL.
Cooling Tower Trouble	Control Room PNL 8, C-7	Any MDCT Local Panel Alarm	
MDCT FAN Trip	Control Room	Fan 2-1, 2-2 or 2-3 trip (OLX 2-1, 2-2, 2-3)	

TABLE 2

ALARMS ASSOCIATED WITH MECHANICAL DRAFT COOLING TOWER

ALARM	LOCATION	ACTUATING DEVICE	SETPOINT
MDCT Pump Overload	Control Room PNL 8, E-2	Overload on CW-P-2A/2B (74/CW-P-2A/2B)	
MDCT Pump Disch. Hdr. Press. Lo	Control Room PNL 8, F-2	SR-PS-1087	15 psig
MDCT Fan Reverse Rotation	Control Room PNL 8, D-7	Any Fan setup for reverse operation (RX 2)	Reverse control relay energize

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TABLE 3

MECHANICAL DRAFT COOLING TOWER INSTRUMENTATION

PARAMETER	IDENTIFICATION	RANGE
River Water Supply Supply Temp.	SR-TR-3882 (Red)	25-100°F
Cooling Twr Disch. Temp.	SR-TR-3882 (Green)	25-100°F
Cooling Twr Air Temp	SR-TR-3880 (Pad)	0-11C F
Cooling Twr Inlet Temp	SR-TR-3880 (Green)	0-110°F
Mixed Disch. Water Temp.	SR-TR-3800 (Blue)	0-110°F
Cooling Twr. Air Temp.	SR-T1-3868/3869	0-110°F
Cooling Twr. Air Temp.	SR-T1-3870/3871	0-110°F
Cooling Twr. Air Temp.	SR-T1-3872/3873	0-110°F
Mech. Draft Cooling Twr. Water Temp.	SR-TR-3879 Records SR-T1-3874, 3875, 3876, 3877, 3878 & 3879	0-110°F

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APPENDIX A

Startup Valve Line-Up

Valve No.	Valve Name/Function	Required Position	Initial
SR-V26A	CW-P-2A Discharge Valve	CL	_____
SR-V27A	Inst. Root to SR-P1-2005	OP	_____
SR-V28	Inst. Root to SR-PS-1087	OP	_____
SR-V58A	Header Drain Valve	CL	_____
SR-V71A	Sluice Gate to CW-P-2A Basin	OP	_____
SR-V71B	Slucie Gate to CW-P-2B Basin	OP	_____
SR-1V-546	Isol. to SR-P1-2005	OP	_____
SR-1V-547	Drain for SR-P1-2005	CL	_____
SR-1V-544	Isol. to press switch 1087	OP	_____
SR-1V-545	Drain for SR-PS-1087	CL	_____
SR-1V-542	Isol to SR-P1-2006	OP	_____
SR-1V-543	Drain for SR-P1-2006	CL	_____
SR-V26B	CW-P-2B Discharge	CL	_____
SR-V27B	Inst. Root to SR-P1-2006	OP	_____
SR-V58B	Header Drain	CL	_____
SR-V55	Tower Basin Bypass To Site Discharge	CL	_____
SR-FV-2B	East Hdr Outboard Dist. Valve	(T)____ Turns Open	_____
SR-FV-2A	East Hdr Inboard Dist Valve	(T)____ Turns Open	_____
SR-FV-2D	East Hdr Outboard Dist Valve	(T)____ Turns Open	_____
SR-FV-2C	East Hdr Inboard Dist Valve	(T)____ Turns Open	_____
SR-FV-2F	East Hdr outboard Dist Valve	(T)____ Turns Open	_____

APPENDIX A

Startup Valve Line-Up

Valve No.	Valve Name/Function	Required Position	Initial
SR-FV-2F	East Hdr Outboard Dist. Valve	(T)____ Turns Open _____	
SR-FV-1B	West Hdr Outboard Dist. Valve	(T)____ Turns Open _____	
SR-FV-1A	West Hdr Inboard Dist Valve	(T)____ Turns Open _____	
SR-FV-1D	West Hdr Outboard Dist. Valve	(T)____ Turns Open _____	
SR-FV-1C	West Hdr Inboard Dist. Valve	(T)____ Tunrs Open _____	
SR-FV-1F	West Hdr Outboard Dist Valve	(T)____ Turns Open _____	
SR-FV-1E	West Hdr Inboard Dist. Valve	(T)____ Turns Open _____	

APPENDIX B

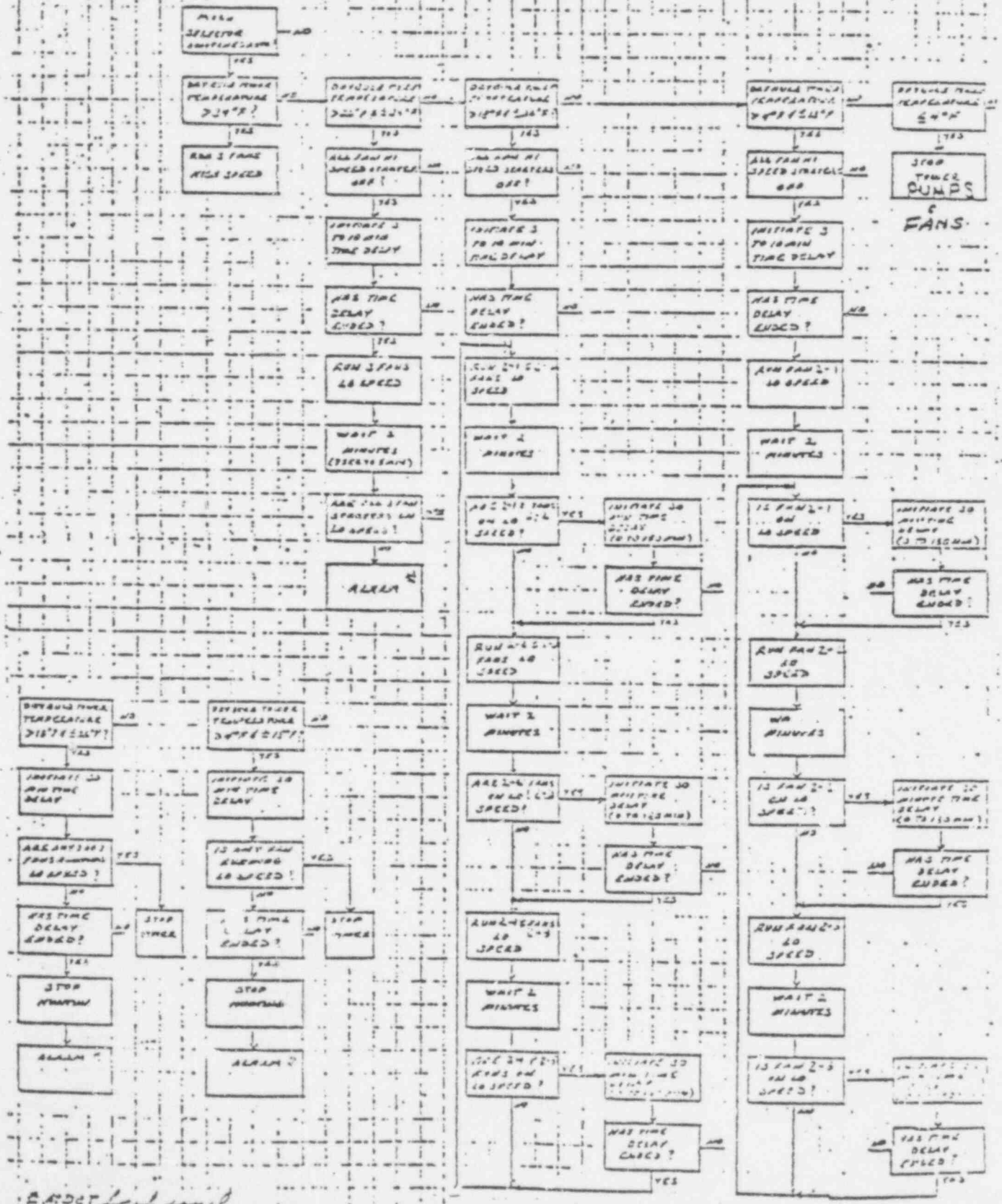
Signatures of those performing/supervising valve line-up

Valve Line-up Signature Sheet

Operator Initials	Operator Signature	Shift	Date	Shift Foreman or Supervisor Sig.	Remarks

APPENDIX C

AUTOMATIC OPERATION DIAGRAM



IC-3
Revision 1
12/10/76

THREE MILE ISLAND NUCLEAR STATION

STATION PREVENTATIVE MAINTENANCE PROCEDURE IC-3

1.0 MECHANICAL ____
ELECTRICAL ____
INSTRUMENT 3
UTILITY ____

2.0 TITLE: RTD TEMPERATURE LOOP CALIBRATION

3.0 PURPOSE

To outline the steps required for uniform calibration of all RTD Temperature Loops.

4.0 PREREQUISITES

4.1 Log any jumpers applied or leads lofted, in the Control Room "Jumper and Lifted Lead Log Book" according to Administrative Procedure 1013.

4.2 Obtain a copy of the reference manuals for each particular instrument in the loop.

4.3 All test equipment used must be traceable to the National Bureau of Standards and be within its current calibration period per 1022.

4.4 The instrument man shall review the interlocks and control functions with the Shift Supervisor/Foreman. The Shift Supervisor/Foreman shall consider potential effect on plant operation.

4.5 The Shift Supervisor/Foreman shall determine any Tech Spec requirements associated with the instrument and will perform redundant component testing or log equipment out of service as applicable.

4.6 Comply with AP 1002 and AP 1003.

4.7 Initiate an RWP, if required.

5.0 ACCEPTANCE CRITERIA

5.1 RPS temperature loops must be accurate to ± 1%.

5.2 All ICS/NNI temperature loops must be accurate to ± 2%.

5.3 "Balance of plant" equipment temperature loop accuracy is the sum of the accuracies of the components in the loop.

5.4 As left data must meet the tolerance specified on the MTX data sheets or as specified by the manufacturers.

6.0 PROCEDURE

6.1 Disconnect the incoming lead wires to the RTD at the RTD connection head.

6.2 Connect a precision decade box (± .01%) to the incoming wires in place of the RTD.

6.3 Insure that the calibration data for the loop is current per I&C Department Procedures 1432-1 or 1432-2.

6.4 Apply the appropriate resistance for 0%, 25%, 50%, 75%, and 100% of the temperature range of the instrument and observe and record the indication of temperature "as found".

6.5 If the indication is not within the tolerance required per Acceptance Criteria of Section 5, troubleshoot the individual loop components as specified in the equipment vendor's manual.

6.6 After adjustments, repairs, and/or replacements of components as required per tech manuals are complete, apply 0%, 25%, 50%, 75%, and 100% of the temperature range of the instrument and observe and record the "as left" indication of temperature.

6.7 Disconnect the decade box from the incoming wires to the RTD.

6.8 Reconnect the incoming wires to the RTD connection head.

6.9 Apply calibration stickers and assign next due date per P.M. Schedule.

6.10 Date and initial the P.M. completion record.

6.11 Restore lifted leads, remove jumpers and complete the log referenced in 4.1.

6.12 Remove all tools and materials upon completion of work and clean up the work area.

6.13 Turn the system over to the Shift Foreman for functional testing as applicable.

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-2.11

REGENERANT WASTE NEUTRALIZATION

Table of Contents

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-2.11

REGENERANT WASTE NEUTRALIZATION

1.0 REFERENCES

1.1 Drawings Applicable for Operation

1.1.1 Make-Up Water Treatment and Condensate Polishing, B&R Flow Diagram 2005.

1.1.2 Demineralized Service Water, B&R Flow Diagram 2007.

1.1.3 Pretreatment Plant, L*A Water Conditioning, B&R File No. 014-00-0101.

1.1.4 Demineralizer System, L*A Water Conditioning Co, B&R File No. 014-00-0510.

1.2 Operating Procedures Applicalbe for Operation

1.2.1 2104-2.1, Cycle Make-Up Pretreatment.

1.2.2 2104-2.2, Demineralized Water.

1.2.3 2104-2.3, Instrument Air.

1.2.4 2104-2.10, Service Air.

1.2.5 2104-3.6, Circulating Water.

1.2.6 2104-2.2, Condensate Polishing.

1.2.7 2107-1.4, Heat Tracing.

1.3 Manufacturer Instruction Manual

1.3.1 L*A Water Purification System, Volumes I thru V (14.00)

1.4 Applicable System Descriptions

1.4.1 Condensate Polishing, Index No. 4B

1.4.2 Make-Up Water Treatment, Index No. 4C

1.4.3 Demineralized Service Water, Index No. 5

1.4.4 Instrument and Service Air, Index No. 10

1.4.5 Circulating Water, Index No. 15

1.5 Curves, Tables, etc.

None

2.0 LIMITS AND PRECAUTIONS

2.1 Equipment

2.1.1 Verify PH instrumentation calibration is current. Compare indication with sample analysis when performed to verify accuracy.

2.1.2 During their operation, check neutralizing effluent disposal pumps WT-P-8A/B for abnormalities.

2.1.3 When pumping acid or caustic, check for positive indication of siphon breakers opening and closing to insure solution is being added. Allow approximately 1/2 hour intervals between acid or caustic additions.

2.1.4 Always maintain caustic temperature above 70°F.

2.2 Administrative

2.2.1 Relative to Environmental Safety, do not release neutraliziang tank contents at a high rate to the river and observe all environmental permits and restrictions.

2.2.2 Ensure the heat tracing on the system components and lines is energized for both freeze protection and to prevent chemical (caustic) crystallization.

2.2.3 Adequate safety precautions for strong chemical solutions must be observed when working with caustic or acid.

2.2.4 Use care when feeding acid and caustic to neutralizing tank to prevent overshooting chemicals resulting in excessvie use of chemicals and overheating of the tank and pump.

60-359

3.0 PREREQUISITES

Initial each step.

____3.1 Instrument Air available per 2104-2.3.

____3.2 Service Air is available per 2104-2.10.

____3.3 Demineralized Service Water System is in operation per 2104-2.2.

____3.4 Electrical power available per 2107-1.1.

Component	Source	Unit
SD-P-7A	MCC 2-31A	8B
SD-P-7B	MCC 2-41A	4B
WT-P-8A/B	MCC 2-31D	2A/2B
WT-P-9/10	MCC 2-31D	1F/3A
WT-V455	Later	____
WT-V456	Later	____

____3.5 Valve line-up complete per Appendix A.

____3.6 Automatic neutralization of the neutralizing tank is not permitted at present time.

____3.7 Automatic termination of release by PH should be utilized. If releasing waste in Manual, have chemistry check PH every 2 hours.

____3.8 Water treatment sump pump (SD-P-7A/B) control switches in AUTO.

____3.9 Acid and caustic storage tanks at sufficient level with 93-96% H_2SO_4 and 50% NaOH. (See 2.1.4).

____3.10 Control switches in STOP for acid pump WT-P-9. and caustic pump WT-P-10. Located on Panel 305.

____3.11 For personnel safety, use care when feeding aicd and caustic to the neutralizing tank.

____3.12 Caustic storage tank (WT-T-8) heater control switch in AUTO.

____3.13 River Water Pump shifting must be coordinated with both Control Rooms.

____3.14 When dischargeing Unit 2 Neutrailizing Tank only

3.14.1 Verify that the Station river water flow is greater than:

a) 25,000 GPM with no Unit 2 Secondary River Pumps running.

b) 33,000 GPM with one Unit 2 Secondary River Pump running.

c) 41,000 GPM with two Unit 2 Secondary River Pumps running.

3.14.2 Discharge rate is limted to less than 100 GPM or < 6,000 GPH.

____3.15 When discharging Unit 2 Neutralizing Tank at the same time Unit 1 is releasing its Neutralizing Tank.

3.15.1 Verify that Station river water flow is greater than:

a) 50,000 GPM with no Unit 2 Secondary River Pumps running.

b) 58,000 GPM with one Unit 2 Secondary River Pump running.

c) 66,000 GPM with two Unit 2 Secondary River Pumps running.

3.15.2 Discharge rate is limited to less than 100 GPM or < 6,000 GPH.

4.0 PROCEDURE

4.1 Manual Neutralization of Tank.

Initial Each Step Upon Satisfactory Completion.

____4.1.1 Verify on LAWT panel that Recycle/waste valves NT1 and 2 control switch is in "AUTO".

____4.1.2 PLACE air operated local override switch to:

"OPEN" for WT-V350 Recycle "NTR" valve.

"CLOSED" for WT-V25 Disposal "NTD" valve.

____4.1.3 Place an effluent Disposal/recirc pump WT-P8A (8B) control switch at LAWT panel into AUTO for low level shutoff. (If HAND must be used, monitor tank level more closely).

____4.1.4 Verify Neutralizing Tank is now being recirculated.

____4.1.5 Neutralize the tank contents, (and verify same) by CAREFULLY adding acid using WT-P-9 and automatic anti-siphon valve WT-V456 if PH is above 8.5 or CAREFULLY add caustic using WT-P-10 and automatic anti-siphon valve WT-V455 if PH is below 6.5.

NOTE: Chemistry may be able to supply quantity of acid or caustic required to be added.

____4.1.6 When the Nautralization Tank PH is between 6.5 and 8.5, the Shift Foreman/Supervisor must initiate a "Waste Neutralizing Tank Release Permit".

____4.1.7 Before releasing a neutralization tank from Unit 2, determine Unit 1 is releasing its neutralization tank.

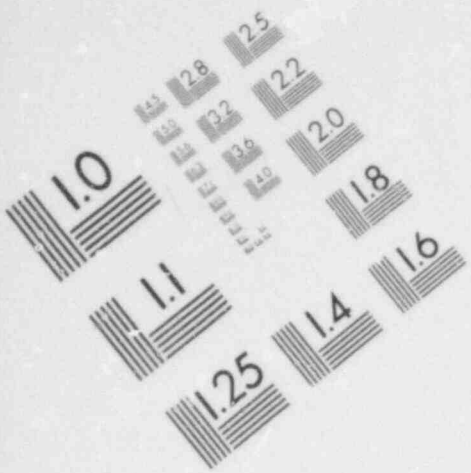
____4.1.8 Verify sufficient river water flow across Unit or Station for discharge mode.

____4.1.9 Perform the following steps to initiate the release which provides automatic termination if PH is not is the 6.5 to 8.5 range.

____4.1.10 Verify WT-V25 release valve OPENS by placing its local air control box override switch to "AUTO".

____4.1.11 "THROTTLE OPEN" the LOCKED isolation valve WT-V73 to obtain the desired 100 gpm (by timing level decrease).

____4.1.12 Observe that the PH controller is operating properly in that the disposal valve WT-V25 is only open with a PH in the range of 6.5 to 8.5.



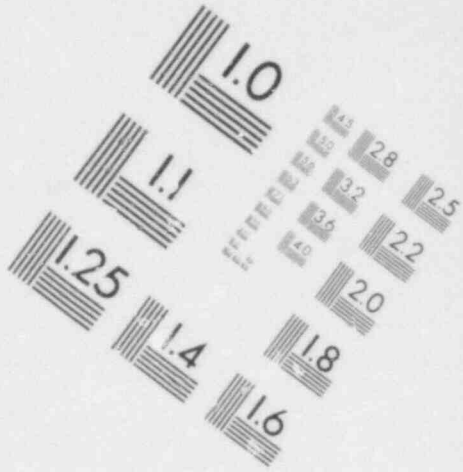
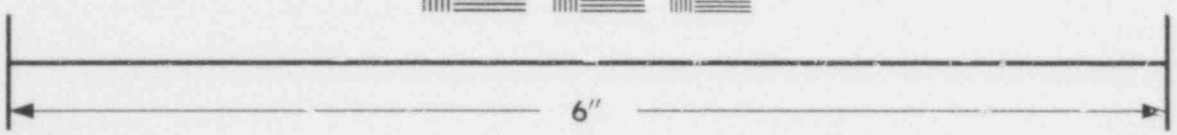
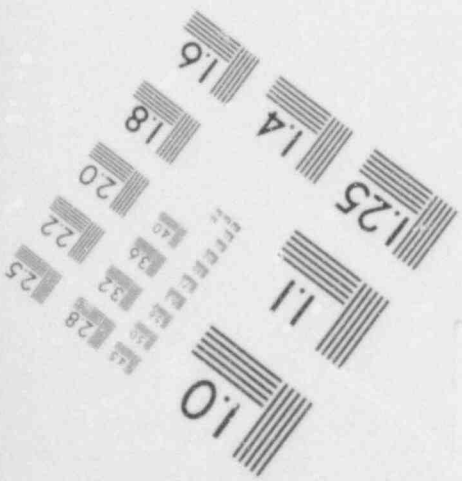
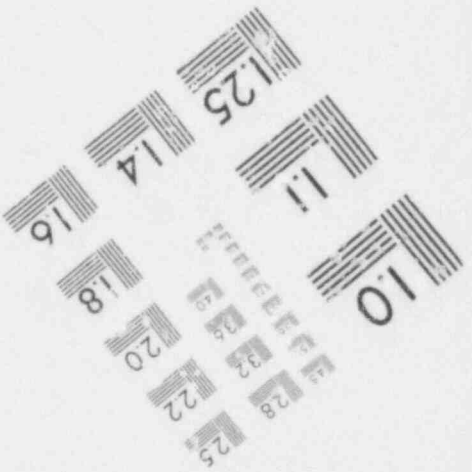


IMAGE EVALUATION TEST TARGET (MT-3)







NOTE: Manual release with WT-V25 local switch in "OPEN" position is allowed with Shift Supervisor/ Shift Foreman permission and constant observance of PH in the case of Instrument malfunctions.

____4.1.13 Verify sampling is obtained per release permit.

____4.1.14 If PH exceeds the 6.5 to 8.5 range, neutralize apain per 4.1.5, resample for PH and continue.

____4.1.15 When WT-P-9A (8B) stops automatically due to low level setpoint, it can be re-started in "HAND" to constantly monitor level and reduce it to a minimum of 23.5" (4,000 gallons) if required. (Do not allow pump suction to become uncovered).

____4.1.16 "LOCK CLOSED" WT-V73, place local air switch for WT-V25 to "CLOSE", verify WT-P-8A (8B) "OFF" and process the Release Permit.

4.1.17 Flush PH cell after release per following steps:

____4.1.18 CLOSE WT-V308B Neutralization Tank PH cell sample isolation valve.

____4.1.19 Verify CLOSED WT-V Later Neutralization Tank PH line sample isolation valve.

____4.1.20 Connect flushing hose to "snap" connector at DO-V79.

____4.1.21 OPEN DO-V79 to provide flushing water.

____4.1.22 Partially OPEN WT-V Later flushing hose valve at PH cell and flush PH cell for several minutes into Neutralization Tank.

NOTE: PH Indication as being Neutral.

____4.1.23 CLOSE DO-V79 to isolate flushing water.

____4.1.24 CLOSE WT-V Later flush water valve at PH cell and disconnect hose at DO-V79 (and coil it up).

4.2 Automatic Neutralization of Tank

Initial Each Step Upon Satisfactory Completion.

____4.2.1 Place acid injection pump WT-P-9) and caustic injection pump (WT-P-10) control switches in AUTO.

____4.2.2 Check recycle and disposal valve control switch NT1 and 2, on LAWT Panel, in AUTO.

____4.2.3 Check WT-V350 local recylce "NTR" valve switch is in OPEN position and WT-V25 disposal NTD valve switch is in AUTO.

____4.2.4 Place an effluent disposal pump (WT-P-8A/B) control switch in AUTO for automatic operation, (of if necessary, place an effluent disposal pump control switch in HAND for manual operation).

____4.2.5 Observe that the pH controller is operating properly in that the Neutralization Tank Waste Disposal Valve WT-V25 does not open unless indicated tank pH is in the range 6.5 to 8.5. (When neutralized, initiate a Release Permit, Appendix C). Throttle open WT-V73 to obtain a 100 gpm release rate (by observing flow indication).

____4.2.6 If in manual pump control, STOP the effluent disposal pump when the desired tank level is reached. (minimum 23.5", 4000 gallons).

____4.2.7 When Neutralization Tank Waste Disposal is no longer desired, place control switches for pumps WT-P-8A/B, WT-P-9 and WT-P-10 in OFF.

____4.2.8 Lock closed WT-V73 and place local WT-V25 disposal NTD valve swtich to closed position.

____4.2.9 Flush pH cell per section 4.13.

____4.2.10 Process Neutralization Tank Release Permit.

APPENDIX A

Valve Line-Up

System: Manual Waste Neutralizing and Tank Release Date

Valve #	Description	Position	Initial
WT-V308A	Neut. Tank Eff. Recirc. Isolation	THROTTLED 70% OPEN	
WT-V308B	Neut. Tank Recirc pH Inst Isolation	OP	
WT-V308C	Neut. Pump WT-P-8A Suction Isolation	OP	
WT-V308D	Neut. Pump WT-P-8B Suction Isolation	OP	
WT-V308E	Neut. Pump WT-P-8A Discharge Isolation	OP	
WT-V308F	Neut. Pump WT-P-8B Discharge Isolation	OP	
WT-V308G	Neut. Tank Drain	CL	
WT-V73	Neut. Tank Eff. Disposal Isolation	LOCKED CLOSED	
WT-V350	Neut. Tank Recirc. Pneumatic Isolation	OP	
WT-V25	Neut. Tank Disposal Pneumatic Isolation	CL	
SR-V55	Sluice Gate Bypass to River	CL *	

* OPEN only if MDCT #2 is being bypassed

APPENDIX B

Signatures of those performing/supervising valve line-up

Valve Line-up Signature Sheet

Operator Initials	Operator Signature	Shift	Date	Shift Foreman or Supervisor Sig.

APPENDIX C
WASTE NEUTRALIZING TANK RELEASE PERMIT

NOTE: _____ SS/SF INITIAL if Unit 1 is dishcargeing Neut. Tank and Refer to 3.14, 3.15.

1. Requested by:_____(Shift Supervisor/Foreman)

   Date:_____ Time:_____ Flow_____gpm.

   _____No. of Unit 2 Secondary River Water Pumps running.

   See 3.14 and 3.15 for flow needed.

2. Description of tank contents: (i.e., neutralized waste, corrosive waste pumpout, etc)_____

   _____

CAUTION: If other than normal regenerant wastes are within the tank, the Chemistry Supervisor must recommend approval to the Shift Supervisor/ Shift Foreman prior to the actual release.

3. Waste Neutralizing Tank Sample pH:_ _ Analysis by:_____
   (Rad Chem Tech (Jr)

   Date:_____ Time:_____

4. Release Approved by_____ Date:_____Time:_____
   Shift Supervisor/Foreman

5. Shift Supervisor/Foreman: Notify Rad. Chem. Tech (Jr) that release will commence at below indicated time and to obtain Influent and Effluent samples approximately one hour later.

   Rad. Chem. Tech Name_____ Time:_____

NOTE: Notify Rad. Chem. Tech (Jr) to notify Shift Supervisor/Foreman when influent and effluent samples are obtained.

6. Time sampled by Rad. Chem. Tech. (Jr): Tank_ _____
   Influent_____
   Station Effluent_____

7. Shift Supervisor/Foreman insure Aux. Operator or his relief follows the release closely (i.e., tank level vs. time) and is in vicinity of the Neutralizing Tank at the termination of the release to insure the disharge has terminated properly, assure valve WT-V73 is closed and data is logged on the attached table.

51-006

Data to be filled in at start and termination of release

	Time	Date	Unit 2 Secondary River Water Pumps Running	River Water Flow gpm	WT-V73 (Turns) Valve Position	Tank Level (Gal)	AUX. Operator Signature
Disch. START							
Disch. STOP							

8. Shift Supervisor/Foreman verified that this data sheet is completed, valve closed and locked _____ Date:_____ Time:_____
Signature

9. Permit returned to Chem. Lab._____ Date_____Time_____
Signature of Returner

10. Additional Analyses Required must be started immediately following Step 3 (by Rad. Chem. Tech. (Jr).

CAUTION: If Suspended Solids and Dissolved Solids analysis will not be completed within 8 hrs., Shift Supervisor/Foreman must be notified. Also, the Shift Supervisor/Foreman must be notified immediately it it is determined by analysis that any of the limits below have been exceeded.

	pH	Suspended Solids*	Dissolved Solids*	Total Iron	Alkalinity	
					P	MO
Tank Sample						
River Influent						
River Effluent						

Tank Limits: pH: 6.0 to 9.0 - N.P.D.E.S. PA 0009920

Suspended Solids: 100 PPM Maximum, 30 ppm Average - N.P.D.E.S. PA 0009920

Discharge Limits: pH: 6.0 to 9.0 - I.W.P. 2270204

Suspended Solids: 560 ppm - I.W.P. 2270204

Dissolved Solids: 500 ppm - Monthly Average, 700 ppm maximum - I.W.P. 2270204

Total Iron: 7 ppm - I.W.P. 2270204

Methyl Purple Alkalinity: 100 ppm as $CaCO_3$ - Corps of Engineers.

THREE MILE ISLAND NUCLEAR STATION

STATION PLANT CHEMISTRY PROCEDURE 1900

DETERMINATION OF pH

1.0 SUMMARY

pH is defined as the common logarithm of the reciprocal of the hydrogen ion concentration (expressed in moles per liter). It provides indication of whether a solution is alkaline or acidic with a pH of 7.0 considered neutral at ambient temperatures. Due to the logarithmic scale, its usefulness is limited to fairly dilute solutions of acids and bases.

2.0 APPARATUS

2.1 pH meter

2.2 5 inch glass pH electrode

2.3 5 inch Calomel electrode

2.4 Electrode holder

3.0 REAGENTS

3.1 Standard pH buffer solutions in the same range as samples to be measured. (prepare buffer solutions per manufacturer's instructions).

4.0 PROCEDURE

4.1 Insure meter is energized. If not, allow 15 minutes from energization for the meter to warm up. A glass electrode and a reference electrode should be connected to the meter. These electrodes should be immersed in demineralized water when not in use.

4.2 Check the reference electrode to ensure adequate filling solution. If necessary fill the electrode with the proper solution as indicated in the following table.

Electrode Vendor	Electrode Type	Filling Solution
Fisher	Calomel Reference Electrode	Saturated Potassium Chloride
Orion	Single Junction Reference	Filling Solution #90-00-01
Corning	Calomel Reference Electrode	Saturated Potassium Chloride
Leeds and Northrup	Calomel Reference Electrode	Saturated Potassium Chloride
Beckman	Reference Electrode and Combination Electrode	4M Potassium Chloride, Saturated with Silver Chloride

4.3 Rinse electrodes with demineralized water and immerse electrodes in a buffer solution haveing a pH similiar to the sample.

4.4 Measure the temperature of the buffer and adjust temperature compensator to this temperature.

4.5 Adjust pH reading to conform to the temperature vs pH tables supplied with the buffer.

NOTE: The temperature of the buffer and samples to be analyzed should always be 25°C ± 2°C.

4.6 Rinse the electrodes with demineralized water and sample.

4.7 Immerse electrodes in the sample, adjust temperature compensator and read pH directly.

4.8 After use, leave the electrodes immersed in demineralized water.

5.0 REFERENCES

5.1 Standard Methods for examination of Water and Waste Water, 13th Edition, 1971.

THREE MILE ISLAND NUCLEAR STATION

STATION CHEMISTRY PROCEDURE NO. 1940

Determination of Free and Total Chlorine

1.0 SUMMARY

Free chlorine and total chlorine may be determined by amperometric titration utilizing phenylarseneoxide as the titrant. In this procedure, free chlorine is determined first by buffering the sample to pH 7 and titrating it. The sample is then buffered to pH 4 and potassium iodide is added. This process reduces any combined chlorine and liberates an equivalent amount of Iodine. The Iodine is then titrated and the result is equivalent to the amount of combined chlorine present in the sample. Total chlorine is then the sum of the combined and free chlorine.

2.0 APPARATUS

2.1 Amperometric Titrator

3.0 REAGENTS

3.1 Phenylarseneoxide solution (1 ML = 0.2 mg cl_2)

3.2 pH 7 Buffer solution

3.3 pH 4 Buffer solution

3.4 5% Potassium Iodide solution

3.5 0.0282 N Iodine solution

4.0 PROCEDURE

CAUTION: The volume of all samples drawn for total and free chlorine analysis shall be of sufficient volume to perform the analysis a minimum of two times. On any out of specification result, the analysis shall be run again to verify the result.

4.1 Fill the pipet to the "0" graduation by opening the pinch valve and then closing it for Fischer-Porter Titrator, or by squeezing reservoir on Wallace & Tiernan Titrator.

4.2 Place 200 ML of sample in the sample jar after rinsing three times.

4.3 Add one ML of pH 7 Buffer to the sample.

4.4 Place sample jar on titrator and place switch in "FREE" position for Fischer-Porter (F-P) Titrator, or for Wallace & Tiernan (W&T) flip switch and adjust pot to full scale.

4.5 After microammeter becomes steady, slowly add titrant to the sample. Note that the needle deflects to the left after each drop of titrant is added.

4.6 Continue to add titrant to the sample until the addition of one more drop of titrant causes no deflection. The end point is the last drop that caused a deflection.

4.7 Record the volume of titrant added to reach the end point; PPM free chlorine = ML titrant.

4.8 Change switch to "TOTAL" position for F-P, or for W&T flip switch and readjust pot.

4.9 Add one ML of pH 4 Buffer and one ML of Potassium Iodide solution.

4.10 Continue titrating until an end point is reached as indicated by no deflection of the microammeter. The end point is the last drop that caused a deflection.

4.11 Record the <u>total</u> volume of titrant added to reach both end points. PPM total chlorine = ML (total) titrant added.

4.12 Once every day perform the following accuracy check. (Only if the amperometric titrator is to be used that day).

4.12.1 Pipet 10ML of 0.0282N Iodine solution into a clean 100ML volumetric Flask. Carefully dilute to the mark with demineralized water. Store this solution in the refrigerator when not in use.

4.12.2 Obtain duplicate 200ML samples of domestic water. These samples must be taken at the same time. (Ideally these samples should contain about 0.20 PPM total chlorine).

4.12.3 Immediately add 1ML of 5% potassium Iodide solution and 1ML of pH 4 buffer solution to each sample.

4.12.4 Analyze one of the samples as usual for TOTAL chlorine as described in section 4.10 and 4.11.

4.12.5 To the remaining sample, carefully pipet 1ML of the diluted Iodine solution prepared in section 4.12.1.

4.12.6 Now analyze this sample for TOTAL chlorine as described in section 4.10 and 4.11.

4.12.7 Calculate % recovery as follows:

$$\% \text{ Recovery} = \frac{(\text{PPM Chlorine from 4.12.6}) \times 100}{(\text{PPM Chlorine from 4.12.14}) + 0.50}$$

4.12.8 If % recovery does not exceed 90%, titrator requires Corrective Maintenance.

5.0 REFERENCES

5.1 Fischer-Porter Titrator Instruction Manual

5.2 Wallace & Tiernan Titrator Instruction Manual

5.3 Standard Methods for the Examination of Water and Wastewater, Part 114B

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-3.9

RIVER WATER CHLORINATION SYSTEM

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THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-3.9

RIVER WATER CHLORINATION SYSTEM

1.0 REFERENCES

1.1 Drawings

1.1.1 C-302-174 Cooling Water Chlorination Units 1 and 2.

1.1.2 SC-71-1385 Fisher and Porter Co. Flow Diagram.

1.1.3 WD 56 M2124 Electric Schematic for Cooling Water.

1.1.4 SS-208-599 Electric Print for CL-P2 Booster Pump.

1.1.5 2021 Circ. Water and River Water Chemical Treatment.

1.2 Other Operating Procedures

1.2.1 1104-31, Secondary Services River Water System.

1.2.2 1104-25, Instrument Air System.

1.2.3 1104-22, Cycle Makeup Pretreatment System.

1.2.4 1104-36, River Water Chlorination System (Unit 1).

1.3 Manufactures Instruction Manuals.

1.3.1 Racom Motor Operator.

1.3.2 Grinnel Diaphram Valves.

1.3.3 Fisher and Porter Co. Chlorination Instruction Manual.

1.3.4 RI-10 Bill of Materials.

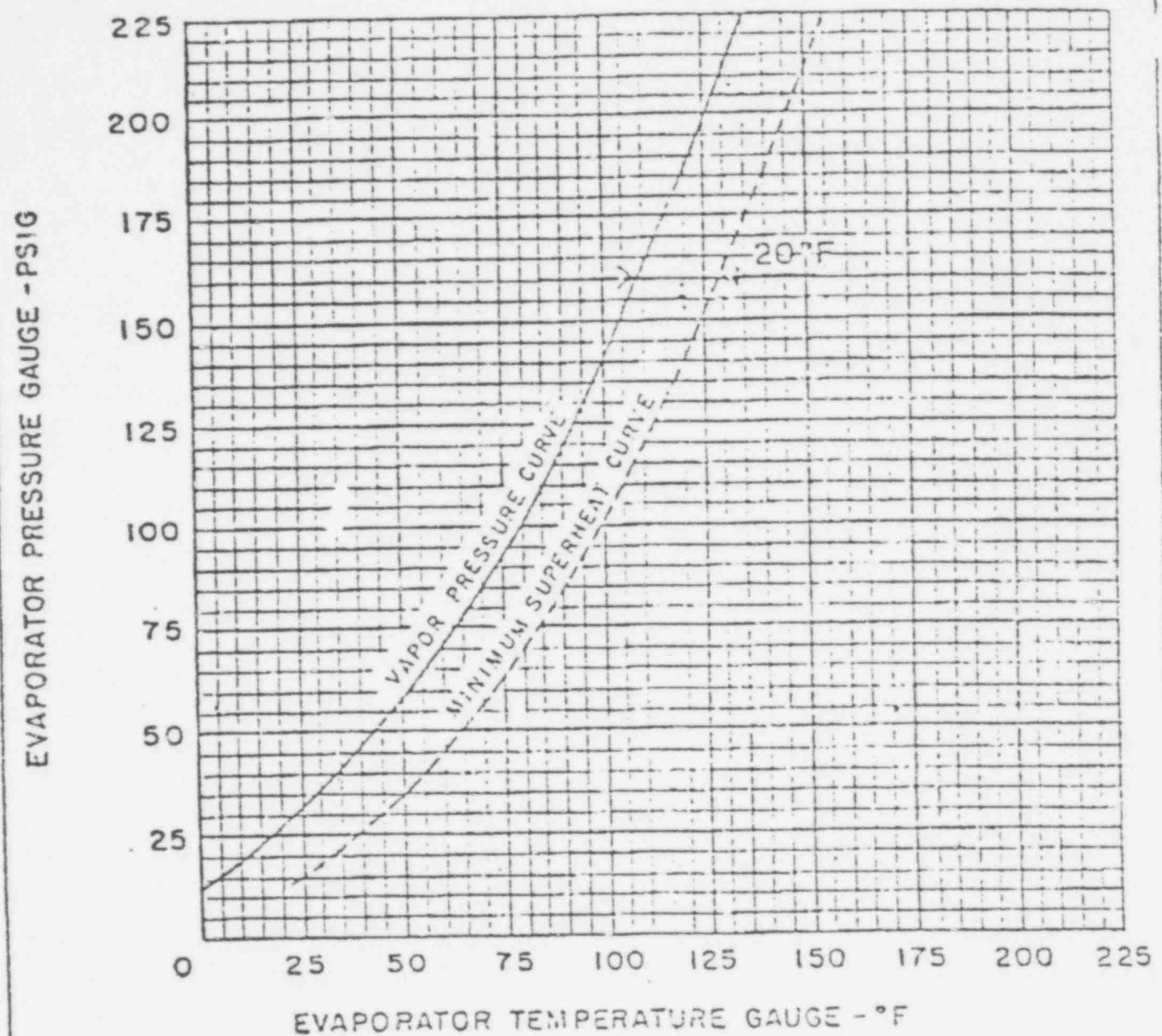
1.4 System Description

1.4.1 Chlorination Systems Plant Manual, Chapter 29, Section C, Volume I.

1.4.2 Secondary Service River Water Systems Plant Manual, Chapter 13, Section C, Volume I.

1.5 Curves and Tables

1.5.1 Evaporator Min. Superheat Curve.



CHLORINE VAPOR PRESSURE CURVE

FOR

USE WITH CHLORINE EVAPORATOR

2.0 LIMITS AND PRECAUTIONS

2.1 Equipment

2.1.1 Periodic checks must be made on makeup water flow to evaporator water jacket to ensure water level is being maintained. There should be a slight trickle flow from the overflow line at all times.

2.1.2 A new lead gasket must be used at the container coupling nut whenever chlorine containers are replaced.

2.1.3 The total chlorine concentration at the Station River Water Discharge shall be monitored and recorded. An analysis for chlorine using SCP 1940 is to be made weekly during a chlorination period by contacting the Chemistry Department.

2.1.4 The evaporator minimum degree of superheat shall be 20°F (as determined by Curve 1.5.1).

2.2. Administrative

2.2.1 Replacement containers must be located in the Chlorination Building at least one day prior to their use in the system to allow their temperature to equalize with room temperature.

2.2.2 Before entry into either the Container Storage or Chlorinator/ Evaporator rooms, the ventilation fans must be started and allowed to run for at least one minute to ensure that any chlorine fumes which may be present in the rooms are exhausted.

2.2.3 When chlorine containers are replaced or the chlorine system is placed back in service after maintenance, all fittings will be checked for leaks by the use of ammonia, by removing the top from the bottle and moving the bottle under the piping and fittings involved. If a leak exists, a dense white cloud will be formed and suitable measures must be taken to seal the leak.

2.2.4 When work is carried out on any part of the system where liquid chlorine is present, it must be purged with dry air to remove any moisture that may be present.

2.2.5 Records of chlorine gas usage must be maintained and any variation from normal must be investigated.

2.2.6 The Chemistry Dept. shall be notified of any change in chlorination rate.

2.2.7 Appropriate changes shall be made to the chlorination rate each time the river water discharge flow is changed by more than 10%.

2.2.8 Each change in chlorination rate shall be logged. The total chlorine concentration, as measured during the next chlorination period, shall also be logged in the OUT BUILDING LOGSHEETS.

3.0 PREREQUISITES

3.1 Unit 2 Nuc. River or Sec. River must be in operation per 2104-3.1 or 2104-3.4, prior to chlorinating in Unit 2 screenhouse.

4.0 OPERATING PROCEDURE

4.1 Normal System Startup.

(Indicate Satisfactory Completion of Steps by Initialing in the margin by each step, and sign at end of section).

____4.1.1 Startup after extended period of shutdown (extended period of shutdown is defined as greater than one day).

4.1.1.1 Prerequisites

____4.1.1.1.1 The Secondary Service River Water is operating per 1104-31.

____4.1.1.1.2 The Instrument Air System is operation per 1104-25.

____4.1.1.1.3 The Cycle Makeup Pretreatment System is operating per 1104-22.

___4.1.1.1.4 Full chlorine cylinders are connected (via the liquid connection) to the chlorine supply manifold.

___4.1.1.1.5 Check that the selector switch for the chlorination system is in the "Off" position.

___4.1.1.1.6 Power available at the following MCC and Distribution Panels and Breakers closed.

a. 1B ES Screenhouse MCC

1. Unit 9B Booster pump CL-P2

b. Distribution Panel CC/SH-2

1. Switch 18 Lights-Chlorinator House.

2. Switch 19 Recepts - Chlorinator House.

3. Switch 20 Chlorine Evap. Htr. Control Pwr.

4. Switch 22 Chlorinator Control Pnl. Pwr.

5. Switch 24 Chlorinator Heater Control Pwr.

___4.1.1.1.7 Check that the following breakers are in the open position.

a. 1B ES and Screen House BUS

1. Unit 7ER chlorinator evaporator heater

___4.1.1.1.8 The valves are lined up per Appendix A.

___4.1.1.1.9 The system has been tested and purged per section 4.5.2.1 and 2.

___4.1.1.1.10 Check that the self contained breathing apparatus or gas mask is available in the screen house.

___4.1.1.1.11 Ventilation fans in chlorine equipment house are operating.

___4.1.1.1.12 Check to insure Chemistry Department standing by to monitor chlorine concentration.

a. Adjust eductor CL-M2 to indicate = 15" Hg.

b. Throttle CL-V43 = ½ turn from fully closed.

c. Throttle CL-V25 = ½ turn from fully closed.

4.1.1.2 Procedure

____4.1.1.2.1 Open CL-V33 slowly and fill evaporator to overflowing, then throttle CL-V33 so that overflow to drain is approximately 1-2 GPH.

____4.1.1.2.2 At the evaporator panel, check the water temperature control at 155°F, the low water temperature control at 140°F and the high water temperature control at 170°F.

____4.1.1.2.3 Close breaker Unit 7ER at the 1B ES and Screen House BUS to energize the evaporator heater.

____4.1.1.2.4 Open the cylinder isolation valve for the cylinder that is to be put into service (CL-V30A, B, or C).

____4.1.1.2.5 Open the appropriate liquid valve 1 full turn.

____4.1.1.2.6 Check this section of the system for leaks as per Section 2.2.3.

____4.1.1.2.7 Open the appropriate header isolaton valve (CL-V22A, B, or C).

____4.1.1.2.8 After the evaporator has stabilized under these conditions open the liquid valve on the container in service two more turns (or as experience dictates).

____4.1.1.2.9 Place the selector switch "Auto-Off-H_2O-SOL" on the River Water Chlorination System in the SOL Position.

____4.1.1.2.9a Place the SOL-V1, AUTO, SOL-V2 switch in the
SOL-V1 position - for Unit #1 chlorination
SOL-V2 position - for Unit #2 chlorination
AUTO position for Unit #1 and #2 chlorination

____4.1.1.2.10 Adjust the gas flow rate on the chlorinator unit as necessary to obtain a total chlorine concentration of 0.15 Mg/ℓ at the river water discharge. A manual titration using SCP 1940, must be performed at this time to confirm that the total chlorine concentration is less than 0.2 Mg/ℓ.

____4.1.1.2.11 Place the selector switch for the River Water Chlorination in the "Auto" position.

____4.1.1.2.12 When the timer initiates chlorine feed, check the following automatic valves function properly.

a. Unit 1 Chlorination
(CL-V17, CL-V18 & CL-V29) open and booster pump starts.

b. Unit 2 Chlorination
(CL-V17, CL-V19 & CL-V29) open and booster pump starts.

c. Unit 1/Unit 2 Dual Operation
(CL-VL7, CL-V18 & CL-V29 open @ 0100, 0900 and 1700 hours and booster pump starts.
(CL-VL7, CL-V19 & CL-V29 open @ 0300, 1100 and 1900 hours and booster pump starts.

____4.1.1.2.13 Check chlorinator loop seal drain valve cracked open to allow trickle flow (located inside chlorinator unit).

4.1.2 System Startup after Overnight Shutdown

4.1.2.1 Prerequisites

____4.1.2.1.1 The system is shutdown as per section 4.3.2.

4.1.2.2 Procedure

___4.1.2.2.1 Place the selector switch in the "AUTO" position at the Chlorinator Control Panel after making sure the evaporator is at operating temperature. (If chlorine gas temperature is >100°F, it is safe to assume the evaporator is up to operating temperature.

4.2 Normal System Operation

4.2.1 Prerequisites

___4.2.1.1 The River Water Chlorination System has been started as per section 4.1.

___4.2.1.2 The Cycle Makeup Pretreatment System is operating to supply filtered water to evaporator at approximately 1-2 GPH.

4.2.2 Procedure

___4.2.2.1 During normal operation the system functions automatically according to time schedules (tork timer) and dosage rates which are set by controls on the chlorinator and ejector. Set the 24 hour tork time to chlorinate at the following times:

a. Unit #1 Chlorination "only"
0100, 0900, and 1700 hours.

b. Unit #2 Chlorination "only"
0300, 1100, and 1900 hours.

c. Unit #1 & Unit #2 Chlorination (Dual Operation)
0100, 0300, 0900, 1100, 1700 and 1900 hours.

CAUTION: Changing chlorinator from dual unit operation to either Unit 1 or Unit 2 operation will require resetting tork time IAW, step a, b,

above and failure to do so will result in excessive chlorinations. Adjust the chlorinate time to a 15 minute chlorination period.

____4.2.2.2 Periodic sampling should be carried out to ensure that less than 0.2 Mg/ℓ of total chlorine is maintained at the river water discharge during a chlorination cycle. This sampling shall be performed on a weekly basis. If the 0.2 Mg/ℓ total residual chlorine limit is exceeded, readjust the chlorine gas flow rate as in section 4.1.1.2 step 10.

____4.2.2.3 If the frequency of chlorination needs changing, it is only necessary to change the program in the tork timer schedule. The timing switch has a 24 hour dial with 96 tabs for 1 to 48 on-off operation with a minimum of 15 minute intervals. The tabs are positioned either "in" or "out". The chlorination frequency can be changed by lifting the tabs at the intervals required.

____4.2.2.4 Periodically the "in service" containers will become empty and will have to be replaced with a full container. To shift containers follow the below procedures.

a. When the "in service" container is expended (indicated by low CL_2 pressure on the evaporator) close the in service manifold isolation valve (CL-V22A, CL-V22B, or CL-V22C).

b. Close the container isolation valve (CL-V30A, B or C).

c. Close the liquid valve on the empty container.

d. Open the container isolation valve (CL-V30A, B, or C) on the container to be placed in service.

e. Crack open and then close the liquid valve on th full container.

f. Check for leaks as per section 2.2.3.

g. Open the header isolation valve (CL-V22A, B or C).

h. Open the liquid valve on the container three turns or as operating experience dictates.

___4.2.2.5 To replace empty container the following procedure shall be followed.

a. Check closed the container isolation valve (CL-V30A, CL-V30B, or CL-V30C) and the respective header isolation valve (CL-V22A, CL-V22B, or CL-V22C).

b. Check closed the liquid valve on the container to be replaced.

c. Disconnect the union connections of the flexible connector assembly from the container isolation valve (CL-V30A, CL-V30B, CL-V30C) and remove the lead gasket from the coupling nut.

d. Replace the empty container.

e. Insert a new lead gasket in each coupling nut; make certain it is properly seated; reconnect the coupling to the container liquid valve and tighten each connection securely using a wrench.

f. Crack open the container isolation valve (CL-V30A, CL-V30B, or CL-V30C).

g. Momentarily "crack" open and then close each container liquid valve and check each connection for leaks as per section 2.2.3.

h. If no leaks are found, close the associated container isolation valve (CL-V30A, CL-V30B, CL-V30C).

i. The container is now in standby.

___4.2.2.6 Periodic checks of the evaporator minimum superheat ($20^{o}F$) will be performed IAW Curve 1.5.1. If the degree of superheat is $<20^{o}F$ submit work request to Instrument Dept. to adjust evaporator water temperature control thermostat to restore minimum superheat.

4.3 Normal System Shutdown

Indicate Satisfactory Completion of Steps by initialing in the margin by each step and sign at end of section.

4.3.1 Shutdown for extended period of time.

(If the system is to be shutdown for extended periods, this procedure shall be used).

4.3.1.1 Prerequisites

___4.3.1.1.1 The River Water Chlorination System is operating per section 4.2.

4.3.1.2 Procedure

___4.3.1.2.1 Place the selector switch for the River Water Chlorination "Auto-Off-H_2O-SOL" in the "SOL" position.

___4.3.1.2.2 Close the container liquid valve for the cylinder in service. The chlorinator is now operating to remove by evaporation all chlorine from the chlorine supply system.

___4.3.1.2.3 Observe chlorine gas pressure gauge PI 518. When it reads 5-10 psig place the selector switch for River Water Chlorination System to "H_2O" position for 10 minutes to flush lines then turn selector switch to "OFF".

____4.3.1.2.4 Open breaker 7ER (Evaporator Heater) on 1B ES Screen House BUS to de-energize evaporator heater.

____4.3.1.2.5 Close the filter water inlet valve CL-V33.

____4.3.1.2.6 Close the header isolation valve (CL-V22A, B or C) on the container that was in service.

____4.3.1.2.7 Close the container isolation valve (CL-V30A, B, or C) on the container that was in service.

4.3.2 Shutdown for short periods of time

(If the system is to be shutdown for short periods (overnight) this procedure shall be used).

4.3.2.1 Prerequisites

____4.3.2.1.1 The River Water Chlorination System is operating per section 4.2.

4.3.2.2 Procedure

____4.3.2.2.1 Turn off the chlorinator by placing the selector switch in the "Off" position.

4.4 Shutdown for Maintenance

4.4.1 Prerequisites

____4.4.1.1 The River Water Chlorination System is operating as per section 4.2.

4.4.2 Procedure

____4.4.2.1 Shutdown the River Water Chlorination System as per section 4.3.1.2 with the exception that in step 3 of section 4.3.1.2 the pressure (as indicated on PI-518) will fall to zero before placing the selector switch for River Water Chlorination System in "Off" position.

4.5 Startup after Maintenance (Also Initial Startup)

4.5.1 Prerequisites

____4.5.1.1 The system is shutdown as per section 4.4.

____4.5.1.2 The prerequisites are as per section 4.1.1.1 with the exception of step 9.

4.5.2 Procedure

____4.5.2.1 Purge the system with dry air. Chlorine, either liquid or gas, reacts with water to form extremely corrosive products. Therefore it is mandatory that after any maintenance on the system, all the piping and equipment must be purged with dry compressed air before admitting chlorine into the system. For purging with air, the following procedure must be followed.

a. Disconnect the flange upstream of CL-V29.

b. Close the upstream & downstream isolation valves for CL-V26 (CL-V25 and CL-V27 respectively).

c. Open the bypass valve CL-V28 for CL-V26.

d. Disconnect the flexible hose connection on an isolated chlorine cylinder, (anyone) and connect a compressed air hose to it.

e. Open the header isolation valve (CL-V22A, CL-V22B or CL-V22C) to which the air hose is connected, and purge the piping and equipment until system is dry. (The system is dry when dry air with no water is emitted from the flange upstream of CL-V29).

f. Close the header isolation valve (CL-V22A, CL-V22B, CL-V22C) to which the compressed air hose is connected.

g. Relieve pressure slowly prior to disconnecting the compressed air hose and reconnect the flexible hose connection to the gas valve on the chlorine cylinder (This container will now serve as a test container).

NOTE: Be sure a new lead gasket is used.

h. Connect the flange upstream of CL-V29.

i. Close the bypass valve CL-V28.

j. Open the downstream and upstream isolation valves (CL-V27, CL-V25) for CL-V26.

4.5.2.2 Test the system for leakage after maintenance, the entire system should be tested for leaks using the cylinder gas valve. The following procedure should be used:

a. Check that the flexible hose connection is connected to the gas valve as per section 4.5.2.1g above.

b. Close the liquid chlorine header isolation valve CL-V23.

c. Open the cylinder isolation valve (CL-V30A, CL-V30B, or CL-V30C) on the test container.

d. Open the header isolation valve (CL-V22A, CL-V22B, or CL-V22C) on the test container.

e. Momentarily open the gas valve of the test container to pressurize this portion of the chlorine supply piping slightly and then shut off tight.

f. Test this portion of the chlorine system for leaks as per section 2.2.3.

NOTE: If leaks are found, open the chlorine header isolation valve (CL-V23) and turn

on the chlorinator to evacuate the chlorine supply piping. Then turn off the chlorinator and correct all leaks.

g. Open the gas valve of the test container one full turn to pressurize this portion of the chlorine supply piping to full container pressure and then shut the gas valve.

h. Repeat step f. above.

i. Check out the other connections t the header by opening in turn, each header isolation valve (CL-V22A, CL-V22B and/or CL-V22C) and container isolation valves (CL-V30A, CL-V30B and/or CL-V30C). (Do not open the container valves, liquid or gas).

j. Sectionally check out the remainder of the chlorine supply piping between the test container and CL-V29 by repeating steps e, f, g, and h above.

k. After the chlorine supply piping has been checked out, close the gas valve on the test container.

l. Turn on the chlorinator by placing the "Auto-Off-H_2O-SOL" selector switch to the "SOL" position. Allow the chlorinator to operate for a few minutes to evacuate the chlorine supply line.

m. Disconnect the flexible hose connection from the gas valve of the test container and reconnect the flexible hose connection to the liquid valve.

NOTE: Be sure a new lead gasket is used.

APPENDIX A

RIVER WATER CHLORINATION STARTUP VALVE CHECKLIST

CL-V22A	Header isolation valve for cylinder CL-T3A (CL-N-2 Header)	____Close
CL-V30A	Cylinder isolation valve for cylinder CL-T3A	____Close
CL-V22B	Header isolation valve for cylinder CL-T3B (CL-N-2 Header)	____Close
CL-V30B	Cylinder isolation valve for cylinder CL-T3B	____Close
CL-V22C	Header isolation valve for cylinder CL-T3C (CL-N-2 Header)	____Close
CL-V30C	Cylinder isolation valve for cylinder CL-T3C	____Close
CL-V23	Liquid chlorine Header isolation valve	____Open
CL-V43	Inlet valve to evaporator CL-Z-2	____Open
CL-V40	Root valve for PI-520 (Loc: Inside Chlorinator Unit)	____Open
CL-V33	Filtered water inlet to evaporator CL-Z-2	____Close
CL-V25	Upstream isolation valve for pressure regulator CL-V26	____Open
CL-V32	Vent valve on chlorine Header	____Close
CL-V28	Bypass valve for P.R.V. CL-V26	____Close
CL-V27	Downstream isolation valve for P.R.V. CL-V26	____Open
CL-V44	Inlet valve to chlorinator CL-G-2	____Open
CL-V29	Chlorine gas isolation valve	____Auto
CL-V17	Inlet valve to ejector, waterline from Sec. Service	____Auto
CL-V18	Chlorine solution valve in distribution Header Unit #1	____Auto
CL-V19	Chlorine solution Header valve to Unit #2	____Auto
CL-V20A	Chlorine solution distribution branch isolation valve	____Open
CL-V20B	Chlorine solution distribution branch isolation valve	____Open
CL-V20C	Chlorine solution distribution branch isolation valve	____Open
CL-V37	Evaporator drain valve	____Close
CL-V46	Wash down connection	____Close

CL-V26	Pressure Control Valve	____Auto
CL-V__	Root Valve for PS-514	____Open
CL-V__	Root Valve for PS-500	____Open
SR-V33	Sec. River Water to Chlorine Ejector	____Open
CL-V21A	Chlorine Solution Dist. Isolation Valve Unit 2	____Open
CL-V21B	Chlorine Solution Dist. Isolation Valve Unit 2	____Open
CL-V21C	Chlorine Solution Dist. Isolation Valve Unit 2	____Open
CL-V35	Chlorine Solution Drain Valve Unit 2	____Close

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APPENDIX B

Signatures of those performing/supervising valve line-up

Valve Line-up Signature Sheet

Operator Initials	Operator Signature	Shift	Date	Shift Foreman or Supervisor Sig.	Remarks

TEMPERATURE, pH, BIOCIDE, AND CHEMICAL RELEASE INVENTORY

50-320 ENVIRO
7802500 24
1-19-78

61-033

References

1. GP 1470 Review of the Non-Radiological Environmental Technical Specifications, Three Mile Island Nuclear Station.
2. Three Mile Island Nuclear Station, Unit 2 Environmental Technical Specifications, (TMI-2, ETS), Nuclear Regulatory Commission.
3. 2104-3.8 Mechanical Draft Cooling Tower Operation.
4. IC-3 RTD Temperature Loop Calibration.
5. 2104-2.11 Regenerant Waste Neutralization.
6. 1900 Determination of pH.
7. 1940 Determination of Free and Total Chlorine
8. 2104-3.9 River Water Chemical Treatment.
9. 2325 Chemical Release Inventory.
10. NPDES Permit - EPA - PA 0009920 and Amendments.
11. Standard Methods for the Examination of Water and Waste Water.
12. Applicable laboratory instrument instruction manuals.
13. GP 1471 - Annual, Non Radiological ETS Report Preparation.

Apparatus and Attachments

None

Precautions

1. Ensure that the following permit limitations are not exceeded:
   - The temperature of the main discharge (001) shall never exceed 87°F, except when the ambient river temperature exceeds 87°F, in which case, the temperature shall not exceed the ambient river temperature.
   - The temperature of the main discharge (001) shall not change by more than 5°F during any one hour period.

- During the period November 1 through April 30, the temperature of the main discharge (001) shall not exceed 12°F above ambient river temperature.
- During the period May 1 through October 31, the temperature of the main discharge (001) shall not exceed 7°F above ambient river temperature.
- During plant cooldown operations, the temperature of the main discharge (001) shall not exceed 12°F above ambient river temperature.
- The main discharge (001) flow rate shall not exceed 150 million gallons per day.

2. Ensure that the Unit 2 Waste Neutralization Tank is neutralized prior to being discharged, and that the pH of this discharge is between 6.0 and 9.0 Standard Units.
3. Ensure that the concentration of Total Residual Chlorine measured at the main discharge (001) does not exceed 0.2 mg/l.
4. Ensure that no other permit limitations are exceeded.
5. Ensure that all station procedures, as listed in the preceeding References, are followed.

Prerequisites and Requirements

Review all pertinent station procedures as listed in the preceeding References.

Procedure

Temperature

During normal operation of the station, discharge flow rate, temperature of the intake water, and station effluent temperature are continually monitored. Station river water temperature rise (Delta T) and the rate of change of the station effluent temperature are calculated. In order to ensure that

the NPDES limitations, as listed in Precautions, are not exceeded, each unit's mechanical draft cooling towers (MDCT's) are operated in accordance with Operating Procedures which specify all required thermal limitations and reporting requirements.

The station intake temperature sensor is located on the upstream wingwall of the TMI-1 intake structure and the station effluent temperation and flow sensors are located in the radiation monitoring pit. The temperature sensors have an accuracy of 2% of full range which is from 25°F to 100°F. The flow sensor has an accuracy of 2% of full range which is from 2,700 gpd to 100 x 10^6 gpd. Annually, all these sensors are calibrated in accordance with plant preventative maintenance procedures.

When the above instrumentation is inoperative or out of calibration limits, the intake and discharge temperatures are taken hourly with standard field thermometers. The intake temperature is taken in the intake structure and the discharge temperature is taken at the radiation monitoring pit.

Monthly, the data is reviewed, tabulated, and reported to the PaDER. Quarterly, the data is reported to the EPA. Nonroutine reports, as specified in ETS Subsection 5.6.2.b shall be submitted to the NRC, as described in GP 0004 (NRC Nonroutine Reports), concurrently with the submittal of NPDES noncompliance notifications.

Annually, a report covering the previous calendar year, as specified in ETS Section 5.6.1, shall be submitted to the NRC as described in GP 1471 (Annual Non-Radiological Environmental Technical Specification Report Preparation).

pH

Prior to each discharge from the Unit 2 - Waste Neutralization Tank, the regenerant waste is neutralized as described in Operating Procedure 2104-2.11. This procedure ensures that at all times, during a discharge, the effluent pH is between 6.0 and 9.0 Standard Units. Prior to discharging the contents of the tank, to ensure that the tank instrumentation is accurate, a grab sample is tanken from a sample valve on the tank and analysed in the laboratory, using the glass pH and Calomel electrodes method, as described in Station Plant Chemistry Procedures 1900 and Standard Methods for the Examination of Water and Waste Water.

If, during a release, the pH of this discharge moves out of 6-9 range, the discharge is terminated and the tank re-neutralized. For each release the above information is recorded and stored at the station.

Monthly, the data is reviewed, tabulated, and reported to the PaDER. Quarterly, the data is reported to the EPA. Nonroutine reports, as specified in ETS Subsection 5.6.2.b shall be submitted to the NRC, as described in GP 0004 (NRC Nonroutine Reports), concurrently with the submittal of NPDES noncompliance notifications.

Annually, a report covering the previous calendar year, as specified in ETS Section 5.6.1, shall be submitted to the NRC as described in GP 1471 (Annual, Non-Radiological Environmental Technical Specification Report Preparation).

Biocide

When chlorination is being protected at TMI-2, at least once per week (7 days) the station discharg is sampled [illegible]tal residual and free available chlorine in conjunction with NPDES [illegible]uiremen[illegible]. [illegible]t 10, 30, and 50 minutes after the initiation of a river wate[illegible]orination, grab samples are taken at the radiation monitoring pit and analysed by the amperometric titration method as described in the station Chemistry Procedure 1940 and Standard Methods for the Examination of Water and Wastewater, Part 114B. Operating Procedure 2104-3.9 "River Water Chlorination System," ensures that the total residual chlorine concentration of the station discharge does not exceed 0.2 mg/l. All results are recorded in the Unit 2 Chemistry Log Book.

Monthly, the data is reviewed, tabulated, and reported to the PaDER. Quarterly, the data is reported to the EPA. Nonroutine reports, as specified in ETS Subsection 5.6.2.b shall be submitted to the NRC, as described in GP 0004 (NRC Nonroutine Reports), concurrently with the submittal of NPDES noncompliance notifications.

Annually, a report covering the previous calendar year, as specified in ETS Section 5.6.1, shall be submitted to the NRC as described in GP 1471 (Annual Non-Radiological Environmental Technical Specification Report Preparation).

If the station determines that it will become necessary to chlorinate past the 0.2 mg/l total residual chlorine limit, a procedure to carry out a chlorine mapping program in the river, (ETS 4.1) will be submitted to the NRC prior to exceeding this limit.

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Chemical Release Inventory

Records of the amounts of caustic, acid, and chlorine use at TMI shall be

maintained and kept at the station. Surveillance Procedures describes how these records are determined and reported.

The results of this monitoring will be summarized semiannually and reported to RS&EE for review. Annually, a report covering the previous calendar year, as specified in ETS Section 5.6.1 shall be submitted to the NRC as described in GP 1471 (Annual, Non-Radiological Environmental Technical Specification Report and Preparation). This annual report will include monthly chlorine, usage and specify the days that it was used. Acid will be tabulated on both a monthly and six month basis. Caustic will be tabulated on a monthly basis.

Any other chemicals which may be used and discharged in the future will be added to this procedure as well as the station's surveillance procedures.

WATER QUALITY ANALYSIS

WATER QUALITY ANALYSIS

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.1.a (4) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, E.T.S.).

Information on the physical and chemical characteristics of the Susquehanna River, at the times and sampling locations of the General Ecological Survey (TMI-2 Section 3.1.2.a.(1)), shall be collected in the vicinity of Three Mile Island Nuclear Station (TMINS). The following parameters shall be measured for all the locations listed in the General Ecological Survey (ETS Section 3.1.2.a.(1)):

Temperature

pH

Dissolved Oxygen

Also, water samples shall be collected at the locations listed in the Benthic Macroinvertebrate portion of the General Ecological Survey (ETS Section 3.1.2.a(1)(a)) and analyzed for the following parameters:

Turbidity

Alkalinity

Total Dissolved Solids

Copper (total and dissolved)

Zinc (total and dissolved)

Sulfate

Discussion and Responsibilities

Metropolitan Edison Company's consultant, Ichthyological Associates, Inc. (IA), will be responsible for implementing all portions of this procedure except those listed below.

General Public Utilities Service Corp. Laboratory (System Lab) will be responsible for the analyses of the water samples taken at the locations listed in TMI-2 ETS Section 3.1.2.a (1)(a)). The parameters which are measured by the System Lab are Turbidity, Alkalinity, Total Dissolved solids, Copper (Total and Dissolved), Zinc (Total and Dissolved), and Sulfate.

The Supervisor of Radiation Protection and Chemistry at TMI will be responsible for sending the samples, collected by IA, to System Lab from TMINS, and ensuring sample bottles are available for IA. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470 Review of the Non-Radiological Environmental Technical Specification Three Mile Island Nuclear Station.
2. GP 1450 Benthic Macroinvertebrates.
3. GP 1451 Ichthyoplankton.
4. GP 1452 Fish.
5. GP 1455 Instrument Calibration-IA.
6. Three Mile Island Nuclear Station, Unit 2 Environmental Technical Specifications, Non-Radiological, Issued May 31, 1977, Nuclear Regulatory Commission.
7. Manual of Methods for Chemical Analysis of Water and Wastes, EPA/625/6-76/003A, Environmental Protection Agency, July 1976.

8. Standard Methods for the Examination of Water and Waste Water, 13th edition.

9. Three Mile Island Station Chemistry Procedures 1916 + 1926.

10. 1973 Annual Book of ASTM Standards, Part 23, Water Analysis D1067-70, Method B.

Apparatus and Attachments

A. Apparatus Required:

1. Photopholt Model 126 A pH Meter (or equivalent).
2. Yellow Springs Instrument (YSI) Model 54 Dissolved Oxygen Meter (or equivalent).
3. Taylor Bi-Therm Model 6074-1 field themometer (or equivalent).
4. One gallon sample collection bottles.
5. Glass Fiber Filter Discs, 4-7cm, without organic binder, Reeve Angel type 934-AH, Gelmen Type A/E, (or equivalent).
6. Filter Holder, membrane filter holder.
7. 500 ml suction flask.
8. Evaporating dishes, porcelain, 100 ml volume (Vycor or Platinum dishes may be used).
9. Steam Bath.
10. Drying Oven 180°C ± 2°C.
11. Desiccator.
12. Analytical Balance, 200g capacity, capable of weighing to 0.1mg.
13. Atomic Absorbtion Spectrophotometer.
14. Assorted Beakers and Volumetric Flasks.
15. Stock Zinc Solution: Carefully dissolve 1.2450 g of Zinc Oxide (ZnO) in a mixture of 10ml conc. HCl and 10ml deionized water. Then dilute to 1 liter in a volumetric flask. This is a 1000 mg/l Zn Stock solution.

16. 25 or 50 ml buret.
17. Phenolphthalein Indicator solution.
18. Methyl Purple Indicator solution.
19. Sulfuric Acid 0.02N; Dilute 2.8 ml of conc. H_2SO_4 to 1 liter. Standardize against 0.0200 N. Na_2CO_3 (1.060 g Anhydrous Na_2CO_3, primary Std. grade oven dried at 140°C) or 0.02N NaOH which has been standardized against a primary standard acid.
20. Hach Laboratory Turbidimeter Model 2100A and Accessories
21. Turbidity Free Water: Pass demineralized water through a 0.45μ pore size membrane filter.
22. Standard Turbidity Suspension.
23. Stock Copper Solution: Carefully weigh 1.00g of electrolyte copper (Analytica Reagent Grade). Dissolve in 5 ml of redistilled Nitric Acid and makeup to 1 liter with deionized water. Final Concentration of Stock Copper Solution is 1000 mg/l Cu.
24. Muffle Furnace.
25. Crucible or acid washed, ashless filter paper.
26. Filtering Apparatus.
27. Methyl Orange Indicator Solution.
28. 1:9 Hydrochloric Acid.
29. Barium Chloride Solution: Dissolve 100g of $BaCl_2 \cdot {}_2H_2O$ in one liter of distilled water, filter through a membrane filter prior to use.
30. Silver Nitrate-Nitric Acid Reagent: Dissolve 8.5g $AgNO_3$ and 0.5 ml conc. HNO_3 in 500 ml distilled water.

B. Attachments:

GPF 1449.001 Three Mile Island Aquatic Study -Field Data Sheet

GPF 1449.002 Ichthyoplankton Field and Laboratory Sheet.

GPF 1449.003 Three Mile Island Aquatic Study-Water Quality Analysis-Data Log Sheet.

Precautions

Insure Susquehanna River Conditions (eg. ice, high flow) will not endanger the health and safety of the sample collection crew.

Samples taken for turbidity measurements should be analyzed as soon as possible. Preservation of samples is not recommended. Maximum suggested holding time is 7 days. The presence of floating debris and coarse sediments which settle out rapidly will give low readings. Finely divided air bubbles will affect the results in a positive manner.

Samples intended for determination of total copper may be preserved by the addition of 5 ml of 1:1 HNO_3 per liter of sample. Such preservation stabilizes the samples for up to 6 months.

Samples intended for determination of dissolved copper must be filtered immediately through a 0.45μ membrane filter. The filtrate is then preserved by the addition of 5 ml of 1:1 HNO_3 per liter of sample. Stability of the preserved sample is approximately 6 months.

Samples taken for alkalinity determinations cannot be preserved. Suggested maximum holding time is 24 hours.

Samples intended for determination of total zinc may be preserved by the addition of 5 ml of 1:1 HNO_3 per liter of sample. Such preservation stabilizes the samples for up to 6 months.

Samples intended for determination of dissolved zinc must be filtered immediately through a 0.45μ membrane filter. The filtrate is then preserved by the addition of 5ml of 1:1 HNO_3 per liter of sample. Stability of the preserved sample is approximately 6 months.

Preservation of total dissolved solids samples is not practical. Analysis should be started as soon as possible. Suggested maximum holding time is 7 days. Too much residue in the evaporating dish will crust over and entrap water that will not be driven off during drying. Total residue should be limited to 200mg.

Maximum suggested holding time for sulfate sample preservation is 7 days.

Prerequisites and Requirements

None

Procedure

A. Field Measurements:

Temperature, pH, and dissolved oxygen measurements are made and recorded at each satation for each sampling period as described in GP 1450 (Benthic Macroinvertebrates), GP 1451 (Ichthyoplankton), and GP 1452 (Fish). Instrument calibration for these measurements is described in GP 1455.. (Instrument Calibration - IA).

I. Temperature Measurement.

1. Surface water temperature is taken with standard field thermometers.
2. The instrument is submerged for 15 seconds or until a stable reading is obtained.
3. The temperature is immediately read and is recorded on the appropriate field data sheet (GPF 1449.001 or GPF 1449.002).

II. pH Measurement.

1. Calibrate as in GP 1455.
2. Collect the sample in about a 250ml plastic jar.
3. Adjust TEMP control on the left side of the instrument to correspond to the temperature of the sample.
4. Immerse the probe in the sample and gently swirl.
5. Switch to the pH mode on the control knob.
6. After a stabilized readout is obtained, record the readout on the appropriate data sheet (GPF 1449.001 or GPF 1449.002).

III. Dissolved Oxygen Measurement.

1. Switch to RED LINE mode on control knob and align meter pointer to red line at the 31 C mark.
2. Switch to ZERO mode and adjust pointer to zero.
3. Remove the probe from its protective case and immerse it directly in the river in situ.
4. Switch to the appropriate scale, move the probe rapidly in a circular motion, and when a steady readout is obtained, record the readout on the appropriate field data sheet (GPF 1449.001 or GPF 1449.002).

B. Field Sample Collections:

In conjunction with the Benthic Macroinvertebrate program (TMI-2 ETS Section 3.1.2.a (1)(a), a one gallon grab sample is collected at each of the five sampling stations which are described in GP 1450. In addition, a duplicate sample is taken at one of the five stations (chosen randomly prior to sampling). Before the actual sample is collected, a pre-cleaned polyethylene bottle is rinsed with river water. The bottle is then submerged just below the surface and filled to the brim. The bottle is capped and a sample identification label is attached. The label contains the date, time, location, and initials of collectors.

The samples are transported to TMI in a cooler at approximately 4°C. The Supervisor of Radiation Protection and Chemistry will ensure that the samples are given to the company courier to be delivered to the System Lab.

C. Sample Analyses:

When the samples are received at the System Lab, the following analyses will be performed. All necessary precautions will be followed. Upon completion of the analyses, the results will be sent to IA and a designated RS&EE representative. Each report will include the sample locations, sample times and dates, analysis times and dates, precautions followed (if applicable), collector's initials, analyst's initials, and results.

I. Total and Dissolved Copper

1. To determine total copper content transfer a 100ml aliquot of well mixed sample to a beaker and add 5ml of 1:1 HCl. Heat sample for 15 minutes at 95°C on a hotplate. After this treatment the sample is filtered and the volume adjusted to 100ml. The sample is ready for analysis.

2. To determine dissolved copper content, filter the well mixed sample, as soon as possible after collection, through a 0.45μ membrane filter. Acidify the filtrate with 1:1 HNO_3 to a pH<2. The sample is ready for analysis.

3. Prepare a 5mg/l working standard by dilution of a 5ml stock solution to 1 liter with deionized water.

4. The following procedure is given in detail for the operation of the Perfin Elmer Model 403 atomic absorbtion spectrometer. Use of other units will require slight modifications to this procedure.

5. Open the air and acetylene supply valves to the AA unit. Adjust the acetylene regulator to 12-13 psig.

6. Turn the power switch to the on position.

7. Set the range control to UV.

8. Set the slit control to 0.4.

9. Install the Cu lamp and using the control on the lamp mount, adjust the lamp current to the value specified on the lamp. Adjust the gain control as necessary to keep the energy meter reading in the lower part of the pink band.

10. Set the wavelength control to 324.7. Peak for maximum reading on the energy meter. Re-adjust gain as necessary.

11. Align the burner head by raising, lowering or slanting it as necessary to position it approximately ⅛ inch below the beam with the slit in the beam's center. A white, ruled card will be helpful.

12. Check the fuel flow by depressing the fuel flow check button. Adjust the fuel pressure to 10 psig and the fuel flow to 40 units on the flowmeter if necessary.

13. Check the oxidant flow by depressing the oxidant flow check button. Adjust the oxidant pressure to 30 psig and the oxidant flow to 60 units on the flowmeter if necessary.

14. Light the burner by depressing the ignite button. When the ignitor flame appears, turn the gasses switch to the on position.

    NOTE: Demineralized water should be aspirated at all times when the burner is lighted to prevent excessive heating of the head. The only exception to this rule is when changing from air to nitrous oxide oxidant.

15. Depress the concentration and repeat buttons.

16. Depress the absorbance and then the auto zero buttons. The auto zero light should flash and then go out. The update light should flash rapidly and the display should indicate a value near zero.
17. Aspirate a 5.0 ppm Cu std. Adjust the burner height, depth and angle for the maximum absorbance reading on the display. An absorbance value of 0.200 or greater should be obtained.
18. Return the aspiration tube to the demineralized water blank and depress the concentration button.
19. When the readout has stabilized, press the auto zero button to zero the instrument.
20. Aspirate a Cu std. having a suitable concentration (slightly greater than maximum anticipated value) for the samples to be determined.
21. If the standard chosen is 5.0 ppm or less, adjust the concentration and concentration vernier controls so that the concentration of the standard appears on the readout. As the value is approached, the 10 average or 100 average buttons may be depressed for a more stable reading.
22. Return the aspiration tube to the demineralized water blank to check the zero point. If the zero has changed, repeat steps 18-21 inclusive.
23. Aspirate each of the samples to be determined. Use care not to cross contaminate the samples. The concentration will appear on the readout. The 10 average or 100 average modes may be used, depending upon the desired precision and stability.

    NOTE: If a large number of samples are to be run, recheck the standard and blank periodically to make sure that no shift has occurred.
24. When the last sample has been run, aspirate blank for several seconds, remove aspiration tube from the blank and move the gasses switch to the shutdown position.

25. Remove the Cu lamp and turn the power switch to the off position.

II. Total and Dissolved Zinc.

1. To determine total zinc content transfer a 100ml aliquot of well mixed sample to a beaker and add 5ml of 1:1 HCl. Heat sample for 15 minutes at 95° C on a hot plate. After this treatment the sample is filtered and the volume adjusted to 100ml. The sample is ready for analysis.

2. To determine dissolved zinc content, filter the well mixed sample, as soon as possible after collection, through a 0.45µ membrane filter. Acidify the filtrate with 1:1 HNO_3 to a pH<2. The sample is ready for analysis.

3. Prepare a 1 mg/l working standard by dilution of 1mg stock solution to 1 liter with deionized water.

4. The following procedure is given in detail for the operation of the Perfin Elmer Model 403 atomic absorbtion spectrometer. Use of other units will require slight modifications to this procedure.

5. Open the air and acetylene supply valves to the AA unit. Adjust the acetylene bottle regulator to 12-13 psig.

6. Turn the power switch to the on position.

7. Set the range control to UV.

8. Set the slit control to 4.

9. Install the Zn lamp and, using the control on the lamp mount, adjust the lamp current to the value specified on the lamp. Adjust the gain control as necessary to keep the energy meter reading in the lower part of the pink band.

10. Set the wavelength control to 214. Peak for maximum reading on the energy meter. Re-adjust gain as necessary.

11. Align the burner head by raising, lowering or slanting it as necessary to position it approximately ¼ in. below the beam with the slit in the beam's center. A white, ruled card will be helpful.
12. Check the fuel flow by depressing the fuel flow check button. Adjust the fuel pressure to 10 psig and the fuel flow to 40 units on the flowmeter if necessary.
13. Check the oxidant flow by depressing the oxidant flow check button. Adjust the oxidant pressure to 30 psig and the oxidant flow to 60 units on the flowmeter if necessary.
14. Light the burner by depressing the ignite button. When the ignitor flame appears, turn the gasses switch to the on position.

    NOTE: Demineralized water should be aspirated at all times when the burner is lighted to prevent excessive heating of the head. The only exception to this rule is when changing from air to nitrous oxide oxidant.
15. Depress the concentration and repeat buttons.
16. Depress the calibrate and then the auto zero buttons. The auto zero light should flash and then go out. The update light should flash rapidly and the display should indicate a value near zero.
17. Aspirate the 1.0 ppm standard. Adjust the burner height, depth and angle for the maximum absorbance reading on the display.
18. Return the aspiration tube to the demineralized water blank and depress the concentration button.
19. When the readout has stabilized, press the auto zero button to zero the instrument.

Aspirate the 1.0 ppm standard and adjust the concentration and concentration vernier controls so that the concentration of the standard appears on the readout. As the value is approached, the 10 average and 100 average buttons may be depressed for a more stable reading.

NOTE: If performing drewgard analysis aspirate the 1000 and 3000 ppm drewgard - 100 standards.

21. Return the aspiration tube to the demineralized water blank to check the zero point. If the zero has changed, repeat steps 18-20 inclusive.

22. Aspirate each of the samples to be determined. Use care not to cross contaminate the samples. The concentration will appear on the readout.

    The 10 average or 100 average modes may be used, depending upon the desired precision and stability.

    NOTE. If a large number of samples are to be run, recheck the standard and blank periodically to make sure that no shift has occurred.

23. When the last sample has been run, aspirate the blank for several seconds, remove the aspiration tube from the blank and move the gasses switch to the shutdown position.

III. Total Dissolved Solids.

1. Prepare and condition glass fiber filters prior to analysis by washing with three 20ml portions of deionized water. Remove all traces of water by applying vacuum using membrane filter apparatus and suction flask.

2. Prepare evaporating dishes by heating clean dish to $550^{\circ} \pm 50^{\circ}$ C in a muffle furnace for one hour. Cool in desiccator. Weigh dishes immediately prior to use.

3. Assemble filter apparatus and apply suction. Transfer a well mixed 100 ml aliquot of sample to the filter funnel. Note: If total dissolved solid content of the sample is known to be low, use of a larger aliquot is permissable.

4. Filter the sample through the glass fiber filter and continue to apply vacuum for at least three minutes after filtration is complete.

5. Transfer 100ml of the filtrate to a weighed evaporating dish and evaporate to dryness on a steam bath.

6. Dry the evaporated sample for at least one hour at 180 ± 2°C. Cool in a desiccator and weigh. Repeat drying cycle until a constant weight is obtained or until weight loss is less than 0.5mg.

7. Calculate total dissolved solids as follows:

$$\text{Total dissolved solids As mg/l} = \frac{(A-B) \times 1000}{C}$$

A = Weight of dried residue + dish in mg

B = Weight of dish in mg

C = Volume of filtrate used in ml

IV. Turbidity

1. Before turning the Hach Turbidimeter on, note whether the meter needle is at the zero point. If not, it may be zeroed by turning the small screw located below the meter.

2. Turn the Hach Turbidimeter power switch on. Allow five minues warm up time.

3. Standardize the instruments by inserting formazin standard and riser into the sample compartment. Adjust range selection switch to 100. Adjust meter to read certified value of formazin standard by turning STANDARDIZE control.

4. Remove formazin standard from sample compartment.

5. Shake sample to thoroughly disperse solids. Wait until air bubbles disappear. Than pour sample into turbidimeter sample tube. Insert tube and riser into sample compartment.

6. Read Turbidity as JTU directly from meter.

7. If turbidity of sample exceeds 40 JTU, dilute sample with appropriate volume of turbidity free water and repeat measurement. Calculate turbidity in this case by multiplying meter reading by dilution factor.

V. Alkalinity.

1. Measure out 50ml of sample into a white evaporating dish.

2. Add 2 drops phenolphthalein indicator and mix.

3. Titrate with .02N sulfuric acid until the red color completely disappears. Record the volume of acid used.

4. Add 2 drops of methyl purple indicator and mix.

5. Continue titrating with .02N sulfuric acid until the color changes from green to purple. Record the <u>total</u> volume of acid used.

6. Calculate the phenolphthalein alkalinity using the volume from Step 3 using the following formula:

$$P_{\text{alk as mg/l } CaCO_3} = \frac{\text{ml acid} \times N_{\text{acid}} \times 50{,}000}{\text{ml sample}}$$

Where N_{acid} = Normality of H_2SO_4

7. Calculate the total alkalinity using the volume from Step 5 using the following formula:

$$\text{Total Alkalinity AS mg/l } CaCO_3 = \frac{\text{ml acid} \times N_{\text{acid}} \times 50{,}000}{\text{ml Sample}}$$

Where N_{Acid} = Normality of H_2SO_4

VI. Sulfate.

1. Place 100 ml sample in a beaker.
2. Add 5ml conc. NH_4OH, boil to a volume of 50ml, and filter through #4 Whatman filter. Wash filter and adjust volume of filtrate to 100ml.
3. Adjust the acidity with HCl to pH 4.5-5.0 using a pH meter or methyl orange indicator.
4. Add an additional 10ml of HCl.
5. Heat the solution to boiling and while stirring add warm barium chloride solution until precipitation appears to be complete. Add 2 ml in excess. Digest the precipitate at 80-90°C for a minimum of 2 hours.
6. Preignite porcelain crucibles at 800° C for 1 hr., cool in a desiccator and weigh.
7. Filter sample at room temperature using filter crucible.
8. Wash the precipitate with small portions of deionized water until the washings are free of chloride as indicated by testing with silver nitrate-nitric acid reagent.
9. Dry the crucible and precipitate and ignite at 800° C for one hour.
10. Cool in desiccator and weigh.
11. $mg/l\ SO_4 = \frac{mg\ BaSO_4 \times 411.5}{ml\ Sample}$

D. Data Handling:

Data obtained from GPF 1449.001, GPF 1449.002, and CPU System Lab are transferred to data log sheets (GPF 1449.003). Entries are reviewed as logged. Data recorded on GPF 1449.003 include: date, station number (determined from descriptions and locations given in GP 1450, GP 1451, and GP 1452), results of the analyses, depth of sample, and initials of person(s) doing analysis.

Field and Laboratory data sheets are stored in a fire proof file cabinet at the LA office in Etters, Pennsylvania for the current year. Past year's data are presented in annual reports which are located in many separate locations.

E. Data Analyses:

At the end of each calendar year, a report will be written covering the previous 12 months of data. The report shall include summaries, analyses, interpretations, and statistical evaluation of the results of the monitoring described in this procedure. This report shall also include a comparison of all stations to determine if any environmental impact has resulted from station operation.

The mean, minimum, and maximum values of each parameter determined will be summarized and presented by month in the annual report. The temperature, pH, and dissolved oxygen values will be analized to assess and detect any changes related to TMINS operation. The water quality parameter values determined by GPU System Lab will be compared to densities of Limnodrilus Hoffmeisteri by accepted statistical methods useful for evaluating changes or differences that maybe related to TMINS operation.

F. Quality Control:

A duplicate sample is taken at one of the five stations (chosen at random prior to each sampling). The extra sample serves as an ongoing check on the procedures performed at GPU System Lab. The extra sample is labeled with the date, time, and initials of collectors. The location is recorded on GPF 1449.003, but not on the sample bottle sent to the GPU System Lab.

Semiannually, duplicate samples are taken at all stations. Half of the samples go to the GPU System Lab, and the other half are sent to another laboratory. Both laboratories analyze the sample for the same parameters.

The results of these split samples are recorded on GPF 1449.003

If large differences are indicated in the results, additional split samplings are performed.

Submitted;	Approved:	Concurrence:
B.J. Beck Engineering Assistant II	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

THREE MILE ISLAND AQUATIC STUDY

Field Data Sheet

Collection Number 1 [ ][ ][ ] 4 [ ][ ] 6 [ ][ ][ ]

No. Spmn _____ No. Egg _____ Mo 9 [ ][ ] Day 11 [ ][ ]

Collected by _____

Location _____ 13 [ ][ ][ ][ ][ ] Rep 18 [ ][ ]

Card No. 20 [1]

Program 01. Lennology Monitoring; 10. Plankton; 15. Entrainment, Plankton; 20. Macroinvertebrates; 30. Water Chemistry; 50. Fisheries Monitoring; 60. Ichthyoplankton; 61. Entrainment, Ichthyoplankton; 70. Tagging; 71. Food Habits; 72. Age & Growth; 80. Impingement; 90. Radiation; Other _____ 21 [ ][ ]

Gear 01. Liner sampler; 05. Ponar grab; 20. Pump; 10. Electroshocker AC; 51. Electroshocker DC; 60. 3m net, 3mm mesh; 70. Trawl, 16' ¼" mesh; 80. Common Seine, 10' x 4' x 1/8" mesh; 90. Trap net, 3' x 6' x ¼" mesh; Other _____ 23 [ ][ ]

Volts 25 [ ][ ][ ]

Amps 28 [ ][ ]

Pulse 30 [ ][ ]

Distance to Shore (m) 32 [ ][ ][ ][ ]

Meter No. _____ Cal Fac 36 [ ][ ][ ]

Revolutions: End _____ Begin _____ # Turns 39 [ ][ ][ ][ ]

No. of Hauls 43 [ ]

Type of Tow 1. Surface; 2. Vertical; 3. Oblique; 4. Bottom; 5. Midwater 44 [ ]

Substrate Type 1. Mud; 2. Sand; 3. Gravel; 4. Rubble; 5. Bed Rock 45 [ ][ ]

REMARKS

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79 [ ][1]

Card No. 20 [2]

Time 21 [ ][ ][ ][ ]

Duration of Sample (min) 25 [ ][ ][ ]

Temperature (°C) Air 28 [ ][ ][ ].[ ]

Water: Surface 32 [ ][ ][ ].[ ]

Oxygen (ppm) Surface 36 [ ][ ].[ ]

pH Surface 39 [ ][ ].[ ]

Conductivity (umhos) 42 [ ][ ][ ][ ][ ]

Secchi Disc (cm) 47 [ ][ ][ ].[ ]

Water Depth (m) 51 [ ][ ].[ ]

Current (cm/sec) Surface 54 [ ][ ][ ].[ ]

Bottom 58 [ ][ ][ ].[ ]

River Stage (m) 62 [ ][ ].[ ][ ]

River Flow (m^3/sec) 66 [ ][ ][ ][ ][ ].[ ]

Depth of Sample 72 [ ][ ].[ ]

Weather 1. Clear; 2. Partly cloudy; 3. Overcast; 4. Haze; 5. Fog; 6. Light rain; 7. Heavy rain; 8. Snow 75 [ ]

Nuclear Service Pumps 76 [ ]

Secondary Service Pumps 77 [ ]

Decay Heat Pumps 61-059 78 [ ]

79 [ ][2]

DATE:
COLLECTORS:

RIVER STAGE & FLOW:
METEOROLOGICAL CONDITIONS:

Station & Collection Number	Time	Temp. (C) Air	Temp. (C) H_2O	D.O. (ppm)	pH	Current Speed (cm/sec)	METER READINGS Beginning	METER READINGS End	Difference	Meter Factor	Volume (m^3)	NUMBER OF FISH PICKED & Initials of Picker A	NUMBER OF FISH PICKED & Initials of Picker B
							A						
							B						
							A						
							B						
							A						
							B						
							A						
							B						
							A						
							B						
GPF 1449.002 8/31/77 Rev. 0							A						
							B						
							A						
							B				.1		

TOTALS:

THREE MILE ISLAND AQUATIC STUDY
WATER QUALITY ANALYSIS
DATA LOG SHEET

Station	Date	Temp.	pH	Dissolved Oxygen	Turbidity	Alkalinity	Total Solids	Dissolved Solids	Copper Total	Copper Dissolved	Zinc Total	Zinc Dissolved	Sulfate	Depth of Sample	Initials of Person Doing Analysis

THREE MILE ISLAND NUCLEAR STATION
UNIT #2 SURVEILLANCE PROCEDURE 2325-M1
CHEMICAL RELEASE INVENTORY

Table of Effective Pages

Page	Date	Revision	Page	Date	Revision	Page	Date	Revision
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2.0			27.0			52.0		
3.0			28.0			53.0		
4.0			29.0			54.0		
5.0			30.0			55.0		
6.0			31.0			56.0		
7.0			32.0			57.0		
8.0			33.0			58.0		
9.0			34.0			59.0		
10.0			35.0			60.0		
11.0			36.0			61.0		
12.0			37.0			62.0		
13.0			38.0			63.0		
14.0			39.0			64.0		
15.0			40.0			65.0		
16.0			41.0			66.0		
17.0			42.0			67.0		
18.0			43.0			68.0		
19.0			44.0			69.0		
20.0			45.0			70.0		
21.0			46.0			71.0		
22.0			47.0			72.0		
23.0			48.0			73.0		
24.0			49.0			74.0		
25.0			50.0			75.0		

Unit 1 Staff Recommends Approval

Approval NA Date —

Cognizant Dept. Head

Unit 2 Staff Recommends Approval

Approval NA Date —

Cognizant Dept. Head

Unit 1 PORC Recommends Approval

NA Date —

Chairman of PORC

Unit 2 PORC Recommends Approval

J. A. Hauber Jr. Date 9-13-77

Vice Chairman of PORC

Unit 1 Superintendent Approval

NA Date —

Unit 2 Superintendent Approval

D. K. Hoelzer for D. F. Wally Date 9/13/77

Manager Generation Quality Assurance Approval NA Date —

61-062

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 SURVEILLANCE PROCEDURE 2325-M1

CHEMICAL RELEASE INVENTORY

1.0 PURPOSE

To assure/document compliance with E.T.S. 3.1.1. a (5).

2.0 PLANT STATUS

Not Applicable.

3.0 LIMITS AND PRECAUTIONS

Not Applicable.

4.0 LOCATIONS OF SYSTEMS

a. WT-T-8, caustic (NaOH) storage tank, Coagulator Building.

b. WT-T-7, acid (H_2SO_4) storage tank, Coagulator Building.

c. CL-T-1, chemical treatment acid (H_2SO_4) storage tank, Circulating Water Chlorination HOuse.

d. CL-T-1A thru CL-T-1J and CL-T-2A thru CL-T-2J, chemical treatment chlorine containers, Circulating Water Chlorination House.

e. Unit I chlorinator to river water pump house.

5.0 EQUIPMENT REQUIRED

Not Applicable.

6.0 PROCEDURE

6.1 Determination of caustic (NaOH) discharged

a. Calculate total gallons of NaOH received in the previous month. This can be taken from the Fuel Oil/Chemical Receiving Forms located in the Operations Department files or as a secondary source, the stores department.

b. Determine the amount of NaOH not used from the level indication on WT-T-8.

c. The difference between a. and b. above (a-b) is the amount of NaOH discharged during the month.

d. The duration and timing of NaOH discharges can be obtained from the completed Appendix C, Waste Neutralizing Tank Release Permit, of 2104-2.11. Record data on Data Sheet 1.

6.2 Determination of acid H_2SO_4 discharged from WT-T-7.

a. Calculate the total gallons of H_2SO_4 received in the previous month and added to WT-T-7. This can be done from the Fuel Oil/Chemical Receiving Forms located in the Operations Department files or as a secondary source, the stores department.

b. Determine the amount of H_2SO_4 not used from the level indication on WT-T-7.

c. The difference between a. and b. above (a-b) is the amount of H_2SO_4 discharged from WT-T-7 during the month.

d. The duration and timing of H_2SO_4 discharges from WT-T-7 can be obtained from the completed Appendix C, Waste Neutraliziang Tank Release Permit, of 2104-2.11. Record data on Data Sheet 1.

6.3 Determination of acid discharged from CL-T-1.

a. H_2SO_4 injected into the Circulating Water System to control the Ph of the circ water is done automatically. The amount of acid used is dependent of the Ph of the circulating water. Because of this it is impractical to determine H_2SO_4 usage from CL-T-1 on a monthly basis. To determine H_2SO_4 discharged from CL-T-1; calculate the total gallons of H_2SO_4 added to CL-T-1 in the previous six months. This can be taken from Fuel Oil/Chemical Receiving Forms located in the Operations Department files or as a secondary source, the stores department.

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b. Determine the amount of acid not used from the level indications on CL-T-1.

c. The difference between a. and b. above (a-b) is the acid discharged from CL-T-1 in the past six months.

6.4 Determination of Chlorine discharged from Unit II chlorination via Circulating Water System

a. Chlorine additions to the Circulating Water System are made automatically to retard algae growth in the circ water. The additions are made three times daily (once/8 hr) in preset quantities. To determine the amount of chlorine injected; obtain the timer setting (in minutes) and the flow setting (Lb/day) from the Chlorinator Control Panel in the Chlorinator Building.

b. Multiply the flow rate, by the time setting.

c. Multiply the number from part b. by 3. This will give the total addition rate of chlorine for any one 24 hour period.

d. To fine the total LB's of chlorine added per day divide the number from part c. by 1440. The resultant number is the total LB's of chlorine added per day.

e. To determine the number of days that the chlorinator has operated during the previous month; check the shift and daily log 2301-S.1.

f. To determine the chlorine injected per month, multiply the number from part d. by the number from part e.

6.5 Determination of Chlorine discharged from the Unit I Chlorinator via Unit II River Water Systems

a. The Unit I chlorinator operates similiar to the Unit II Circ Water Chlorinator. Determine the flow rate and the timer setting from the Chlorinator Control Panel in the Unit I Chlorinator House.

b. Multiply the flow rate by the timer setting.

c. Multiply the number from part b. by 3. This will give the total addition rate of chlorine for any one 24 hour period.

d. To find the total LB's of chlorine added per day divide the number from part c. by 1440. The resultant number is the total LB's of chlorine added per day.

e. To determine the number of days that the chlorinator has operated during the previous month; check the shift and daily logs 2301-S.1.

f. To determine the chlorine injected per month multiply the number from part d. by the number from part e.

DATA SHEET 1

MONTH _____

NEUTRALIZING TANK RELEASES

	DATE	TIME START	TIME STOP	DURATION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Total Duration _____

Total Caustic (NaOH) WT-T-8 _____

Total Acid (H_2SO_4) WT-T-7 _____

CHLORINE DISCHARGES

		Unit II Chlorinator	Unit I Chlorinator
a.	Timer setting		
b.	Flow rate setting		
c.	a. x b. x 3		
d.	e. ÷ 1440		
e.	Days Chlorinator Operated		
f.	Total LB's Chlorine d. x e.		

BENTHIC MACROINVERTEBRATES

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.2.a.(1)(a) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

Benthic macroinvertebrates shall be sampled to detect and assess the significance of changes in species composition, standing crop biomass, distribution, and abundance as related to Three Mile Island Nuclear Station (TMINS).

Discussion and Responsibilities

Metropolitan Edison Company's consultant (Ichthyological Associates, Inc. - IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. Elliot, J.M. 1971. Some methods for the statistical analysis of samples of benthic invertebrates. Freshwater Biological Association Scientific Publication No. 25. Ambleside, Westmorland, U.K. 144 pp.

4. Lloyd, M., J.H. Zar, and J.R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Amer. Midl. Nat. 79(2):257-272.

5. Sokal, R.R., and F.J. Rohlf. 1969. Biometry, the principles and practice of statistics in biological research. W.H. Freeman, San Francisco. 776 pp.

6. Whittaker, R.H., and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia Basin, southeastern Washington. Ecology 39:46-65.

7. Woolf, C.M. 1968. Principles of biometry. Van Nostrand Co., Lts., Toronto, Canada. 359 pp.

Apparatus and Attachments

a. Apparatus required:

Boat equipped with a motor.

Ponar grab sampler (23 x 23 cm).

Wide rimmed wash bucket.

Rinse container.

Large plastic buckets with lids or equivalent.

Taylor Bi-Therm Field Thermometer (Model 6074-1) or equivalent.

U.S. Standard No. 30 sieve (28 meshes per in., 0.595 mm openings).

Ten percent formalin solution.

Rose bengal stain.

Transparent tape.

Quart and gallon jars.

White enamel or clear glass pan.

Forceps.

Multiple-tally denominators.

Syracuse watch glasses.

Microscope slides.

Cover slips for slides.

Vials (1 to 14 dram capacity).

Amman's lactophenol (100 g phenol, 100 ml lactic acid, 200 ml glycerine, 100 ml water).

Hoyer's mounting media (50 ml water, 30 g gum arabic, 20 ml glycerine, 200 g chloral hydrate).

Ethanol (70 to 80%).

KOH (5 to 10%).

Stereo microscope.

Compound microscope.

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter or equivalent.

Photovolt Model 126A pH meter or equivalent.

Crucib.

Crucible tongs.

Drying oven.

Mettler H31 Balance (or equivalent).

Desiccator.

Drierite.

b. Attachments:

GPF 1450.001 - Description of macroinvertebrate stations.

GPF 1450.002 - Location of benthic macroinvertebrate stations in the vicinity of TMINS.

GPF 1450.003 - Macroinvertebrate collection label.

GPF 1450.004 - Three Mile Island Aquatic Study field data sheet.

GPF 1450.005 - Benthic data form.

Precautions

Insure Susquehanna River conditions (e.g. ice, high flow) will not endanger the health and safety of the benthic sample collection crew.

Prerequisites and Requirements

None.

Procedure

a. Field Procedure

Samples shall be collected semimonthly at the five macroinvertebrate stations in the vicinity of TMINS (conditions permitting). Replicate (4) samples are taken both inside and outside of the thermal plume. Description and location of macroinvertebrate stations are presented as GPF 1450.001 and GPF 1450.002. Samples are taken at each station with a 23 x 23 cm (529 cm^2) Ponar grab sampler.[1*] Each sample is first placed into a wide rimmed wash bucket, then into a large plastic bucket with the appropriate label. All residual

*Superscript refer to comments in Quality Control Sec[illegible].

substrate from the Ponar and wash bucket are rinsed with river water and placed with the rest of the sample in the plastic bucket, which is then fitted with a lid. The label consists of the date, replicate designator (A, B, C, or D), and a unique collection number (GPF 1450.003). The collection number consists of the initials of the biologist in charge, the last two digits of the year, and numbers running consecutively from 001 to 995. The last digit of the collection number designates the station location (e.g. 001-005, 011-015). Data recorded on the field data sheet (GPF 1450.004) at the time of collection include initials of collectors, gear, date, location, substrate type, time of day, air and water temperature[2], water depth, weather conditions, dissolved oxygen[2], pH[2], secchi disc, and surface and bottom current rate[2] (conditions permitting). River stage and flow, obtained from the River Forecast Center in Harrisburg, Pennsylvania, are also recorded.

b. Laboratory Procedure

Samples are returned to the lab no later than three hours after collection and washed through U.S. Standard No. 30 sieves (28 meshes per inch, 0.595 mm openings). Stones and sticks too large to be retained as part of the sample are carefully washed to remove attached organisms and discarded. The washed sample is placed in a quart or gallon jar with the field label and preserved in a mixture of 10% formalin and rose bengal stain (about one gram of rose bengal stain per litre of formalin). The stain facilitates sorting of macroinvertebrates from the detritus and sediment present in the sample. The sample is then stored until it is picked. A sample is allowed to stand for at least 24 hours prior to being picked to allow the dye to stain the organisms. The stained sample is wet sieved through a U.S. Standard No. 30 sieve to remove the solute of rose bengal stain. A portion of the sample is placed in a white enamel or clear glass pan and picked with unaided eye by a biologist

or trained personnel. When all the organisms are removed, the portion is discarded and another portion placed in the pan until the whole sample has been picked. As organisms are picked from the sample, they are sorted into major groups (i.e. Oligochaeta, Chironomidae, Mollusca, miscellaneous) and placed in Syracuse watch glasses with a small amount of water. Many oligochaetes are damaged when the samples are washed; only those with a complete anterior end are enumerated using a multiple-tally denominator. Every tenth oligochaete picked is placed in a watch glass from which individuals are selected for species determination.

Where practical all specimens from each sample are enumerated and identified to the lowest feasible taxon (GPF 1450.005, Page 1 of 2)[3].

Identification of oligochaetes is dependent on external and internal organs. Most Enchytraeidae, Naididae, and the tubificids Aulodrilus, Branchiura, Peloscolex, and Limnodrilus udekemianus can be identified by their somatic chaetae (hair-like structures present on all oligochaetes except the order Branchiobdellida) or external structures at all stages in their development. Sexually mature specimens are needed for species identifications of most Limnodrilus, Ilyodrilus, and Tubifex. Limnodrilus is the only tubificid collected possessing only bifurcate crotchet chaetae; Ilyodrilus and Tubifex additionally possess capilliform chaetae. All immature tubificids without capilliform chaetae are assumed to be immature Limnodrilus. Of the sexually mature Limnodrilus encountered during the sampling period, about 90% are L. hoffmeisteri; immature Limnodrilus are grouped with L. hoffmeisteri for interpretation of data. Immature Ilyodrilus and Tubifex collected are recorded as immature tubificids with capilliform chaetae (abbreviated it/cc on GPF 1450.005, Page 2 of 2). For data analysis, these are grouped with I. templetoni and T. tubifex and calculated on a percentage basis from the number of sexually mature specimens collected at each station.

Oligochaetes are re-sorted under a stereo microscope (8 to 40X) into the following groups: Naididae, Tubifex-Ilyodrilus, Peloscolex, Branchiura, megadrile, and Limnodrilus. Limnodrilus comprise the majority of oligochaetes collected; Limnodrilus selected for species determination are taken from the watch glass containing every tenth worm picked. Specimens to be identified from the other oligochaete groups are taken from all watch glasses containing oligochaetes. Individuals are then selected for species identification as follows: if the replicate sample contains 1 to 15 individuals of a group, all are used; 16 to 109 worms, 10 are randomly selected; 110 to 250, 10% of worms picked; 251 to 500, 25 worms; 501 to 1000, 30; 1001 to 1500, 35; and 1501+, 40 are randomly selected. Larger oligochaetes, such as megadriles, Peloscolex and Branchiura, can be identified without mounting on microscope slides.

Tubificid worms used for identification are placed in approximately one ml of Ammon's lactophenol in one dram vials with a label containing the collection number. Lactophenol digests muscle tissues, making it easier to observe internal structures. Heating the vials overnight in a drying oven (55 C) speeds the process. The worms are then rinsed in ethanol and mounted on microscope slides in Hoyer's mounting media. Naidid worms are cleared when mounted directly in Hoyer's mounting media. Each slide is labeled with the collection number on transparent tape. Organisms are identified with a compound microscope, recorded on a sheet of paper, then tallied and recorded on GPF 1450.005 under "No. on Slides". After identification, slides are retained at least one year.

Chironomids are grouped by recognizable genera (e.g. Chironomus, Procladius, Cryptochironomus, Polypedilum) and miscellaneous Chironomidae with a stereo microscope. Individuals of each group are counted, and a portion is removed for species determination as follows: 0 to 3 in a group, all are used for identification; 4 to 14, 50% are randomly selected (in case of odd numbers the higher number is retained for identification); 15 to 109, 10 individuals are

randomly selected; 110-250, 10%; 251-500, 25; 501 to 1000, 30. Numbers in each group retained for species identification are recorded on data form GPF 1450.005 under "No. on slides". Under "species" on GPF 1450.005 groups are assigned a letter designator ("A", "B", "C", etc. to "MISC"). Organisms retained for identification are placed in one dram vials in 80% ethanol with a label containing collection number and letter designator. Chironomids are cleared in a warm 5 to 10% solution of KOH and mounted on microscope slides in Hoyer's mounting media. Slides are labeled similarly to oligochaetes, but also contain the group letter designator. Identifications are recorded on data form GPF 1450.005 and slides are retained for at least one year.

Flatworms (Turbellaria) contract when preserved directly in formalin, which renders species identification difficult. They are determined to the class Turbellaria. The phyla Nemertinea and Nematoda are treated similarly. Numbers and biomass are not calculated for entoprocts and bryozoans because of their colonial nature.

Limicolous earthworms encountered unidentifiable to the family Lumbriculidae or Sparganophilidae are recorded as "megadriles" (a term which collectively encompasses many families of earthworms).

Leeches (Hirudinea) contract when preserved directly in formalin, which makes identification difficult. Large, mature specimens are needed for genus and species determinations in the family Erpobdellidae; immature or badly distorted specimens are identified only as Erpobdellidae. Mooreobdella microstoma has been the only erpobdellid collected identifiable to species. Individuals of M. microstoma are grouped with Erpobdellidae for diversity calculations.

Numbers of larval and pupal Diptera are combined for data interpretation.

If keys are unavailable or incomplete for species separation in some genera, apparently different species of a genus are given letter designators (i.e., Enkiefferiella sp. A, sp. B, etc.).

Organisms of each taxon are placed in separate crucibles and dried in a drying oven at 55 C for 24 hours, cooled in a desiccator, and weighed to the nearest 0.1 mg on a Mettler H31 balance[2]. During this process the crucibles are handled only with crucible tongs to avoid oil or moisture contamination. Weights are not determined for individuals less than 0.1 mg or those retained for taxonomic purposes. When possible, molluscan taxa are decalcified in a 7 to 8 M solution of HCl, rinsed in water, and weighed.

Where appropriate, enumeration, identification, calculated dry weight, and weight per individual are recorded on benthos data forms (GPF 1450.005, Page 2 of 2)[4]. In addition, the form includes number of organisms retained for identification ("No. on Slides"), number of organisms or each taxon weighed, the crucible used ("Cruc. No."), the weight of the crucible before and after the organisms have been added ($\frac{\text{"Tare + Organism (g)"}}{\text{Tare (g)}}$), and the actual dry weight. For the current year, field and data forms are stored at Ichthyological Associates' Office, Etters, Pennsylvania in a fireproof file cabinet. Past years' data are presented in annual reports which can be found in many separate locations.

c. Data Processing

Densities (number/m^2) are calculated for taxa that comprise more than one percent of the total number of organisms collected each year. Biomass (mg/m^2) is calculated for taxa that are present most of the year and contribute substantially to the overall biomass (e.g. Limnodrilus hoffmeisteri, Chironomus decorus, and Coniobasis virginica). Other taxa may be included if they become particularly abundant. Densities and biomass are calculated on a monthly basis at the end of the sampling year for presentation in the annual report.

Diversity indices are used to analyze community structure. Monthly estimates of diversity (information per individual) as defined by Shannon's formula:

$$D = \sum_{i=1}^{s} n_i/N \log_2 n_i/N$$

are computed for each station from the formula:

$$D = C/N \, (N\log_{10}N - \sum n_i \log_{10} n_i)$$

where D = information per individual, C = 3.321928 (converts $\log_{10}$ to $\log_2$), N = total number of individuals, n_i = total number of individuals in the i^{th} species, s = the number of species in the sample for a station (Lloyd et al. 1968). This index summarizes the number of taxa present and the distribution of individuals among the taxa. The similarity in species composition between sampling stations is investigated by an index of percent similarity (Whittaker and Fairbanks 1958). This index is expressed as:

$$PSc = 100 - 0.5 \sum |a - b|$$

where PSc = the percent similarity and a and b = the percentages of a species in samples A and B. This is a quantitative measure of the relative similarity of species composition in two samples.

Changes in populations of Limnodrilus hoffmeisteri are examined by a three-factor analysis of variance. Comparisons are made for years, sample dates, the macroinvertebrate stations, and interactions between these factors.

The distribution of benthic organisms is clumped rather than random; a logarithmic transformation $[\log_{10}(y+1)]$ is used on densities of L. hoffmeisteri for each replicate to normalize the data (Elliot 1971). The Student-Newman-Keuls multirange test (P = 0.05) is employed if differences are indicated (Woolf 1968).

A stepwise multiple regression is performed to examine the dependence of a variable (density of Limnodrilus hoffmeisteri) on two or more independent variables (e.g. water temperature, pH, dissolved oxygen, flow, etc.) (Sokal and Rohlf 1969).

d. Quality Control

1. If a benthic sample is taken and the Ponar does not close completely the Ponar is cleaned and a new sample taken.

2. Instrument calibrations are discussed in GP 1455.

3. Identification of benthic organisms are made by specialists. Specimens have been sent to experts for confirmation and identification. Records of identifications made by persons other than biologists at Ichthyological Associates, Etters, Pennsylvania are kept on file. Laboratory reference specimens are stored in 80% ethanol in 1 to 14 dram vials or on microscope slides. Taxonomic keys, reference collection, and descriptions in the following documents are presently used, as needed, in the identification of benthic organisms:

Beck, E.C., and W.M. Beck, Jr. 1969. Chironomidae (Diptera) of Florida. III. The Harnischia complex (Chironominae). Bull. Fla. St. Mus. 13(5):277-313.

Beck, W.M., Jr., and E.C. Beck. 1966. Chironomidae (Diptera) of Florida: I. Pentaneurini (Tanypodinae). Bull. Fla. St. Mus. 10(8):305-379.

Beck, W.M. 1976. Biology of larval chironomids. Fla. Dept. of Environmental Regulation Technical Series 2(1). 58 pp.

Boesel, M.W. 1974. Observations on the Coelotanypodini of the northeastern states with keys to the known stages (Diptera:Chironomidae:Tanypodinae). J. Kans. Ent. Soc. 47(4):417-432.

Brinkhurst, R.O., and B.G.M. Jamieson. 1971. Aquatic Oligochaeta of the world. University of Toronto Press, Toronto. 860 pp.

Brown, H.P. 1972. Biota of freshwater ecosystems identification manual No. 6. Aquatic dryopoid beetles (Coleoptera) of the United States. U.S. Government Printing Office, Washington, D.C. 82 pp.

Burch, J.B. 1973. Biota of freshwater ecosystems identification manual No. 11. Freshwater unionacean clams (Mollusca:Pelecypoda) of North America. U.S. Government Printing Office, Washington, D.C. 176 pp.

Burks, B.D. 1975. The mayflies, or Ephemeroptera, of Illinois. [First published in 1953 as Illinois Nat. Hist. Survey, Bull. 26(1)]. Reprinted by Entomological Reprint Specialists, Los Angeles, California.

Curry, L.L. 1958. Larvae and pupae of the species of Cryptochironomus (Diptera) in Michigan. Limnol. and Oceanogr. 3(4):427-442.

Edmondson, W.T. (editor). 1959. Freshwater biology. Second edition. John Wiley and Sons, New York, New York. 1248 pp.

Edmunds, G.F., S.L. Jensen and L. Berner. 1976. The mayflies of North and Central America . Univ. of Minnesota Press, Minneapolis. 330 pp.

Foster, N. 1972. Biota of freshwater ecosystems manual No. 4. Freshwater polychaetes (Annelida) of North America. U.S. Government Printing Office, Washington, D.C. 15 pp.

Harman, W.N., and C.O. Berg. 1971. The freshwater snails of central New York with illustrated keys to the genera and species. Cornell Univ. Ag. Exp. Sta., Ithaca, New York 1(4):1-68.

Hilsenhoff, W.L. 1975. Aquatic insects of Wisconsin. Technical Bull. No. 89. Dept. of Natural Resources, Madison, Wisconsin. 53 pp.

Hiltunen, J.K. 1973. Keys to the tubificid and naidid Oligochaeta of the Great Lakes region. Second edition. Great Lakes Fishery Laboratory, Ann Arbor, Michigan. 25 pp.

Holsinger, J.R. 1972. Biota of freshwater ecosystems identification manual No. 5. The freshwater amphipod crustaceans (Gammaridae) of North America. U.S. Government Printing Office, Washington, D.C. 89 pp.

Howmiller, R., and M.S. Loden. 1976. Identification of Wisconsin Tubificidae and Naididae. Wisc. Acad. Sci. Arts, Lett. 64:185-197.

Hungerford, J.B. 1976. (First published 1948 as Univ. Kansas Sci. Bull. 32). The Corixidae of the Western Hemisphere. Reprinted by Entomological Reprint Specialists, Los Angeles, California. 827 pp.

Johannsen, O.A. 1969. Aquatic Diptera. (First published in 1934, 1935, 1937, and 1937 as Parts I through IV. Memoirs 164, 177, 205, and 210 Cornell Univ. Exp. Station). Reprinted by Entomological Reprint Specialists, Los Angeles, California. 369 pp.

Klemm, D.J. 1972. Biota of freshwater ecosystems identification manual No. 8. Freshwater leeches (Annelida:Hirudinea) of North America. U.S. Government Printing Office, Washington, D.C. 53 pp.

Mason, W.T. 1973. An introduction to the identification of chironomid larvae. Environmental Protection Agency, Cincinnati, Ohio. 90 pp.

Needham, J.G.,and M.J. Westfall, Jr. 1955. A manual of the dragonflies of North America (Anisoptera), including the Greater Antilles and the provinces of the Mexican border. Univ. of California Press, Berkeley and Los Angeles. 615 pp.

Parrish, F.K. 1975. Keys to water quality indicative organisms of the southeastern United States (second edition). U.S.E.P.A., Cincinnati, Ohio. 195 pp.

Reynolds, J.W. 1975. Sparganophilus pearsei n. sp. (Oligochaeta:Sparganophilidae) a nearctic earthworm from western North Carolina. Megadrilogica. 2(2):9-11.

_____. 1977. The earthworms of Tennessee (Oligochaeta). II. Sparganophilidae, with the description of a new species. Megadrilogica. 3(3):61-64.

Roback. S.S. 1957. The immature tendipedids of the Philadelphia area. Monogr. Acad. Nat. Sci. Philad. No. 9. 180 pp.

_____. 1974b. The immature stages of the genus Coelotanypus (Chironomidae: Tanypodinae:Coelotanypodini) in North America. Proc. Acad. Nat. Sci. Philad. 127(2):9-19.

_____. 1976. The immature chironomids of the eastern United States. I. Introduction and Tanypodinae-Coelotanypodini. Proc. Acad. Nat. Sci. Philad. 126(2):9-19.

Ross, H.H. 1972. The caddisflies, or Trichoptera, of Illinois. [First published in 1944 as Illinois Nat. Hist. Survey, Bull. 23(1).] . Reprinted by Entomological Reprint Specialists, Los Angeles, California. 326 pp.

Saether, O.A. 1975. Nearctic and Palaearctic Heterotrissocladius (Diptera: Chironomidae). Bull. Fish. Res. Board Can. 193. 65 pp.

_____. 1976a. Keys to larvae and pupae of Orthocladiinae and Telmatogetoninae. 61 pp. (Unpublished).

_____. 1976b. Revision of Hydrobaenus, Trissocladius, Zalutschia, Paratrissocladius, and some related genera (Diptera:Chironomidae). Bull. Fish. Res. Board Can. 195:287 pp.

_____. 1977. Taxonomic studies on Chironomidae:Nanocladius, Pseudochironomus, and the Harnischia complex. Bull. Fish. Res. Board Can. 196. 143 pp.

Sawyer, R.T. 1972. North American freshwater leeches, exclusive of the Piscicolidae, with a key to all species. Illinois Bio. Monogr. 46. 154 pp.

Teskey, H.J. 1969. Larvae and pupae of some eastern North American Tabanidae (Diptera). Mem. Ent. Soc. Can. 63. 147 pp.

Teskey, H.J. and J.F. Burger. 1976. Further larvae and pupae of eastern North American Tabanidae (Diptera). Can. Ent. 108(10). 1085-1096.

Usinger, R.L. (editor). 1956. Aquatic insects of California with keys to North American genera and California species. Univ. of California Press. Berkeley and Los Angeles. 508 pp.

Walker, E.M. 1958. The Odonata of Canada and Alaska. Volume Two. Part III: the Anisoptera - four families. Univ. of Toronto Press, Toronto. 318 pp.

Walker, E.M., and P.S. Corbet. 1975. The Odonata of Canada and Alaska. Volume Three. Part III; The Anisoptera - three families. Univ. of Toronto Press, Toronto and Buffalo. 307 pp.

Wiggins, G.B. 1977. Larvae of the North American caddisfly genera. Univ. of Toronto Press, Toronto. 401 pp.

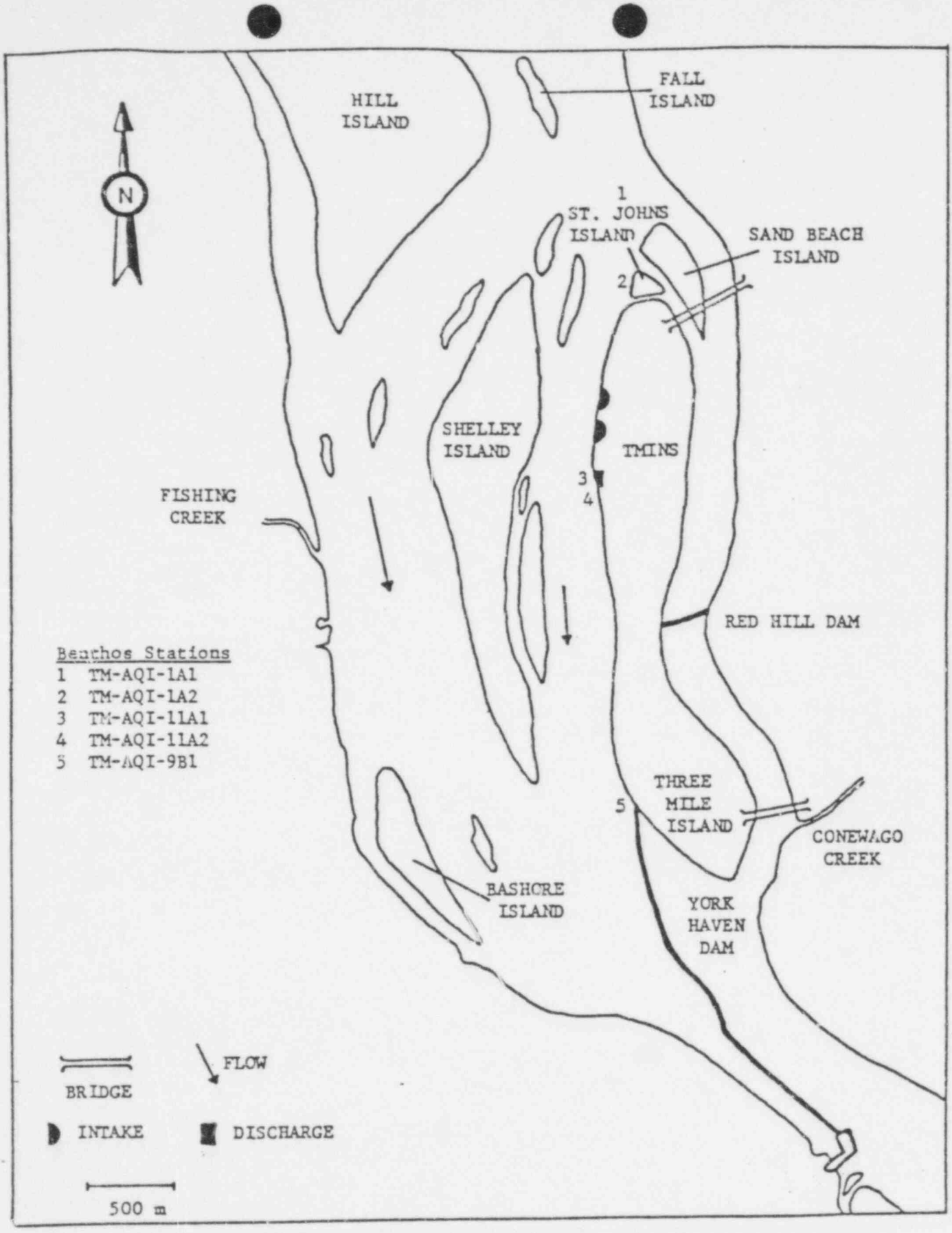
4. Correct completion of field and data forms is performed by an experienced biologist. Data forms include initials of picker, date collected, bottom type, collection number and date processed.

Submitted:	Approved:	Concurrence:
J.E. Mudge Environmental Scientist	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

Description of macroinvertebrate stations.

Station Number	Description
TM-AQI-1A1	40° 09' 52" N, 76° 43' 26" W. North end of Sand Beach Island, 30 to 75 m offshore. Water depth varied from 0.5 to 2.0 m. Substrate composed of sand, coal particles, and detritus; sometimes with mud and/or clay. Trace amounts of oil sometimes present.
TM-AQI-1A2	40° 09' 36" N, 76° 43' 30" W. Southwest St. Johns Island, 1 to 15 m offshore at mouth of channel between TMI and St. Johns Island. Water depth varied from 0.5 to 1.5 m. Substrate composed mostly of sand, coal particles, mud, and detritus; sometimes with gravel or clay. Trace amounts of oil sometimes present.
TM-AQI-11A1	40° 09' 09" N, 76° 43' 39" W. 1 to 10 m downstream from TMI Discharge, 1 to 15 m offshore. Water depth varied from 0.25 to 1.0 m. Substrate composed of mud mixed with coal particles, fine sand, and detritus; sometimes with muck, clay, or gravel. Trace amounts of oil present.
TM-AQI-11A2	40° 09' 07" N, 76° 43' 39" W. 70 to 75 m downstream from TMI Discharge, 1 to 15 m offshore. Water depth varied from 0.25 to 1.5 m. Substrate composed of mud with fine sand, some coal particles, and detritus; sometimes with clay. Trace amounts of oil present.
TM-AQI-9B1	40° 08' 03" N, 76° 43' 33" W. 1900 m downstream from TMI Discharge, 5 to 15 m offshore. Water depth varied from 0.75 to 1.5 m. Substrate composed of mud with muck, detritus, and fine sand, with some coal particles. Trace amounts of oil present.



Location of benthic macroinvertebrate stations in the vicinity of TMINS.

Macroinvertebrate Collection Label.

JHE 77 001A

9 May 1977

61-083

THREE MILE ISLAND AQUATIC STUDY

Field Data Sheet

Collection Number 1 JHE 4 77 6 181

No. Spmn _____ No. Sop _____

Collected by JHE, JLP — Mo 9 08 — Day 11 02

Location N. Sand Beach Ts. IA1 — 13 _____ Rep 18 _____

Card No. 20 1

Program 01. Lonestarr Monitoring; 10. Plankton; 15. Entrainment, Plankton; 30. Macroinvertebrates; 50. Water Chemistry; 60. Fish-ess Monitoring; 60. Ichthyoplankton; 61. Entrainment, Ichthyoplankton; 70. Tagging; 71. Food Habits; 72. Age & Growth; 80. Impingement; 90. Radiocesium; Other _____ — 21 20

Gear 01. Liner samplers; 05. Petter grab; 70. Pump; 50. Electro-fisher AC; 51. Electro-fisher DC; 60. Set net, 3inch mesh; 75. Trawl, 16' 3" mesh; 80. Common Seine, 10' x 4' x 1/8" mesh; 90. Trap net, 3' x 6' x 3" mesh; Other _____

23 _____

Volts — 25 _____

Amps

Pulse

Distance to Shore (m) — 32 _____

Meter No. _____ — 36 _____

Revolutions: End _____ Begin _____

No. of Hau — 43 _____

Type of T — 44 _____

Substrate Type — 45 2

REMARKS

GPP 1450.004
8/31/77
Rev. 0

78 _____

Page 1 of 1

79 1

Card No. 20 2

Tim — 22 0930

Durat / ample (m — 25 _____

Temperature (

Air — 28 225

er: Surface — 32 245

Oxygen (ppm) Surface — 36 6.3

pH Surface — 39 7.9

Conductivity (umhos) — 42 _____

Secchi Disc (cm) 18" — 47 475

Water Depth (m) — 51 _____

Current (cm/sec) Surface — 25 _____

Bottom — 58 _____

River Stage (m) — 62 1.13

River Flow (m^3/sec) — 66 3085

Depth of Sample — 72 0.5

Weather 1. Clear; 2. Partly cloudy; 3. Overcast; 4. Hazy; 5. Fog; 6. Light rain; 7. Heavy rain; 8. Snow — 75 1

Nuclear Service Pumps — 76 _____

Secondary Service Pumps — 77 _____

Decay Heat Pumps — 78 _____

79 1

BENTHIC DATA FORM

Collection No JHE 77 0638 Picked by JHE
Date Collected 1 June 77 Bottom Type Mud - Oyster Reef
Date Processed 20 June 77

Species	No. Slides	No. Coll.	Calculated Total Dry Wt. (mg)	Average Weight per Indiv. (mg)	No. Weighed	Cruc. No.	Tare + Organism(g) Tare (g)	D We
Nemertinea		1			—			
Nematoda		1			—			
Tubifex	2	2			—			
Limnodrilus	40	1649			160	15E	7.7195	
Asellus sp		1			—			
Gammarus fasciatus		3			3	47E	7.2020	
"A"	30	524			544	41E	7.8431	
"B"		13			6	34E	7.8025	
mis	4	4			—			
Genio[illegible]rgmicr		14			14	32E	7.6465	
Pisidium spp.		3			—			
Sphaerium spp		4			4	37	7.6061	

EXAMPLE

GPP 1450.005
8/31/77
Rev. 0

61-085

BENTHIC DATA FORM

Collection No. JHE 77 063B
Date Collected 1 June 77
Date Processed 20 June 79

Picked by JHE
Bottom Type Mud - detritus

Species	No. on Slides	No. Coll.	Calculated Total Dry Wt. (mg)	Average Weight per Indiv. (mg)	No. Weighed	Cruc. No.	Tare + Organism(g) / Tare (g)	Dry Weig (mg
Nemertinea		1			—			
Nematoda		1			—			
Tubifex tubifex	2	1			—			
it/ec		1			—			
Limnodrilus	40	1649	255.3	0.1	1600	15E	7.9676 / 7.7185	249.
L. hoffmeisteri	19	783	121.2					
L. spp.	21	866	134.1					
Asellus sp.		1			—			
Gammarus fasciatus		3			3	47E	7.2035 / 7.2020	1.5
Chironomus decorus "A"	30	574	84.1	0.1480	544	41E	7.9236 / 7.8431	80.5
Procladius sp. "B"	7	13	2.2	0.0167	16	34E	7.8026 / 7.8025	0.1
misc.	4				—			
Ablabesmyia								
Cryptochironomus nr. fulvus		3						
Goniobasis livescens		14	317.0		14	32E	7.9635 / 7.6465	317.0
Pisidium sp.		3			—			
Sphaerium spp.		4	15.1		4	37	7.6212 / 7.6061	15.1

ICHTHYOPLANKTON

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.2.a.(1)(b) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

The far-field ichthyoplankton program will investigate the presence and species composition of larval and young fishes in Lake Frederic (York Haven Reservoir). Base line information on yearly fluctuations in spawning activity and natural fluctuations in the larval densities of various species within the reservoir will be gathered. Data will be used for comparison with estimates of entrained larvae [TMI-2, ETS - Section 3.1.2.a.(3)] to evaluate the possible effects of the Three Mile Island Nuclear Station (TMINS) operation on ichthyoplankton populations in the lower Susquehanna River.

Discussion and Responsibilities

Metropolitan Edison Company's consultant (Ichthyological Associates, Inc. - IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. Armstrong, P.B. 1962. Stages in the development of Ictalurus nebulosus. Syracuse Univ. Press. Syracuse, N.Y.

4. Bailey, R.M., J.E. Fitch, E.S. Herald, E.A. Lachner, C.C. Lindsey, C.R. Robins, and W.B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada. Amer. Fish. Soc. Special Publ. No. 6. 150 pp.

5. Battle, H.I. 1940. The embryology and larval development of the goldfish, Carassius auratus Lesueur, from Lake Erie. Ohio. J. Sci., 40(2):82-93.

6. Cooper, J E. 1976. Eggs and larvae of the logperch, Percina caprodes. M.S. Thesis, Appalachian Environmental Laboratory, University of Maryland.

7. Fish, M.P. 1932. Contribution to the early life histories of sixty-two species of fishes from Lake Erie and its tributary waters. U.S. Bur. Fish. Bull. 47(10):293-398.

8. Gerlach, J.M. 1973. Early development of the quillback carpsucker, Carpiodes cyprinus. M.S. Thesis, Millersville State College. Millersville, Pennsylvania.

9. Hogue, J.J., Jr., R. Wallus, and L.K. Kay. 1976. Preliminary guide to the identification of larval fishes in the Tennessee River. Tennessee Valley Authority, Division of Forestry, Fisheries, and Wildlife Development. Tech. Note B19. 67 pp.

10. Lippson, A.J. and R.L. Moran. 1974. Manual for identification of early developmental stages of fishes of the Potomac River Estuary. Martin Marietta Corporation, Environmental Technology Center. Baltimore, Maryland. 282 pp.

11. Lloyd, M., J.H. Zar, and J.R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Amer. Midl. Nat. 79(2):257-272.

12. Mansueti, A.J. 1964. Early development of the yellow perch, Perca flavescens. Ches. Sci. 5(1-2):46-66.

13. Mansueti, A.J. and J.D. Hardy, Jr. 1967. Development of fishes of the Chesapeake Bay region; an atlas of egg, larval, and juvenile stages. Natural Resources Institute. University of Maryland. 202 pp.

14. May, E.B. and C.R. Gasaway. 1967. A preliminary key to the identification of larval fishes of Oklahoma, with particular reference to Canton Reservoir, including a selected bibliography. Oklahoma Department of Wildlife Conservation Bull. No. 5. 42 pp.

15. Meyer, F.A. 1970. Development of some larval centrarchids. Prog. Fish-Cult. 32(3):130-136.

16. Nelson, W.R. 1968. Embryo and larval characteristics of sauger, walleye, and their reciprocal hybrids. Trans. Am. Fish. Soc. 97(2):167-174.

17. Norden, C.R. 1961. The identification of larval yellow perch, Perca flavescens and walleye, Stizostedion vitreum. Copeia 1961 (3): 282-288.

18. Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. J. Theoret. Biol. 13: 131-144.

19. Poole, R.W. 1974. Introduction to quantitative ecology. McGraw Hill, New York. 532 pp.

20. Siefert, R.E. 1969. Characteristics for separation of white and black crappie larvae. Trans. Am. Fish. Soc. 98(2):326-328.

21. Snyder, D.E. 1976. Terminologies for intervals of larval fish development. pp. 41-60. In J. Borman, editor. Great Lakes fish egg and larvae identification: proceedings of a workshop. U.S. Fish and Wildlife Service. National Power Plant Team. Ann Arbor, Michigan.

22. Snyder, D.E. and M.B. Snyder. 1975. Terminologies for early development forms of teleosts. A paper prepared for presentation at the meeting of the Northeast Division of the American Fisheries Society, February, 1975, New Haven, Connecticut. Rice Division, NUS Corporation Ecological Sciences Center, Pittsburgh, Pennsylvania. 52 pp.

23. Sokal, R.R. and F.J. Rohlf. 1973. Introduction to biostatistics. W.H. Freeman and Co., State University of New York. 368 pp.

24. Stewart, N.H. 1926. Development, growth, and food habits of the white sucker, Catostomus commersoni Lesueur. U.S. Bur. Fish. Bull. 42:147-181.

25. Taber, C.A. 1969. Distribution and identification of larval fishes in the Buncombe Creek Arm of Lake Texoma with observations on spawning habits and relative abundance. Ph.D. Thesis, University of Oklahoma. 106 pp.

26. Weber, C.I., ed. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. National Environmental Research Center. Cincinnati, Ohio.

27. Whittaker, R.H. and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia Basin, Southeastern Washington. Ecology 39:46-65.

Apparatus and Attachments

a. Apparatus required:

A standard field thermometer (C).

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter or equivalent.

Photovolt Model 126A pH meter or equivalent.

Marsh-McBirney (Model 201) Portable Water Current Meter or equivalent.

Boat equipped with a motor.

Push net apparatus and frame.

Half-meter plankton nets (0.5 mm mesh) fitted with detachable cups

General Oceanics Digital flow meter (Model 2030).

Glass or plastic jars with tight fitting lids.

U.S. Standard No. 30 mesh sieve.

White enamel pan.

37% commercial solution formaldehyde diluted to 25, 10, and 5%.

Glass vials with tight fitting lids.

Bausch and Lomb binocular dissecting scope (7X to 30X) or equivalent.

Ocular micrometer.

Helios precision dial caliper or equivalent.

Dissecting forceps (fine).

Dissecting needles.

b. Attachments:

GPF 1451.001 - Description of ichthyoplankton push net stations in York Haven Reservoir.

GPF 1451.002 - Locations of ichthyoplankton push net stations sampled in York Haven Reservoir.

GPF 1451.003 - Ichthyoplankton Field and Laboratory Sheet.

GPF 1451.004 - Sample Label.

GPF 1451.005 - Laboratory Data Sheet.

Precautions

Insure Susquehanna River conditions (e.g. ice, high flow) will not endanger the health and safety of the ichthyoplankton crew.

Prerequisites and Requirements

None.

Procedure

a. Field Procedure

Samples are taken weekly at 14 stations in Lake Frederic in the vicinity of TMINS, April through August (conditions permitting). Station descriptions and locations are given in GPF 1451.001 and GPF 1451.002. Day and night samples shall be taken each week, at each location, about 12 hours apart. Replicate (2) surface samples are taken with paired 0.5 m plankton nets (0.5 mm mesh) set off the front of a boat. Each net mouth measures 0.46 m x 0.46 m and each net tapers to a length of about 1.5 m. At the cod end of each net is fastened a detachable cup for removal of the sample. The nets are pushed upstream, 10 to 20 m offshore (depending on flow conditions) for 4 mimutes, traveling about 200 m at each station. The 14 stations are sampled in random order each week to minimize the bias of "time" when the samples are taken. The order is preselected weekly by the use of a random numbers key on a calculator, or a random numbers table.

Before setting the nets at each station, a flow meter reading is taken and recorded on GPF 1451.003. Time is recorded when the nets are set. After the sample is taken, the flow meter readings are again recorded; both nets are rinsed three times and each filtrate is poured into prelabeled quart jars. Labels on the jar lids are for quick identification only and include station number and replicate (1 through 14, replicate A or B).

Sample labels within the jars include collection number (consisting of the program biologist's initials, the last two digits of the year, and numbers running consecutively from 001 to 999), replicate, station number, date, and station name. The format is presented in GPF 1451.004.

Samples are immediately preserved in no less than 20% formalin (more if gammarids or suspended debris is present). Recorded with each sample are selected environmental parameters: air and water temperature, dissolved oxygen, pH, and surface current rate (conditions permitting). Also recorded for each sampling date is river stage and flow obtained from the River Forecast Center in Harrisburg, Pennsylvania (see GPF 1457.003).

Samples are returned to the laboratory and stored until they are sorted.

b. Laboratory Procedure

Samples are rinsed with water through a U.S. Standard No. 30 mesh sieve, and washed into a white enamel pan to facilitate removal of the larvae. Specimens are enumerated and recorded on GPF 1451.003 and stored with the field label (GPF 1451.004) in glass vials with 10% formalin for later identification; only specimens ≤ 25 mm are reported. Larvae are later examined under a binocular dissecting scope and identified to the lowest feasible taxon. Measurements are taken to the nearest 0.5 mm with an ocular micrometer or a Helios precision dial caliper and larvae are catagorized as to life stage (as per Snyder 1976). This information is recorded and enumerated on GPF 1451.005. Specimens are then labeled as per GPF 1451.004 with the inclusion of the species and number in the vial, and stored by date in about a 5% formalin solution.

Life stages are defined as: egg - the embryo before hatching; larva - the early development of the fish after hatching during which the fins are formed and the larval finfold is absorbed. The larval stage is further

divided into: (1) protolarvae (P) characterized by the lack of formed rays in the fins and finfold (includes the yolk-sac bearing larvae); (2) mesolarvae (ms) characterized by the development of finrays in the finfold, development of the median fins and absence of pelvic fins; (3) metalarvae (mt) characterized by the presence of the pelvic fins (or fin buds). The term young is used for fishes of the current year's spawn which are fully transformed larvae, characterized by complete absorption of the larval finfold and attainment of the adult compliment of rays and spines in all fins.

In large samples, only the first 100 of any one species are measured and classified as to life stage. Identifications are made with keys and descriptions by Armstrong (1962), Battle (1940), Cooper (1976), Fish (1932), Gerlach (1973), Hogue et al. (1976), Lippson and Moran (1974), Mansueti (1964), Mansueti and Hardy (1967), May and Gasaway (1967), Meyer (1970), Nelson (1968), Norden (1961), Siefert (1969), Stewart (1926), Snyder and Snyder (1975), and Taber (1969), as well as intercompany and personal laboratory notes, personal communications, and by comparisons with the laboratory reference collection. Identifications, verifications, and advice are obtained from experts in the field as needed. Records of identifications made by persons other than the biologist at LA in Etters, Pennsylvania are recorded and kept on file.

c. Data Processing

Numbers of larvae caught are standardized to estimate density, by converting to numbers per 100 cubic meters of water (n/100 m^3), by:

$$\frac{\text{n (fish in net A)}}{\text{m}^3\text{ (volume filtered by net A)}} \times 100$$

The volume (m^3) filtered by each net is obtained by dividing the number of flow meter turns by a constant factor (F), which is the number of turns/m^3 for that meter. This factor is obtained by a yearly calibration (GP 1455). Mean densities

are obtained by averaging the catch of each net per collection:

$$\frac{n/100\ m^3 \text{ of A} + n/100\ m^3 \text{ of B}}{2}$$

Analysis is done on densities and numbers of ichthyoplankton by analyses of variance, analyses of covariance, multiple regressions/correlations (Sokal and Rohlf 1973), percentage similarity values (Whittaker and Fairbanks 1958; Poole 1974), diversity indices (Lloyd et al. 1968; Pielou 1966; Poole 1974; Weber 1973), or any other accepted method useful for determining and evaluating changes or differences between the preoperational and postoperational phase; upstream and downstream; and east, middle and west reservoir ichthyoplankton populations.

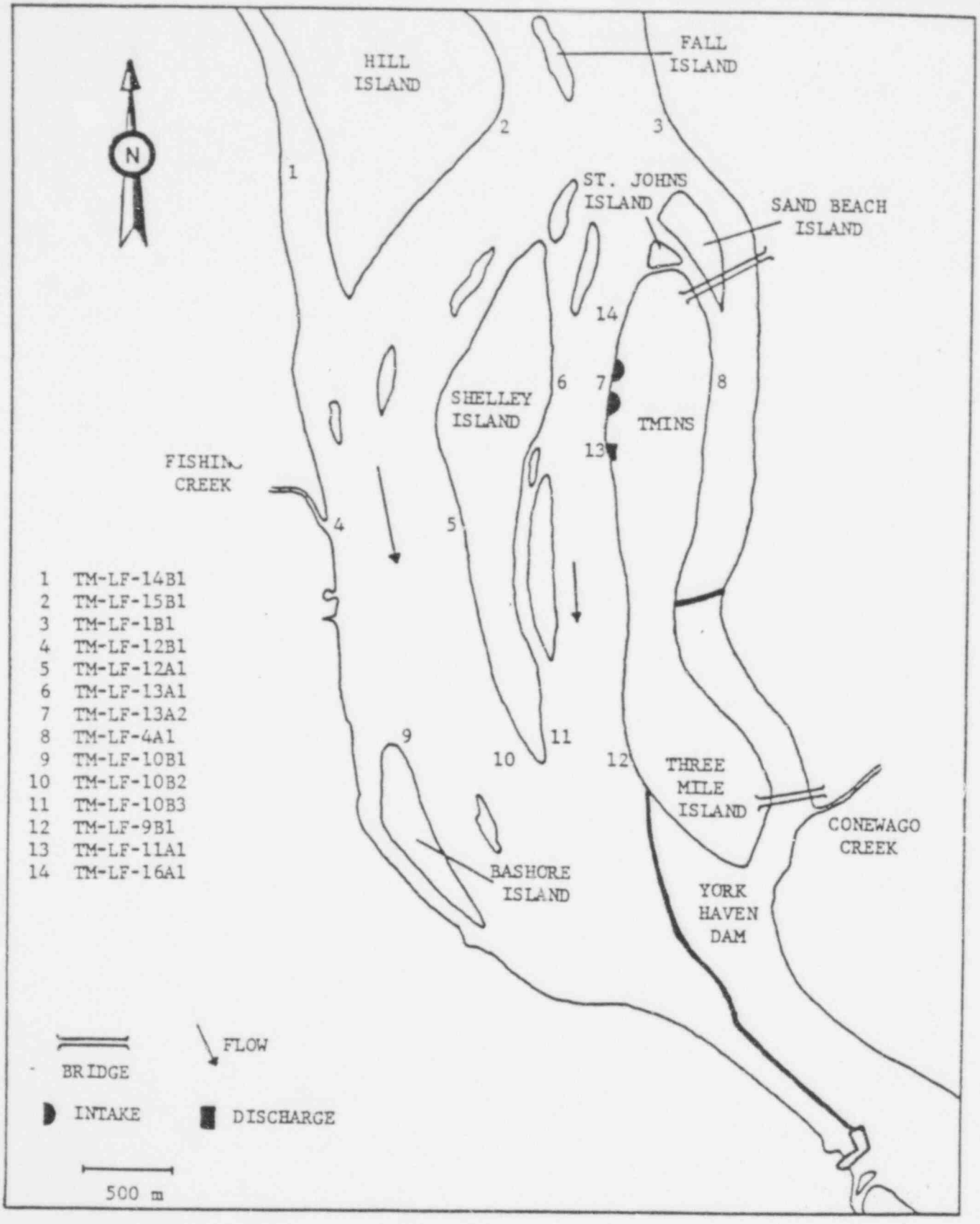
The ichthyoplankton data for the current year will be stored in a fireproof file cabinet. Past year's data are presented in annual reports which can be found in many separate locations.

Submitted:	Approved:	Concurrence:
J.E. Mudge Environmental Scientist	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

Description of ichthyoplankton push net stations in York Haven Reservoir.

Station Number	Description
1) TM-LF-14B1	40° 10' 12" N, 76° 45' 00" W beginning from a point about 700 m downstream from the fall-line riffles along the west shore of York Haven Pond. Water depth varied from 1.0 to 1.5 m.
2) TM-LF-15B1	40° 10' 02" N, 76° 44' 14" W beginning from a point east of Hill Island about 500 m below the fall-line riffles. Water depth varied from 1.0 to 1.5 m.
3) TM-LF-1B1	40° 10' 11" N, 76° 43' 27" W beginning from a point upstream of the Tri County Marina along the east shore of York Haven Pond. Water depth varied from 1.0 to 2.0 m.
4) TM-LF-12B1	40° 08' 45" N, 76° 44' 46" W beginning from a point about 200 m below the mouth of Fishing Creek along the west shore of York Haven Pond. Water depth was about 1.0 m.
5) TM-LF-12A1	40° 08' 57" N, 76° 44' 17" W beginning from a point on the west shore of Shelley Island opposite Station 12B1. Water depth varied from 1.0 to 1.5 m.
6) TM-LF-13A1	40° 09' 16" N, 76° 43' 54" W beginning from a point along the east shore of Shelley Island opposite the TMINS Unit 1 Intake. Water depth varied from 1.5 to 2.0 m.
7) TM-LF-13A2	40° 09' 16" N, 76° 43' 40" W beginning from a point upstream from the TMINS Unit 2 Intake to a point upstream of the Unit 1 Intake. Water depth varied from 3.0 to 8.0 m.
8) TM-LF-4A1	40° 09' 16" N, 76° 43' 17" W beginning at a point along the east shore of TMI opposite the TMINS Unit 2 Cooling Tower #3. Water depth varied from 1.0 to 1.5 m.
9) TM-LF-10B1	40° 08' 06" N, 76° 44' 30" W beginning at a point about 200 m downstream from the north tip of Bashore Island, on its eastern shore. Water depth was about 1.0 m.
10) TM-LF-10B2	40° 08' 02" N, 76° 43' 58" W beginning at the southwestern tip of Shelley Island. Water depth varied from 1.0 to 1.5 m.
11) TM-LF-10B3	40° 08' 08" N, 76° 43' 56" W beginning at the southeastern tip of Shelley Island. Water depth varied from 1.0 to 1.5 m.
12) TM-LF-9B1	40° 08' 08" N, 76° 43' 35" W beginning at a point 200 m upstream from the York Haven Dam along the southeastern shore of TMI. Water depth was about 1.0 m.
13) TM-LF-11A1	40° 09' 04" N, 76° 43' 39" W beginning at a point 200 m downstream from the TMINS Discharge. Water depth was about 1.0 m.
14) TM-LF-16A1	40° 09' 19" N, 76° 43' 38" W beginning at a point 500 m downstream from the north tip of TMI along the west shore. Water depth was about 1.0 to 1.5 m



Locations of ichthyoplankton push net stations sampled in York Haven Reservoir.

GPF 1451.002
8/31/77
Rev. 0

61-096

ICHTHYOPLANKTON FIELD & LABORATORY SHEET

DATE: 26 April 77
COLLECTORS: BFL, LMW

RIVER STAGE & FLOW: 2.13↑, 2,187.6 m³
METEOROLOGICAL CONDITIONS: clear, calm

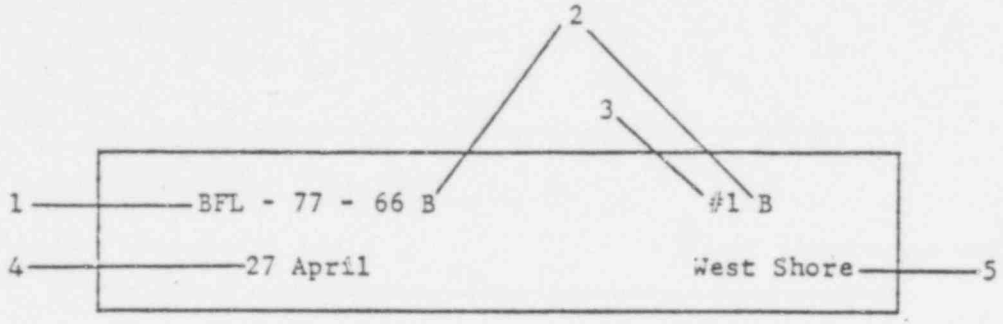
Station & Collection Number	Time	Temp. (C) Air	Temp. (C) H_2O	D.O. (ppm)	pH	Current Speed (cm/sec)	METER READINGS	Beginning	End	Difference	Meter Factor	Volume (m^3)	NUMBER OF FISH PICKED & Initials of Picker A	BFL	B
1	2158	9.0		9.9		NA	A	77640.5	78297.4	656.9	18	36.49	1		2
BFL-77-64							B	89387.6	89997.0	609.4	17.3	35.23			
6	2207	9.0	12.[illegible]	[illegible].4	[illegible].7	NA	A	78297.4	78750.1	452.7	18	25.15	0		0
-65							B	[illegible]9960	90439.8	442.8	17.3	25.60			
1	2224	8.5	13.0	9.2	7.9	NA	A	7[illegible]1	79593.9	843.8	18	46.88	10		15
-66							B	10439.8	[illegible]	823.5	17.3	47.60			
5	2238	9.0	11.6	10.4	8.5	NA	A	79593.[illegible]	[illegible]	[illegible]08.6	18	39.37	0		0
-67							B	91263.3	91983.[illegible]	720.2	[illegible]3	41.63			
9	2249	8.5	12.0	9.2	8.3	NA	A	80302.5	81070.[illegible]	768	18	[illegible].68	5		2
-68							B	91983.5	92748.9	[illegible]4	17.3	44.24			
10	2259	7.5	11.2	10.1	8.4	NA	A	81070.8	81788.7	717.9	18	39.88	0		0
-69							B	92748.9	93465.6	716.7	17.3	41.43			
4	2310	7.5	13.0	9.8	8.3	NA	A	81[illegible]88.7	82528.8	740.1	18	41.12	4		2
-70							B	93465.6	9[illegible]04.5	738.9	17.3	42.71			

TOTALS: 20 21

EXAMPLE

GPF 1451.003
8/31/77

SAMPLE LABEL



1. Collection number consisting of program biologist's initials, last two digits of the year, and the number of the sample (numbered consecutively from 001 to 999).

2. Replicate (A or B).

3. Station number (1 through 14).

4. Date

5. Station name.

LABORATORY DATA SHEET

COLLECTION NUMBER: BFL-77-66 B

DATE: 26 April

STATION: #1 (West Shore)

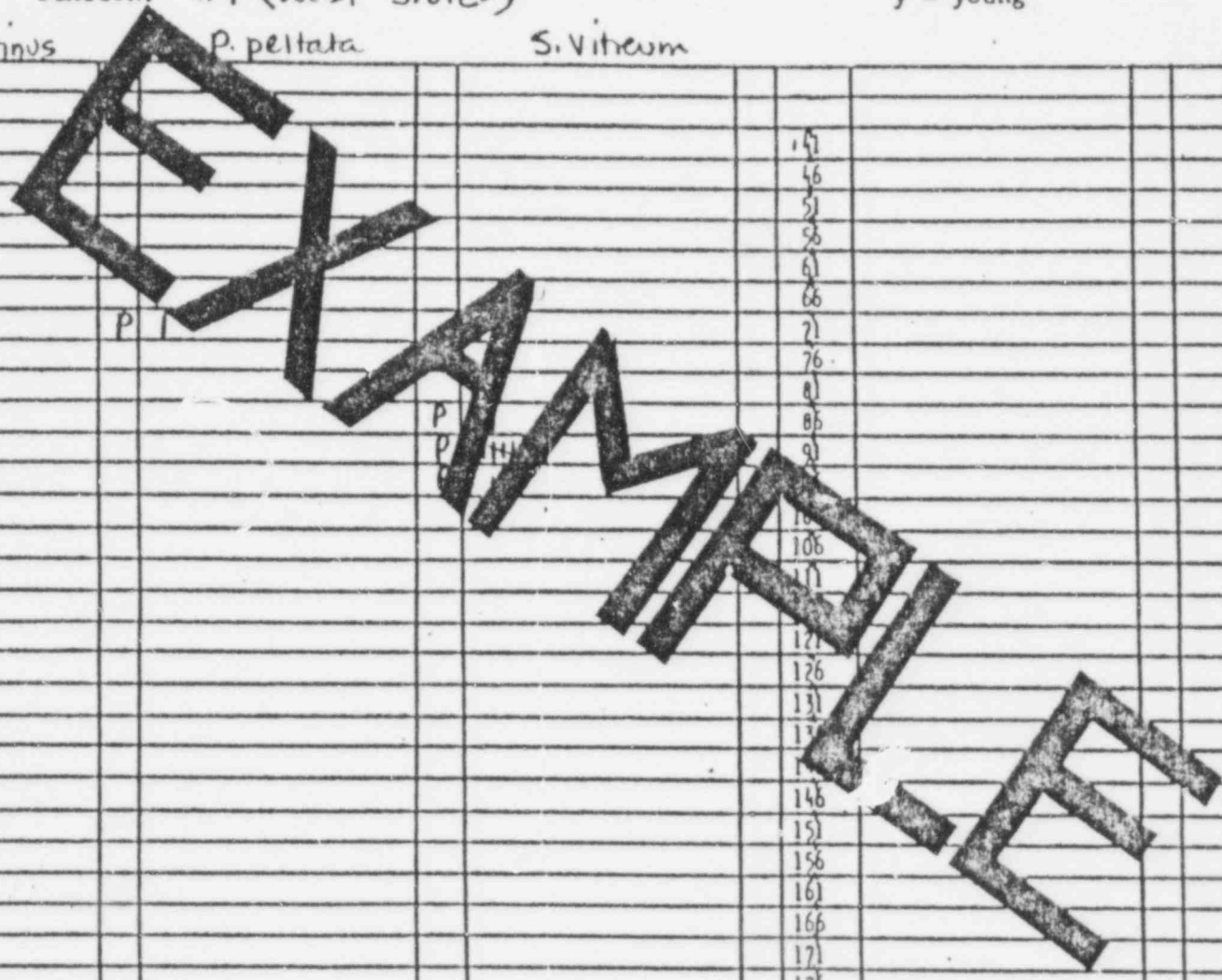
Stages: p = protolarvae
ms = mesolarvae
mt = metalarvae
y = young

IDENTIFIED BY: BFL

DATE: 9 June 77

Species: C. cyprinus P. pellata S. vitreum

(mm/stage)



TOTALS: 2 1 12 = 15

GPF 1451.005
8/31/77

FISH

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.2.a.(1)(c) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

The ichthyofauna shall be sampled to detect and assess changes in species composition, relative abundance, seasonal and spatial distribution, condition, and diversity of species as related to Three Mile Island Nuclear Station (TMINS) operation.

Discussion and Responsibilities

Metropolitan Edison Company's consultant (Ichthyological Associates, Inc. - IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

REFERENCES FOR TRAPNET AND SEINE

3. Carlander, K.D. 1953. Handbook of freshwater fishery biology with the first supplement. Wm. C. Brown Co., Dubuque, Iowa. 430 pp.

4. _____. 1969. Handbook of freshwater fishery biology. Vol. 1. Life history data on freshwater fishes of the United States and Canada, exclusive of the Perciformes. Iowa State Univ. Press, Ames, Iowa. 752 pp.

5. _____. 1977. Handbook of freshwater fishery biology. Vol. 2. Life history data on centrarchid fishes of the United States and Canada. Iowa State Univ. Press, Ames, Iowa. 431 pp.

6. Lloyd, M., J.H. Zar, and J.R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Amer. Midl. Nat. 79(2):257-272.

7. Miller, J. and K. Buss. [1963?]. The age and growth of the fishes in Pennsylvania. Pa. Fish Comm. 26 pp.

8. Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Board Can. Bull. 184. 966 pp.

9. Sokal, R.R. and F.J. Rohlf. 1973. Introduction to biostatistics. W.H. Freeman and Co., San Francisco, California. 368 pp.

10. Trautman. M.B. 1957. The fishes of Ohio with illustrated keys. Ohio State Univ. Press, Columbus, Ohio. 683 pp.

11. Weatherley, A.H. 1972. Growth and ecology of fish populations. Academic Press, New York. 293 pp.

12. Whittaker, R.H. and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia Basin, Southeastern Washington. Ecology 39:46-65.

REFERENCES FOR ELECTROFISHING

13. Dixon, W.J., ed. 1975. Biomedical computer programs. University of California Press, Berkeley, California. 792 pp.

14. Lloyd, M., J.H. Zar, and J.R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Amer. Midl. Nat. 79(2):257-272.

15. Novotny, D.W. and G.R. Priegel. 1974. Electrofishing boats: Improved designs and operational guidelines to increase the effectiveness of boom shockers. Technical Bulletin No. 73. Department of Natural Resources, Madison, Wisconsin. 48 pp.

16. Weatherley, A.H. 1972. Growth and ecology of fish populations. Academic Press, New York. 293 pp.

17. Weber, C.I., ed. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. U.S. Environmental Protection Agency, Cincinnati, Ohio.

18. Whittaker, R.H. and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia Basin, Southeastern Washington. Ecology 39:46-65.

Apparatus and Attachments

a. Apparatus required for trapnet:

0.91 m by 1.83 m trapnet with 0.91 m by 15.24 m lead (1.27 cm^2 mesh).

Taylor Bi-Therm field thermometer (Model 6074-1) or equivalent.

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter (or equivalent).

Photovolt Model 126A pH meter (or equivalent).

Secchi disc.

Measuring board.

Pelouze (Model YG-1000-A) dietetic scale (or equivalent).

Ten percent formalin.

Boat equipped with a motor.

Wash tub.

Floy tag gun and tags (or equivalent).

Blank field labels.

Index cards.

Plastic jars with lids.

b. Apparatus required for seine:

3.05 m by 1.22 m seine with 0.32 cm mesh.

Taylor Bi-Therm field thermometer (Model 6074-1) or equivalent.

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter (or equivalent).

Photovolt Model 126A pH meter (or equivalent).

Secchi disc.

Ten percent formalin.

40% isopropanol.

Glass jars with lids.

Boat equipped with a motor.

Blank field labels.

Measuring board (or equivalent).

Ohaus Dial-O-Gram beam balance (or equivalent).

Plastic bags.

Index cards.

Permanent storage labels.

Nikon binocular dissection scope (or equivalent).

Sorting trays.

Forceps and probes.

c. Apparatus required for electrofishing:

Coffelt VVP-10 variable voltage pulsator (or equivalent) and 4.0 kw alternator.

Wash tubs.

Foot switch and hook-up wires.

Aluminum boom, 0.9 m hoops, electrodes, and cathode array (DC and PDC only).

Pelouze (Model YG-1000-A) dietetic scale (or equivalent).

Hanson spring balance (or equivalent).

Measuring board.

Floy tag gun and tags (or equivalent).

Secchi disc.

Conductivity meter.

Taylor Bi-Therm field thermometer (Model 6074-1) or equivalent.

Clamp lamp.

Battery (12-volt).

Floodlights.

Dip nets.

Boat equipped with 35 hp and 6 hp outboard motors.

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter (or equivalent).

Photovolt Model 126A pH meter (or equivalent).

d. Attachments:

GPF 1452.001 - Descriptions of trapnet sampling stations.

GPF 1452.002 - Locations of trapnet sampling stations.

GPF 1452.003 - Three Mile Island Aquatic Study, Trapnet Field Sheet.

GPF 1452.004 - Individual Fish Data Sheet.

GPF 1452.005 - Tagged Fish Card.

GPF 1452.006 - Descriptions of seine sampling stations.

GPF 1452.007 - Locations of seine sampling stations.

GPF 1452.008 - Three Mile Island Aquatic Study, Field Data Sheet.

GPF 1452.009 - Length Frequency - Mean Weight Sheet.

GPF 1452.010 - Seine Collection Species List Card.

GPF 1452.011 - Seine Collection Permanent Storage Label.

GPF 1452.012 - Description of AC electrofishing zones.

GPF 1452.013 - Location of AC electrofishing zones.

GPF 1452.014 - Three Mile Island Aquatic Study,Field Data Sheet.

GPF 1452.015 - Individual Fish Data Sheet.

GPF 1452.016 - Numbers of fishes captured by AC electrofisher during May 1977.

GPF 1452.017 - Length Frequency - Mean Weight Sheet.

GPF 1452.018 - Operating instructions for Coffelt VVP-10 variable voltage pulsator.

Precautions

Sampling will not be attempted when weather or river conditions (e.g. thunderstorms, ice, high flow) endanger the health and safety of the biologists. The biologist in charge should determine whether sampling is feasible.

The manufacturer's operating instructions for the VVP-10 variable voltage pulsator are presented as GPF 1452.018.

Prerequisites and Requirements

None.

Procedure

1. TRAPNET

a. Field Procedure

Samples are taken semimonthly, conditions permitting, at four stations (GPF 1452.001 and GPF 1452.002) with a 0.91 m by 1.83 m trapnet with a 0.91 m by 15.24 m lead (1.27 cm^2 mesh). Nets are set for two consecutive 24-hr periods with the lead perpendicular to the shoreline, conditions permitting. Each net is assigned a unique collection number which consists of the initials of the biologist in charge, the last two digits of the year, and numbers running consecutively from 001 to 999, which is recorded on GPF 1452.003 (Page 1 of 2).

Data recorded at set and pickup of each net include initials of collectors, date, weather, time, air and surface water temperature, dissolved oxygen concentration, pH, secchi disc, and river stage (conditions permitting). Temperatures are measured with standard field thermometers. Dissolved oxygen and pH are determined from water samples taken at each station. River stage is obtained from the River Forecast Center in Harrisburg, Pennsylvania. These data are recorded on GPF 1452.003 (Page 1 of 2).

Fishes collected in a trapnet are placed in a tub of river water. Specimens are identified to the lowest feasible taxon, enumerated, examined for ectoparasites and anomalies, and individually measured (fork length, FL, in mm) on a measuring board and weighed to the nearest gram in the field. Decomposing but identifiable fishes are measured but not weighed. These data are recorded on GPF 1452.004. The numbers of fish collected, released, preserved, tagged, and recaptured are recorded on GPF 1452.003 (Page 2 of 2). When a large

number (>50) of one species is captured in a collection, a subsample of 50 specimens is individually measured and weighed, and an estimate made of the total number. Fishes are released alive in the field near the site of capture. Specimens are preserved in about 10% formalin and returned to the laboratory when species new or rare to the study area are captured or when identification cannot be done in the field. A label with collection number, date, and location is placed in the container.

Brown bullhead (>235 mm FL), channel catfish (>225 mm FL), rock bass (>155 mm FL), smallmouth bass (>200 mm FL), largemouth bass (>200 mm FL), and walleye (>275 mm FL) are tagged with sequentially numbered Floy FD 67 "spaghetti" tags inscribed with the laboratory address. Tags are inserted into the musculature of the fish ventral (brown bullhead and channel catfish) or posterior (rock bass and smallmouth bass) to the dorsal fin. Stressed or unhealthy specimens are not tagged. Tag numbers are recorded on GPF 1452.004.

Fishes are obtained semiannually for radioenvironmental analyses by Metropolitan Edison Company's radiological consultant. Selected specimens are sacrificed, filleted, and the fillets frozen. Each pair of fillets is frozen separately with a label containing the date of capture, location, and gear. Individual fillets are later combined to comprise catfish (brown bullhead and channel catfish) and bass (rock bass and smallmouth bass) flesh. Fish are taken both upstream (one kg) and downstream (one kg) from the TMINS Discharge.

b. Laboratory Procedure

Tag number, scientific name, location of capture, date, gear, length, and weight for each tagged fish are recorded on numerically filed index cards (GPF 1452.005). Recapture data also appear on these cards.

c. Data Processing

Mean weights per 5 mm fork length interval are calculated per collection period for all species and will be compared on a station to station basis.

Condition factor (K) for fishes comprising more than 10% of the trapnet catch in any year is calculated from the formula (Weatherley 1972):

$$K = 100W/L^3$$

where W = the mean weight (g) per 5 mm fork length interval and L = the upper limit of each 5 mm fork length interval expressed in mm.

Reproductive status for fishes comprising more than 10% of the trapnet catch in any year is defined as follows: young are spawned during the current calendar year; juveniles are incapable of reproduction or minnows and darters less than 26 mm collected prior to the current spawning season; and adults are capable of reproduction. Classifications are based on field observations and information in the literature (Carlander 1953, 1969, 1977; Miller and Buss 1963); Scott and Crossman 1973; Trautman 1957).

Species diversity indices (D) are calculated for each trapnet station using the Shannon-Weaver function presented by Lloyd et al. (1968):

$$D = C/N(N\log_{10}N - \sum n_i \log_{10} n_i)$$

where C = 3.321928 (converts base 10 log to base 2), N = total number of individuals, and n_i = total number of individuals in the i^{th} species.

Percent similarity (Whittaker and Fairbanks 1958) is computed as follows:

$$PSc = \sum \min(a,b)$$

where PSc = the percent similarity and a and b = the percentages of a species in samples A and B. PSc values range from 0.0 (no similarity) to 100.0 (complete similarity).

Kendall's coefficient of rank correlation (Sokal and Rohlf 1973) is applied to the catch data to analyze the yearly variation in rankings of species at a station.

2. SEINE

a. Field Procedure

Ten stations (GPF 1452.006 and GPF 1452.007) are sampled semimonthly, conditions permitting, with a 3.05 m by 1.22 m seine with 0.32 cm mesh. Size and habitat of seine stations vary and effort is based on complete coverage of the area rather than a specific number of hauls at each station. Data recorded on GPF 1452.008 (Page 1 of 2) include collection number, date, initials of collectors, location, time, duration of sample, air and surface water temperature, dissolved oxygen, pH, secchi disc, estimated water depth, river stage, weather, number of hauls, and substrate type (conditions permitting). Temperatures are measured with standard field thermometers. Dissolved oxygen and pH are determined from water samples taken at each station. River stage is obtained from the River Forecast Center in Harrisburg, Pennsylvania. All specimens collected at a station are preserved in 10% formalin and placed in a quart jar except for large fishes which are measured (fork length, FL, in mm) and released in the field; lengths are recorded on GPF 1452.008 (Page 2 of 2) under the remarks column next to the scientific name of the fish measured. A field label containing collection number, date, and location is placed with each preserved sample. Samples unidentified in the field are then transported to the laboratory for identification and processing.

b. Laboratory Procedure

After one week preserved fishes are rinsed in water and let stand for 24 hours to remove formalin; the process is repeated for a second day and then specimens are transferred to 40% isopropanol for processing and storage. Each collection is processed individually. For large collections containing more than 125 fish of one species a subsample of 125 fish of that species is

removed for length and weight analysis (GPF 1452.009). Fish of a species in each collection are measured to within a 5 mm fork length interval. Specimens within these length intervals are weighed together to the nearest 0.1 g on an Ohaus Dial-O-Gram beam balance. The number of fish per length interval and their total weight are entered on GPF 1452.009 in the appropriate station column. After processing, the species in each collection are placed in separate plastic bags within the quart jar. Into each jar is placed an index card containing the numbers per species (GPF 1452.010) and a permanent storage label (GPF 1452.011) giving state, county, collection number, gear, station number, locality, date, time, and initials of collectors. The numbers per species, total number of specimens, and total number of species are entered on GPF 1452.008.

c. Data Processing

Mean weights per 5 mm fork length interval are calculated per collection period for all species and will be compared on a station to station basis.

Condition factor (K) for fishes comprising more than 10% of the seine catch in any year is calculated from the formula (Weatherley 1972):

$$K = 100W/L^3$$

where W = the mean weight (g) per 5 mm fork length interval and L = the upper limit of each 5 mm fork length interval expressed in cm.

Reproductive status for fishes comprising more than 10% of the seine catch in any year is defined as follows: young are spawned during the current calendar year; juveniles are incapable of reproduction or minnows and darters less than 26 mm collected prior to the current spawning season; and adults are capable of reproduction. Classifications are based on field observations and information in the literature (Carlander 1953, 1969, 1977; Miller and Buss 1963; Scott and Crossman 1973; Trautman 1957).

Species diversity indices (D) are calculated for each seine station using the Shannon-Weaver function presented by Lloyd et al. (1968):

$$D = C/N(N\log_{10}N - \sum n_i \log_{10} n_i)$$

where C = 3.321928 (converts base 10 log to base 2), N = total number of individuals, and n_i = total number of individuals in the i^{th} species.

Percent similarity (Whittaker and Fairbanks 1958) is computed as follows:

$$PSc = \sum \min(a,b)$$

where PSc = the percent similarity and a and b = the percentages of a species in samples A and B. PSc values range from 0.0 (no similarity) to 100.0 (complete similarity).

Kendall's coefficient of rank correlation (Sokal and Rohlf 1973) is applied to the catch data to analyze the yearly variation in rankings of species at a station.

3. ELECTROFISHING

a. Field Procedure

Twelve zones are sampled semimonthly by AC electrofisher (GPF 1452.012 and GPF 1452.013), conditions permitting. The electrofisher consists of a 4.0 kw alternator and a Coffelt VVP-10 variable voltage pulsator mounted in a flat bottomed aluminum boat. The boat is powered by a 35 hp outboard motor for travel between zones, and a 6 hp outboard motor while sampling. Two aluminum booms extend two 0.9 m diameter hoops about 2 m in front of the boat. The booms may be adjusted to compensate for the varying weights of the biologists netting fish. The booms may also be moved laterally.

The variable voltage pulsator can deliver alternating current, AC (0-230 volts, 0-11 amps); direct current, DC (0-300 volts, 0-11 amps); and pulsed direct current, PDC at a pulse width of 20 to 80% and a pulse rate of 0-200 pulse per second. For AC shocking two 1.2 m lengths of flexible conduit

are attached to each hoop as electrodes. For DC and PDC operations "dropper" electrodes consisting of 15.2 cm lengths of 1.3 cm diameter stainless steel tubing are attached to the hoops with 0.46 m lengths of wire and No. 27 test clips. The tubes are partially covered by a sleeve of waterproof insulation which may be moved up and down on the tube to expose a greater or lesser area of the electrode in response to changes in water conductivity. Droppers may also be added or removed from the hoops depending on the conductivity. The booms must be adjusted so that the exposed portion of the droppers is below the water surface to ensure that maximum charge is concentrated in the water. A cathode array, consisting of one to five 1.2 m lengths of flexible conduit per side, is hung over the sides of the boat during DC and PDC operations.

Use of the shocker boat in DC and PDC modes is in the experimental stage at the time of this writing. According to Novotny and Priegel (1974) use of DC and PDC, while presenting a greater danger to personnel, does less physical damage to fishes. An additional advantage of PDC operation is that fish are drawn to the anodes. Since the anodes are near the water surface this should result in increased catches under turbid water conditions (Novotny and Priegel 1974).

Shocking operations are conducted at night. Floodlights aimed at the water surface are mounted at the bow of the boat. Stunned fish are netted and placed in tubs by two biologists on a wooden deck at the bow which is surrounded by a safety rail. Fish are returned to the center of the zone and processed. For safety, a foot operated "dead man" switch is controlled by one of the biologists at the bow of the boat. The boat operator also regulates the electrical current.

Physical data recorded before the start of each collection include: collection number (a unique number consisting of the initials of the biologist in charge, the last two digits of the year, and numbers running consecutively from 001 to 999), date, time of day, duration of sample, collectors, location, air and water temperature, secchi disc, pH, dissolved oxygen, and conductivity (conditions permitting). Gear used (AC, DC, or PDC), output voltage and amperage, and where applicable, percent pulse width and pulse frequency are also taken. These data are recorded on GPF 1452.014.

The twelve zones sampled are each about 500 m long. A single downstream pass in a zone constitutes a collection. One zone (16B8 - Fall Island) is sampled by making a downstream pass along both the west and east shores of Fall Island from the Fall line to the south tip of the island.

Fish taken by the electrofisher are identified, counted, and fork length (mm) and weight (grams) are measured in the field. Numbers of fishes captured and their disposition (released, tagged, or processed) are recorded on GPF 1452.015. Rock bass (>155 mm FL), smallmouth bass (> 200 mm FL), largemouth bass (>200 mm FL), brown bullhead (>235 mm FL), channel catfish (>225 mm FL), and walleye (>275 mm FL) are tagged with serially numbered plastic "spaghetti" tags (FD 67, Floy Tag and Mfg. Co., Seattle, Washington). Each tag is inscribed with a unique number and the laboratory address. The tags are inserted into the musculature of the fish posterior to the dorsal fin. Stressed or unhealthy specimens are not tagged. Tag numbers are recorded on GPF 1452.004.

Fishes are obtained semiannually for radioenvironmental analyses by Metropolitan Edison Company's radiological consultant. Selected specimens are sacrificed, filleted, and the fillets frozen. Each pair of fillets is frozen separately with a label containing the date of capture, location, and

gear. Individual fillets are later combined to comprise catfish (brown bullhead and channel catfish) and bass (rock bass and smallmouth bass) flesh. Fish are taken both upstream (one kg) and downstream (one kg) from the TMINS Discharge.

b. Laboratory Procedure

Tag number, scientific name, location of capture, date, gear, length, and weight for each tagged fish are recorded on numerically filed index cards (GPF 1452.005). Recapture data also appear on these cards.

c. Data Processing

At the end of the year, data on number of fishes taken are transferred from field data sheets to rough tables, and then typed into finished tables (GPF 1452.016). These tables are included in the annual report.

Analysis of electrofishing data includes but is not limited to:

Condition factor (K) is computed for the year's catch at each zone, for fishes that comprise greater than 10% of the catch from all zones by the formula (Weatherley 1972):

$$K = 100\ W/L^3$$

where W = the mean weight (g) per 5 mm fork length interval and L = the upper limit of each 5 mm fork length interval expressed in cm. Raw data from each month's field data sheets are transferred to length frequency sheets (GPF 1452.017) and the total number and total weight per 5 mm fork length interval at each zone are recorded on GPF 1452.017.

Species diversity (H') is calculated for the total catch at each zone with the machine formula of the Shannon-Weaver information-theory, the measure of mean diversity per individual (Lloyd et al. 1968):

$$H' = C/N\ (N\log_{10}N - \sum_{i=1}^{i} n_i \log_{10} n_i)$$

where C = 3.321928 (converts base 10 logarithms to base 2), N = total number of individuals, and n_i = total number of individuals in the i^{th} species. Species diversity is affected both by the richness of species and by the

distribution of individuals among species. Diversity indices may range from zero to 3.321928 $\log_{10}N$ (Weber 1973).

Total catch per effort, calculated as the mean catch per collection is determined by dividing the year's catch in a zone by the number of collections made in a zone. Catch per effort values for the zones are compared to determine similarities and differences in the numbers of fish available to the electrofisher.

An index of percentage similarity (Whittaker and Fairbanks 1958) is used to determine the similarity of species composition among stations:

$$PSc = 100 - 0.5 \left| a - b \right|$$

where PSc = percentage similarity, and a and b = the percentages of a species at zones A and B. The PSc values may range from 0.0 (no similarity) to 100.0 (complete similarity). Percentage similarity measures the relative similarity of numerical composition in terms of species populations and leads to grouping of zones by dominant or major species.

The ranks of the species captured at each of the 12 zones are compared with Kendall's measure of rank correlation, T (Dixon 1975). The critical value of T above which the zones are positively correlated is determined from the formula:

$$t_{.05[\infty]} = \frac{T_{crit}}{2(2N+5)/9N(N-1)}$$

where N = the number of paired observations and $t_{.05[\infty]}$ = a tabulated t-value from the student's t-distribution.

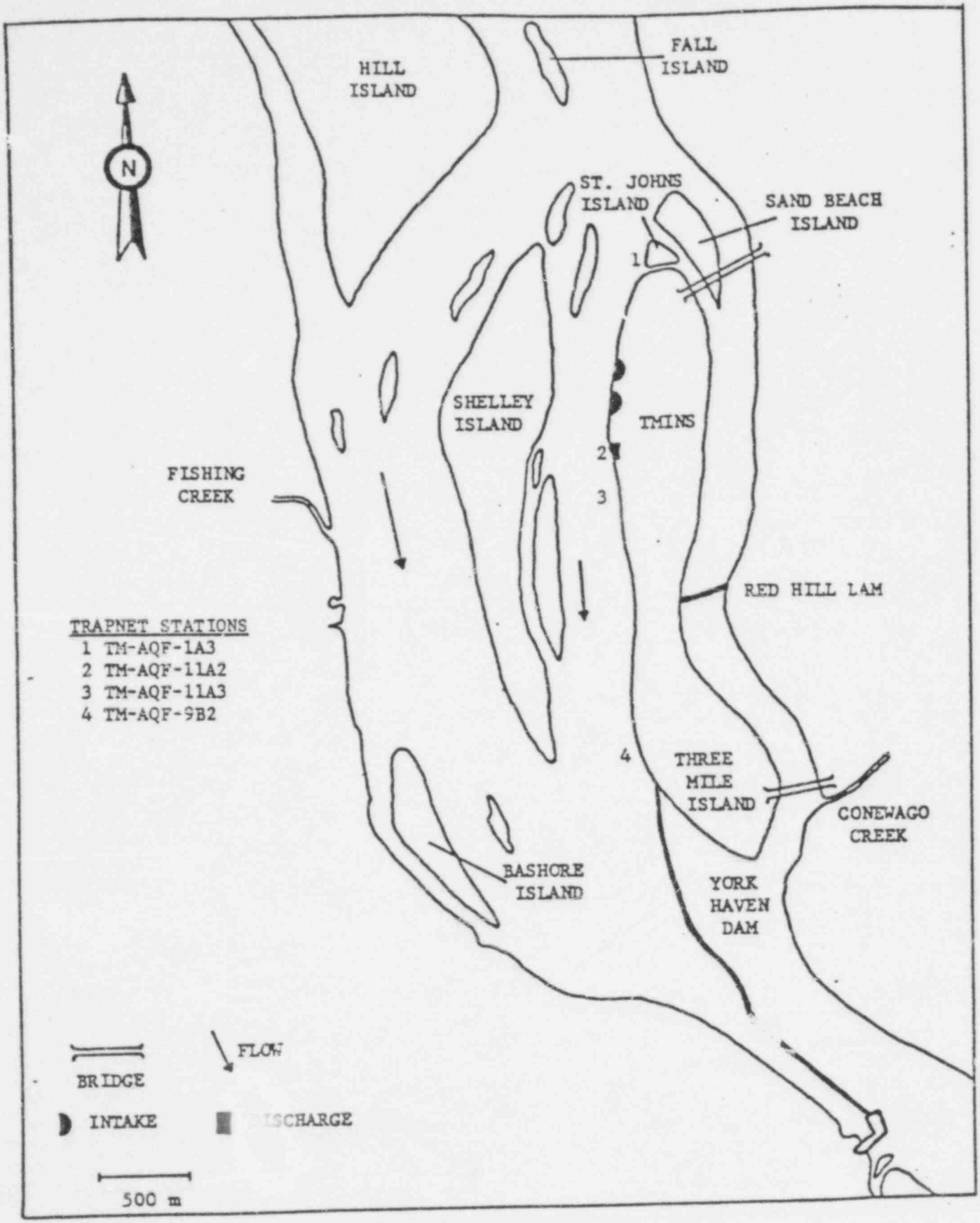
Field and laboratory data sheets for the Fish Programs are stored in a fireproof file cabinet at the LA office in Etters, Pennsylvania for the current year. Past year's data are presented in annual reports which can be found in many separate locations.

Submitted:	Approved:	Concurrence:
J.E. Mudge Environmental Scientist	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

Descriptions of trapnet sampling stations.

Station Number	Description
TM-AQF-1A3	Southwest shore of St. Johns Island.
TM-AQF-11A2	TMINS Discharge.
TM-AQF-11A3	200 m downstream from TMINS Discharge.
TM-AQF-9B2	1900 m downstream from TMINS Discharge.



Locations of trapnet sampling stations.

GPF 1452.002
8/31/77
Rev. 0

THREE MILE ISLAND AQUATIC STUDY
Trapnet Field Sheet

Coll. No. RWM-99-199

Program: Fisheries Monitoring

Location: TMINS Discharge

Gear: Trapnet

Date 1: yr 99 | mo 02 | day 31

7: 50

9: 11A2

12: 90

Rep. No. 14:

Card No. 16: 1

Collected by PCR, RWM

Number & size of jars

Set date (month, day) 17: 02 | 31

Weather: 1. clear; 2. partly cloudy; 3. over-cast; 4. fog; 5. haze; 6. light-rain; 7. heavy rain; 8. snow

Time 22: 10[illegible]

Temperature: Air 26[illegible]

(C) Water 30[illegible]4Ø

Oxygen (ppm) 34[illegible]18

pH [illegible]

Secci disc (cm) [illegible]

River Stage (m) 43[illegible]98

79

Card No. 16: 2

Pickup date (month, day) 17: 02 | 32

Weather code 21: 3

Time 22: 0950

Temperature: Air 26: 5Ø

Water 30: 3.5

Oxygen (ppm) 34: 12.5

pH 37: 8.2

Secci disc (cm) 40: 5Ø

River Stage (m) 43: 3.88

Reset Time 46: 0955

Remarks:

50

79

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61-118

CODE	SPECIES	TOT	PRES	REL	TAG	RECAP	REMARKS
262	Esox masquinongy						
274	Cyprinus carpio	2		2			
278	Notemigonus crysoleucas						
280	Notropis amoenus						
283	N. hudsonius						
284	N. procne						
286	N. spilopterus	1		1			
321	Carpiodes cyprinus	2		2			
322	Catostomus commersoni						
325	Moxostoma macrolepidotum						
332	Ictalurus catus						
334	I. nebulosus	3					
335	I. punctatus			5	2	1	
371	Ambloplites rupestris	2		2			
373	Lepomis auritus						
375	L. gibbosus	10		10			
376	L. macrochirus						
377	Micropterus dolomieu						
379	Pomoxis annularis						
380	P. nigromaculatus						
401	Etheostoma [illegible]di						
403	Perca flavescens						

GPF 1452.003
8/31/77
Rev. 0

INDIVIDUAL FISH DATA SHEET

Collection No.: RWM-99-199

Collector(s): PCR, RWM

Date: Yr 99 Mo 02 Day 32

Program: Fisheries Monitoring 50

Location: TMINS Discharge 11A2

Gear: Trapnet 90

Time: 0950

No.	Sp.	Fl.	Weight	Tag No.	Recap	Comment	Sp.	Fl.	Weight	Tag No.	Recap	Comment
1	274	141	52									
2	274	106	30									
3	286	92	10									
4	321	370	980									
5	321	336	730									
6	334	314	496	806								
7	334	305	523	807								
8	334	295	486	808								
9	335	432	970	809								
10	335	401	863	810								
11	335	310	350		602							
12	335	163	50									
13	335	158	44									
14	335	150	39									
15	335	157	46									
16	335	121	30									
17	371	125	42									
18	371	146	69									
19	375	141	8[illegible]									
20	375	143	[illegible]0									
21	375	157	[illegible]25									
22	375	14[illegible]	8[illegible]									
23	375	[illegible]	[illegible]									
24	375	146	[illegible]7									
25	375	137	7[illegible]									
26	375	125	52									
27	375	142	72									
28	375	130	58									
29												
30												

EXAMPLE

TAG NO. 141 SPECIES I. punctatus LENGTH 326 WEIGHT 290

DATE TAGGED 30 May 1976 LOCATION TM-[illegible]-982 GEAR Trapnet

RECAPTURE DATA

DATE 14 June 1977 LOCATION TM-AC[illegible] LENGTH 3[illegible] WEIGHT 310 GEAR Trapnet

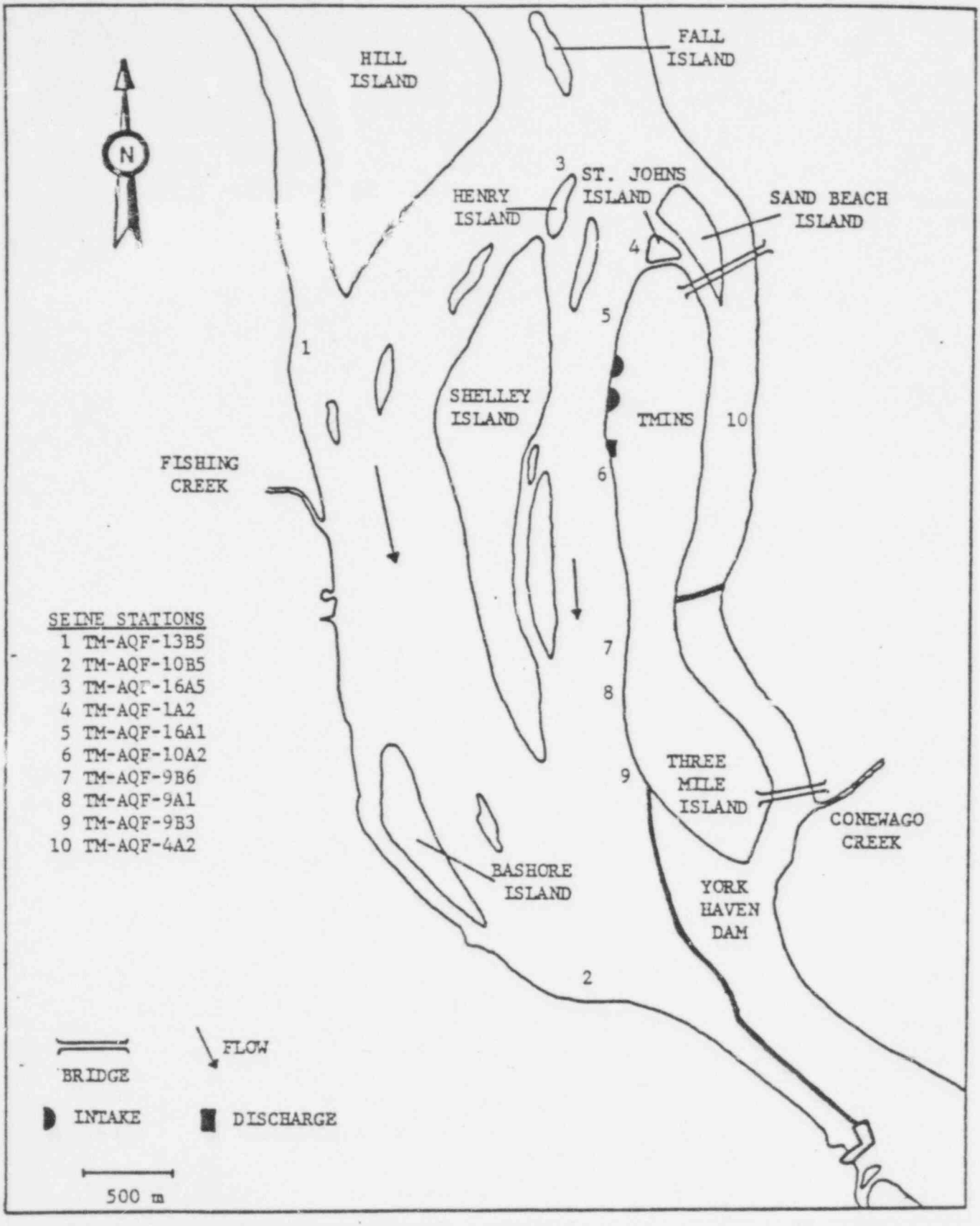
EXAMPLE

GPF 1452.005
8/31/77
Rev. 0

61-121

Descriptions of seine sampling stations.

Station Number	Description
TM-AQF-13B5	Pennsylvania Fish Commission boat ramp on northwest shore of York Haven Pond.
TM-AQF-10B5	Southwest shore of York Haven Pond, just upstream from York Haven Generating Station race.
TM-AQF-16A5	North shore of Henry Island.
TM-AQF-1A2	Northwest shore of St. Johns Island.
TM-AQF-16A1	West shore of TMI, 25 m upstream from boat dock.
TM-AQF-10A2	West shore of TMI, 150 m downstream from TMINS Discharge.
TM-AQF-9B6	West shore of TMI, 1100 m downstream from TMINS Discharge.
TM-AQF-9A1	West shore of TMI, 1500 m downstream from TMINS Discharge.
TM-AQF-9B3	West shore of TMI, 2000 m downstream from TMINS Discharge.
TM-AQF-4A2	Boat launch on east shore of east channel.



Locations of seine sampling stations.

THREE MILE ISLAND AQUATIC STUDY

Field Data Sheet

Collection Number 1 RWM 4 99 6 201

No. Spmn 574 No. Spp 9

Collected by RWM, PCR

Location Northwest shore of St. Johns Island

Mo 9 07 Day 11 32

13 1A2 Rep 18

Card No. 20 1

Program 01. Limnology Monitoring; 10. Plankton; 15. Entrainment, Plankton; 20. Macroinvertebrates; 30. Water Chemistry; 50. Fisheries Monitoring; 60. Ichthyoplankton; 61. Entrainment, Ichthyoplankton; 70. Trapping; 71. Food Habits; 72. Age & Growth; 80. Impingement; 90. Autecology; Other

21 50

Gear 01. Lone sampler; 05. Petersen grab; 20. Purse; 60. Electroshocker AC; 61. Electroshocker DC; 62. Gill net, 1inch mesh; 70. Trawl, 16' 3" mesh; 80. Common Seine, 10' x 4' x 1/8" mesh; 90. Trap net, 3' x 8' x 5' mesh; Other

23 0

Volts 25

Amps 28

Pulse 30

Distance to Shore (m) 32

Meter No. 36

Revolutions: End

Begin

39

No. of H 43 3

Type of 44

Substrate Type 45 1

REMARKS

GPF 1452.008
8/31/77
Rev. 0

Page 1 of 2

76

79 1

Card No. 20 2

Tim 21 1234

Durati mple 25 8

Temperature (Air 28 12.0

ter; Surface 32 19.0

Oxygen (ppm) Surface 36 9.4

pH Surface 39 8.1

Conductivity (umhos) 42

Secchi Disc (cm) 47 51.0

Water Depth (m) 51 0.5

Current (cm/sec) Surface 54

Bottom 58

River Stage (m) 62 1.08

River Flow (m^3/sec) 66

Depth of Sample 72

Weather 1. Clear; 2. Partly cloudy; 3. Overcast; 4. Haze; 5. Fog; 6. Light rain; 7. Heavy rain; 8. Snow 75 6

Nuclear Service Pumps 76

Secondary Service Pumps 77

Decay Heat Pumps 78

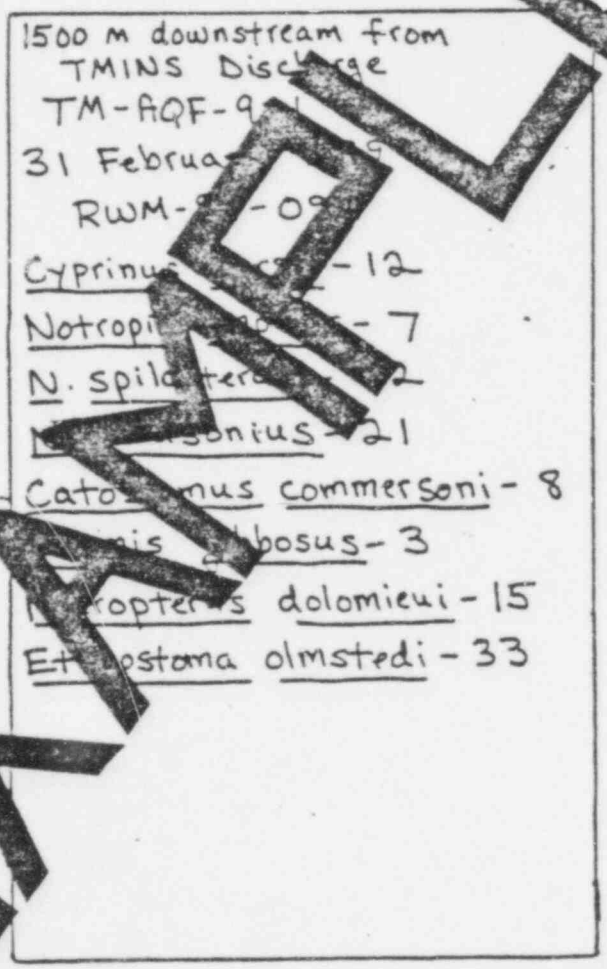
79 1

LENGTH FREQUENC MEAN WEIGHT SHEET

Spe es N. spilopterus Processed by RWM Gear Seine Date Collected 20 June 1977

Station No. 1A2 Station No. 16A1 Station No. 10A2 Station No. 9A1 Station No. 9B3

FL interval	Station No. 1A2 No.	Wt.	Station No. 16A1 No.	Wt.	Station No. 10A2 No.	Wt.	FL interval	Station No. 9A1 No.	Wt.	Station No. 9B3 No.	Wt.
6							6				
11							11			2	<0.1
16							16				
21							21				
26							26				
31	2	0	1	2			31			7	2.6
36	9	5	13	8	NO		36	3	2.0	19	11.1
41	7	5.8	30	2			41	6	5.4	9	7.9
46	1	1.0	21	5	FISH		46	1	1.0	2	2.2
51			1	5			51				
56			5	4	TAKEN		56				
61			2	0			61				
66							66				
71	1	5.5					71				
76							76				
81	1	6.0					81				
86							86				
91							91				
96							96				
101							101				
106							106				
111							111				
116							116				
121							121				
126							126				
131							131				
136							136				
141							141				
146							146				
151							151				
156							156				
161							161				
166							166				
171							171				
176							176				
181							181				
186							186				
191							191				
196							196				
	Total No. 2		Total No. 87		Total No.			Total No. 10		Total No. 39	
	Total Wt. 24.3		Total Wt. 106.9		Total Wt.			Total Wt. 8.4		Total Wt. 23.8	


1500 m downstream from
TMINS Discharge
TM-AQF-9
31 Februa
RWM-
Cyprinu
Notropi
N. spil
Catos
commersoni - 8
bosus - 3
dolomieui - 15
olmstedi - 33

THREE [illegible] ISL[illegible] AQUATIC STUDY

State PA [illegible] Coll. No. RWM-99-099
Gear 3.05 [illegible] m seine (0.32 cm mesh)
Zone No. [illegible] tion No. TM-AQF-9A1
Locality 1500 [illegible] m from
TMINS [illegible]
[illegible]
Date 3 [illegible]ruary 1999 Time 1005
Jar: Size [illegible]rt No. 1 of 1
[illegible] by R[illegible] PCR

Description of AC electrofishing zones.

Zone	Description
TM-AQF-15B2	Along west shore of reservoir, riffles to 500 m downstream
TM-AQF-16B8	Along east and west shores Fall Island, riffles to south tip
TM-AQF-4A1	Along east shore TMI, north bridge to 500 m downstream
TM-AQF-15A1	Along west shore Shelley Island, north tip to 500 m downstream
TM-AQF-15A2	Along east shore Shelley Island, north tip to 500 m downstream
TM-AQF-16A2	Along west shore TMI, north tip to 500 m downstream
TM-AQF-13A1	Along west shore TMI, boat dock to Discharge.
TM-AQF-10A3	Along west shore TMI, Discharge to 500 m downstream
TM-AQF-9B5	Along west shore TMI, 1500 to 2000 m downstream from Discharge
TM-AQF-10B1	Along east shore Shelley Island (opposite south tip Beech Island) to 500 m downstream
TM-AQF-10B3	Along west shore Shelley Island, 500 m upstream to south tip
TM-AQF-11B1	Along west shore of reservoir from a small unnamed creek 500 m below the mouth of Fishing creek downstream 500 m

GPF 1452.012
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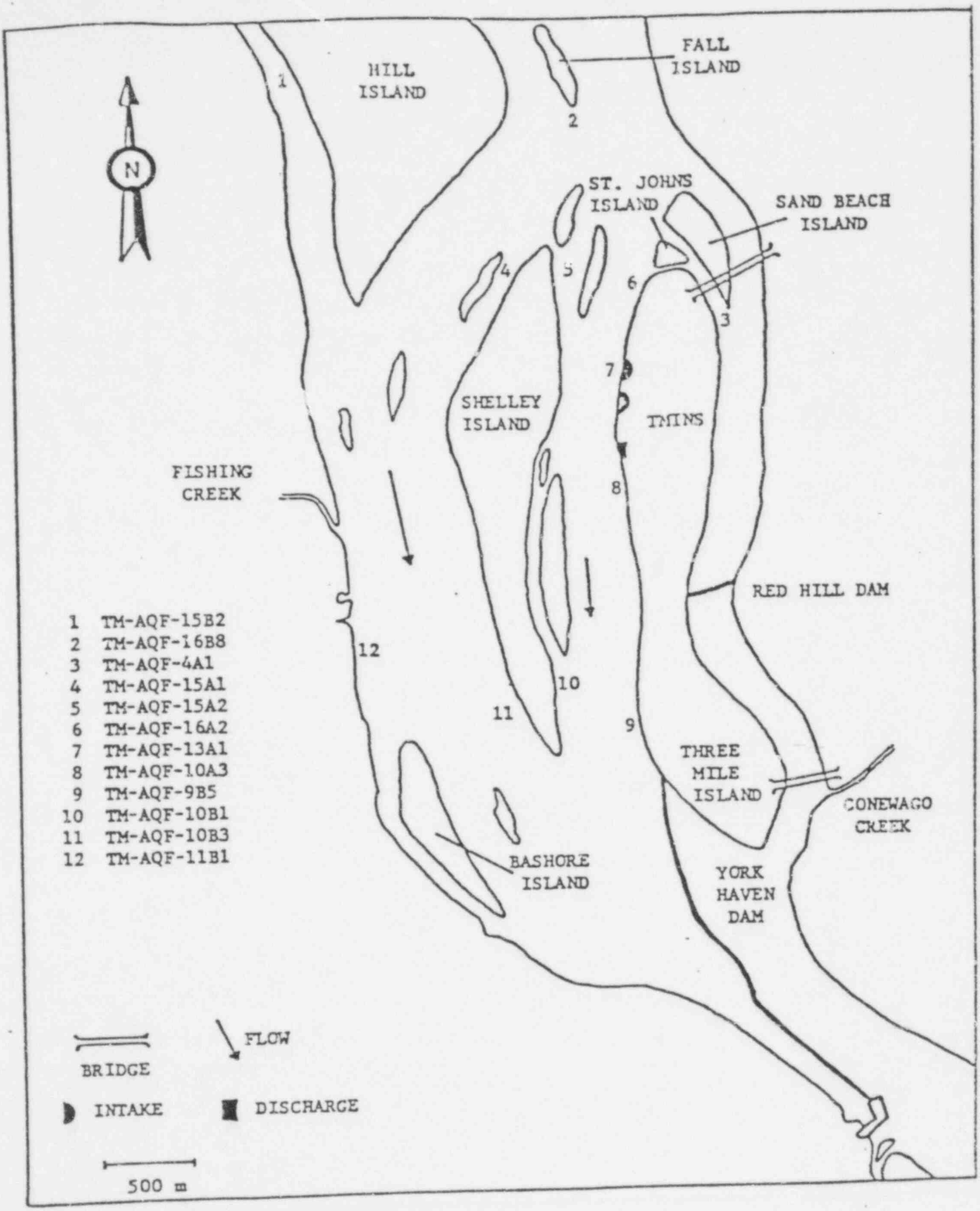

Location of AC electrofishing zones.

81-129

THREE MILE ISLAND AQUATIC STUDY

Field Data Sheet

Collection Number: 1 H A H 4 7 7 6 1 4 9

No. Spmm _____ No. Spp _____

Collected by REE HAH LOW

Location 1W. TMI N. tip - 500m downstream

Mo 9 0 8 Day 11 0 1

13 1 6 A 0 2 Rep 18

Card No. 20 1

Program 01. Limnology Monitoring; 10. Plankton; 18. Enrichment, Plankton; 28. Macroinvertebrates; 38. Water Chemistry; 58. Fisheries Monitoring; 68. Ichthyoplankton; 81. Examinations, Ichthyoplankton; 78. Tagging; 71. Food Habits; 72. Age & Growth; 88. Impingement; 90. Radiation; Other _____ 21 5 0 7 0

Gear 01. Liner sample; 08. Peter grab; 20. Pump; 68. Electro-shocker AC; 81. Electro-shocker DC; 60. Sm net, 1mm mesh; 70. Trawl, 16' 3" mesh; 86. Cornman Sarns, 10' x 4' x 1/8" mesh; 90. Trap net, 3' x 6' x ¼" mesh; Other _____ 23 1

Volts 25

Amps 28

Pulse 40 % 180/sec 30

Distance to Shore (m) 32

Meter No. _____ 34

Revolutions: End _____ Begin _____

No. of H[illegible] 43

Type of [illegible] 1. Sm[illegible] 2. Vertical; [illegible] 44

Substrate Type [illegible] 45

REMARKS

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79 1

Card No. 20 2

Tide 21 2 2 3 0

Duration Sample (2[illegible]) 25 2 1

Temperature (°C) Air 28 2 2.5

Water: Surface 32 2 5.0

Oxygen (ppm) Surface 36 7.4

pH Surface 39 8.2

Conductivity (umhos) 42 3 2 0

Secchi Disc (cm) 16" 47 4 0.6

Water Depth (m) 51

Current (cm/sec) Surface 54

Bottom 58

River Stage (m) 62

River Flow (m^3/sec) 66

Depth of Sample 72

Weather 1. Clear; 2. Partly cloudy; 3. Overcast; 4. Haze; 5. Fog; 6. Light rain; 7. Heavy rain; 8. Snow 75

Nuclear Service Pumps 76

Secondary Service Pumps 77

Decay Heat Pumps 78

79 1

EXAMPLE

INDIVIDUAL FISH DATA SHEET

Collection No.: HAN-77-149

Collector(s): REE HAN LOW

Date: Yr 77 Mo 08 Day 01

Program: Fishery Monitoring - Tagging

Location: W. TMI N. tip - 500m downstream — 16A02

Gear: POC Electrofisher

Time: 2230

No.	Sp.	Fl.	Weight	Tag No.	Recap	Comment	Sp	Fl.	Weight	Tag No.	Recap	Comment
1	377	329	520	3265			335	[illegible]	[illegible]			
2	"	210	140	3266			375	[illegible]	[illegible]2			
3	"	243	254	3267			"	144				
4	"	184	100				"	131	63			
5	"	120	22				"	132	6[illegible]			
6	"	102	16				"	130	[illegible]			
7	"	99	14				"	[illegible]4	[illegible]6			
8	"	108	18				"	87	16			
9	"	97	12				"	100	23			
10	"	106	15				"	91	18			
11	"	105	19									
12	406	175	56									
13	"	179	63									
14	"	144	32									
15	"	162	48									
16	"	166	57									
17	"	154	44									
18	"	144	38									
19	"	152	45									
20	"	150	[illegible]									
21	373	192	[illegible]0									
22	"	14[illegible]	107									
23	"	16[illegible]	[illegible]									
24	"	150	[illegible]									
25	"	152	105									
26	371	160	97									
27	"	115	34									
28	376	117	35									
29	"	122	47									
30	379	92	11									

EXAMPLE

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Numbers of fishes captured by [illegible] electrofisher during May 1977.

Zone	11B1	10B3	10B1	13A1	10A3	9B5	15B2	16B8	4A1
Date	3 May	3 May	3 May	3 May	4 May	4 May	11 May	11 May	11 May
Time	2040	[illegible]	2235	2318	0005	0100	2100	2203	2337
Duration (min)	21	26	20	19	15	17	20	27	15
Air Temp. (C)	14	14.0	13.5	12.5	14.0	12.0	12.5	13.5	9.0
Water Temp. (C)	17.0	16.5	16.5	16.5	16.5	15.5	14.0	14.0	14.0
Volts	170	195	200	190	190	170	175	195	180
Amps	6.5	[illegible]	6.[illegible]	6.5	6.5	6.5	6.5	5.5	7.0
Rainbow trout	-	-	[illegible]	-	-	-	-	1	-
Carp	2	2	[illegible]	[illegible]	2	-	1	6	1
Golden shiner	7	-	-	[illegible]	-	-	-	-	-
Fallfish	-	-	-	[illegible]	-	-	-	-	-
Quillback	2	6	8	[illegible]	1	4	-	1	-
White sucker	-	1	1	[illegible]	[illegible]	4	-	-	2
Northern hog sucker	-	-	-	1	[illegible]	-	-	-	-
Shorthead redhorse	-	-	-	1	[illegible]	1	-	3	-
Yellow bullhead	-	-	-	-	[illegible]	-	-	1	-
Brown bullhead	-	-	1	-	[illegible]	-	-	1	-
Channel catfish	-	-	-	-	[illegible]	-	-	1	-
Rock bass	-	1	-	3	3	1	8	9	-
Redbreast sunfish	3	16	2	15	12	[illegible]	[illegible]	7	5
Green sunfish	-	-	-	-	[illegible]	[illegible]	[illegible]	-	-
Pumpkinseed	60	38	15	4	5	7	18	-	7
Bluegill	11	4	-	-	-	-	5	1	-
Smallmouth bass	1	27	1	20	24	[illegible]	8	22	2
Largemouth bass	-	-	-	-	-	[illegible]	2	-	-
White crappie	7	-	-	-	-	-	-	-	-
Black crappie	1	-	-	-	1	-	1	-	-
Yellow perch	-	1	-	-	-	-	-	-	-
Walleye	-	3	1	1	1	3	1	-	1
No. of Spmn.	94	99	29	45	58	26	58	53	18
No. of Spp.	9	10	7	7	11	8	9	11	6

Zone	16B2	15A2	15A1	15B2	16B8	4A1	16A2	15A2	15A1
Date	12 May	12 May	12 May	16 May	16 May	16 May	17 May	17 May	17 May
Time	0020	0105	0134	2114	2235	2350	0025	0125	0207
Duration (min)	20	15	16	20	25	19	18	20	18
Air Temp. (C)	9.5	9.0	8.0	17.5	18.0	15.0	15.5	15.5	14.5
Water Temp. (C)	[illegible]	14.0	14.5	19.5	19.0	18.5	18.0	18.5	18.5
Volts	165	170	190	160	190	200	195	185	185
Amps	6.5	5.5	6.5	7.0	6.0	6.5	6.5	6.5	6.5
Rainbow trout	-	-	-	-	-	-	-	-	-
Carp	3	1	[illegible]	-	4	17	-	2	-
Golden shiner	-	-	[illegible]	-	-	-	-	-	-
Fallfish	-	2	1	-	-	-	-	-	-
Quillback	-	-	1	[illegible]	1	-	2	6	-
White sucker	-	-	-	[illegible]	-	-	1	1	-
Northern hog sucker	-	-	1	[illegible]	-	-	-	-	-
Shorthead redhorse	2	-	1	-	-	-	5	1	-
Yellow bullhead	1	-	-	-	-	-	-	-	-
Brown bullhead	-	-	-	-	-	-	-	-	-
Channel catfish	-	-	-	-	-	-	-	-	-
Rock bass	4	1	3	3	[illegible]0	-	10	1	4
Redbreast sunfish	7	3	9	8	18	[illegible]	10	9	14
Green sunfish	-	-	-	1	[illegible]	[illegible]	[illegible]	-	-
Pumpkinseed	7	[illegible]	-	7	[illegible]	[illegible]	2	1	-
Bluegill	-	-	-	3	-	1	-	-	-
Smallmouth bass	12	2	9	3	30	1	18	9	9
Largemouth bass	1	-	-	2	-	[illegible]	-	-	-
White crappie	-	-	-	-	-	1	-	-	-
Black crappie	1	-	-	1	-	-	-	-	-
Yellow perch	-	-	-	-	-	-	-	-	-
Walleye	1	-	-	1	-	-	2	1	-
No. of Spmn.	39	9	30	35	67	27	50	31	27
No. of Spp.	10	5	8	12	8	6	8	9	3

Zone	11B1	10B3	10B1	13A1	10A3	9B5	Total
Date	17 May	17 May	17 May	17 May	17 May	18 May	
Time	2052	2127	2205	2240	2325	0002	
Duration (min)	[illegible]	23	22	18	16	15	
Air Temp. (C)	[illegible].5	24.0	23.0	23.0	19.0	20.0	
Water Temp. (C)	21.5	20.5	19.5	20.0	20.0	19.5	
Volts	200	[illegible]205	200	195	200	200	
Amps	6.0	[illegible]5.0	5.0	6.0	6.5	6.5	
Rainbow trout	-	-	-	-	-	-	1
Carp	[illegible]	[illegible]	-	-	2	-	51
Golden shiner	1	[illegible]	-	-	-	-	8
Fallfish	-	[illegible]	-	-	-	-	4
Quillback	6	-	[illegible]	-	-	2	46
White sucker	-	-	[illegible]	[illegible]	1	1	17
Northern hog sucker	-	-	[illegible]	[illegible]	-	-	2
Shorthead redhorse	1	-	[illegible]	1	5	1	30
Yellow bullhead	-	-	[illegible]	[illegible]	-	-	2
Brown bullhead	-	-	-	[illegible]	-	-	3
Channel catfish	-	-	-	1	-	-	3
Rock bass	-	-	1	[illegible]	2	2	67
Redbreast sunfish	-	7	3	[illegible]	8	-	180
Green sunfish	-	-	-	[illegible]	[illegible]	[illegible]	1
Pumpkinseed	5	4	7	[illegible]	[illegible]	[illegible]	196
Bluegill	6	-	-	-	[illegible]	-	31
Smallmouth bass	-	9	-	15	[illegible]15	5	247
Largemouth bass	1	-	-	-	[illegible]	-	6
White crappie	1	-	-	-	[illegible]	-	9
Black crappie	3	1	-	-	-	-	9
Yellow perch	-	-	-	-	-	-	1
Walleye	-	-	-	1	-	1	18
No. of Spmn.	27	21	14	26	37	12	932
No. of Spp.	9	4	5	7	7	6	22

LENGTH FREQUENCY MEAN WEIGHT SHEET

Spe :s L. aurifus Processed by HAH Gear 115 Electrofisher Date Collected March 1976

FL interval	Station No. 15B2 No.	Wt.	Station No. 16B8 No.	Wt.	Station No. 4A1 No.	Wt.	Station No. 16A2 FL interval	No.	Wt.	Station No. 15A2 No.	Wt.
6							6				
11							11				
16							16				
21							21				
26							26				
31							31				
36							36				
41							41				
46							46				
51							51				
56							56				
61							61				
66							66				
71							71				
76							76				
81	I	(10)					81				
86	I	(15)					86				
91	I	(14)					91				
96	I	(18)					96		(23)		
101							101				
106							106				
111	II	(58)	I	(24)			111				
116	II	(58)					116	II	(		
121	IHT I	(279)	I	(38)			121	II			
126	IIII	(168)	II	(90)			126	III	(36)	II	(82)
131	I	(50)	I	(44)			131		(		
136	II	(79)	III	(162)			136		(5		
141	II	(112)	I	(56)			141	III	(272)	I	(70)
146	III	(180)	I	(60)			146	IIII	(282)		
151	IHT I	(419)					151			I	(84)
156	IHT	(392)					156			I	(92)
161	IHT-IHT	(833)	I	(84)			161	III	(286)	I	(98)
166	IIII	(368)	I	(94)			166	I	(110)		
171	IHT I	(620)					171			II	(242)
176	IHT II	(820)					176			I	(122)
181	IIII	(567)					181				
186	II	(300)					186				
191							191				
196							196				
	Total No. 70		Total No. 12		Total No. 1			Total No. 22		Total No. 9	
	Total Wt. 5380g		Total Wt. 652g		Total Wt. 18g			Total Wt. 1364g		Total Wt. 790g	

GPF 1452.017

VARIABLE VOLTAGE PULSATOR
ELECTRO-SHOCKER
Model VVP-10

* * * * * * * * * * DANGER * * * * * * * * * *

HIGH VOLTAGE IS DANGEROUS

USE EXTREME CAUTION - FOLLOW OPERATING INSTRUCTIONS

OPERATING INSTRUCTIONS

1. Set the POWER switch to the OFF or down position.
2. Set the OUTPUT VOLTAGE ADJ control to the extreme counterclockwise position.
3. Set the AC OFF DC switch to the OFF position.
4. Connect the electrodes to be used to the desired output connector. (Pin B on the connector should be connected to the positive electrode and Pin D to the negative electrode.)
5. Connect the AC INPUT 230 VAC connector to the 230 volt AC 60 cycle power source.
6. Set the METER SELECTOR switch to the desired position.
7. FOR AC 60 CYCLE USE:
   a. Set the POWER switch to the ON or up position.
   b. Set the AC OFF DC switch to the AC position.
   c. Slowly rotate the OUTPUT VOLTAGE ADJ control clockwise to the desired output voltage.
8. FOR DC USE:
   a. Repeat steps 1 through 6.
   b. Set the AC OFF DC switch to the DC position.
   c. Set the DC-PULSE switch to the DC position.
   d. Slowly rotate the OUTPUT VOLTAGE ADJ control clockwise to the desired output voltage.
9. FOR PULSE USE:
   a. Repeat steps 1 through 6.
   b. Set the AC OFF DC switch to the DC position.
   c. Set the DC-PULSE switch to the PULSE position.
   d. Set the FREQUENCY ADJUST control for the desired frequency as indicated on the frequency meter.
   e. Set the PULSE WIDTH ADJUST control to the desired pulse width as indicated on the PERCENT PULSE WIDTH meter.

f. Slowly rotate the OUTPUT VOLTAGE ADJ control clockwise to the desired output voltage.

10. Pins A & C of the output connector may be used for an electrode switch to turn the output of the unit on or off by removing the wire between Pins A and C and connecting a switch thereto. (See INPUT-OUTPUT CONNECTIONS diagram, Page 10)

NOTE: During operation, before changing from one output to another, set the OUTPUT VOLTAGE ADJ control to the extreme counter-clockwise position.

IMPINGEMENT OF ORGANISMS

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.2.a.(2) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

The impingement program will investigate the numbers and species impinged on the river water intake screens (TMI-1 and TMI-2); the day-night differences in impingement frequency; the extent of mortality of impinged fish; and compare the impingement experience at Unit 1 versus Unit 2.

Discussion and Responsibilities

Metropolitan Edison Company's consultant (Ichthyological Associates, Inc. - IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. A.E.C. 1972. Final environmental statement related to operation of Three Mile Island Nuclear Station, Units 1 and 2. Docket Nos. 50-289 and 50-320. United States Atomic Energy Commission, Washington, D.C. page III-8.

4. Carlander, K.D. 1953. Handbook of freshwater fishery biology with the first supplement. Wm. C. Brown Co., Dubuque, Iowa. 430 pp.

5. _____. 1969. Handbook of freshwater fishery biology. Vol. 1. Life history data on freshwater fishes of the United States and Canada, exclusive of the Perciformes. Iowa State Univ. Press. Ames, Iowa. 752 pp.

6. Metropolitan Edison Company. 1971. Environmental report operating license stage. Three Mile Island Nuclear Station, Unit 1 and Unit 2.

7. _____. 1975. Supplement II: Environmental report operating license stage - Unit 2. Three Mile Island Nuclear Station, Unit 1 and Unit 2.

8. Miller, J. and K. Buss. [1963?]. The age and growth of the fishes in Pennsylvania. Pa. Fish Comm. 26 pp.

9. Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fish Res. Board Can. Bull. 184. 966 pp.

10. Trautman, M.B. 1957. The fishes of Ohio with illustrated keys. Ohio State Univ. Press, Columbus, Ohio. 683 pp.

Apparatus and Attachments

1. Apparatus required:

A Taylor Bi-Therm field thermometer (Model 6074-1) or equivalent.

Marsh-McBirney (Model 201) Portable Water Current Meter or equivalent.

A fish collection device constructed of 6.4 mm mesh seine material.

Glass or plastic jars.

Meter stick for measuring fish.

Ohaus Dial-O-Gram beam balance or equivalent for weighing fish.

A white enamel pan.

b. Attachments:

GPF 1453.001 - Three Mile Island Aquatic Study, Field Data Sheet.

GPF 1453.002 - Fisheries Species and Codes.

GPF 1453.003 - Individual Fish Data Sheet.

GPF 1453.004 - Numbers of fishes impinged at the Unit 1 Intake during a 24-hr impingement survey on 18-19 March 1977.

GPF 1453.005 - Summary of lengths, weights, breeding condition, and numbers of fishes impinged at the Unit 1 Intake on 18-19 March 1977.

Precautions

None.

Prerequisites and Requirements

Samples are taken unless access to the Intake structures is not granted by Metropolitan Edison Company or if mechanical problems result in the traveling screens not functioning. In such cases, the program will be suspended until the problem is corrected.

Procedure

a. Field Procedure

River water for condenser makeup and the secondary service cooling system is drawn from the Susquehanna River through vertical traveling screens by river water circulating pumps, located at the intake structures. These structures are enclosed in concrete buildings along the west shore of Three Mile Island and are flush with the shoreline. River water passes under a skimmer wall, which has trash bars with two foot vertical spacings, through automated trash racks with one inch vertical bar spacings, and through vertical traveling screens of 3/8 inch mesh before going through the river water pumps. The flow velocity under normal and low river flows and normal operating conditions is 0.2 ft/sec (A.E.C. 1972).

The fish and refuse from the automated trash racks and vertical traveling screens are washed into wire mesh bins. The bin for the traveling screens at Unit 1 also receives the discharge from all river water pump automatic discharge strainers of 1/8 inch mesh.

Fish samples will be collected at the vertical traveling screens for TMINS Units 1 and 2. The following sampling schedule will be employed (conditions permitting):

November through February - monthly,
March through April - semimonthly,
May through June - weekly,
July through October - semimonthly.

The procedure for obtaining impingement samples is described below. The traveling screens are set on an automatic wash cycle that runs at 8-hr intervals. Quantitative and qualitative analyses are performed on fishes collected from the traveling screens at 2000, 0400, and 1200 hr over a 24-hr period. Prior to the start of each survey the screens are cleaned by operating them in the wash mode for 15 minutes. After the screens are cleaned the collection device is placed in the trash bin,that receives the screen wash, to collect fish. During the sampling period an automatic wash mode will occur once every eight hours. Also,when a specified pressure gradient is reached across the face of the screens, the screens will wash continuously until the deferential pressure gradient is reduced. Each sampling period is terminated at the end of the wash cycle. Fish that accumulate in the net during the designated time period constitute a sample.

Live and dead fish[1*] are sorted from the trash by hand, placed in separate glass jars with identifying labels[2], and delivered to the laboratory for processing. This procedure is performed for each sample period. At the end of 24 hours,the net is removed from the trash bin. The information recorded for each 8-hr interval includes: air and intake water temperature, collection number (initials of investigator, last two digits of the year, and numbers running consecutively from 001 to 999), date, time, location, collector's initials, program code, number and kind of river water pumps operating for each Unit[3], and river stage and flow (obtained from the River Forecast Center in Harrisburg, Pennsylvania). The above information is recorded on GPF 1453.001 (Page 1 of 2). The intake velocity (cm/sec)[4] is taken once during each survey directly outside the Intake structures. This information is recorded on GPF 1453.001 (Page 1 of 2) during the appropriate sampling period.

* Superscript refer to comments in Quality Control Section (d).

b. Laboratory Procedure

Impinged fish are processed in the laboratory within 24 hours after the sample is collected. For each sample impinged fish are sorted and identified to the lowest feasible taxon. Species codes are determined from GPF 1453.002. Individual length (fork length, FL), weight (g), and condition (alive or dead) are recorded on GPF 1453.003. The total number of specimens and species is recorded on GPF 1453.001 (Page 1 of 2). The total number of each species is recorded on GPF 1453.001 (Page 2 of 2) next to the appropriate species name. Individual specimens are weighed to the nearest 0.1 gram on a Dial-O-Gram beam balance[4]. The volumetric flow rate (utilizing the rated capacity of the river water pumps operating)[5] is determined and recorded on GPF 1453.004.

Reproductive status for fishes is defined as follows: young are spawned during the current calendar year; juveniles are incapable of reproduction, or minnows and darters less than 26 mm collected prior to the current spawning season; and adults are capable of reproduction. Classifications are based on field observations and information in the literature (Carlander 1953, 1969; Miller and Buss 1963; Scott and Crossman 1973; Trautman 1957).

Field and laboratory data sheets are stored in a fireproof file cabinet for the current year. Past year's data are presented in annual reports which can be found in many separate locations.

c. Data Processing

Information from GPF 1453.001 and GPF 1453.003 is tabulated and typed into a table for each survey date for each Unit (GPF 1453.004). Data for total number, fork length ranges (5 mm groups), total weight, and reproductive status is summarized for each species and typed into a table for each survey date for each Unit (GPF 1453.005).

These tables are summarized to determine the total number and biomass of fishes and specimens impinged at Unit 1 and 2, and combined to give the total impingement for TMINS. Estimates of total number and biomass impinged at TMINS each month is made from the following formula:

$$T = (\overline{X})(Z)$$

where T = estimate of number or biomass
$\overline{X}$ = mean number or biomass per 24-hr survey for Units 1 and 2.
Z = number of days in each month.

Yearly estimates will also be compiled for each Unit and the TMINS.

Attempts will be made to relate the number impinged to intake velocity, volumetric flow rate at TMI-1 and TMI-2, day-night differences, and to other fisheries programs.

d. Quality Control

1. This is determined by whether or not the specimens show opercular movement.

2. The label contains the Unit number (TMI-1 or TMI-2), date, time of collection, initials of collector, and condition of fish (alive or dead).

3. Information is obtained from the Unit 1 and Unit 2 Control Room operators.

4. Instrument calibrations are discussed in GP 1455.

5. Information is obtained from the Environmental Report: Operating License Stage. 1971. page 3.5-3 (for Unit 1, river water pumps) and Supplement II, Environmental Report: Operating License Stage, Unit 2. 1975. page 3.5-2 (for Unit 2, river water pumps).

Submitted:	Approved:	Concurrence:
J.E. Mudge Environmental Scientist	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

THREE MILE ISLAND AQUATIC STUDY

Field Data Sheet

Collection Number: 1 GAN 4 77 6 002

No. Spmn 13 No. Spp 2

Collected by GAN

Location TMI-UNIT #1 INTAKE

Mo 9 03 Day 11 18

13 Rep 18

Card No. 20 1

Program 01. Lymnology Monitoring; 10. Plankton; 15. Entrainment, Plankton; 20. Macroinvertebrates; 30. Water Chemistry; 50. Fisheries Monitoring; 60. Ichthyoplankton; 61. Entrainment, Ichthyoplankton; 70. Tagging; 71. Food Habits; 72. Age & Growth; 80. Impingement; 90. Radiation; Other

21 50

Gear 01. Lowe sampler; 05. Petersen grab; 20. Pump; 50. Electro-shocker AC; 51. Electro-shocker DC; 60. Tow net, Tucker sheet; 70. Trawl, 16' 8" mesh; 80. Commercial Seine, 10' x 4' x 1/8" mesh; 81. Trap net, 2' x 6' x 5' mesh; Other

23

Volts 25

Amps 28

Pulse 30

Distance to Shore (m) 32

Meter No.

Revolutions: End 34

Begin

39

No. of H 43

Type o 44

Substrate Type 45

REMARKS

GPF 1453.001
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78

79 1

Card No. 20 2

Ti 21 2000

Durati ample (25

Temperature (Air 28 075

ter: Surface 32 60

Oxygen (ppm) Surface 36

pH Surface 39

Conductivity (umhos) 42

Secchi Disc (cm) 47

Water Depth (m) 51

Current (cm/sec) Surface 54

Bottom 58

River Stage (m) 62 290

River Flow (m^3/sec) 66 36790

Depth of Sample 72

Weather 1. Clear; 2. Partly cloudy; 3. Overcast; 4. Haze; 5. Fog; 6. Light rain; 7. Heavy rain; 8. Snow 75

Nuclear Service Pumps 76 2

Secondary Service Pumps 77 2

Decay Heat Pumps 78 0

79 1

EXAMPLE

61-145

CODE	SPECIES	TOT	PRES	REL	PROC	TAG	RECAP	REMARKS
262	Esox masquinongy							
274	Cyprinus carpio							
278	Notemigonus crysoleucas							
280	Notropis amoenus							
282	N. cornutus							
283	N. hudsonius							
284	N. procne							
286	N. spilopterus							
287	Pimephales notatus							
289	Rhinichthys atratulus							
292	Semotilus corporalis							
321	Carpiodes cyprinus							
322	Catostomus commersoni							
324	Hypentelium nigricans							
325	Moxostoma macrolepidotum							
334	Ictalurus nebulosus							
335	I. punctatus	2						2 ALIVE
371	Ambloplites rupestris							
373	Lepomis auritus							
375	L. gibbosus							
376	L. macrochirus							
377	Micropterus dolomieui							
379	Pomoxis annularis							
380	P. nigromaculatus							
401	Etheostoma olmstedi	11			11			6 ALIVE; 5 DEAD
403	Perca flavescens							

FISHERIES SPECIES AND CODES

Species Code	Scientific Name	Common Name
200	Amiidae	Bowfin
201	Amia calva Linnaeus	Bowfin
210	Anguillidae	Freshwater eels
211	Anguilla rostrata (Lesueur)	American eel
220	Clupeidae	Herrings
221	Alosa aestivalis (Mitchill)	Blueback herring
222	Alosa mediocris (Mitchill)	Hickory shad
223	Alosa pseudoharengus (Wilson)	Alewife
224	Alosa sapidissima (Wilson)	American shad
225	Brevoortia tyrannus (Latrobe)	Atlantic menhaden
226	Dorosoma cepedianum (Lesueur)	Gizzard shad
240	Salmonidae	Trouts
241	Salmo gairdneri Richardson	Rainbow trout
242	Salmo trutta Linnaeus	Brown trout
243	Salvelinus fontinalis (Mitchill)	Brook trout
260	Esocidae	Pikes
261	Esox lucius Linnaeus	Northern pike
262	Esox masquinongy Mitchill	Muskellunge
263	Esox niger Lesueur	Chain pickerel
270	Cyprinidae	Minnows and carps
271	Campostoma anomalum (Rafinesque)	Stoneroller
272	Carassius auratus (Linnaeus)	Goldfish
273	Clinostomus funduloides Girard	Rosyside dace
274	Cyprinus carpio Linnaeus	Carp
275	Ericymba buccata Cope	Silverjaw minnow
276	Exoglossum maxillingua (Lesueur)	Cutlips minnow
277	Nocomis micropogon (Cope)	River chub
278	Notemigonus crysoleucas (Mitchill)	Golden shiner
279	Notropis spp.	
280	Notropis amoenus (Abbott)	Comely shiner
281	N. analostanus (Girard)	Satinfin shiner
282	N. cornutus (Mitchill)	Common shiner
283	N. hudsonius (Clinton)	Spottail shiner
284	N. procne (Cope)	Swallowtail shiner
285	N. rubellus (Agassiz)	Rosyface shiner
286	N. spilopterus (Cope)	Spotfin shiner
287	Pimephales notatus (Rafinesque)	Bluntnose minnow
288	Pimephales promelas Rafinesque	Fathead minnow
289	Rhinichthys atratulus (Hermann)	Blacknose dace
290	Rhinichthys cataractae (Valenciennes)	Longnose dace

Species Code	Scientific Name	Common Name
291	Semotilus atromaculatus (Mitchill)	Creek chub
292	Semotilus corporalis (Mitchill)	Fallfish
320	Catostomidae	Suckers
321	Carpiodes cyprinus (Lesueur)	Quillback
322	Catostomus commersoni (Lacepede)	White sucker
323	Erimyzon oblongus (Mitchill)	Creek chubsucker
324	Hypentelium nigricans (Lesueur)	Northern hog sucker
325	Moxostoma macrolepidotum (Lesueur)	Shorthead redhorse
330	Ictaluridae	Freshwater catfishes
331	Ictalurus spp.	
332	Ictalurus catus (Linnaeus)	White catfish
333	Ictalurus natalis (Lesueur)	Yellow bullhead
334	Ictalurus nebulosus (Lesueur)	Brown bullhead
335	Ictalurus punctatus (Rafinesque)	Channel catfish
336	Noturus insignis (Richardson)	Margined madtom
350	Cyprinodontidae	Killifishes
351	Fundulus diaphanus (Lesueur)	Banded killifish
352	Fundulus heteroclitus (Linnaeus)	Mummichog
360	Percichthyidae	Temperate basses
361	Morone americana (Gmelin)	White perch
362	Morone saxatilis (Walbaum)	Striped bass
370	Centrarchidae	Sunfishes
371	Ambloplites rupestris (Rafinesque)	Rock bass
372	Lepomis spp.	
373	Lepomis auritus (Linnaeus)	Redbreast sunfish
374	Lepomis cyanellus Rafinesque	Green sunfish
375	Lepomis gibbosus (Linnaeus)	Pumpkinseed
376	Lepomis macrochirus Rafinesque	Bluegill
377	Micropterus dolomieui Lacepede	Smallmouth bass
378	Micropterus salmoides (Lacepede)	Largemouth bass
379	Pomoxis annularis Rafinesque	White crappie
380	Pomoxis nigromaculatus (Lesueur)	Black crappie
400	Percidae	Perches
401	Etheostoma olmstedi Storer	Tessellated darter
402	Etheostoma zonale (Cope)	Banded darter
403	Perca flavescens (Mitchill)	Yellow perch
404	Percina caprodes (Rafinesque)	Logperch
405	Percina peltata (Stauffer)	Shield darter
406	Stizostedion vitreum vitreum (Mitchill)	Walleye
450		Hybrids

INDIVIDUAL FISH DATA SHEET

Collection No.: GAN 77-002

Collector(s): GAN

Date: Yr 77 Mo 03 Day 18

ogram: IMPINGEMENT

Location: TMI - UNIT #1 INTAKE

Gear:

Time: 2000

No.	Sp.	FL.	Weight	Tag No.	Recap.	Comment	Sp.	FL.	Weight	Tag No.	Recap.	Comment
1	401	47	0.9			DEAD						
2	401	50	1.2			DEAD						
3	401	46	0.9			DEAD						
4	401	46	0.9			DEAD						
5	401	49	0.9			DEAD						
6	401	45	0.9			ALIVE						
7	401	47	1.0			ALIVE						
8	401	44	0.9			ALIVE						
9	401	52	1.6			ALIVE						
10	401	54	1.3			ALIVE						
11	401	50	1.1			ALIVE						
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
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29												
30												

EXAMPLE

Numbers of fishes impinged at the Unit 1 Intake during a 24-hr impingement survey on 18-19 March 1977.

Date	18		19		19			
Time	1200-2000		2000-0400		0400-1200			
Volumetric Flow Rate (m^3/sec)	1.67		1.67		2.17			
Number of River Water Pumps:								
Nuclear Service	2		2		2			
Standby Service	2		2		2			
Decay Heat	0		0		1			
River Flow (m^3/sec)	3679.0		3396.0		3311.1		Total	
Condition of Fish	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Spottail shiner	-	-	-	3	-	1	-	4
Channel catfish	-	-	-	1	1	-	3	1
Margined madtom	-	-	-	1	-	-	-	1
Redbreast sunfish	-	-	-	-	-	1	-	1
Pumpkinseed	-	-	-	-	1	-	1	-
Tessellated darter	8	5	[illegible]	32	10	9	17	46
Banded darter	-	-	[illegible]	[illegible]	-	-	-	3
Total	8	5	[illegible]	[illegible]	12	11	21	56

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Summary of lengths, weights, breeding condition, and numbers of fishes impinged at the Unit 1 Intake on 18-19 March 1977.

Species	Fork Length Range (5 mm groups)	Reproductive Status	Total Weight (g)	Total Number
Spottail shiner	46-50, 66-70	1 Juvenile, 3 Adults	11.1	4
Channel catfish	56-70	4 Juveniles	11.5	4
Margined madtom	51-55	1 Juvenile	1.4	1
Redbreast sunfish	41-45	1 Juvenile	1.5	1
Pumpkinseed	51-55	1 Juvenile	2.7	1
Tessellated darter	31-70	18 Juveniles, 45 Adults	66.9	63
Banded darter	31-40	3 Juveniles	1.7	3
			96.8	77

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ENTRAINMENT OF ICHTHYOPLANKTON

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 3.1.2.a.(3) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

Entrained ichthyoplankton shall be collected at the Three Mile Island Nuclear Station (TMINS) Intake structures, to assess and detect significant changes in species composition; relative abundance; spatial and temporal distribution; and diversity of species as it relates to the operation of TMINS. Entrained ichthyoplankton densities shall be compared with the ichthyoplankton densities in the river [TMI-2, ETS - Section 3.1.2.a.(1)(b)].

Discussion and Responsibilities

Metropolitan Edison Company's consultant (Ichthyological Associates, Inc. - IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. Armstrong, P.B. 1962. Stages in the development of Ictalurus nebulosus. Syracuse Univ. Press. Syracuse, N.Y.

4. Bailey, R.M., J.E. Fitch, E.S. Herald, E.A. Lachner, C.C. Lindsey, C.R. Robins, and W.B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada. Amer. Fish. Soc. Special Publ. No. 6. 150 pp.

5. Battle, H.I. 1940. The embryology and larval development of the goldfish, Carassius auratus Lesueur, from Lake Erie. Ohio. J. Sci., 40(2):82-93.

6. Cooper, J.E. 1976. Eggs and larvae of the logperch, Percina caprodes. M.S. Thesis, Appalachian Environmental Laboratory, University of Maryland.

7. Fish, M.P. 1932. Contribution to the early life histories of sixty-two species of fishes from Lake Erie and its tributary waters. U.S. Bur. Fish. Bull. 47(10):293-398.

8. Gerlack, J.M. 1973. Early development of the quillback carpsucker, Carpiodes cyprinus. M.S. Thesis, Millersville State College. Millersville, Pennsylvania.

9. Lathrop, B.F. 1976. Ichthyoplankton. Pages 7-35 In G.A. Nardacci, and W.A. Potter, et al. An ecological study of the Susquehanna River in the the vicinity of the Three Mile Island Nuclear Station. Supplemental Report for 1975. Ichthyological Associates, Inc. 249 pp.

10. Lippson, A.J. and R.L. Moran. 1974. Manual for identification of early developmental stages of the Potomac River Estuary. Martin Marietta Corporation, Environmental Technology Center. Baltimore, Maryland. 282 pp.

11. Mansueti, A.J. 1964. Early development of the yellow perch, Perca flavescens. Ches. Sci. 5(1-2):46-66.

12. Mansueti, A.J. and J.D. Hardy, Jr. 1967. Development of fishes of the Chesapeake Bay region; an atlas of egg, larval, and juvenile stages. Natural Resources Institute. University of Maryland. 202 pp.

13. May, E.B. and C.R. Gasaway. 1967. A preliminary key to the identification of larval fishes of Oklahoma, with particular reference to Canton Reservoir, including a selected bibliography. Oklahoma Department of Wildlife Conservation Bull. No. 5. 42 pp.

14. Meyer, F.A. 1970. Development of some larval centrarchids. Prog. Fish-Cult. 32(3):130-136.

15. Nelson, W.R. 1968. Embryo and larval characteristics of sauger, walleye, and their reciprocal hybrids. Trans. Am. Fish. Soc. 97(2):167-174.

16. Norden, C.R. 1961. The identification of larval yellow perch, Perca flavescens and walleye, Stizostedion vitreum. Copeia 1961(3):282-288.

17. Siefert, R.E. 1969. Characteristics for separation of white and black crappie larvae. Trans. Am. Fish. Soc. 98(2):326-328.

18. Snyder, D.E. 1976. Terminologies for intervals of larval fish development. pp. 41-60. In J. Borman, editor. Great Lakes Fish Egg and Larvae Identification: Proceedings of a Workshop. U.S. Fish and Wildlife Service. National Power Plant Team. Ann Arbor, Michigan.

19. Sokal, R.R. and F.J. Rohlf. 1969. Biometry, the principles and practice of statistics in biological research. W.H. Freeman, San Francisco. 776 pp.

20. Stewart, N.H. 1926. Development, growth, and food habits of the white sucker, Catostomus commersoni Lesueur. U.S. Bur. Fish. Bull. 42:147-181.

21. Taber, C.A. 1969. Distribution and identification of larval fishes in the Buncombe Creek Arm of Lake Texoma with observations on spawning habits and relative abundance. Ph.D. Thesis, University of Oklahoma. 106 pp.

22. Whittaker, R.H. and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia Basin, Southeastern Washington. Ecology 39:46-65.

23. Woolf, C.M. 1968. Principles of biometry. Van Nostrand Co., Lts., Toronto, Canada. 359 pp.

Apparatus and Attachments

a. Apparatus required:

A standard field thermometer (C).

A Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter or equivalent.

A Photovolt Model 126A pH meter or equivalent.

Half-meter plankton nets (0.5 mm mesh) with detachable cups at cod end.

Brass 0.5 m plankton net frames.

General Oceanics Digital flow meter (Model 2030).

A wash tub.

Glass or plastic jars (0.9 l) with lids.

U.S. Standard No. 30 mesh sieve.

A white enamel pan.

Glass vials with lids.

Ocular micrometer.

Helios dial caliper.

Dissecting forceps (fine).

Bausch and Lomb binocular dissecting scope (7X to 30X) or equivalent.

37% commercial solution formaldehyde diluted to 25, 10, and 5%.

b. Attachments:

GPF 1454.001 - Three Mile Island Nuclear Station Unit 1 Intake.

GPF 1454.002 - Field and Laboratory Data Sheet.

GPF 1454.003 - Collection label.

GPF 1454.004 - Three Mile Island Nuclear Station Unit 2 Intake.

GPF 1454.005 - Laboratory Data Sheet.

GPF 1454.006 - Number and density of ichthyoplankton taken by 0.5 m net in the TMINS Unit 1 Intake suction bay on 25-26 May 1977.

GPF 1454.007 - Results of the three way analysis of variance performed on densities of ichthyoplankton taken by 0.5 m net during entrainment studies at the TMINS Unit 1 Intake, March through September 1976.

GPF 1454.008 - Results of Student-Newman-Kuels multirange test performed on the logarithmic mean densities of ichthyoplankton taken by 0.5 m net during entrainment studies at the TMINS Unit 1 Intake in 1976.

GPF 1454.009 - Indices of percent similarity of species composition between 1000, 1600, 2200, and 0400 hr and surface and oblique tows for entrainment studies at the TMINS Unit 1 Intake, March through September 1976.

Precautions

None.

Prerequisites and Requirements

Samples are taken unless access to the Intake structures is not granted by Metropolitan Edison Company or if the sampling area in the suction bays is inundated by water resulting from high river flows.

Procedure

a. Field Procedure

Replicate (2) samples are taken semimonthly April through August (conditions permitting). Surface and oblique samples are taken at 1000, 1600, 2200, and 0400 hr by towing a 0.5 m plankton net (0.5 mm mesh) across the TMINS Intake

suction bay (a distance of about 20 m) see GPF 1454.001. The order in which the samples are taken (surface, oblique or oblique, surface) is determined from a random numbers table. The volume of water filtered is measured by a General Oceanics digital flow meter mounted in the mouth of the net. Data recorded during each sample period are collection number (initials of investigator, last two digits of the year, numbers running consecutively from 001 to 999), date, time, pH, dissolved oxygen, water temperature, flow meter turns, and the number of nuclear service, secondary service, and decay heat river water pumps in operation, conditions permitting,(GPF 1454.002). Meters are calibrated as per GP 1455. River stage for 0700 hr,obtained from the River Forecast Center in Harrisburg, Pennsylvania, is recorded prior to 1000 hr and after 0400 hr.

Surface samples (from Unit 1) are taken as follows: the initial flow meter readout is recorded and the plankton net is lowered from the catwalk at the south end of the suction bay until the net is fully immersed. The net is then towed to the north end of the suction bay and retrieved by means of the net suspension line. The flow meter turns are recorded. The net is then rinsed three separate times in a wash tub to concentrate the sample. All three portions of the sample are placed in a labeled 0.9 liter jar and the sample is preserved in about a 25% formalin solution. A label permanently affixed to the lid of the jar contains: location (Unit 1 or Unit 2), time (1000, 1600, 2200, 0400 hr), depth (surface or oblique), and replicate designator (A or B). In addition, a collection label with the principal investigator's collection number, location, date, time, depth, and replicate designator is placed in the sample (GPF 1454.003). Samples are returned to the laboratory for storage until they can be processed. Procedures for oblique samples are the same as those for surface samples with the exception that oblique tows originate about 1.0 m from the bottom of the suction bay. Procedures for

Unit 2 are the same as those for Unit 1 with the exception that tows in Unit 2 originate from the north end of the suction bay (GPF 1454.004).

b. Laboratory Procedure

Laboratory procedures for ichthyoplankton entrainment are the same as for the far-field ichthyoplankton program (GP 1451) with the exception of the laboratory data sheet (GPF 1454.005).

c. Data Processing

Data from the laboratory data sheet (number of fish per sample) is standardized by the following method:

$$\text{Density (number of fish/100m}^3\text{ of water sampled)} = \frac{\text{Number of fish per sample}}{\text{Volume of the sample (m}^3\text{)}} \times 100$$

An example of a completed table for one sampling date is presented as GPF 1454.006.

An analysis of variance (ANOVA) is performed to test for differences between sampling dates, times, and depths (Sokal and Rohlf 1969). A logarithmic $\left[\log_{10}(y+1)\right]$ transformation is employed to normalize the data. Analysis is performed for total fish and those families and species present in sufficient numbers to warrant analysis (GPF 1454.007).

The Student-Newman-Keuls multirange test (SNK) is used to determine which sample means are significantly different after an initial difference is recognized by ANOVA (Woolf 1968) GPF 1454.008.

An index of percent similarity is computed to identify likenesses between depths and times with respect to composition of fishes (Whittaker and Fairbanks 1958) GPF 1454.009. It is expressed as:

$$PSc = \sum \min \left|a,b\right|$$

where PSc = the percent similarity, and a and b = the percentages of species a and b in samples A and B. PSc values range from 0.0 (no similarity) to 100.0 (complete similarity). This is an emperical index and measures relative similarity in terms of species composition and generally leads to the grouping of communities by dominant or major species.

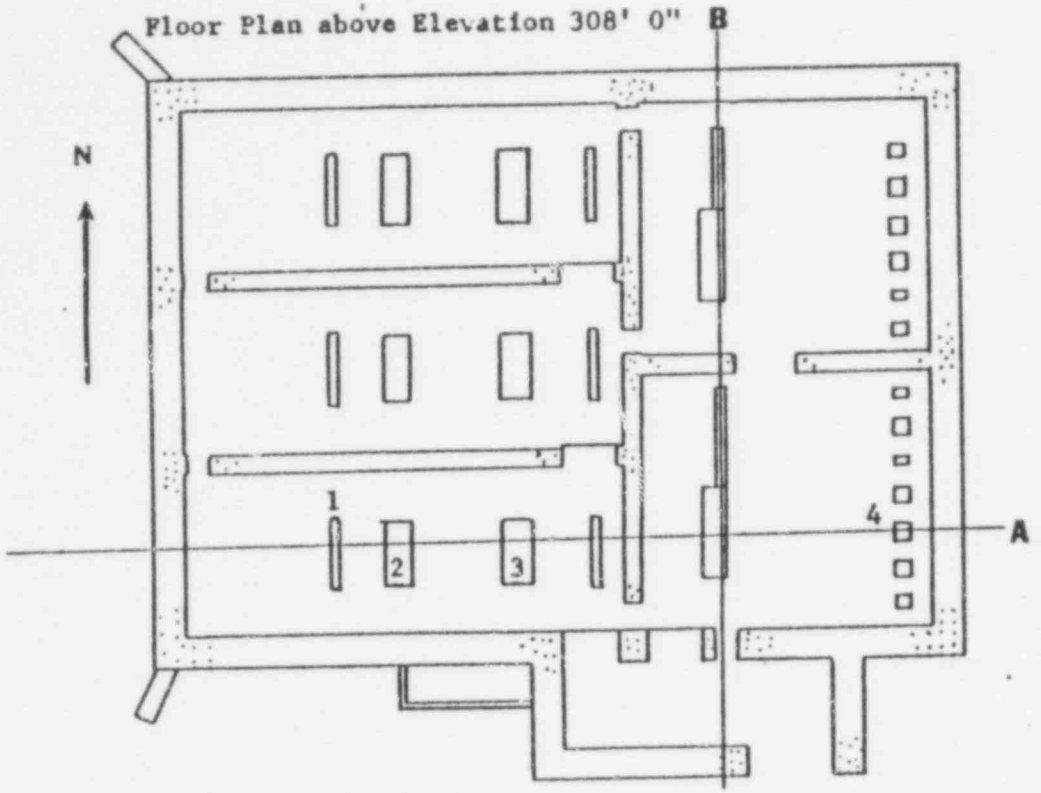
The above are the types of data analyses performed to date. Additional analyses deemed necessary to evaluate change shall be done by accepted methods.

Field data sheets and laboratory data sheets are stored in a fireproof file cabinet for the current year. Past year's data are presented in annual reports which can be found in many separate locations.

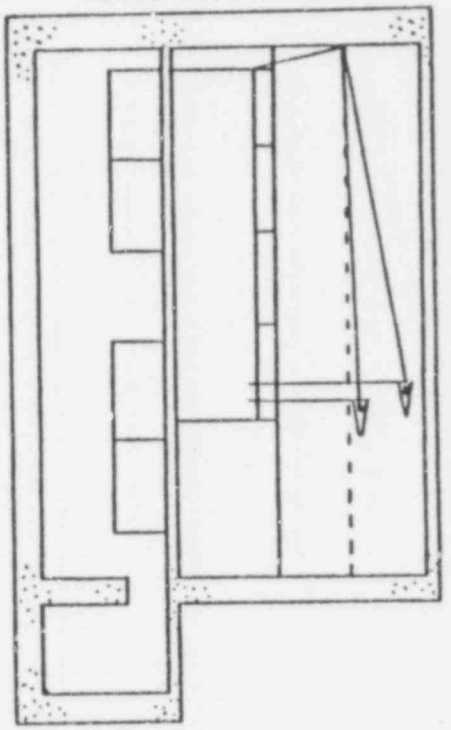
Submitted:	Approved:	Concurrence:
J.E. Mudge Environmental Scientist	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

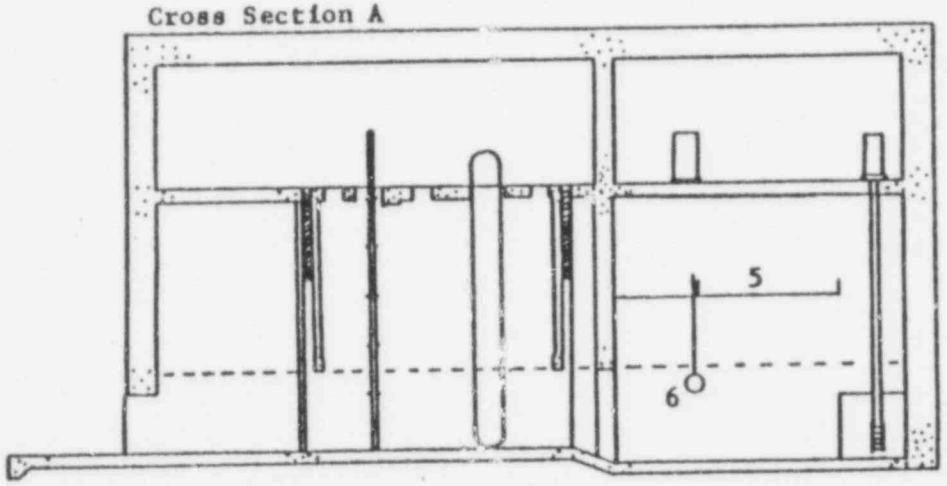
Floor Plan above Elevation 308' 0"



Cross Section B



Cross Section A



1 Stop log
2 Course Trash Bars
3 Traveling Screens
4 River Water Pumps
5 Pump Suction Bay
6 0.5 m Plankton Net
------ Normal River Elevation 278' 0"

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Three Mile Island Nuclear Station Unit 1 Intake.

FIELD AND LABORATORY DATA SHEET

DATE: 25-26 May 1977

	1000	1600	2200	0400
PRIMARY SERVICE PUMPS:	3	3	3	3
SECONDARY SERVICE PUMPS:	2	2	2	2
BACKUP HEAT PUMPS:	0	0	0	0
RIVER STAGE (a) 0700 MS				1.19

COLLECTED BY PCR, REE

TIME PERIOD	ACTUAL TIME	WATER TEMP. (C)	DISSOLVED O2 (ppm)	pH	DUPLICATE	SURFACE COLLECTION NUMBER	SURFACE TUBE	SURFACE VOLUME (ml)	OBLIQUE COLLECTION NUMBER	OBLIQUE TUBE	OBLIQUE VOLUME (ml)	TOTAL NUMBER OF TUBES & INITIALS OF PICKER: SURFACE	TOTAL NUMBER OF TUBES & INITIALS OF PICKER: OBLIQUE
1000	SURFACE 1010	24.0	7.8	8.3	A	PCR-77-21	27883.7	3.5	PCR-77-21	27689.6 27752.6	3.6	35 PCR	34 PCR
	OBLIQUE 1003				B		[illegible]	3.6		27822.2	3.9	25 PCR	30 PCR
1600	SURFACE 1606	25.0	9.4	8.3	A	PCR-77-22	28140		PCR	28011.0	3.6	11 PCR	23 PCR
	OBLIQUE 1600				B		28208.8	3.6		280[illegible]	3.8	7 PCR	11 PCR
2200	SURFACE 2206	25.0	9.6	8.6	A	PCR-77-23	28355.5 28411.5	3.2	PCR-77-23	28272.7	3.6	10 PCR	10 PCR
	OBLIQUE 2200				B		28475.6	3.6		28342.7	4.0	15 PCR	14 PCR
0400	SURFACE 0349	24.5	8.9	8.6	A	PCR-77-24	28673.8	3.6	PCR-77-24	28543.9	3.9	16 PCR	20 PCR
	OBLIQUE 0342				B		28733.8	3.4		28610.0	3.7	22 PCR	14 PCR

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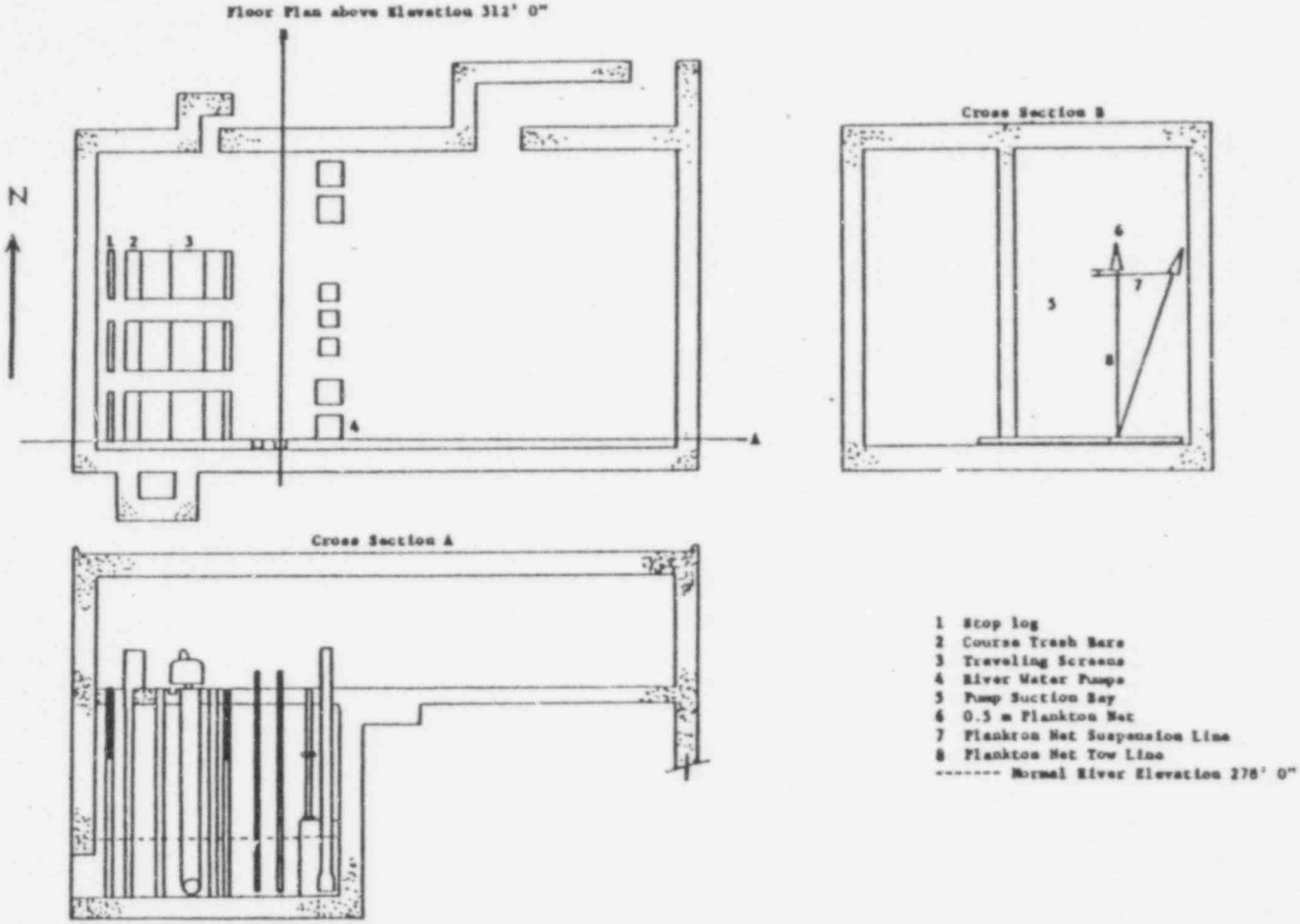
Collection Label

PCR = 77 - 001 Unit 1 24 May 1977

1000 Surface A



1 Stop log
2 Course Trash Bars
3 Traveling Screens
4 River Water Pumps
5 Pump Suction Bay
6 0.5 m Plankton Net
7 Plankton Net Suspension Line
8 Plankton Net Tow Line
------- Normal River Elevation 278' 0"

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Three Mile Island Nuclear Station Unit 2 Intake.

ST 1 Cyprinus carpio

LOCATION Unit 1 IDENTIFIED BY P.C. Ritson

DATE 25-26 May 1977

Laboratory Data Sheet

TIME PERIOD	1000				1600			
DEPTH	SURFACE		OBLIQUE		SURFACE		OBLIQUE	
REPLICATE	A		A	B	A	B	A	B
mm								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
TOTAL	8	1	2	2	0	0	1	0

EXAMPLE

No designation = protolarvae
ms = mesolarvae
mt = metalarvae
y = young

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SPECIES Cyprinus carpio

LOCATION Unit 1 IDENTIFIED BY PC Ritson

DATE 25-26 Ma, 1977

Laboratory Data Sheet

TIME PERIOD	2200				0400			
DEPTH	SURFACE		OBLIQUE		SURFACE		OBLIQUE	
REPLICATE	A		A	B	A	B	A	B
mm								
TOTAL	7	2	4	1	3	7	6	1

No designation = protolarvae
ms = mesolarvae
mt = metalarvae
y = young

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Number (n) and dens[illegible] (n/[illegible]m^3) of [illegible]thyoplankton taken by 0.5 m net in the TMINS Unit 1 Intake suction bay on 25-26 May 1977.

Time Period	1000						1600			
Station	SURFACE		OBLIQUE		SURFACE		OBLIQUE			
Time	1010		1003		1606		1600			
Water Temp. (C)	24.0				25.0					
Dissolved Oxygen (ppm)	7				9.4					
pH					8.3					
River Stage (m)	22									
Replicate	a	b	a	b	a	b	a	b	a	b
Volume Sampled (m^3)	3.5	[illegible]	3.6	[illegible]	3.8	3.6	3.6	3.8		
	n n/100m^3	n n/100m^3	n n/100m^3	n n/100m^3	n n/100m^3	n n/100m^3	n n/100m^3	n n/100m^3		
LARVAE										
Campostoma/Nocomis/Semotilus	- -	- -	[illegible]	25	- -	- -	- -	- -		
Cyprinus carpio	8 228.57	1 27.78	[illegible]	[illegible]	- -	- -	1 27.78	- -		
Notemigonus crysoleucas	- -	- -	- -	- -	- -	- -	- -	- -		
Notropis amoenus	- -	- -	- -	- -	- -	- -	- -	- -		
N. hudsonius	17 485.71	5 138.89	12 333.33	1 [illegible]	1 26.32	- -	1 27.78	1 26.32		
N. spilopterus	- -	- -	- -	- -	- -	- -	- -	- -		
Semotilus corporalis	- -	- -	- -	- -	- -	- -	1 27.78	- -		
Carpiodes cyprinus	1 28.57	- -	4 111.11	1 25.[illegible]	- -	- -	- -	- -		
Catostomus commersoni	- -	1 27.78	3 83.33	2 51.28	[illegible]26	[illegible]5.56	4 111.11	2 52.63		
Moxostoma macrolepidotum	- -	- -	- -	- -	2 [illegible].63	4 111.11	- -	- -		
Lepomis gibbosus/L. macrochirus	2 57.14	1 27.78	- -	4 102.56	- -	- -	- -	1 26.32		
Etheostoma olmstedi	- -	- -	- -	- -	- -	- -	- -	- -		
E. zonale	3 85.71	9 250.00	7 194.44	12 307.69	1 26.32	- -	- -	- -		
Percina peltata	4 114.29	8 222.22	5 138.89	7 179.49	2 52.63	- -	15 416.67	7 184.21		
Total Larvae	35 999.99	25 694.45	33 916.66	30 769.22	10 263.16	6 166.67	22 611.12	11 289.48		
YOUNG										
Catostomus commersoni	- -	- -	- -	- -	- -	1 27.78	- -	- -		
Total Young	- -	- -	- -	- -	- -	1 27.78	- -	- -		
TOTAL	35 999.99	25 694.45	33 916.66	30 769.22	10 263.16	7 194.45	22 611.12	11 289.48		

Time Period	2200						0400			
Station	SURFACE		OBLIQUE		SURFACE		OBLIQUE			
Time	2206		2200		0349		0342			
Water Temp. (C)	25.0				24.5					
Dissolved Oxygen (ppm)	9				8.9					
pH					8.6					
River Stage (m)					1.19					
Replicate	a	b		b	a	b	a	b		
Volume Sampled (m^3)	3.2	3	3.6	0	3.6	3.4	3.9	3.7		
	n	n/100m^3	n	n/100m^3	n	n/100m^3	n	n/100m^3	n	n/100m^3	n	n/100m^3	n	n/100m^3
LARVAE														
Campostoma/Nocomis/Semotilus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyprinus carpio	7	218.75	2	55.56	[illegible]		1	[illegible]	3	83.33	7	205.88	6	153.85	1	27.03
Notemigonus crysoleucas	-	-	-	-	-	-	-	-	-	-	1	29.41	-	-	-	-
Notropis amoenus	-	-	-	-	-	-	-	-	1	27.78	-	-	-	-	1	27.03
N. hudsonius	1	31.25	6	166.67	4	111.11	9	229.[illegible]0	5	138.89	[illegible]	205.89	7	179.49	3	81.08
N. spilopterus	-	-	-	-	-	-	-	-	-	-	1	[illegible].41	-	-	-	-
Semotilus corporalis	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Carpiodes cyprinus	-	-	-	-	-	-	-	-	1	[illegible]	[illegible]	58.82	2	51.23	1	27.03
Catostomus commersoni	1	31.25	-	-	-	-	-	-	[illegible]		-	-	1	25.64	-	-
Moxostoma macrolepidotum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lepomis gibbosus/L. macrochirus	-	-	-	-	-	-	-	-	1	[illegible]8	-	-	-	-	-	-
Etheostoma olmstedi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	27.03
E. zonale	-	-	1	27.78	1	27.78	-	-	4	111.11	1	29.41	1	25.64	5	135.14
Percina peltata	1	31.25	6	166.67	1	27.78	4	100.00	1	27.78	3	88.24	3	76.92	2	54.05
Total Larvae	10	312.50	15	416.68	10	277.78	14	350.00	16	444.45	22	647.05	20	512.82	14	378.39
YOUNG																
Catostomus commersoni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Young	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	10	312.50	15	416.68	10	[illegible]	14	350.00	16	444.45	22	647.05	20	512.82	14	378.39

GPF 1454.006
8/31/77
Rev. 0

Results of the three way analysis of variance performed on d[illegible] hyoplankton taken by 0.5 m net during entrainment studies at the THINS Unit 1 Intake, March through September 1976.

Species	Dates Compared	Date	Depth[1]	[illegible]	[illegible]e/Depth	Date/Time	Depth/Time	Date/Depth/Time
Cyprinidae	10-11 Mar - 11-12 Aug	*	[illegible]			NS	NS	NS
Cyprinus carpio	26-27 May - 24-25 Jun	NS				NS	NS	NS
Notropis hudsonius	28-29 Apr - 14-15 Jul	*				*	NS	*
N. spilopterus	24-25 Jun - 11-12 Aug	NS	[illegible]	NS		*	NS	NS
Catostomidae	12-13 May - 24-25 Jun	*		NS		*	NS	NS
Carpiodes cyprinus	12-13 May - 24-25 Jun	*		*		NS	NS	NS
Centrarchidae	24-25 Jun - 11-12 Aug	NS	*	NS		NS	NS	NS
Lepomis gibbosus/L. macrochirus	24-25 Jun - 11-12 Aug	*	*	NS		NS	NS	NS
Percidae	28-29 Apr - 11-12 Aug	*	NS	*		*	NS	*
Perca flavata	28-29 Apr - 11-12 Aug	*	NS	*		*	[illegible]	NS
Total	10-11 Mar - 15-16 Sep	*	*	NS		NS	[illegible]	NS

1 Surface and Oblique.
2 1060, 1600, 2200, and 0400 hr.
* Significant at 0.05 level.
NS = Not Significant.

GPF 1454.007
8/31/77
Rev. 0

Results of Student-Newman-Kuels multirange test performed on the logrithmic mean densities of ichthyoplankton taken by 0.5 m net during entrainment studies at the TMINS Unit 1 Intake in 1976. Sample dates and times underscored showed no significant differ ce (P = 0.05).

Species	Sample Date											Time			
Cyprinidae	14	Mar 23-24	Mar 10-11	Aug 11-12	Jul 28-29	Jul 14-15	Apr 28-29	May 12-13	May 26- 7	Jun 9-10	Jun 24-25	1600	1000	0400	2200
Notropis hudsonius	Jul [illegible]-29		May 26-27	May 12-[illegible]	Jun 9-10	Jun 24-25						1600	1000	2200	0400
Catostomidae	May 12-13	[illegible]	Jun 9-10	[illegible]											
Carpiodes cyprinus	May 12-13	Jun 24-25	Jun 9-10	[illegible]								1600	1000	2200	0400
Lepomis gibbosus/L. macrochirus	Jun 24-25	Aug 11-12	Jul 28-29	Jul 14-15											
Percidae	Jul 28-29	Aug 11-12	Jul 14-15	Apr 28-29	May 26-27	Jun 24-25	Jun 9-10	May 12-13				2200	0400	1000	1600
Percina peltata	Jul 28-29	Aug 11-12	Jul 14-15	Apr 28-29	May 26-27	Jun 24-25	Jun 9-10	May 12-13				2200	0400	1600	1000
Total Larvae	Sep 15-16	Apr 14-15	Mar 23-24	Mar 10-11	Aug 11-12	Jul 28-29	Apr 28-29	Jul 14-15	May 26-27	Jun 9-10	Jun 24-25	[illegible]ay [illegible]-13			

Indices of p[illegible]ilarity o[illegible]cies composition between 1000, 1600, 2200, and 0400 hr and surface and obli[illegible]e tows [illegible]rainment studies at the TMINS Unit 1 Intake, March through September 19[illegible].

					OBLIQUE				
				1000					
			82.5	1600		67			
		55.6	55.9	22[illegible]	60.3	[illegible]	75.8		
	68.5	75.8	81.7	0400	82.7	69	51.2	86.2	
OBLIQUE	2200	1600	1000		1000	[illegible]00	2200	0[illegible]	SURFACE
				0400	79.9	60	50		
				2200	45.3	54.5			
				1600	77.6				
				SURFACE					

GPF 1454.009
8/31/77
Rev. 0

61-168

INSTRUMENT CALIBRATION - IA

Purpose and Scope

The purpose of this procedure is to list and explain calibration methods for instruments used by Ichthyological Associates, Inc. (IA) for the programs specified in the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

Discussion and Responsibilities

Metropolitan Edison Company's consultant (IA) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. American Public Health Association, Inc. 1975. Standard methods for the examination of water and wastewater. 14th edition. New York 1193 pp.

4. GP 1449. Water Quality Analysis.

5. GP 1450. Benthic Macroinvertebrates.

6. GP 1451. Ichthyoplankton.

7. GP 1452. Fish.

8. GP 1453. Impingement of Organisms.

9. GP 1454. Entrainment of Ichthyoplankton.

10. GP 1458. Thermal Plume Mapping.

11. Yellow Springs Instrument (YSI) instruction manual.

12. General Oceanics, Inc. instruction manual.

13. Mettler instruction manual.

14. Ohaus Dial-O-Gram instruction manual.

15. ASTM E1. Standard Specification for ASTM Thermometers.

16. ASTM E77. Standard Method for Verification and Calibration of Liquid-In-Glass Thermometers.

17. ASTM E220. Standard Method for Calibration of Thermocouples by Comparison Techniques.

Apparatus and Attachments

a. Apparatus:

ENDECO Digital Thermometer (Model 133).

Taylor Bi-Therm field thermometer (Model 6074-1).

NBS Traceable Thermometer

Photovolt Model 126A pH meter.

Yellow Springs Instrument (YSI) Model 54 dissolved oxygen meter.

Marsh-McBirney (Model 201) Portable Water Current Meter.

Lietz Rangefinder (Model 8026-19).

General Oceanics Digital Flow Meter (Model 2030).

Mettler H31 Balance.

Ohaus Dial-O-Gram beam balance.

Pelouze Dietetic Scale (Model YG-1000-A).

b. Attachments:

GPF 1455.001 - Three Mile Island Aquatic Study, Instrument Calibration Data Log.

Precautions

None.

Prerequisites and Requirements

All completed calibration records (GPF 1455.001) and laboratory calibration certificates will be retained for the duration of the monitoring programs in a single calibration record book on file at the IA field office in Etters, Pa.

Procedure

I. ENDECO Digital Thermometer (Model 133).

A. The thermometer will be calibrated before each day's use and each hour during use as follows:

1. Set Selector Switch to ZERO position and adjust the display to 0.00°C using the 0 adjust dial.
2. Set Selector Switch to full scale position and adjust the display to read 40.0°C using the F.S. adjust dial.

B. The thermometer will be field calibrated before each day's use as follows:

1. Immerse the thermometer and a field thermometer, calibrated according to Section II, in the stream to be sampled.
2. Allow readings to stabilize. If the readings differ by more than 1°C, perform a calibration of the thermometer according to Section I.(C).

C. The thermometer will be calibrated after any maintenance, at least quarterly, and before each consecutive series of plume maps as follows:

1. Calibrate according to ASTM E220 in temperature baths adjusted to 0°C and 30°C. The reference thermometer will be calibrated according to Section III.
2. The calibration results will be recorded on GPF 1455.001.

3. Attach a label to the instrument to indicate proper adjustment for an accurate temperature reading. The label will consist of date of calibration, the calibration adjustment, and the initials of the person performing the calibration.
4. Return the instrument to Environmental Devices Corporation for adjustment if the thermometer deviates more than $\pm$ 0.5°C from the reference thermometer reading.

II. Taylor Bi-Therm field thermometer (Model 6074-1).

The thermometer will be calibrated initially and at least quarterly thereafter as follows:

1. Calibrate according to ASTM E220 in a temperature bath adjusted to 0°C. The reference thermometer will be calibrated according to Section III.
2. Adjust the thermometer according to the procedure outlined by the manufacturer. If the thermometer cannot be corrected to within $\pm$ 1.0°C, return to the manufacturer.
3. Calibrate as in (1) but at 30°C.
4. If the reading at 30°C deviates by $\pm$ 1.0 C, return to manufacturer.
5. Record calibration results on GPF 1455.001.

III. Reference Thermometer: NBS Traceable Thermometer.

The reference thermometer which conforms with ASTM E1 will be verified annually as follows:

1. Verify the thermometer according to ASTM E77. The calibration reference will be a thermometer with NBS traceability.
2. File the laboratory certification in the calibration records book. This record will certify NBS traceability.

3. If the thermometer readings are not verified to be within the accuracy specified by ASTM E1 or the manufacturer's specifications, whichever is less, return the thermometer to the manufacturer.

IV. Photovolt Model 126A pH Meter.

A. The pH meter will be calibrated before each use as follows:

1. Switch to BATT and verify proper battery condition.
2. Switch to REF and adjust reference reading to 7.0 using REF control on the left side of the instrument.

B. The pH meter will be calibrated before each day's use as follows:

1. Calibrate as in Section IV. (A)
2. Calibrate the pH meter according to APHA Standard Method 424 in buffered solutions of pH 7 and pH 10.
3. Record the calibration results on GPF 1455.001.
4. Return the pH meter to the manufacturer if the necessary adjustments cannot be made within 0.1 pH.

V. YSI (Model 54) Dissolved Oxygen (D.O.) Meter.

A. The D.O. meter will be calibrated hourly during use as follows:

1. With the instrument in the OFF position, adjust the meter pointer to zero using the black set screw on the meter face.

B. The D.O. meter will be calibrated before each day's use as follows:

1. Change probe membrane if the membrane has not been changed in 4 weeks or if the instrument response time is slow. Record maintenance and type of membrane on GPF 1455.001.
2. Switch to RED LINE and adjust meter needle to red line on meter face.
3. Recharge instrument batteries when unable to adjust to RED LINE.
4. Switch to ZERO and adjust to zero with zero control knob.

5. Place a freshwater saturated paper towel in the protective plastic jar and place it over the end of the probe being careful not to touch the membrane.
6. Allow 10 mimutes for stabilization.
7. Switch to TEMPERATURE and read.
8. Refer to instruction manual to determine calibration value. Determine ppm dissolved oxygen at temperature found in step 7. Record value on GPF 1455.001.
9. Switch to appropriate ppm range and adjust the CAL knob until the meter reads the correct calibration value from step 8.
10. Record results on GPF 1455.001.

C. The D.O. meter will be calibrated after any maintenance and monthly as follows:

1. Calibrate the meter using one of the following:

1A. Saturated Water Technique.

a. Saturate 300 ml of water by placing on a magnetic stirrer for at least 15 min.

b. Place the probe in the saturated water and read temperature.

c. Refer to instruction manual to determine the calibration value for the sample temperature.

d. Switch to the appropriate ppm range and adjust the calibration value using the calibration knob.

1B. Winkler Titration as outlined in APHA Standard Method 442.

2. Record the calibration results on GPF 1455.001.

VI. Marsh-McBirney (Model 201) Portable Water Current Meter.

A. The water current meter will be calibrated before each day's use as follows:

1. Set the Selector Switch to the CAL position. The needle should register in the CAL sector of the scale. This indicates the batteries are good and the instrument is operating properly.
2. Insert new batteries if the meter fails to register in the CAL sector.
3. If the meter still fails to register correctly, contact the factory.

B. The water current meter will be calibrated after any maintenance and at least quarterly as follows:

1. Place the probe in the center of a non-metallic (plastic) container of fresh water.
2. Wait 30 minutes to insure that the water is stationary.
3. Set the Selector Switch to the 75 cm/sec full scale position.
4. Note the meter reading. If the meter reading is less than 3 cm/sec, it is satisfactory.
5. If the meter reading is greater than 3 cm/sec, return the meter to Marsh-McBirney, Inc.
6. Record the calibration information on GPF 1455.001.

VII. Leitz Rangefinder (Model 8026-19).

The rangefinder will be calibrated annually as follows:

1. Hold the equipment in a horizontal position, and sight at a target with a distance more than 2 km from the equipment (such as a mountain or a building).
2. Turn the scale ring to superimpose doubled images exactly.
3. The scale on the ring should indicate infinity ( ). If not, proceed to step 4.

4. Loosen the three fixing screws on the side plate of the scale ring.
5. Hold and rotate the side plate to bring the scale to infinity, and tighten the fixing screws.
6. Repeat steps 1 through 3 again. If equipment does not indicate infinity, proceed to step 4.
7. Repeat step 6 until equipment indicates infinity.
8. Record the calibration information on GPF 1455.001.

(Note: This procedure can also be carried out on a nearer target if the distance to such target is known.

VIII. General Oceanics Digital Flow Meter (Model 2030).

The flow meter will be calibrated semianmually as follows:

1. Each flow meter will be calibrated with a Calibration Checker (Model 2030 - CF) distributed by General Oceanics, Inc.
2. Record the initial flow meter readout (GPF 1455.001).
3. Place flow meter on the Calibration Checker, and allow impeller to spin.
4. Record the final flow meter readout (GPF 1455.001).
5. Subtract step 2 from step 4 and record total flow meter counts.
6. Check number of counts against counts listed in the operating instruction manual.
7. If step 5 is greater than step 6, instrument is operating satisfactorily.
8. If step 5 is less than step 6, return instrument to manufacturer.
9. Record calibration results on GPF 1455.001.

IX. Mettler H31 Balance.

A. The balance will be calibrated before each set of weighings as follows:

1. Check to see that the balance is leveled.
2. Check to see that the balance is properly tared.
3. If necessary, level and tare balance as instructed in the Mettler instruction manual.
4. If balance can not be leveled or tared, call manufacturer.

B. The balance is given a preventive maintenance check annually by a Mettler Instrument Corp. representative.

1. The service consists of accuracy tests and calibration traceable to the National Bureau of Standards, and cleaning, lubricating, and adjusting to original specifications.

2. Upon completion of the service, a tag is affixed to the balance. The tag consists of the name of the representative performing the service, the month and year of calibration, and the month and year of the next scheduled maintenance.

3. This information is recorded on GPF 1455.001 or calibration certificates.

X. Ohaus Dial-O-Gram beam balance.

A. The balance will be calibrated before weighing each collection as follows:

1. Make sure balance is zeroed before weighing.
2. If balance must be zeroed, check instructions given in Dial-O-Gram balance manual.
3. If balance can not be properly zeroed call manufacturer.

B. The balance will be calibrated at least quarterly as follows:

1. Properly adjust balance to zero.
2. Weigh Ohaus counterweight provided with the scale (Actual Weight - 141.5 g) on the Mettler H31 balance and record weight on GPF 1455.001.
3. Weigh Ohaus couterweight on the balance and record weight on GPF 1455.001.
4. Enter any difference between steps 2 and 3.
5. If the difference is greater than 1.0 gram, a calibration adjustment must be performed.
6. The calibration is accomplished by following the procedure indicated in the instruction manual.
7. The results of this procedure are recorded on GPF 1455.001.
8. A tag is placed on the balance after a calibration procedure is performed. The tag is inscribed with the initials of the person doing the calibration and the date of the calibration.

XI. Pelouze Dietetic Scale (Model YG-1000-A).

A. The scale will be calibrated before each use as follows:

1. With platform empty, set zero ("0") of dial to pointer.
2. If scale can not be properly zeroed replace scale.

B. The scale will be calibrated at least monthly as follows:

1. Same as Section X.(B), for steps 1 through 4.
2. If the difference is greater than 2.0 grams, re-zero the scale and repeat Section X.(B), steps 1 through 4.
3. The results are recorded on GPF 1455.001.

Submitted:	Approved:	Concurrence:
A. H. Roth Environmental Engineer	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

THREE MILE ISLAND AQUATIC STUDY

INSTRUMENT CALIBRATION DATA LOG

Date Calibration Done:_____

Calibration Performed By (Signature):_____

Project Leader Review (Signature):_____

Instrument: Type:_____ Model:_____

Manufacturer:_____ Serial No.:_____

Calibrations Performed as per GP 1455:_____

INSTRUMENT PERFORMANCE

Power Supply	Zero	Standards Used	Instrument Readings	Difference (+ or -)

Parts Replaced:_____

_____

Instrument Returned to Manufacturer (Date):_____

Instrument Received Back From Manufacturer (Date):_____

Work Done on Instrument While at Manufacturer:_____

_____

_____

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- use reverse side if necessary - indicate so -

AERIAL REMOTE SENSING

Purpose and Scope

The purpose of this procedure is to explain the activities necessary to meet the requirements of Section 3.1.2.b. (1) of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, E.T.S.).

Vegetation communities of the Three Mile Island Nuclear Station (TMINS) site and vicinity shall be aerially photographed annually to detect and assess the significance of damage, or lack thereof as related to cooling tower drift dispersion.

Drift from the cooling tower could lead to ecological effects that would appear as vegetation stresses on color infrared aerial photographs (transparencies). Field studies are required to identify the cause of stresses detected on the photographs.

Discussion and Responsibilities

Metropolitan Edison Company's consultant (N.U.S.Corporation) will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470 Review of Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. Aldrich, R. C. 1975. Detecting disturbances in a forest environment. Photogrammetric Engineering and Remote Sensing - 41:39-48.

4. Gausman, H. W. and R. Cardenas. 1970. Aerial photography for sensing plant anomalies. Third Annual Earth Resources Program Review, Vol. II. NASA-TM-X-67404, Houston, Texas.

5. Heller, R.C. 1970. Remote detection of insect epidemics in conifers. Third Annual Earth Resources Program Review, Vol. II, NASA-TM-X-67404, Houston, Texas.

6. Heller, R.C. and J. F. Wear. 1969. Sampling forest insect epidemics with color films. Sixth International Symposium on Remote Sensing of the Environment Proc. 1969: 1157-1167.

7. Howard, J. A. 1970. Aerial Photo Ecology. American Elsevier, New York.

8. Kuchler, A. W. 1967. Vegetation Mapping. Ronald Press, New York

9. National Research Council. 1970. Remote sensing with special reference to agriculture and forestry. National Academy of Sciences, Washington, D.C.

10. U.S.D.A. 1969. Forester's guide to aerial photo interpretation. Agriculture Handbook 308. U.S.D.A. Forest Service, Washington, D.C.

11. Weber, F. F. and F. C. Polcyn. 1972. Remote sensing to detect stress in forests. Photogrammetric Engineering 38:163-175.

Apparatus and Attachments

1. Aerial photography

   Equipment and Supplies: (Kucera and Associates, Mentor, Ohio and Precision Photo Labs, Dayton, Ohio).

   a. Camera, Zeiss RMK-A-4.

   b. Filter MB

   c. Color infrared film, Kodak 2443 Aerochrome

   d. Scale of original photography 1" = 500'

   e. Processing, Kodak 14-11CM Versamat CIR Processor, with Kodak EA5 chemical processing

2. Interpretation of aerial photographs

   a. Richards elevating light table, model GFL-940MCE

   b. Bausch and Lomb Stereo microscope

   c. Stereozoom Power Pod, model MC-1

   d. Mirrored stereoscope, model F71E

3. Field reconnaissance

   Materials and Supplies:

   a. Hand lens

   b. Field notebook

   c. Plant press

   Attachments:

   GPF 1456.001 Ground Truth Data Sheet

   GPF 1456.002 Plant Field Tally Sheet

4. Interview and Field Trip Reports

   Equipment:

   a. Notebook

   b. Tape recorder

   Attachments:

GPF 1456.003	Communication Form
GPF 1456.004	Flow Chart for Processing Field Data and Preparing Trip Reports
GPF 1456.005	Record of Report/Analysis Review

Precautions

Not applicable.

Prerequisites and Requirements

Not applicable.

Procedure

A. Aerial Photography

1. Take photos between 11 AM and 2 PM EDT during the middle to late growing season. (July 15 to September 15)
2. Take stereo photos at a scale of 1 inch = 500 feet and cover all areas within two miles of the TMINS cooling tower.
3. The flight direction is north-south.
4. Photographs are to be free of cloud shadows.
5. Compile a flight log to include:
   a. Model number of camera and lens (these remain the same for each flight - exceptions must be authorized).
   b. Film and lot number.
   c. Filter number.
   d. Altitude at the end of each flight line.
   e. Time at the end of each flight line.
   f. Date of flight.
   g. Flight map showing flight lines.

6. Original photographs are to be 9 by 9 inch positive stereo transparencies.

7. Obtain two sets of single coverage prints from the transparencies, if requested by Met-Ed.

B. Interpretation of Aerial Photographs

1. Scan the photographs for:

   a. Quality of the transpariencies, i.e. color, resolution, scale, and cloud cover.

   b. Obvious changes in color tone and pattern.

   c. Areas where tone, pattern, or textural characteristics require specific ground truthing.

2. Select areas for field reconnaissance and mark these on appropriate maps.

3. Select and compare areas with the greatest and least potential for being affected by drift from the cooling tower.

C. Field Reconnaissance

1. Visit areas selected for field reconnaissance during photo-interpretation - (a) selected transects for verification of species presence and general observations and (b) specific locations where vegetation stress has been detected.

2. Observe species present, relative abundance and general vegetation conditions.

3. Examine affected plant parts and tissues for visible symptoms.

4. Examine plants for signs of causal organisms.

5. Determine species affected and distribution of affected plants.

6. Compare plant conditions within and outside of affected areas.

7. Note environmental conditions including soil and water relationships in the affected areas.

8. Complete forms CPF 1456.001 and 1456.002.

D. Interviews

1. The presence of plant disease or noticeable plant injury can be documented by interviewing people who are familiar with the area (e.g. workers, agricultural and forestry agents, local nurserymen or pathologists). Interviews are important in obtaining background information needed to assess the cause of any vegetation stress observed during the studies.
2. Identify pertinent agencies or personnel who have knowledge of the study area.
3. Obtain authorization to contact individual through the consultant project manager.
4. Make contact and document results on Communication Form (GPF 1456.003).
5. In evaluating the results of an interview, take into consideration; attitudes of individual, professional qualifications, correct use of common or scientific names, tupe of observation or evidence.

E. Field Trip Reports

1. Normal trip reports shall include the following sections: introduction if appropriate, methods, results and discussion, and reference literature used. The contents of each section are described in the following paragraphs.
2. The introduction shall state the trip objectives, participants, and dates for the study. Other relevant introductory material such as the reason for the particular trip shall also be included.

3. The methods section shall contain a description of the procedures employed in data collection. Previous reports and pertinent literature should be cited as appropriate. The description and location of study areas is stated in this section.

4. The results and discussion section shall summarize the trip results and integrate them with the findings of previous trips. Analyzed data shall be presented in tabular form or in figures, as appropriate. Any deviations from the proposed objectives or methods shall be discussed and explained.

5. A literature cited section shall be included. If necessary a bibliography shall be appended to the report.

6. A summary for the procedures for processing field data and preparing trip reports is presented in GPF 1456.004. Trip report copies shall be submitted to the appropriate section, department and project managers. Each reviewer retains a copy of the report and sends review comments (GPF 1456.005) to the team leader and project manager. The team leader than prepares the final report and submits it to the project manager along with the field data to be included in the Met-Ed files. If substantive changes have occurred in this report as a result of review, additional copies are supplied to the department and section managers for their files.

F. Evaluation of Results

By March 1 of each year, the consultant (N.U.S.Corporation) will submit a final, written report to the Supervisor - RS&EE. This report which covers the previous calendar years work will include

a description of the program, results, and interpretive analyses of environmental impacts. Results reported shall contain information encompassing but not limited to: sampling date; time of day; film type(s); spectral band(s); and one (1) set of resultant color photographs or color slide transparencies encompassing at a minimum area approximately one kilometer (1 km) from the radius of the Unit 2 towers.

The Supervisor - RS&EE will ensure that this information is included in the annual report to the N.R.C. and placed on file with the N.R.C. Regional Director of Inspection and Enforcement.

Submitted:	Approved:	Concurrence:
D. Callahan Environmental Engineer	R. M. Klingaman Manager - Generation Engineering	W. E. Potts Acting Manager Generation Quality Assurance

Distribution: Standard per GP 0016

File:

cc: File: _____

Project Manager _____

GROUND TRUTH DATA SHEET

Client: _____

Project: _____

Name of Area Surveyed: _____

Date: _____ Name of Surveyor(s) _____

Time/Weather: _____

_____

Description:

Photo no./location:

Vegetation type:

Species present/dispersion:

Ground cover:

Height/stratification:

Relative abundance:

Crown size:

Maturity/vitality:

Plant vigor:

Symptomatology:

Samples collected:

Environmental conditions observed: _____

_____

Human influence factors: _____

Additional Notes:

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Dispersion:
- Random
- Regular groupings
- Irregular groupings

Abundance:
- Very rare
- Rare
- Occasional
- Common
- Abundant

Vitality:
- Germinated but no reporduction
- Maintained by vegetative reporduction
- Maintained by sexual reproduction(seed)

Plant Injury Observations:

Suspected Pathogen:

Biotic(specify) _____

_____

Abiotic(specify) _____

_____

Species/Crop and variety affected: _____

_____

No. of plants or acreage affected: _____

Percent of each plant affected: _____

Parts of each plant affected: _____

_____

Percent of plants affected in study area: _____

Remarks: _____

_____

_____

GPF 1456.001

PLANT FIELD TALLY SHEET

Project: ____________________ ________ Collector: ____________________

Collect No.	Plant Name	Habitat or Vegetation Type	Location	Date

GPC 1456.001
9/8/77
Rev. 0

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COMMUNICATIONS FORM

PERSON CONTACTED _____ DATE _____

TITLE _____ TYPE OF CONTACT _____

AFFILIATION _____ PERSON MAKING CONTACT _____

ADDRESS _____ ACTION NEEDED _____

TELEPHONE _____

DISTRIBUTION (1) Client File _____ (2) Vice President (3) Author,

(4) _____ (5) _____ (6) _____

(7) _____

DISCUSSION: _____

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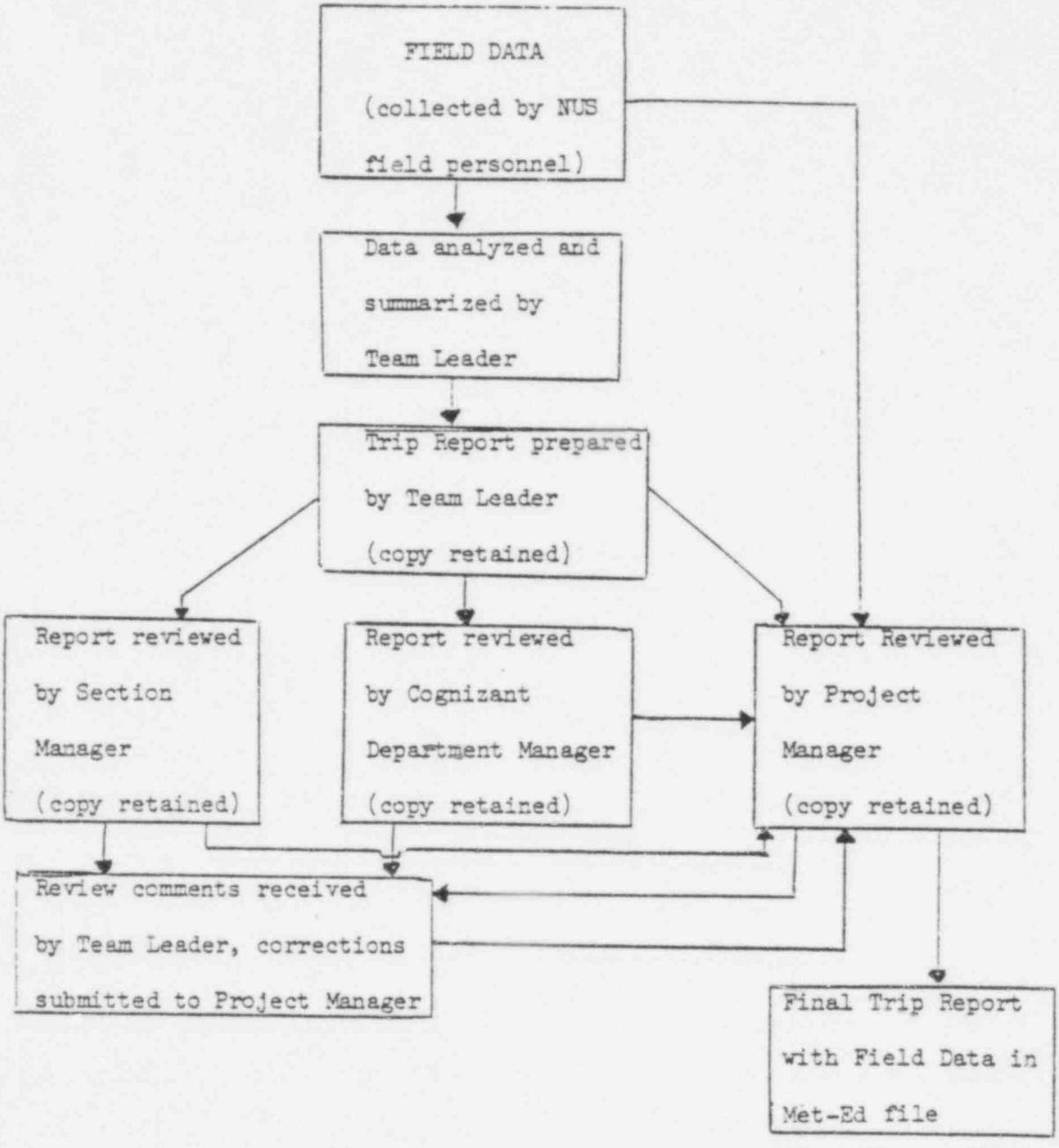
SIGNATURE _____

CPF 1456.003
9/8/77

FLOW CHART FOR PROCESSING FIELD DATA AND PREPARING TRIP REPORTS



GPF. 1456.004
9/8/77
Rev. 0

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RECORD OF REPORT/ANALYSIS REVIEW

Project Title _____ Page _____ of _____

Client Number _____

Report/Analysis Title _____

Date _____

Author _____

Project Manager _____

Commentary Reviewed

Author (Signature _____ Date _____

Department Manager (Signature) _____ Date _____

Division Gen. Mgr. (Signature) _____ Date _____

Purpose of Review: _____

_____

_____

_____

_____

Summary of Reviewed Procedure and Results: _____

_____

_____

_____

Code Verification Required Yes _____ No _____

Reviewer _____

GPF 1456.005
9/8/77
Rev. 0

THERMAL PLUME MAPPING

Purpose and Scope

The purpose of this procedure is to list and explain the activities necessary to meet the requirements of Section 4.2 of the Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications, Non-Radiological (TMI-2, ETS).

Plume surveys will be made to characterize the waters of the Susquehanna River in the vicinity of TMINS with respect to temperature.

Plume surveys will be conducted at least three times a year, during periods when the following conditions are expected to occur:

a. maximum condenser cooling water discharge temperature.

b. maximum area of thermal discharge plume.

Data will be collected at locations and depths following a pattern designed to survey and support definition of the thermal structure of that portion of the Susquehanna River affected by the operation of TMINS.

During each survey, measurements of air temperature, wind speed, and wind direction will be taken.

Discussion and Responsibilities

Metropolitan Edison Company's consultant, Ichthyological Associates, Inc. (IA), will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

This procedure shall be performed at the following frequency:

1. Once per year during scheduled shutdown, for refueling or other reason, of Unit 1, when TMINS cooling water temperature rise (ΔT) is expected to be maximum. Thermal plume mappings will be conducted throughout the day.

2. Same as (1), but for Unit 2.

3. Once per year, during the summer low flow occurring between June and September, when the river flow at the River Forecast Center in Harrisburg, Pennsylvania is less than 10,000 cfs. If the TMINS ΔT at this time is greater than 2°C, additional thermal plume mappings will be conducted that day.

4. Other occasions as specified by RS&EE.

References

1. GP 1470. Review of the Non-Radiological Environmental Technical Specifications: Three Mile Island Nuclear Station.

2. Three Mile Island Nuclear Station, Unit 2, Environmental Technical Specifications: Non-Radiological. May 31, 1977. Nuclear Regulatory Commission.

3. GP 1455. Instrument Calibration - IA.

Apparatus and Attachments

a. Apparatus required:

ENDECO Digital Thermometer (Model 133) or equivalent.

Boat equipped with a motor.

Lietz Rangefinder (Model 8026-19) or equivalent.

A 3.0 m pole marked off in 0.5 m increments.

b. Attachments:

GPF 1458.001 - TMI Plume Map Data Sheet.

GPF 1458.002 - Thermal Plume Results

GPF 1458.003 - Thermal Plume Summary

Precautions

Ensure Susquehanna River conditions (e.g. ice, high flow) will not endanger the health and safety of the thermal plume crew.

Prerequisites and Requirements

The existance of one of the four conditions defined under Discussion and Responsibilities will be verified before this procedure is initiated. All temperatures will be recorded to the nearest 0.1 C.

Procedure

a. Field Procedure

Calibrate the ENDECO Digital Thermometer and the Lietz Rangefinder in accordance with GP 1455.

Temperature measurements are taken at transects in the vicinity of the TMINS cooling water discharge (GPF 1458.001). Thermal plume transects have been established to include two control (ambient river temperature) transects upstream of the TMINS Discharge at the Unit 1 Intake North Wingwall Tip and 25 m upstream of the Discharge. Indicator transects have been established at the Discharge and 25 m, 50 m, 75 m, 100 m, 125 m, 150 m, 200 m, 300 m, 400 m, 800 m, 1000 m, and 1900 m downstream of the Discharge. Markers have been placed on shore to locate each transect. These transects are sampled for each survey in a north to south direction. Temperature measurements are taken at distances of 5 m, 20 m, and 40 m from shore for each transect. For the first plume map of the day, the distances from shore are measured with a Lietz Rangefinder.

The thermister is attached to one end of a 3.0 m pole which is marked off in 0.5 m increments. Vertical temperature profiles are taken from surface to bottom at 0.5 m intervals with an ENDECO Digital Thermometer. All temperature readings will stabilize before being recorded. This data is recorded on GPF 1458.001.

Temperature of the TMINS intake and discharge water will be measured at the start and finish of each plume map. The intake temperature will be measured at the TMINS Intake water temperature sensor on the North Wingwall of Unit 1. The discharge temperature is measured inside the discharge pipe (conditions permitting).

Operational data is obtained for each map from the TMINS Units 1 and 2 Control Rooms and recorded on GPF 1458.001. The river elevation is read from the indications on the Unit 1 Intake structure. The river flow is obtained from the River Forecast Center in Harrisburg, Pennsylvania. Operational data will be obtained at the start and finish of each plume map to detect any change in TMINS operation.

b. Laboratory Procedure and Data Processing

Plume map data will be reduced and presented in the format shown in GPF 1458.002 and GPF 1458.003. All temperatures will be adjusted according to the most recent calibration. Thermal plume map results will be reported annually. Meteorological data taken at the time of each plume map include: wind speed, wind direction, air temperature, and dew point temperature. This data is obtained annually from Pickard, Lowe, and Garrick, Inc.

The plume map data for the current year will be stored in a fireproof file cabinet. Past year's data are presented in annual reports which can be found in many separate locations.

Submitted:	Approved:	Concurrence:
A. H. Roth Environmental Engineer	R.M. Klingaman Manager Generation Engineering	W.E. Potts Acting Manager Operational Quality Assurance

Distribution: Standard Distribution per GP 0016.

TMI PLUME MAP DATA SHEET

Date: 5 MAY 1977

River Flow (cfs): 30,700

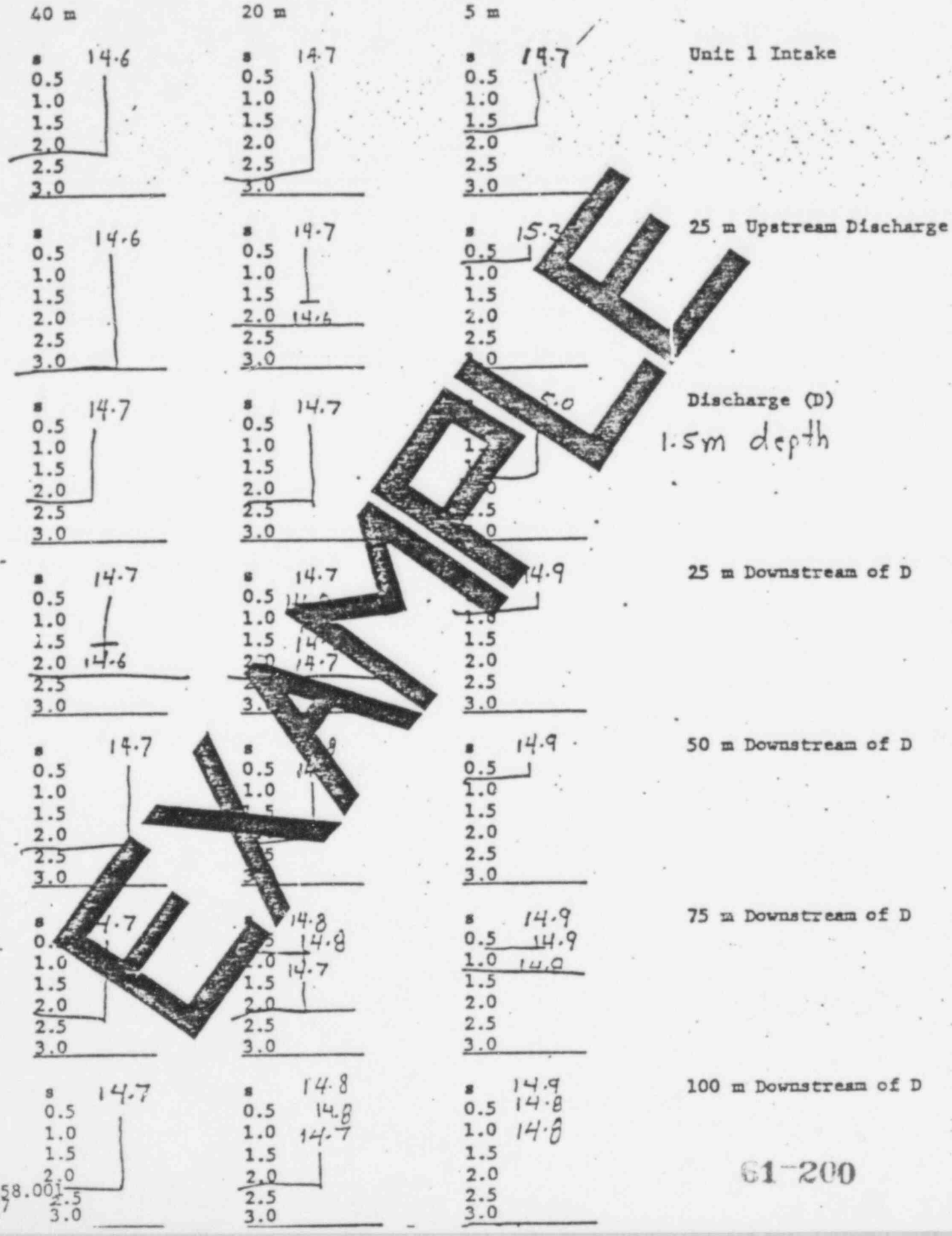
River Elevation: _____

	START	FINISH
Time:	1310	1430
Discharge Rate (gpm):	[illegible]	30,000
Discharge Temperature (F):	61.1	61.1
Intake Temperature (F):	59.4	59.4

	UNIT 1		UNIT 2	
	START	FINISH	START	FINISH
Station Operation Level (%):	0	0	50	50
Nuclear Service Pumps:	2	2	2	2
Secondary Service Pumps:	1	1	1	1
Decay Heat Pumps:	1	1	NA	NA

ENDECO Thermometer temperature adjustment = 0.0

TMI PLUME MAP 5 May 77 Date 1310 Time



EXAMPLE

81-200

CPF 1458.00i
8731/77
Rev. 1

40 m	20 m	5 m	
s	s	s	125 m Downstream of D
0.5	0.5	0.5	
1.0	1.0	1.0	
1.5	1.5	1.5	
2.0	2.0	2.0	
2.5	2.5	2..'	
3.0	3.0	3.0	
s	s	s	150 m Downstream of D
0.5	0.5	0.5	
1.0	1.0	1.0	
1.5	1.5	1.5	
2.0	2.0	2.0	
2.5	2.5	2.5	
3.0	3.0	3.0	
s 14.8	s 14.8	s 14.9	0 m Downstream of D
0.5 14.7	0.5	0	
1.0	1.0	1.0	
1.5	1.5	1.5	
2.0	2.0 14.7	2.0	
2.5	2.5	2.5	
3.0	3.0	3	
s	s		300 m Downstream of D
0.5	0.5		
1.0	1.0		
1.5	1.5		
2.0	2.0	2.0	
2.5	2.5	2.5	
3.0	3.0	3.0	
s 14.8	s	s 15.0	400 m Downstream of D
0.5	0.5	0.5 15.1	
1.0 14.7	1.0	1.0	
1.5	1.5	1.5	
2.0	.0	2.0	
2.5	5	2.5	
3.0		3.0	
s	s	s	800 m Downstream of D
0.5	0.5	0.5	
1.0	1.0	1.0	
1.5	1	1.5	
2.0	0	2.0	
2.5	.5	2.5	
3.0	3.0	3.0	
s	s	s	1000 m Downstream of D
0.5	0 5	0.5	
1.0	0	1.0	
1.5	1.5	1.5	
2.0	2.0	2.0	
2.5	2.5	2.5	
3.0	3.0	3.0	

40 m	20 m	5 m
s	s	s
0.5	0.5	0.5
1.0	1.0	1.0
1.5	1.5	1.5
2.0	2.0	2.0
2.5	2.5	2.5
3.0	3.0	3.0
s	s	s
0.5	0.5	0.5
1.0	1.0	1.0
1.5	1.5	1.5
2.0	2.0	2.0
2.5	2.5	2.5
3.0	3.0	3.0
s	s	
0.5	0.5	
1.0	1.0	1.0
1.5	1.5	1.5
2.0	2.0	2
2.5	2.5	2
3.0	3.0	3.0
s 14.7	s 14.8	3
0.5	0.5	
1.0	1.0	5.0
1.5	1.5	1.5
2.0	2.0	2.0
2.5 14.6	2	2.5
3.0	3.0	3.0

1900 m Downstream of D

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THERMAL PLUME RESULTS

Thermal plume temperature data (C) taken at 0.5 m intervals surface (S) to bottom at 5 m, 20 m, and 40 m offshore, above and below the TMINS Discharge, 5 May 1977.

Station Operation Level (%): 0	Time: 1310
Nuclear Service Pumps: 2	Intake Temp. (C): 15.2
Secondary Service Pumps: 1	Effluent Temp. (C): 16.2
Decay Heat Pumps: 1	Air Temp. (C): 19.0
Effluent Rate (cfs): 66.84	Wind Speed (mph): 3
River Flow (cfs): 30,700	Wind Dir.: NE

Distance From Three Mile Island Shore				
40 m	20 m	5 m	Depth	
14.6	14.7	14.7	S	Unit 1 Intake
14.6	14.7	14.7	0.5 m	
14.6	14.7	14.7	1.0	
14.6	14.7	14.7	1.5	
14.6	14.7		2.0	
	14.7		2.5	
14.6	14.7	15.3	S	5 m Upstream of Discharge
14.6	14.7	15.3	0.5	
14.6	14.7		1.0	
14.6	14.7		1.5	
14.6	14.6		2.0	
14.6			2.5	
14.6			3.0	
14.7	14.7	15.0	S	Discharge (D)
14.7	14.7	15.0	0.5	
14.7	14.7	15.0	1.0	Depth at Discharge
14.7	14.7		1.5	Pipe = 1.5 m
14.7	14.7		2.0	
14.7	14.7	14.9	S	25 m Downstream of D
14.7	14.8	14.9	0.5	
14.7	14.8		1.0	
14.7			1.5	
14.6	14.7		2.0	
14.7	14.8	14.9	S	50 m Downstream of D
14.7	14.7	14.9	0.5	
14.7	14.7		1.0	
14.7	14.7		1.5	
14.7	14.7		2.0	
14.7	14.8	14.9	S	75 m Downstream of D
14.7	14.8	14.9	0.5	
14.7	14.7	14.8	1.0	
14.7	14.7		1.5	
14.7	14.7		2.0	

Distance From Three Mile Island Shore				
40 m	20 m	5 m		
			Depth	
14.7	14.8	14.9	S	100 m Downstream of D
14.7	14.8	14.8	0.5 m	
14.7	14.7	14.8	1.0	
14.7	14.7		1.5	
14.7	14.7		2.0	
14.8	14.8	14.9	S	200 m D[illegible]eam of
14.7	14.8	14.9	0.5	
14.7	14.8	14.9	1.0	
14.7	14.8		1.5	
14.7	14.7		2.0	
14.8	14.8	15.0	S	[illegible]00 [illegible]ownst[illegible]am of D
14.8	14.8	15.1	0.5	
14.7	14.8		1	
14.7	14.8			
14.7	14.8			
14.7	14.8		[illegible]	
14.7				
14.7	14.8	15.3	[illegible]	[illegible]00 m Downstream of D
14.7	14.8		[illegible]	
14.7	14.7		1.0	
14.7	14.7		1.5	
14.7	14.7		[illegible]	
14.6	14.7		2.[illegible]	

THERMAL PLUME SUMMARY

Summary of surface water temperatures (C) at selected plume map stations, discharge and ambient river temperature differences, air temperatures, wind conditions, discharge rate, river flow, and station operation level February through November 1976.

	Feb 19	Feb 20	Feb 21	Feb 21	Feb 21	Feb 21	Feb 21	Feb 21	Feb 21	Feb 21	Feb 21	Feb 22	Feb 23	Mar 5	Mar 19	Apr 1	Apr 15
Ambient River - 5 m offshore at Intake			2.2	2.2	2.3	2.6	2.7	2.7	2.8	2.8	3.0	3.1	1.6	6.0	3.4	9.7	11.8
Discharge - 5 m offshore		3.0		2.7	2.6	2.9	3.3	3.1	5.2	5.5	7.6	5.8	1.8	6.2	4.7	9.1	11.6
50 m downstream of Discharge (D) 5 m offshore		2.7		2.4	2.4	2.7	3.2	3.0	4.2	4.2	4.6	4.3	1.7	6.3	4.3	9.5	11.8
50 m downstream of D 20 m offshore	2.1		2.2	2.2	2.2	2.6	2.7	2.7	2.8	2.9	3.3	3.2	1.6	6.0	3.8	9.7	11.9
100 m downstream of D 5 m offshore	2.7	2.7	2.3		2.4	2.8	3.0	2.8	4.0	4.1	4.3	4.2	1.7	6.4	4.1	9.6	11.9
100 m downstream of D 20 m offshore		NA	2.2		2.2	2.6	2.7	2.7	2.9	3.1	3.1	3.1	1.6	6.0	3.6	9.7	11.9
Discharge Temp. minus Ambient River Temp.	2.	0.6		0.3	0.3		0.6	0.4	2.4	2.7	4.6	2.7	0.2	0.2	1.3	-0.6	-0.2
Air Temp. (C)	13.0		3.	3.0		.0	10.5	15.0	11.0	NA	NA	NA	4.0	20.0	16.0	NA	21.0
Wind Direction	N	NW	SE	ESE		S		S	S	S	S	S	WNW	NW	NW	W	S
Wind Speed (mph)	3	6		8		8	0	9	9	9	10	20	14	19	20	10	10
Discharge Rate ($ft^3/sec \times 10^{-3}$)	0.02	0.038	0	0	0	0.039	045	0.045	0.111	0.111	0.116	0.111	0.039	0.049	0.04	0.033	0.024
River Flow ($ft^3/sec \times 10^{-3}$)	55.6	240.0	229.0		229.0	219.0		219.0	209.0	209.0	209.0	193.0	164.0	102.0	40.0	44.4	26.7
Station Operation Level (%)	100	0	0		0	0		0	0	0	0	0	0	0	0	0	0

	Apr 29	May 13	May 27	Jun 2	Jun 10	Jun 24	Jul 13		Aug 12		Sep 9	Sep 22	Oct 7	Oct 21	Nov 4	Nov 18
Ambient River - 5 m offshore at Intake	12.8	17.5	15.3	18.9	25.8	23.0	21.					18.3	16.5	10.6	6.5	3.5
Discharge - 5 m offshore	12.2	17.2	15.4	18.3	25.5	23.3			24.		.8	17.4	17.3	10.2	7.1	4.3
50 m downstream of Discharge (D) 5 m offshore	12.5	17.4	15.6	18.5	25.7	23.5	22.2	24.1	24.9		23.0	17.9	16.9	10.4	6.8	3.9
50 m downstream of D 20 m offshore	12.7	17.4	15.4	18.9	25.9	23.0	22.0	24.1	24.9		23.0	18.3	17	10.5	6.4	3.5
100 m downstream of D 5 m offshore	12.6	17.4	15.6	18.6	25.9	23.4	22.2	24.1	24.8		23.1	18.2	16	10.5	6.8	3.7
100 m downstream of D 20 m offshore	12.8	17.4	15.5	18.9	25.9	23.1	22.0	24.0	24.8		23.0	18	16.7		6.5	3.4
Discharge Temp. minus Ambient River Temp.	-0.6	-0.3	0.1	-0.6	-0.3	0.3	0.5	0.6	-0.1	-0	0			-0.	0.6	0.8
Air Temp. (C)	18.0	19.5	21.0	16.0	30.0	29.0	24.5	27.0	28.5	29.0		9.0	19	11.0	9.0	1.5
Wind Direction	NW	S	WNW	E	W	SSW	N	W	S	W		W	NW	W	NW	NW
Wind Speed (mph)	10	5	4	0	3	8	2-3	5-7	5	4	4	0	2	18	3	4
Discharge Rate ($ft^3/sec \times 10^{-3}$)	0.045	0.078	0.094	0.04	0.04	0.039	0.04	0.045	0.027	0.053	0.062		0.045	0.067	0.049	0.038
River Flow ($ft^3/sec \times 10^{-3}$)	37.5	20.6	35.0	37.7	25.2	96.2	39.8	13.5	39.2	11.6	8.3		23.1	43.6	72.3	23.6
Station Operation Level (%)	0	0	40	100	100	100	100	100	100	100	100	100	100	50	100	0

NA = Not Available.

HYDRAULIC EFFECTS

Purpose and Scope

This procedure defines the program to be conducted to comply with Three Mile Island Nuclear Station Unit 2 Environmental Technical Specifications, Section 4.3, "Hydraulic Effects": "The licensee shall monitor the portion of the Susquehanna River in the vicinity of cooling tower discharge structures out to the middle channel to determine the extent of scouring or sedimentation of the river bed that is occurring as a result of operating the Three Mile Island Nuclear Station."

Discussion and Responsibilities

Gilbert Associates, Inc. (GAI) will perform all work specified in this procedure. The Radiation Safety and Environmental Engineering Section (RS & EE) will perform program review in accordance with GP 1470. This procedure will be performed once per year during low river flow, approximately June, in conjunction with the Hydrographic Survey. No changes will be made to this procedure without written authorization from RS & EE.

References

Operating and Maintenance Instructions for the Raytheon Recording Fathometer, Model DE-119, October 1, 1955.

GP 1470, "Review of the Non-Radiological Environmental Technical Specification Program for Three Mile Island Nuclear Station."

Apparatus and Attachments

1) Boat and motor.

2) Raytheon Model DE-119 portable recording fathometer, or equivalent.

3) 350 ft. of 1/16 inch diameter calibrated aircraft cable and supporting boom.

4) 5 styrofoam buoys with flags.

5) 6 steel pipes, 1 to 2 inch diameter, 8 ft. to 10 ft. long.

6) 2 walkie-talkies.

7) 2 transits and related survey equipment.

8) All equipment necessary to satisfy applicable U. S. Coast Guard and State of Pennsylvania water safety regulations.

9) GPF 1459.001 Hydraulic Survey Locations.

Precautions

To insure safety of personnel, all U. S. Coast Guard and State of Pennsylvania regulations pertaining to small boat handling shall be followed. Also, extreme caution should be exercised while the 350 ft. tag line is extended to insure that recreational boaters in the vicinity do not collide with the line. Coast Guard approved life jackets shall be worn by all members of the survey crew while working on the boat. All safety requirements of the Pa. Bureau of Waterways permit shall be followed.

Prerequisites and Requirements

A permit for this survey must be issued by the Pennsylvania Bureau of Waterways prior to starting. The permit application will be approved by Met-Ed prior to submittal to the State. All conditions of this permit must be followed during the survey.

Procedure

The fathometer will be field calibrated at the beginning and at the end of each day's survey. This is done using a surveying rod to measure the depth of water at a location where the river bottom is relatively uniform, and adjusting the fathometer to the same depth reading. Such field adjustment eliminates the need for theoretical adjustment of the fathometer based on water temperature, salinity, and other effects.

Since the water surface is the survey datum, it is imperative also that the water surface elevation be recorded at the beginning and at the end of each day's survey. Water surface elevation will be obtained from the markings on the Unit 1 intake structure.

THe locations of the Hydraulic Survey are shown on GPF 1459.001. The location of the cooling tower discharge line is defined by two TMINS coordinate points and two angles. The first step in laying out horizontal control is to establish the discharge pipe centerline utilizing the above information. Then a parallel offset line is established a convenient distance, x, from the centerline. A radius point, consisting of a 2-inch diameter iron pipe is driven in along this offset on shore, radius point is selected, its location is determined and recorded. This radius point will be located at the start of the first survey and will be used for all future surveys.

A transit is then set on the radius point and the parallel offset range buoys are placed. They will be about 50 feet apart, the first one being 400 feet out from the pivot. The range line buoys are also placed and located by angle and stadia distance. The range line is established 15 to 20 feet offshore,

parallel to the shoreline, and in water deep enough to generate the acoustical signal utilized by the recording fathometer, usually 3 to 4 feet. The range buoys consist of 1 to 2-inch diameter iron pipes driven into the river bed. For safety and ease of sighting, a styrofoam buoy with flag is fixed to this pipe. The transitman then turns a 45° angle to either side of the parallel offset and locates a position conveniently behind the radius point, along the 45° line. He then removes the transit from the radius point and sets one instrument at each point just established. These transits will sight along the 45° lines and insure horizontal control during the actual survey. The horizontal control is now complete and the hydrographic survey can begin.

For each arc, the calibrated cable tag line is attached to the radius point and the boat positioned at the beginning of a circular transect along with the downstream side of the range line. With the fathometer operating, a line is transcribed across the strip chart denoting the beginning of the transect. With the boat pulling outward, the line is drawn taut. The boat is then angled outward and slightly upstream and moved slowly at a constant rate of speed toward the first 45° control line.

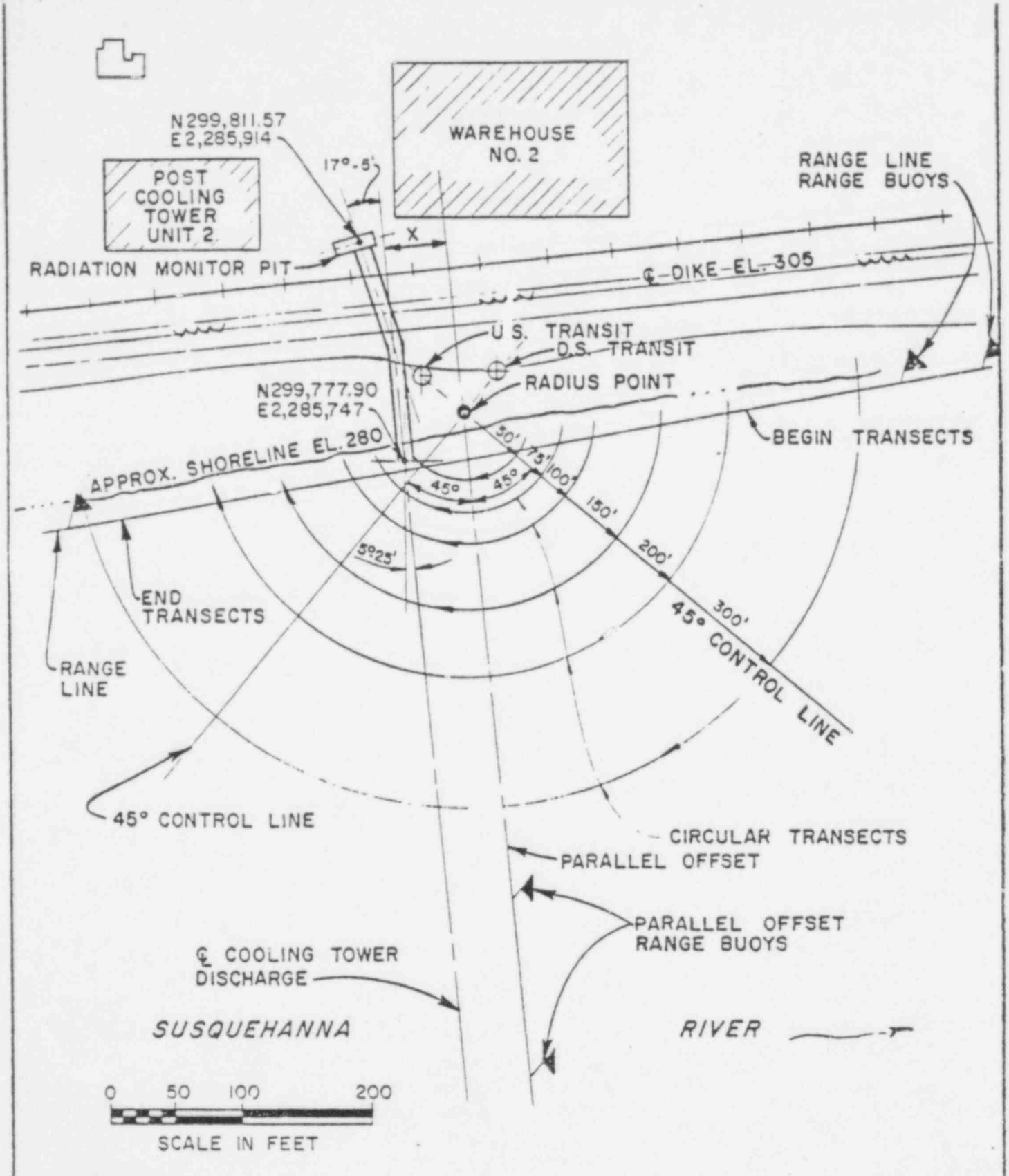
As the fathometer transducer, mounted aft, passes the first 45° control line, the instrument man notifies the boat crew by radio and another line is transcribed across the strip chart denoting this event. He then walks from the upstream (U. S.) transit to the downstream (D. S.) transit. The boat approaches the parallel offset and as the transducer passes this line, that is, when the parallel offset range buoys are in line, this event is recorded on the strip chart. The instrument man again signals the boat crew when the transducer

crosses the upstream 45° line, and the boat crew uses the range line buoys to locate the upstream range line which terminates the scan. Bottom soundings are taken along the arcs defined by radii of 50, 75, 100, 150, 200 and 300 feet from the radius point. The number of arcs may be reduced in later surveys if insignificant scouring is found during the initial survey.

This procedure gives good horizontal control, with 5 check points along each transect. Horizontal accuracy is to ± 1 foot along the radii from the radius point and ± 2 feet along the arc. The vertical control should be to ± 0.5 feet.

The tape record of the fathometer readings and the survey notes are returned to the GAI office, where readings are reduced and plotted at a minimum interval of 25 feet along each arc. The annual report will be submitted to RS & EE within 60 days of survey completion and will include the final river bottom contour plot, comparison with previous surveys (if any), and conclusions as to scouring or sedimentation of the river bottom which may be caused by the TMI discharge. All data will be stored until the end of the calendar year, except for the original of the final river bottom contour plot, which will be stored indefinitely.

Submitted:	Approved:	Concurred:
A. H. Roth Environmental Engineer	R. M. Klingaman Manager Generation Engineering	W. E. Potts Acting Manager Operational Quality Assurance



Hydraulic | Survey | Locations

THREE MILE ISLAND NUCLEAR STATION

GPF 1459.001
9/12/77
Rev. 0

61-211

GP 1460
9-1-77
Rev. 0

EROSION CONTROL INSPECTION

Purpose and Scope

The purpose of the procedure is to list and explain the activities required to meet the requirements of Section 4.4 of the Three Mile Island Nuclear Station, Unit 2 Non-Radiological Environmental Technical Specifications (TMI-2, E.T.S.) The corridors of the transmission lines built specifically to handle the generating capacity of TMINS will be monitored.

Routine transmission line corridor inspections will be conducted to identify erosion problem areas. The procedure insures that appropriate steps are taken to stabilize such areas.

Discussion and Responsibilities

Met-Ed's Director-Forestry will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470 Review of the Non-Radiological Environmental Technical Specification: Three Mile Island Nuclear Station.
2. Three Mile Island Nuclear Station, Unit 2 Environmental Technical Specifications: Non-Radiological, May 31, 1977, Nuclear Regulatory Commission.

Apparatus and Attachments

A. Apparatus Required:

Erosion Control Inspection Log Book

B Attachments:

GPF 1460.001 Description of Transmission lines specifically built to handle the generating capacity of TMINS.

GPF 1460.002 Location of Transmission lines serving TMINS.

GPF 1460.003 Erosion Control Inspection Report.

Precautions

Not applicable

Prerequisites and Requirements

Not applicable

Procedure

A. Field Procedure

Inspection:

One foot patrol of the entire length of right-of-way will be made annually (March-April) to report conditions with regard to soil erosion caused by the operation and maintenance of the transmission facilities. Met-Ed line department personnel will walk and observe the entire right-of-way from sub-station to sub-station.

The transmission lines patrolled annually are described in GPF 1460.001 and illustrated in GP1460.002.

The assigned line department personnel will verbally report to the Director-Forestry any erosion condition found and its location. The verbal report will be made at the completion of the inspection. The Director-Forestry will then complete the Erosion Control Inspection Report (GPF 1460.003)

Restoration:

Any reported soil erosion conditions caused by the operation and maintenance of the line will be restored to conform as nearly as possible to the natural lay of the land. Seeding and mulch application will also be established to stabilize the disturbed soil. A report of the work done and degree of stabilization accomplished will be made on GPF 1460.003.

B. Reporting Procedure:

Upon completion of each inspection GPF 1460.003 shall be filled out and entered in the Erosion Control Field Log Book which will be located in the Director-Forestry office. All areas showing evidences of abnormal erosion conditions, related to transmission line operations & maintenance activities, shall be identified and recorded. Corrective actions and estimations of effective stabilization shall be included. A copy of each entry shall be sent (not later than 60 days after completion) to the TMI - Office Supervision, where it will be entered in a duplicate log book for onsite inspection.

By March 1 of each year, the Director-Forestry will submit a written report, to the Supervisor-RS&EE, which covers the previous calendar year's inspections. This report will include a summary of the field inspection program and all corrective actions taken, as well as an assessment of the observed impact of TMINS transmission lines on the environment.

Submitted:	Approved:	Concurrence:
E.S. Ulrich Director-Forestry	R.M. Klingaman Manager-Generation Engineering	W.E. Potts Acting Manager Generation Quality Assurance

Distribution: Standard per GP 0016

Description of Transmission Lines Specifically Built to Handle the Generating Capacity of TMINS

No.	Description	Voltage	Line Credit Number	Total Mileage
1	TMINS to Hosensack Substation	500 kv	5026	74.74
2	TMINS to Middletown Substation	230 kv	1091	1.44
3	TMINS to Middletown Substation	230 kv	1092	1.52
4	TMINS to Middletown Substation	230 kv	1082	1.44

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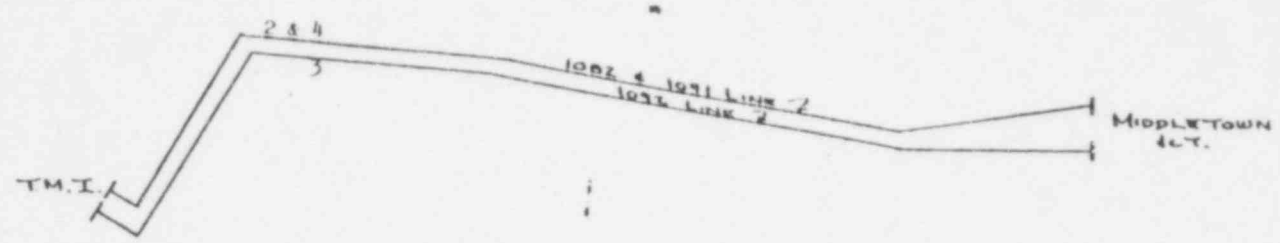
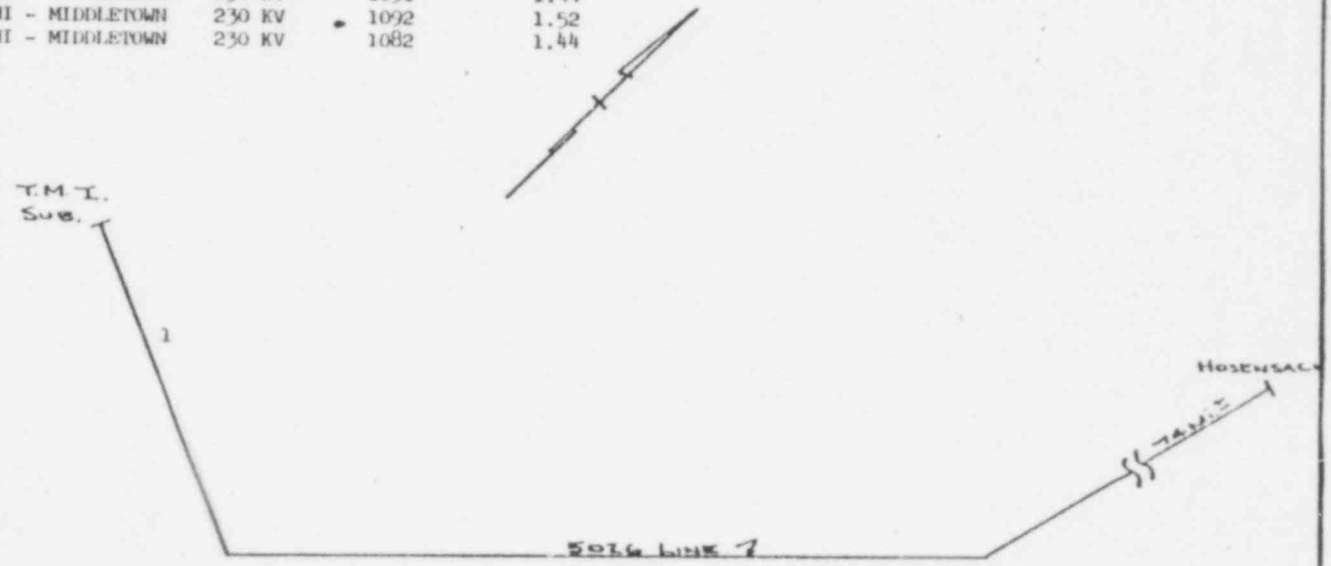
CPS 1460.002
9-1-77
Rev. 0



CODE	DESCRIPTION	KV	LINE CKT. NO.	MILES
1	TMI - HOSENSACK	500 KV	5026	74.74
2	TMI - MIDDLETOWN	230 KV	1091	1.44
3	TMI - MIDDLETOWN	230 KV	1092	1.52
4	TMI - MIDDLETOWN	230 KV	1082	1.44



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EROSION CONTROL INSPECTION REPORT

Inspection No.:

Date (s) of Inspection:

Inspection Locations:

1. Was any erosion found? Yes

No

2. If yes, give location (s) and size of area (s) effected:

3. If yes, describe type of stabilization program and date initiated:

4. If yes, give completion date of stabilization and estimation of effectiveness:

5. Comments:

Submitted:

Director Forestry Date

GPF 1460.003
9-1-77
Rev. 0

61-217

HERBICIDE APPLICATIONS

Purpose and Scope

The purpose of this procedure is to list and explain the activities required to meet the requirements of Section 4.5 of the Three Mile Island Nuclear Station, Unit 2, Non-Radiological Environmental Specifications (TMI-2, E.T.S.) An inspection program will be conducted to ensure that herbicide application, to control undesirable tall growing vegetation in the transmission corridors associated with Three Mile Island Nuclear Station (TMINS), conform to current Federal and State regulations. Only the corridors with transmission lines specifically built to handle the generating capacity of TMINS will be monitored.

Discussion and Responsibilities

The Met-Ed Director-Forestry will be responsible for implementing this procedure. The Radiation Safety and Environmental Engineering Section (RS&EE) will be responsible for reviewing these activities per GP 1470. No changes will be made to this procedure without written authorization from RS&EE.

References

1. GP 1470 Review of the Non-Radiological Environmental Technical Specification: Three Mile Island Nuclear Station.
2. Three Mile Island Nuclear Station, Unit 2 Environmental Technical Specifications: Non-Radiological. May 31, 1977, Nuclear Regulatory Commission.
3. Federal Insecticide, Fungicide and Rodenticide Acts as amended in 1972. Cited as the "Federal Environmental Pesticide Control Act of 1972." Public Law 92-516 92nd Congress. Federal Register 10729, October 21, 1972.

4. Specifications for Chemical Treatment of Undesirable Tree Growth. Metropolitan Edison Company. OD-280 1-76. 14 p.

Apparatus and Attachments

A. Apparatus Required:

Transmission Chemical Report Log Book

B. Attachments:

GPF 1461.001 Description of Transmissions lines specifically built to handle the generating capacity of TMINS.

GPF 1461.002 Location of Transmission lines serving TMINS.

GPF 1461.003 Transmission Chemical Report.

Precautions

Only chemical herbicide approved by the Environmental Protection Agency (EPA) and the Federal Insecticide, Fungicide & Rodenticide Act (FIFRA)* as Amended in 1972 shall be used.

Prerequisites and Requirements

Chemical herbicide treatment is to be applied only as needed to control tall growing undesirable tree species on those portions or areas of the rights-of-way where their ultimate height growth would interfere with the electric reliability of the transmission lines.

* Federal Insecticide, Fungicide and Rodenticide Act as amended in 1972. Cited as the "Federal Environmental Pesticide Control Act of 1972" Public Law 92-516 92nd Congress AR 10729, October 21, 1972

Procedure

A. Field Procedure

Inspections of the rights-of-way (GPF 1461.001 and 1461.002) will be made to determine when the herbicide application is required, the type of herbicide to be used, the percent of herbicide mix to carrier, and the amount of mixed, herbicide-carrier solution to be applied per wooded acre of right-of-way. This inspection will be made by Met-Ed's Directory-Forestry or designee as required (usually every 4 to 7 years.)

The application of the chemical herbicide will be in accordance with "Specifications for Chemical Treatment of Undesirable Tree Growth" under the direction of the Director-Forestry. This specification complies with current E.P.A. regulations.

B. Reporting Procedure

After completion of the herbicide application, transmission chemical report (GPF 1461.003) shall be completed by the Director-Forestry. GPF 1461.003 includes:

(1) the Line Circuit number

(2) Voltage or KV class

(3) Location of application to and from

(4) the average right-of-way width

(5) the type of chemical mixture applied

(6) method of treatment (type of application)

(7) the actual gallons of solution applied

(8) the actual measured acres receiving herbicide application

(9) the contractor applying same

(10) division forester responsible for inspection and application

(11) dates of application

The Director-Forestry will enter completed GPP 1461.001 forms into the Transmission Chemical Report Log Book, which will be located in the Director-Forestry office.

No later than March 1 of each year, the Director-Forestry will submit a written report to the Supervisor-RS&EE, which covers the previous calendar year's herbicide application. The report will include, but not necessarily be limited to the following:

(1) type (s) of herbicide applied,

(2) concentration of herbicide active materials,

(3) rate of herbicide application,

(4) method of application,

(5) frequency of application,

(6) location of application and,

(7) date of application

Wind condition and spraying of restricted area information required by the E.T.S. will not be recorded as it is not applicable to the basal herbicide application method employed by Metropolitan Edison Company. If no herbicide applications are made within the calendar year the Director-Forestry is still required to submit a written statement to that affect to the Supervision-RS&EE.

In addition, the annual report will document any herbicide spillage accident (s) that occur and present the corrective actions taken.

Submitted:	Approved:	Concurrence:
E.S. Ulrich Director-Forestry	R.M. Klingaman Manager-Generation Engineering	W.E. Potts Acting Manager Quality Assurance

Description of Transmission Lines Specifically Built to Handle the Generating Capacity of TMINS

No.	Description	Voltage	Line Credit Number	Total Mileage
1	TMINS to Hosensack Substation	500 kv	5026	74.74
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3	TMINS to Middletown Substation	230 kv	1092	1.52
4	TMINS to Middletown Substation	230 kv	1082	1.44

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GPP 1.61.002
9-1-77
Rev. 0
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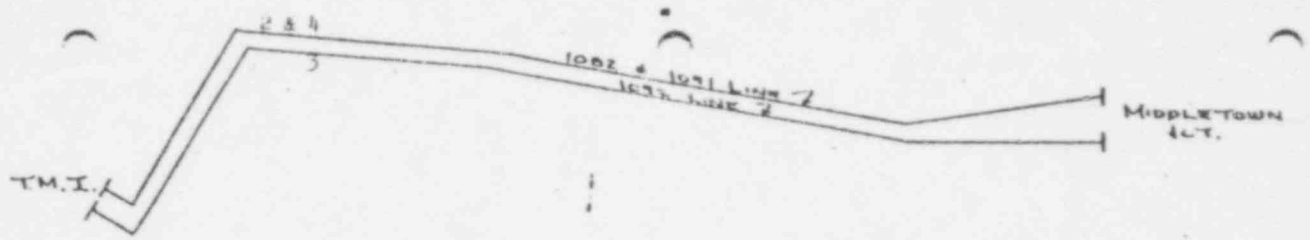

CODE	DESCRIPTION	KV	LINE CKT. NO.	MILES
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4	TMI - MIDDLETOWN	230 kV	1082	1.44

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Met-Ed TRANSMISSION CHEMICAL REPORT

Division ______ Year ______ Date ______

Div. Forester ______

Line Number	Voltage KV Class	Location From	Location To	Est. Acreage	Average R/W Width	Chemical, Mixture, & Method of Treatment	Min. Gals. of Solut. per Avg. Acre Required	Actual Gals. of Solution Applied	Actual Measured Acres	Cost per Acre	Total Cost	Contractor
GPF 1461.001 9-1-77 Rev. 0 Page 1 of 1												
Totals of Above												