THREE MILE ISLAND NUCLEAR STATION
UNIT #1 OPERATING PROCEDURE 1103-6
REACTOR COOLANT PUMP OPERATION

PORC CHAIRMAN
UNIT 1
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THREE MILE ISLAND NUCLEAR STATION - UNIT 1

Reactor Coolant System Operating Procedure #1103-6

Reactor Coolant Pump Operation

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6.2.1.1 Pump

1. The system pressure that must be maintained for required R.C.P., N.P.S.H., and Seal #1 D/P, shall be within the limits of the enclosed curve. See Fig. 1 & 1A.
2. If bearing temperature is less than 225° F, seal injection water flow must be started prior to starting a reactor coolant pump.
3. Intermediate cooling water to the reactor coolant pumps must be supplied prior to starting the pumps.
4. Seal injection water flow is required to all reactor coolant pumps when reactor coolant temperature is above 190° F and pressure is above 100 psig, except when operating in the loss of injection mode.

NOTE: If seal injection water is not supplied, keep #1 seal leak off and #1 seal bypass closed.

NOTE: Upon restoration of seal water flow, the pump bearing temperature should not be changed at a rate greater than 1° F/min.

5. Operating the reactor coolant pumps in the loss of injection mode with intermediate cooling water operating may result in damage to the pump bearing and/or seals from particles in the reactor coolant.
6. No operations involving breaching of an oil hydraulic system on a RCP motor are to be performed until the RC system has

been cooled to below the flash point of the oil. This includes maintenance, troubleshooting, fill and drain.

NOTE: The flash points of most oils in this service are in the vicinity of 450° F, a suitable margin of safety will exist if the R.C. System is cooled to 400°F.

7. A seal number 1 outlet temperature above 225° F may result in damage to mechanical seals and the pump must be stopped.

8. The reactor coolant pump must be stopped if bearing temperature is above 225° F; also see 25 and 26.

9. The #1 seal bypass valve (MUV38) should remain closed unless;

   a. R.C.P. radial bearing and/or #1 seal leakoff temperature are approaching their alarm setpoint of 225°F.

   NOTE: It should only then be opened if #1 seal leak off flow is < 1 gmp and RCS pressure is >100 psig and <1,000 psig. If 225°F is reached on radial bearing or seal water temperature and RCS pressure >1000 psig stop that R.C. pump.

10. Do not open the number 1 seal bypass unless the number 1 seal leakoff valve is open. Never open the seal bypass valve during a loss of injection water.

11. Do not operate or start an R.C. pump with less than 275 psi delta P across seal number 1.

12. Do not start or operate an R.C. pump with less than 0.2 gpm seal leakage (Seal #1 Leakoff Flow).

13. Do not exceed 5 gpm number 1 seal leakoff flow.

14. Minimum inlet pressure to the number 2 seal if 15 psig, corresponding to 27 psig at the number 1 seal leakoff manual pressure control valve. (Indication on upstream side of valve.

15. Minimum level in the standpipe is 24 inches.

    NOTE: Low level alarm instrumentation is 36 inches; do not get below 36 inches unless an observer is available locally to monitor standpipe level to 24 inches.

16. Minimum delta P across the thermal barrier is 30 inches for a running pump and 5 inches for a nonrotating pump.

17. Do not close the number 1 seal leakoff valve during R.C. pump operation except in case of high number 1 seal leakoff.

    NOTE: Refer to AP 1202-16, R.C. Pump and Motor Emergencies for exceptions.

18. The following limits apply for vibration at the pump shaft with 4 pump operation (measured near bottom of pump coupling):

    (a) At 15 mils (peak-to-peak composite):
    Satisfactory, but balancing should be done at first convenient opportunity.

    (b) Over 15 mils (peak-to-peak composite):
    Balance as soon as possible.

    (c) If peak-to-peak composite reaches 20 mils, notify Westinghouse.

(d) If peak-to-peak composite exceed 20 mils with 4-pump operation, or 30 mils with single pump operation, SHUT DOWN and notify Westinghouse for futher information.

19. Do not fill the Reactor Coolant System or pressurize the R.C. pump stuffing box when the pump and motor are uncoupled.

20. With no R.C. pumps operating, do not start a makeup pump with a full open flow path to the R.C. pumps.

NOTE: This precaution is suggested prudent operating practice.

21. Maximum inlet pressure to the number 2 seal is 78 psig.

NOTE: This value corresponds to 90 psig at the number 1 seal leakoff manual pressure control valve.

22. The minimum number 1 seal bypass flow is 1 gpm.

23. If maximum allowable bearing or number 1 seal leakoff temperature limits have been exceed and the pump is returned to service, monitor seal leakage rates, bearing and number 1 seal leakoff temperatures and vibration. If limits of these parameters are exceeded the pump must be shutdown and inspected.

24. Any time an R.C. pump is operated, number 3 seal purge flow should be provided.

NOTE: Purge flow rate should be approximately 25 GPH.

25. Under conditions where both intermediate cooling and seal injection are lost, and the affected R.C. pump(s) continue to operate, the following apply:

(a) If possible, reestablish seal injection within 1 minute. If this accomplished, it is not necessary

to isolate number 1 seal leakoff or establish cooling water immediately.

(b) If both seal and cooling water systems are inoperative for longer than 1 minute, close the isolation valve inseal number 1 leakoff line. Number 2 and number 3 seal leakoff remain open. The pump can be maintained in this condition for possibly up to 10 minutes. Monitor number 2 seal flow and temperature. If the seal leakage flow becomes high or the number 2 seal inlet temperature exceeds 225° F, stop the pump.

(c) If condition 25.(b) occurs, establish cooling services as follows:

1. Restore intermediate cooling water flow to thermal barrier at an inlet temperature of 105° F or less.
2. Open number 1 seal leakoff and monitor flow and outlet temperature.
3. When seal leakoff water temperature decreases to below 225° F, verify adequate seal return flow exists and start R.C. pump.
4. Reestablish injection water flow.

NOTE: If not possible to establish intermediate cooling as in 25.(c).1 above, very slowly (less than 1° F/min) establish injection flow. Open number 1 seal leakoff and proceed with 25.(c).3.

26. For hot restart of the R.C. pump when the R.C. System is above 225° F, the following sequence is used:

(a) Restore the thermal barrier heat exchanger cooling water inlet temperature to $\leq 105^{o}$ F.

(b) Wait until the seal leak-off water temperature and the bearing temperature have decreased to $\leq 220^{o}$ F.

(c) Insure that adequate flow (0.2 GPM) exists across the seals, then start pump motor.

(d) Reestablish seal injection flow gradually to limit bearing temperature reduction rate to $\leq 1^{o}$ F per minute.

6.2.1.2 R.C.P. Motor

1. Maximum allowable voltage variation is $\pm$ 10%.
2. Maximum allowable frequency variation is $\pm$ 5%.
3. Maximum allowable voltage frequency variation is the sum of $\pm$ 10%.
4. Maximum time for locked rotor without damage at 100% voltage is 11.5 sec.

   NOTE: Time to full speed from zero speed - 100% voltage with no reverse R.C. flow is 8 seconds.

   NOTE: Time to full speed from zero speed - 100% voltage with reverse R.C. flow (3 pumps operating and starting fourth pump) is 9 seconds.

5. Pump motor start limits are 3 starts from ambient temperature, allowing the motor to coast to rest between starts, or 2 starts if motor is at operating temperature. Thereafter 20 minutes running or 40 minutes with motor stopped must elapse before an additional start may be attempted.

6. Minimum speed without high pressure oil lift pumps operating is 300 rpm.

7. Maximum allowable thrust bearing temperature is 200° F (this is a shutdown point).

8. Maximum allowable stator temperature 150° C, 302° F.

9. Maximum allowable time without cooling water is 10 minutes including coastdown time.

10. Minimum allowable voltage at motor terminals during starting is 80%.

11. The backstop and oil lift pumps must be started prior to or at 500 rpm when the RC pump motor is de-energized.

12. Approximate motor current for the four pump cold R.C. temperature (test) condition is 731 amps at normal power factor and 790 amps at a possible reduced power factor which may occur for several minutes following the start of the pump

13. Approximate motor current for the single pump cold R.C. temperature condition is 640 amps at normal power factor and 700 amps at a possible reduced power factor which may occur for several minutes following the start of the pump.

14. Do not exceed a R.C. P. motor vibration of 2 mils.

NOTE: Vibration is measured at the pump vibra-switch.

6.2.2 Administrative

1. Never start two R.C.P.'s simultaneously. Start the second pump after the starting current from the first pump returns to normal running current.

2. If available, loose parts monitor should be energized and volume turned up prior to starting a RCP.

3. Emergency Electrical System lined up per OP-1107-2 prior to starting R.C.P.'s.

4. R.C.P.'s must be tripped if:

   (a) Motor bearing temps. exceed the following:

Upper & Lower Guide	185°F
Up & Down Thrust	195°F

   (b) Motor winding temp. exceeds 302°F.

   (c) Pump bearing temp. exceeds 225°F.

   (d) Pump Seal #1 leakoff temp. exceeds 225°F.

   (e) Motor stand vibration exceeds .002".

   (f) Air cooler leak detection alarm.

   (g) Shaft vibration on Bently Nevada System exceeds 20 mils 4 pump operation or 30 mils single pump operation.

5. Maintain seal #2 differential pressure > 15 psig.

   NOTE: This corresponds to a reading of > 27 psig on PI-39.

6. Verify the individual pump seal injection flow control manual needle valves have been set for equal flows, about 8 gpm to each pump.

7. Do not run Lift Oil System longer than necessary to prevent carbonizing oil.

6.3 Operating Procedures

6.3.1 R.C.P. Startup

6.3.1.1 Prerequisites

Indicate satisfactory completion of steps below by initialing each step and sign name at end of applicable section.

1. The Nuclear Services Closed Cycle Cooling Water System lined up for normal operation per OP 1104-11. Verify the following valves open:

RCP-1A	Motor Cooler Valves
NS-V6A	Cooler Inlet
NS-V33A	Upper Brg. Cooler #1 Outlet
NS-V33B	Upper Brg. Cooler #2 Outlet
NS-V34A	Motor Air Cooler
NS-V91A	Lower Brg. Oil Cooler
RCP-1B	Motor Cooler Valves
NS-V6B	Cooler Inlet
NS-V33C	Upper Brg. Cooler #1 Outlet
NS-V33D	Upper Brg. Cooler #2 Outlet
NS-V34B	Motor Air Cooler
NS-V91B	Lower Brg. Oil Cooler
RCP-1C	Motor Cooler Valves
NS-V6C	Cooler Inlet
NS-V33E	Upper Brg. Cooler #1 Outlet
NS-V33F	Upper Brg. Cooler #2 Outlet
NS-V34C	Motor Air Cooler
NS-V91C	Lower Brg. Oil Cooler
RCP-1D	Motor Cooler Valves
NS-V6D	Cooler Inlet
NS-V33G	Upper Brg. Cooler #1 Outlet
NS-V33H	Upper Brg. Cooler #2 Outlet
NS-V34D	Motor Air Cooler
NS-V91D	Lower Brg. Oil Cooler

2. The Intermediate Cooling System lined up for normal operation per OP 1104-8. Verify the following valves open:

RCP-1A	Thermal Barrier Heat Exchanger Valves	
	IC-V77A	Inlet Valve
	IC-V79A	Outlet Valve
RCP-1B	Thermal Barrier Heat Exchanger Valves	
	IC-V77B	Inlet Valve
	IC-V79B	Outlet Valve
RCP-1C	Thermal Barrier Heat Exchanger Valves	
	IC-V77C	Inlet Valve
	IC-V79C	Outlet Valve
RCP-1D	Thermal Barrier Heat Exchanger Valves	
	IC-V77D	Inlet Valve
	IC-V79D	Outlet Valve

3. The Normal and Emergency Electrical System lined up for normal operation per OP 1107-1 and 1107-2 respectively.
4. 125 VDC available at the switchgear for breaker control.
5. Place the control switches for the RCP's, H.P. lift pumps, and backstop oil pumps in PULL-TO-LOCK and position ckt. breakers as follows:

   RCP's 1A & C bkrs. racked in on 6900 V A.C. bus 1A.

   RCP's 1B & D bkrs. racked in on 6900 V A.C. bus 1B.

   Insure 69 switches for RCP bkrs. are in normal position.

Backstop oil pump bkrs. racked in and closed on following MCC:

R.P. MCC 1A
RCP-3A-1, 3B-1, 3C-1 and 3D-1

R.P. MC - 1B
RCP-3A-2, 3B-2, 3C-2 and 3D-2

H.P. oil lift pump bkrs. racked in and closed on following MCC:

E.S. MCC 1A
RCP-2A-1 and RCP-2C-1

E.S. MCC 1B
RCP-2B-1 and RCP-2D-1

D.C. Dist. Pnl. 1C
RCP-2A-2 and RCP-2C-2

D.C. Dist. Pnl. 1D
RCP-2B-2 and RCP-2D-2

6. Power available to all associated RCP controls and instrumentation.

7. RCS pressure being maintained above minimum RCP NPSH and #1 seal DP as ind. on RC-3A (0-500 psig). See Fig. 1 & 1A.

8. Establish demin. water purge flow to #3 seal chambers. Open the following:

   CA-V257 A/D and CA-V258 A/D and adjust flow rate for 2 to 4 GPM per pump as indicated on FI-288 A/D.

NOTE: Demin. water flow will prevent boron crystal buildup during operation. Monitor reclaimed water storage tank level periodically.

9. M.U. pump running on min. flow recirc. mode.

10. Place all RCP radial bearing temperature and #1 seal leak off temperatures on a 5 minute trend. (Computer points 0525-0528 #1 0521-0524 rad brg temp). Seal out.

    CAUTION: If any of the temperatures are approaching their alarm setpoints and #1 seal leak off flow on any RCP is <1gpm with RCS pressure >100 psig but <1,000 psig then open MU-V38. If greater than 1000 psig in the R.C.S. stop the pump.

6.3.1.2 Procedure

This section of the procedure will cover the steps necessary to start the RCP's when the plant is in a low pressure cold condition. Three RCP's will be started when NPSH requirements have been met and will be used to heat the plant up to 500°F where the fourth RCP will be started and the heatup completed.

1. Verify that seal injection flow has been established to each R.C.P. as ind. on MU-PI-42 total injection flow and local indication MU-FI-8 A/D. Refer to OP 11042.

2. Verify reading on DPI-18, labyrinth seal D/P, is $\geq$ 5" H_2O.

    NOTE: A pressure drop of 5" H_2O is required prior to starting pump. Upon starting the D/P should increase to 4050 inches H_2O which corresponds to the desired seal in leakage flow of 5 GPM.

3. Fill standpipes by opening and closing MU-V39 as needed. Verify hi alarm cleared.

4. Verify seal #2 differential pressure is > 27 psi and <90 psi on MU-PI-39.

   NOTE: Adjust the D/P toward the low end since D/P will increase as R.C.S. pressure increases and will require readjustment of MU-V187.

5. Verify seal #1 D/P > 280 psi on DPI13 for each pump, and seal #1 leakoff flow is ≥0.2 GPM, on FR-43.

6. About four (4) minutes prior to starting a Reactor Coolant Pump, start one backstop oil pump. About two minutes later start one lift oil pump. (Starting the backstop oil pump first allows the air in the oil lines to bleed out properly).

7. Assure that RCP and motor alarms are cleared and no condition exists that would be injurious to pump and motor operation.

8. Verify RCS pressure within limits of Fig. 1 & 1A.

9. Start the desired reactor coolant pump from console CC. If for any reason, the RCP does not start, or trips off during a start attempt, do not attempt to restart the pump until the cause is determined and corrected.

10. Secure lift, and backstop oil pumps one minute after pump reaches full speed.

11. Carefully observe all parameters associated with the pump and motor performance to verify proper operation.

    a. If DH pump is running secure OP 11044 prior to starting second RCP.

12. As plant conditions permit increase RCS pressure to upper ends of limits of Fig. 1 & 1A.

13. Line up seal return to M.U. tank per OP 11042.

14. Repeat steps 8 through 14 to start a second R.C.P. in the loop opposite to first pump.

    a. Prior to starting 3rd RCP withdraw rod groups 14 per OP-11059.

15. Repeat steps 8 through 14 to start a third R.C.P.

    NOTE: Expected heat up rate of 30° F per hour with 3 R.C.P's operating.

16. When R.C.S. temperature exceeds 500°F (fourth pump starting interlock) start fourth RCP per steps 7 through 12.

6.3.2 RCP Shutdown and Restart at Power

6.3.2.1 Prerequisites

Indicate satisfactory completion of steps below by initialing each step and sign name at end of applicable section.

1. Four RCP's operating, plant startup complete and operating in the power range.

6.3.2.2 Procedure

If a RCP must be shutdown during power operation, power should be lowered to the appropriate reduced power levels allowed by the safety system setpoints for the resulting combination of running RCP's, before stopping the pump. Before restarting a pump during plant operation, the reason for its initial trip or shutdown should be known and its cause corrected, all interlocks and safety alarms must be satisfied. The pump may

not be restarted until the reactor power has been reduced to < 30% of full power.

1. RCP shutdown @ power.
   (a) Reduce power within RPS limits.
   (b) Start a lift pump and backstop oil pump for associated RCP.
   (c) Trip RCP.
   (d) When pump has stopped rotating and anti-reverse rotation has been verified, oil lift and backstop pumps may be tripped off.
   (e) Maintain seal injection flow and thermal barrier cooling flow.
   (f) If pump is to be off for greater then one hour, isolate NSCCW to the motor within one hour after securing the pump hang a caution tag on the RCP control switch.

   NOTE: On emergency trip refer to AP 1202-16.

2. RCP restart @ power.
   (a) Initial cause of trip corrected.
   (b) Reduce reactor power to < 30% of full power.
   (c) About four (4) minutes prior to starting a Reactor Coolant Pump, start one backstop oil pump. About two (2) minutes later start one lift oil pump. (Starting the backstop oil pump first allows the air in the oil lines to bleed out properly).
   (d) Verify all alarms cleared and all interlocks satisfied for associated pump.

(e) Start RCP, insure starting current drops to normal and pump is up to speed in 9 seconds, as determined by flow and motor amps.

(f) After verifying pump is operating normally, return plant to desired power level.

3. Hot Restart of RCP's (RCS < 225°F) after loss of both I.C. and Seal Injection.

NOTE: This condition is highly improbable since it requires a blackout and failure of both diesels.

(a) Restore I.C. flow after insuring I.C. temp. is < 105°F. to RCP thermal barriers and monitor out-let temps. on computer points 0490-0493.

(b) Open #1 seal leakoff isolation valve MU-V26, and monitor #1 seal leakoff water and pump radial bearing temps. on computer points 0521-24 and 0529-32.

(c) Bypass the seal injection flow interlock in RCP's start ckt. by reducing set point monitor low pot to zero.

NOTE: The set point monitor is located in NNI cabinet O, row 10, module 5.

(d) Verify seal water and bearing temps. are <225°F, and seal flow is > 0.2 gpm.

(e) Start one RCP in each loop.

(f) Using MU-V32 slowly establish seal injection to all RCP's. Limit bearing temps. cooldown rate to <1° F/min. as ind. on computer points 0529-32.

(g) Increase seal injection flow to normal (32 gpm) using MU-V32 and place control in AUTO.

(h) Return seal injection flow setpoint monitor to normal setpoint.

(k) Restart remaining two RCP's as plant conditions require.

6.3.3 RCP Shutdown and Layup

6.3.3.1 Prerequisites

Indicate satisfactory completion of steps below by initialing each step and sign name at end of applicable section.

1. RCP's operating, RCS in a shutdown condition.

6.3.3.2 Procedure

This section of the procedure will cover the steps necessary to secure the RCP's during a plant shutdown and cooldown.

1. Trip one RCP in each loop per section 6.3.2.2 steps 1 b-e.

2. During plant cooldown adjust MU-V187 as necessary to maintain 27 psig on inlet to #2 seal as ind. on MU-PI-39.

   CAUTION: Monitor #1 seal leak off temperature and radial bearing temperatures. If they approach 225°F and #1 seal leak off flow on any RCP is <1 gpm with RCS pressure >100 psig but <1,000 psig open MU-V38.

3. When RCS Pressure reaches 380 psi line up seal return to Aux. Building sump, open MU-V192 and close MU-V190.

   CAUTION: Seal #1 ΔP must be maintained < 275 psi.

4. Ensure NPSH limits are maintained per Fig. 1 & 1A for operating pumps during low RCS pressure condition.
5. As plant conditions permit trip the two operating RCP's per section 6.3.2.2 steps 1.b thru f.
6. After all RC pumps have been stopped and the RCS pressure is < 100 psig and temp. < 190°F., secure seal injection to RCP's close MU-V25 seal #1 leakoff stop valve and MU-V20 seal injection stop valve.
7. Return seal #1 leakoff flow path to normal, open MU-V190 and close MU-V192.
8. Hand rotate RCP's once a week if radiation levels permit as follows:
   (a) Start backstop oil pump, then two (2) minutes later start lift pump. (This allows air in the oil lines to bleed out properly).
   (b) Hand rotate RCP.
   (c) Operate oil pumps for 5 minutes.
   (d) Secure oil pumps.

Performed By_____ Date_____

Reviewed By SRO
or RO License_____ Date_____

FIGURE 1

Point	Temp °F	Press. (psia)
A	75	80
B	125	325
C	175	460
D	275	460
E	320	2250

Instrument Error 50 psig (-25 assumed in Tech Spec -25 for installed recorder) ±12°F

2. Allowable RC Pump combination
   Above 195° All
   Below 195° 1-A, 1-B; 0-A, 1-B
   1-A, 0-B
   Instrument error ±12°F

3. Minimum RC pressure to maintain compression force on fuel cladding (natural circulation)
   OP 1101-1 Fig. 1.0 - 05.11
   Instrument Error ±50 psig -12°F

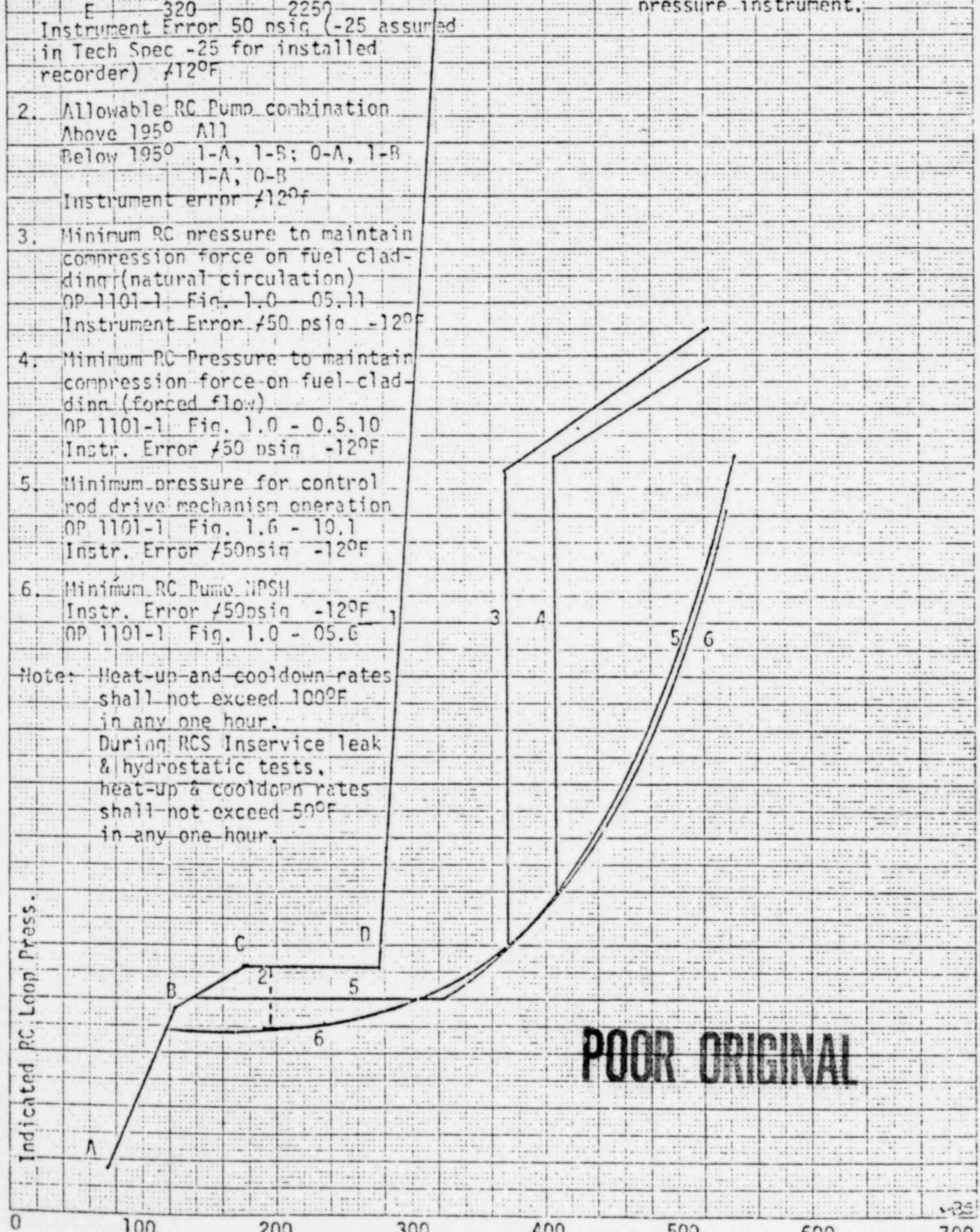
4. Minimum RC Pressure to maintain compression force on fuel cladding (forced flow)
   OP 1101-1 Fig. 1.0 - 0.5.10
   Instr. Error ±50 psig -12°F

5. Minimum pressure for control rod drive mechanism operation
   OP 1101-1 Fig. 1.6 - 10.1
   Instr. Error ±50psig -12°F

6. Minimum RC Pump NPSH
   Instr. Error ±50psig -12°F
   OP 1101-1 Fig. 1.0 - 05.6

Note: Heat-up and cooldown rates shall not exceed 100°F in any one hour.
During RCS Inservice leak & hydrostatic tests, heat-up & cooldown rates shall not exceed 50°F in any one hour.

Caution: Operation below system pressure of 450 psig requires the use of Figure 1A, and the use of the low range pressure instrument.



Heat-Up/Cooldown

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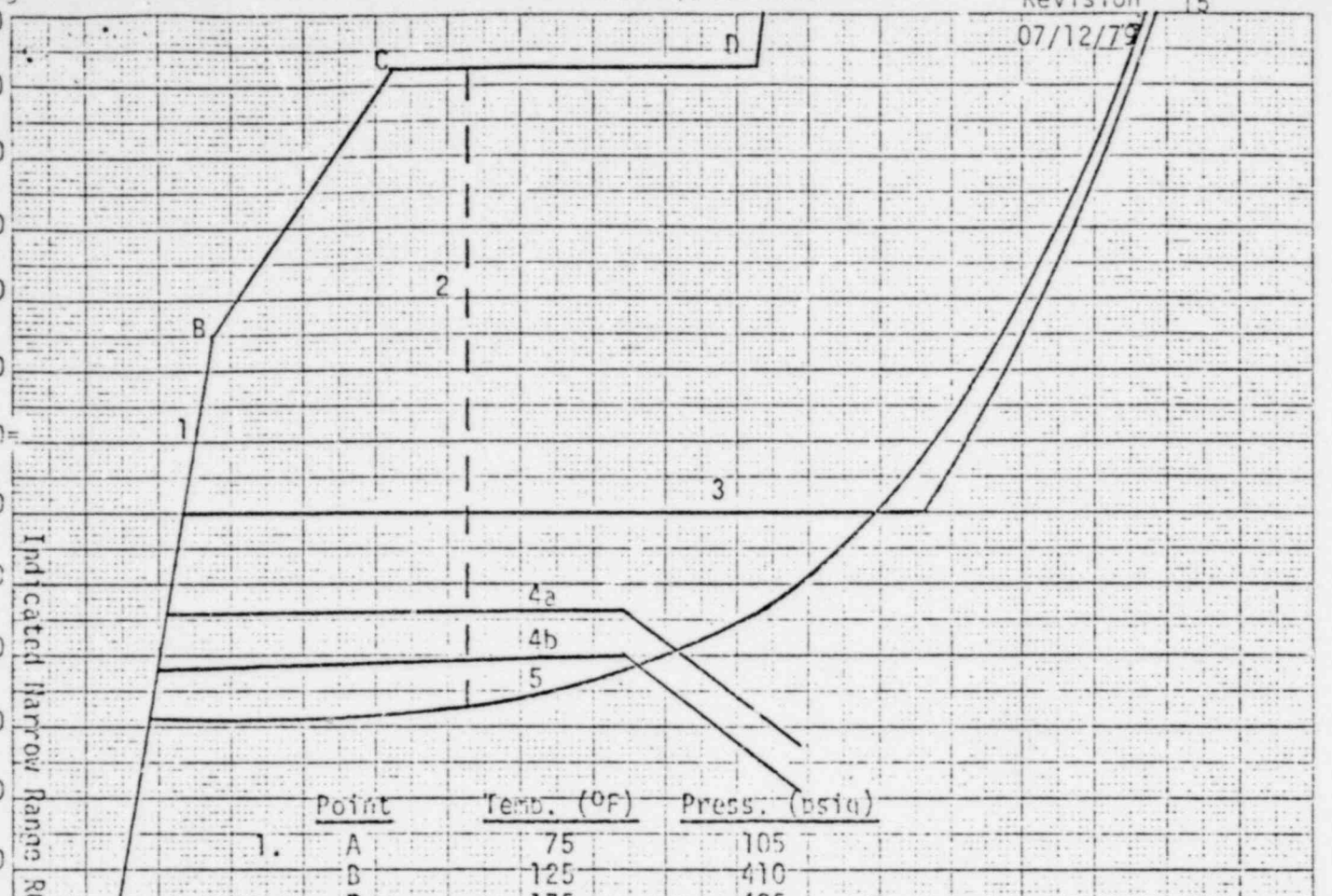

Indicated Narrow Range RCS Pressure, psig

Indicated RC Temp. °F

Point		Temp. (°F)	Press. (psig)
1.	A	75	105
	B	125	410
	C	175	485
	D	275	485

Instrument Error: -25 psig / 12°F
Consistent with T.S. Fig. 3.1-1

2. Allowable RC Pump Combination
Above 195°F All
Below 195°F 1-A, 1-B; 0-A, 1-B; 1-A, 0-B
Tech Spec Fig. 3.1-1 Instrument Error 12°F

3. Minimum RC Press. for Operating CRDM
Instrument Error 410 psig - 12°F OP 1101-1 Fig. 1.6 - 10.1

4a. Max. Press. for Operation of DH System while operating RCP "C" or "D" Instrument Error - 10 psig, - 12°F
OP 1101-1 Fig. 1.0 - 22.3

4b. Maximum Press for Operation of DH System while operating RCP "A" or "B" Instrument Error - 10 psig, -12°F OP 1101-1
Fig. 1.0 - 22.2

5. Minimum RC Pump NPSH, Instrument Error / 10 psig -12°F
OP 1101-1 Fig. 1.0 - 22.2 & Fig. 1.0 - 05.6

Note: Heat-up and Cooldown Rates shall not exceed 100°F in any one hour. During RCS Inservice Leak & Hydrostatic Tests, Heat-up and Cooldown Rates shall not exceed 50°F in any one hour.

23.0

TABLE 1

REACTOR COOLANT PUMP AND MOTOR
INTERLOCKS, TRIPS AND ALARMS

Item	Setpoint
Starting Interlock No. 1 Temperature Switch	500°F RCS Temperature
Starting Interlock No. 2	
1. Reactor Power	Less than 30%
2. Mtr. Backstop Oil System Flow	> 0.4 GPM
3. Mtr. Oil Lift System Pressure	Greater than 1750 PSIG
4. Mtr. Upper Bearing Oil Level	9 in.
5. Mtr. Lower Bearing Oil Level	6.5 in.
6. Mtr. Heat Exchanger Cooling Water Flow	N.S. Pumps Bkr. Contacts
7. Pump Seal Injection Water Flow	22 GPM
8. Pump Thermal Barrier Cooling Water Flow (Total Int. Cooling Water System Flow)	550 GPM
9. Mtr. Starting Under Voltage	6.62 KV
10. Pump Seal No. 1 Delta Pressure	280 PSI
Interlock Permissive to Stop Oil Lift Pump When Starting RC Pump	500 RPM
Trips	
1. Running Under Voltage (Time Delay)	6.15 KV @ 5.18 sec.
2. Instantaneous Overcurrent (Short Circuit)	7478 amps
3. Current Differential	5 amps
4. RC Pump Trips if Both IC Flow and Seal Injection Flow Low.	
5. Low Instantaneous Trip	1273 amps

Table 2

	Item	Setpoint
Alarms		
1.	AC Oil Lift Pump Disch. Press. Low	1750 psig
2.	DC Oil Lift Pump Disch. Press. Low	1750 psig
3.	Backstop Low Oil Flow	< 0.24 GPM
4.	Lube Oil Low Flow	7.0 GPM
5.	Mtr. Upper Bearing High Oil Level	13 in.
6.	Mtr. Upper Bearing Low Oil Level	9 in.
7.	Mtr. Lower Bearing High Oil Level	10.5 in.
8.	Mtr. Lower Bearing Low Oil Level	6.5 in.
9.	Air Cooler Leak Detector Hi Level	Cooler Leakage
10.	High Vibration (Motor Frame)	0.002 in.
11.	Pump Full Speed Low	700 RPM
12.	High Inlet Air Temp. to Motor	122° F
13.	Down Thrust Bearing Temp. High	195° F
14.	Up Thrust Bearing Temp. High	195° F
15.	Upper Guide Bearing Temp. High	185° F
16.	Lower Guide Bearing Temp. High	185° F
17.	Pump Tripped	N/A
18.	High Stator Winding Temp.	302° F
19.	RCP Labyrinth Seal Diff. Press. Low	30 in. H_2O
20.	RC Pump Seal Injection Flow Low	22 GPM
21.	RC Pump Seal Injection Flow High	42 GPM
22.	RCP Seal No. 1 Outlet Water Temp. High	200° F
23.	RCP Seal No. 1 Leak Off High Flow	5 GPM
24.	RCP Seal No. 1 Leak Off Low Flow	0.86 GPM
25.	RCP Seal No. 1 Bypass Low Flow	0.8 GPM
26.	RCP Seal No. 1 Differential Press. Low	280 psig
27.	RCP Bearing Water Temp. High	190° F
28.	RCP Stand Pipe Level High	60 in.
29.	RCP Stand Pipe Level Low	36 in.
30.	Ground Fault	200 V @ 8 sec.
31.	Instantaneous Overcurrent (Short Circuit)	7478 amps
32.	Running Undervoltage	6.15 KV @ 5.18 sec.
33.	Time Delay Overcurrent (Overload)	800A @ 10 sec.
34.	RCP Thermal Barrier Cooling Water Outlet Temperature High	140° F

APPENDIX A

RCP Motor No Load Testing (Uncoupled)

A.1 PURPOSE:

A.1.1 Provide guidance for running the RC Pump Motors Uncoupled for testing.

NOTE: See Section 6.1 of this procedure.

A.2 LIMITATIONS AND PRECAUTIONS

A.2.1 Nuclear Safety - NA

A.2.2 Environmental Safety - NA

A.2.3 Personnel Safety - Insure that all extraneous tools and equipment have been completely cleared from inside the pump motor stand area, the motor shaft is free to rotate unobstructed, and that the personnel screens are in place.

NOTE: The screens should be removable during the test to facilitate shaft IRD readings.

A.2.4 Equipment Protection - Comply with applicable Limits and Precautions of Section 6.2 of this procedure.

A.3 PREREQUISITES

NOTE: Indicate satisfactory completion of Sections A.3 and A.4 by initialing the appropriate checklist attached to this procedure.

A.3.1 Verify the motor has been completely reassembled:

a. Lower Bearing Housing

b. Upper Bearing Housing

NOTE: Verify alignment shims were removed?

c. All oil levels are correct.

d. Access covers are in place.

e. All electrical connections and lube pump motors properly installed.

f. All cooling water lines are reinstalled

g. All lube oil piping is installed

h. All instrumentation is operational.

A.3.2 Perform the following on each motor to be tested only to allow starting of the RC Motor with no load. Enter all jumpers in jumper log.

	RCP-1A	RCP-1B	RCP-1C	RCP-1D
a. Intermediate Cooling Water Interlock 209-070; Pull Fuse	FD15-XCC	FD15-XCC	FD15-XCC	FD15-XCC
b. Makeup Flow Interlock 209-066; In ICS/NNI jumper	0-3-3-5 0-3-3-6	0-3-3-7 0-3-3-8	0-3-3-9 0-3-3-10	0-3-3-11 0-3-3-12
c. Seal Injection Flow Interlock 209-065; Pull Fuse	FD91-XCC	FD219-XCL	FD91-XCC	FD219-XCL

A.3.3 Perform the applicable portions of the following steps of Section 6.3.1. of this procedure.

a. Step 6.3.1.1. Nuclear Services Closed Cooling Water

b. Step 6.3.1.3. Electrical System lineup

c. Step 6.3.1.4. 125VDC for Switchgear.

d. Step 6.3.1.5. Control Switches for all motors

e. Step 6.3.1.6. Instrumentation and Controls.

A.3.4 Insure motors are not red tagged. If blue tagged insure compliance with AP1002.

A.4 PROCEDURE

A.4.1 Call up the following computer points for the motor to be tested. Data should be taken every two minutes for the first twenty minutes and then every ten minutes thereafter.

	RCP1A	RCP1B	RCP1C	RCP1D
a. Upper Guide Bearing	Group	Group	Group	Group
b. Upthrust Bearing	110	111	112	113
c. Downthrust Bearing				
d. Lower Guide Bearing				
e. Stator				

A.4.2 Verify 6900V Bus energized

A.4.3 Place all oil pumps in pull to lock with breakers closed.

A.4.4 Station observer at motor with communication.

A.4.5 Start one backstop pump and remove the other from pull-to-lock.

A.4.6 Start the DC Lube Oil pump to assure that it operates. Let it run for two minutes. Verify lube oil pressure is >1800 psig. Shut off the DC Lube Oil Motor.

A.4.7 Start the AC Lube Oil Pump and verify lube oil pressure is >1800 psig.

A.4.8 Verify the DC Lube Oil Pump is in standby.

A.4.9 Start the RC Pump Motor. If for any reason, the RCP does not start or trips off during a start attempt, do not attempt to restart the pump until the cause is determined and corrected.

A.4.10 When the motor reaches full speed, shut down the lift and backstop pumps. (Approx. 1 minute after start.)

A.4.11 Take data from the computer as directed in step A.4.1. Attach completed printout to the checkoff list.

A.4.12 Record vibration readings per PME53 on checklist. Record motor voltage/amperes on checklist.

NOTE: Use IRD hand held system as required.

A.4.13 Allow the motor to run for one hour or until bearing temperatures stabilize whichever comes first.

A.4.14 Start one Backstop Lube Oil Pump.

A.4.15 Start one Lube Oil Pump.

CAUTION: Uncoupled motor takes longer to coastdown. Lift pumps must be operational during entire coastdown.

A.4.16 Stop RC Pump Motor

A.4.17 Time the coastdown.

A.4.18 Shut off the lube oil motors when motor has stopped.

A.4.19 Remove the jumpers/replace the fuses from step A.3.2. Record in the jumper log.

Appendix A - No Load Motor Testing

RC-P-1A Checklist (Initial each step as it is completed)

A.3.1

_____a.

_____b.

_____c.

_____d.

_____e.

_____f.

_____g.

_____h.

A.3.2

_____a.

_____b.

_____c.

A.3.3

_____a.

_____b.

_____c.

_____d.

_____e.

____ A.3.4

_____A.4.1.

_____A.4.2. Bus 1A2 energized

A.4.3.

_____1ARP MCC RCP-3A-1 Closed

_____1BRP MCC RCP-3A-2 Closed

_____1 ES MCC RCP-2A-1 Closed

_____1 DC Panel RCP-2A-2 Closed

_____A.4.4.
A.4.5.

_____RCP-3A-1 Red Light

_____RCP-3A-2 Green Light

A.4.6.

_____DC Pump operates

_____Oil Pressure >1800 psig

_____DC Pump off

A.4.7.

_____AC Pump operates

_____Oil Pressure >1800 psig

A.4.8.

_____DC Pump in Standby

A.4.9.

_____Start RC Pump Motor

A.4.10.

_____Backstop pumps turned off

Appendix A - No Load Motor Testing

RC-P-1A Checklist (Initial each step as it is completed)

A.3.1

_____a.

_____b.

_____c.

_____d.

_____e.

_____f.

_____g.

_____h.

A.3.2

_____a.

_____b.

_____c.

A.3.3

_____a.

_____b.

_____c.

_____d.

_____e.

_____ A.3.4

_____A.4.1.

_____A.4.2. Bus 1A2 energized

A.4.3.

_____1ARP MCC RCP-3A-1 Closed

_____1BRP MCC RCP-3A-2 Closed

_____1 ES MCC RCP-2A-1 Closed

_____1 DC Panel RCP-2A-2 Closed

_____A.4.4.
A.4.5.

_____RCP-3A-1 Red Light

_____RCP-3A-2 Green Light

A.4.6.

_____DC Pump operates

_____Oil Pressure >1800 psig

_____DC Pump off

A.4.7.

_____AC Pump operates

_____Oil Pressure >1800 psig

A.4.8.

_____DC Pump in Standby

A.4.9.

_____Start RC Pump Motor

A.4.10.

_____Backstop pumps turned off

A.4.18.

_____Shutoff the lube oil motors.

A.4.19.

_____Remove jumpers/replace fuses

(Checklist step A.3.2.)

Appendix A - No Load Motor Testing

RC-P-1B Checklist (Initial each step as it is completed)

A.3.1

_____a.

_____b.

_____c.

_____d.

_____e.

_____f.

_____g.

_____h.

A.3.2

_____a.

_____b.

_____c.

A.3.3

_____a.

_____b.

_____c.

_____d.

_____e.

_____A.3.4

_____A.4.1.

_____A.4.2. Bus 1B2 energized

A.4.3.

_____1ARP MCC RCP-3B-1 Closed

_____1BRP MCC RCP-3B-2 Closed

_____1 ES MCC RCP-2B-1 Closed

_____1 DC Panel RCP-2B-2 Closed

_____A.4.4.
A.4.5.

_____RCP-3B-1 Red Light

_____RCP-3B-2 Green Light

A.4.6.

_____DC Pump operates

_____Oil Pressure >1800 psig.

_____DC Pump off

A.4.7.

_____AC Pump operates

_____Oil Pressure >1800 psig.

A.4.8.

_____DC Pump in standby

A.4.9.

_____Start RC Pump Motor

A.4.10.

_____Backstop pumps turned off

RC-P-1B Checklist (cont'd)

A.4.11

_____Computer data attached (Attach when test is complete).

A.4.12

_____At one minute record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At ten minutes record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At five minutes record:

Motor voltage _____ volts

Motor amperes _____ amps

A.4.13

_____Motor run time is >1 Hr. or temperatures have stabilized

A.4.14

_____Start a backstop lube oil pump.

A.4.15

_____Start one Lube Oil Pump.

A.4.16

_____Stop the RC Pump Motor.

A.4.17

_____Record coastdown time _____ min. _____ sec.

RC-P-1B Checklist (cont'd)

A.4.18

_____Shutoff the lube oil motors.

A.4.19

_____Remove jumpers/replace fuses.

(Checklist step A.3.2.)

Apprendix A - No Load Motor Testing

RC-P-1C Checklist (Initial each step as it is completed)

A.3.1

_____a.

_____b.

_____c.

_____d.

_____e.

_____f.

_____g.

_____h.

A.3.2

_____a.

_____b.

_____c.

A.3.3

_____a.

_____b.

_____c.

_____d.

_____e.

_____A.3.4

_____A.4.1.

_____A.4.2. Bus 1A3 energized

_____A.4.3.

_____1ARP MCC RCP-3C-1 Closed

_____1BRP MCC RCP-3C-2 Closed

_____1 ES MCC RCP-2C-1 Closed

_____1 DC Panel RCP-2C-2 Closed

_____A.4.4.
_____A.4.5.

_____RCP-3C-1 Red Light

_____RCP-3C-2 Green Light

_____A.4.6.

_____DC Pump operates

_____Oil Pressure >1800 psig

_____DC Pump off

A.4.7.

_____AC Pump operates

_____Oil Pressure >1800 psig.

A.4.8.

_____DC Pump in Standby

A.4.9.

_____Start RC Pump Motor

A.4.10.

_____Backstop pumps turned off

RC-P-1C Checklist (cont'd)

A.4.11

_____Computer data attached (Attach when test is complete).

A.4.12

_____At one minute record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At ten minutes record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At five minutes record:

Motor voltage _____ volts

Motor amperes _____ amps

A.4.13

_____Motor run time is >1 hr. or temperatures have stabilized

A.4.14

_____Start a backstop lube oil pump

A.4.15

_____Start one Lube Oil Pump

A.4.16

_____Stop the RC Pump Motor

A.4.17

_____Record coastdown time _____ min. _____ sec.

RC-P-1C Checklist (Initial each step as it is completed)

A.4.18

_____Shutoff the lube oil motors.

A.4.19

_____Remove jumpers/replace fuses

(Checklist step A.3.2.)

Appendix A - No Load Motor Testing

RC-P-1D Checklist (Initial each step as it is completed)

A.3.1

_____a.

_____b.

_____c.

_____d.

_____e.

_____f.

_____g.

_____h.

A.3.2

_____a.

_____b.

_____c.

A.3.3

_____a.

_____b.

_____c.

_____d.

_____e.

_____A.3.4

_____A.4.1.

_____A.4.2. Bus 1B3 energized

_____A.4.3.

_____1ARP MCC RCP-3D-1 Closed

_____1BRP MCC RCP-3D-2 Closed

_____1 ES MCC RCP-3D-1 Closed

_____1 DC Panel RCP-3D-2 Closed

_____A.4.4.
A.4.5.

_____RCP-3D-1 Red Light

_____RCP-3D-2 Green Light

A.4.6.

_____DC Pump operates

_____Oil Pressure >1800 psig

_____DC Pump off

_____A.4.7.

_____AC Pump operates

_____Oil Pressure >1800 psig.

A.4.8.

_____DC Pump in Standby

A.4.9.

_____Start RC Pump Motor

A.4.10.

_____Backstop pumps turned off

RC-P-1D Checklist (cont'd)

A.4.11

_____Computer data attached (Attach when test is complete).

A.4.12

_____At one minute record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At ten minutes record:

Frame vibration X _____ mils

Y _____ mils

Shaft vibration X _____ mils

Y _____ mils

_____At five minutes record:

Motor voltage _____ volts

Motor amperes _____ amps

A.4.13

_____Motor run time is >1 hr. or temperatures have stabilized.

A.4.14

_____Start a backstop lube oil pump

A.4.15

_____Start one Lube Oil Pump

A.4.16

_____Stop the RC pump motor

A.4.17

_____Record coastdown time _____ min. _____ sec.

RC-P-1D Checklist (cont'd)

A.4.18

_____Shutoff the lube oil motors

A.4.19

_____Remove jumpers/replace fuses

(Checklist step A.3.2.)