ATTACHMENT IV to JPN-95-051

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Standby Liquid Control (SLC) Surveillance Extensions

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
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FITZPATRICK - 24 MONTH OPERATING CYCLE

STANDBY LIQUID CONTROL (SLC)
SURVEILLANCE EXTENSIONS

REPORT NO.: JAF-RPT-SLC-00336 REV. 1

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24 MONTH OPERATING CYCLE
SLC SURVEILLANCE EXTENSIONS

TABLE OF CONTENTS

24 MONTH OPERATING CYCLE
SLC SURVEILLANCE EXTENSIONS

I. Executive Summary

The FitzPatrick plant will be operating on a 24 month fuel cycle. This longer cycle length has a direct effect on surveillance, maintenance, and test activities that are currently performed on a 18 month or refuel outage basis.

At FitzPatrick, the Standby Liquid Control System (SLC) components are routinely inspected, tested, and maintained to provide a highly reliable system. Typically, the various components in the system are tested on a daily, monthly, and refueling basis. In addition, periodic preventative maintenance is performed on the system.

SLC test and calibration frequencies are mandated by Plant Technical Specifications and the ASME Section XI Inservice Test Program. Maintenance activities are based on operational feedback and manufacturers recommendations.

This study evaluates the changes to surveillance requirements to support a nominal twenty-four month fuel cycle. Justification is provided, where appropriate, to support test interval extensions.

The evaluations conclude that a portion of the SLC surveillance intervals can be safely extended to support a nominal 24 month operating cycle (see table 1). Operational improvements include reduced test cycles on equipment. Cost savings and a reduction in worker occupational exposures are also expected since plant personnel and resources will not be diverted to perform unnecessary testing.

II. Purpose

The FitzPatrick plant will be operating on a 24 month fuel cycle. To avoid either an 18-month surveillance outage or a mid-cycle outage, changes are required to the SLC surveillance test intervals prescribed by the FitzPatrick Technical Specifications.

Substantiating the effects of the longer cycle length on SLC surveillance, and test activities requires a comprehensive review of the system, its individual components, and the integrated effect of all test activities on operability.

III. Evaluation Methodology

The once per cycle surveillance record for the applicable system components will be evaluated for a time period defined in the evaluation section (Section IV).

System instruments that will be having their calibration frequency extended to 24 months will have a drift evaluation developed. The drift evaluation will justify the calibration frequency extension or the calibration frequency will not change.

System components that will be having their surveillance frequency extended to 24 months will be evaluated in the following manner. If surveillance records reveals more than one failure to meet acceptance criteria per component, then the surveillance frequency can not be extended. One failure per component is viewed as acceptable. If exceptions are to be taken, they will be presented in the evaluation section (Section IV).

IV. Safety Functions and Evaluation

The Standby Liquid Control System is a relatively basic system which is used only in a standby mode during normal operation.

SLC test, and inspection activities were evaluated to determine the impact of a 24 month operating cycle. The longer cycle length requires an extension of the surveillance test interval for:

1. Manual initiation of the system and pump recirculation flow test. (ST-6B)

2. Explosive valve and primer assembly tests. (ST-6D)

3. Injection of demineralized water into the Reactor Vessel. (ST-6D)

4. Relief valve pressure setpoint test. (ST-6C/MP-59.07)

5. Disassembly and inspection of one out of two explosive valve internals. (MST-11.11)

SLCS boron concentration is checked monthly (reference 24) by chemical analysis of the sodium pentaborate solution. The affect of the longer operating cycle on the 660 ppm acceptance criteria was evaluated (Reference 23) by GE. The calculation shows that 660 ppm is adequate to shutdown the reactor for an equilibrium, uprated core loaded for a 24 month cycle.

Other SLC surveillances, such as, valve tests and pump tests are performed during power

operation and are not directly impacted by the longer fuel cycle.

The operability of systems and components required by the plant's safety analyses is established by the surveillance requirements contained in the Technical Specifications. Surveillance testing, by definition, can only identify that a component or a system is incapable of performing its safety function (i.e., inoperable). Preventive maintenance, however, reduces the number of failures found during plant operation or during testing. Recurring problems are generally corrected by PM activities.

The design objective of the SLC system is to bring the reactor from full power to a cold, xenon-free shutdown condition in the event that sufficient control rods cannot be inserted, to accomplish reactor shutdown in the normal manner.

The system utilizes two squib activated shear explosive valves in parallel as a means of isolating each pump from the reactor vessel to prevent inadvertent injection of Boron to the RPV. The valves are maintained in the closed position and are activated only in an emergency to provide a flow path to the reactor vessel. Additionally, the firing circuit continuity for each valve is continuously monitored by pilot lights, ammeters, and a annunciator signaling loss of continuity in the control room to alert plant control room operators if problems with the circuit occurred. The valves were tested for operability by surveillances ST-6D and MST-11.11, the surveillance records yield the following results. ST-6D was completed on 6/83, 2/85, 1/87, 9/88, 4/90, 2/92, 9/92 and 1/95 and there were no failures identified. MST-11.11 was completed on 4/90, 2/92, 4/94 and 1/95 and there were no failures identified.

The system utilizes two positive displacement pumps capable of delivering greater than 50 gpm at a head of greater than or equal to 1275 psig. The pumps are tested monthly during normal plant operation. The pumps are tested for operability by surveillances ST-6B and ST-6D, the surveillance records yield the following results. ST-6B was completed on 6/83, 2/85, 1/87, 9/88, 4/90, 2/92, 4/94 and 1/95 and there were no failures identified. ST-6D was completed on 6/83, 2/85, 1/87, 9/88, 4/90, 2/92, 9/92 and 1/95 and there were no failures identified.

The relief valves in the system protect the piping and pumps, which are nominally designed for 1500 psig, from over pressure. The valves are only used and pressurized during the brief system testing periods. The valves were tested for operability by surveillance ST-6C, the surveillance records yield the following results. ST-6C was completed on 6/83, 2/85, 1/87, 9/88, 1/90, 4/90, 2/92, 9/92, 4/94 and 1/95 and there were no failures identified. Surveillance ST-6C has been deleted and MP-59.07 (Ref. 25) will take its place until a MST is developed.

The system utilizes Sodium Pentaborate solution for the negative reactivity addition to the reactor. To protect the system piping against solution precipitation, the solution is kept at least 10°F above solution saturation temperature. This is accomplished by a tank

heater and a piping heat tracing system. Temperature indication and alarms for the system annunciate in the control room. If a problem were to develop, the above design features would provide ample indications for plant personnel to remedy the situation. The system temperature is checked daily and provides assurance that the system is maintained as required by Technical Specifications. Plant temperature instrumentation installed on the SLC tank is capable of being calibrated (Ref. 19) while the unit is at power, technicians monitor the tank temperature during the calibration process. There is no hardship in testing or calibrating these instruments at any time and the calibrations are not cycle dependent. Keeping these instruments on an 18 month calibration frequency will not be a burden to plant operation or personnel. Based on past calibration history, the temperature instrumentation will not support frequency extension. Therefore, the calibration frequency will not change.

Once the solution has been prepared in the tank, the concentration of boron will not change unless more boron or water is added. Level indications and alarms are used to detect whether the solution volume has changed, which might be indicative of a solution concentration change. The actual tank level is checked daily via two independent means and would detect instrument level changes due to water addition, water evaporation or system leaks. The calibration (Ref. 20) of these instruments on an 18 month frequency will not be a burden to plant operation or personnel. Based on past calibration history, the level instrumentation will not support frequency extension. Therefore, the calibration frequency will not change. The level instruments are capable of being calibrated while the unit is at power the calibration frequency of 18 months is not cycle dependent.

The SLC system is designed with two (2) check valves installed to isolate the reactor from the SLC system. These two check valves are presently tested on a refueling basis. (ST-6D). The valves are tested for operability by surveillance ST-6D, the surveillance records yield the following results. ST-6D was completed on 6/83, 2/85, 1/87, 9/88, 4/90, 2/92, 9/92 and 1/95 and there were no failures identified. These valves are used for containment isolation purposes and can only be leak rate tested when the reactor is in cold shutdown. In addition to the isolation requirement, the valves must also open to provide a flow path to the reactor during SLC initiation. This function can only be tested during cold shutdown by injecting flow into the reactor. Therefore, this test is being extended to a 24 month freguency.

V. Summary and Conclusions

To support the 24 month fuel cycle, changes are proposed to the SLC surveillance test intervals for the following system functional tests (See Table 1):

- Recirculation Flow Test (ST-6B)
- Explosive Valve Tests (ST-6D)

- Demineralized Water Injection Test (ST-6D)
- Relief Valve Setpoint Test (ST-6C/MP-59.07)
- Explosive Valve Inspection Test (MST-11.11)

SLC instrument calibrations and functional tests (Ref. 19 and 20) which are performed once every operating cycle can continue to be performed on an 18 month schedule without an outage or being a burden to plant operation or safety.

VI. References

1. James A. FitzPatrick Nuclear Power Plant, Maintenance Department Preventative Maintenance Schedule.

2. James A. FitzPatrick Nuclear Power Plant, I&C Department Maintenance Program Master Schedule.

3. Operational Occurrence Report Logs from 1986 to 1990.

4. James A. FitzPatrick Nuclear Power Plant, Technical Specifications.

5. James A. FitzPatrick Nuclear Power Plant, Updated Final Safety Analysis Report, Section 7.2.

6. Flow Diagram, Standby Liquid Control System, DWG. No. 11825-FM-21A.

7. Operating Procedure OP-17, Standby Liquid Control System.

8. Operations Surveillance Test Procedure ST-6A, Standby Liquid Control Pump Functional Test.

9. Operations Surveillance Test Procedure ST-6B, Standby Liquid Control Recirculation Test.

10. Operations Surveillance Test Procedure ST-6C, Standby Liquid Control Relief Valve Test (IST).

11. Operations Surveillance Test Procedure ST-6D, Standby Liquid Control Initiation and Demineralized Water Injection into Reactor Vessel Test (IST).

12. Operations Surveillance Test Procedure ST-6H, Standby Liquid Control Pump Inservice Test (IST).

13. Maintenance Procedure MP-11.1, Standby Liquid Control Pump Maintenance.

14. Maintenance Procedure MP-11.2, Standby Liquid Control Pump Maintenance.

15. Maintenance Procedure MP-11.3, Standby Liquid Control Safety Relief Valve Repair.

16. Maintenance Procedure MP-11.4, Standby Liquid Control Accumulator Repair.

17. Maintenance Procedure MP-11.10, Standby Liquid Control Explosive Valve Inspection and Replacement.

18. Maintenance Surveillance Test MST-11.11, Standby Liquid Control Explosive Valve Inspection and Replacement.

19. Instrument Surveillance Procedure ISP-82-1, Standby Liquid Control System Temperature Instrument Calibration.

20. Instrument Surveillance Procedure ISP-82, Standby Liquid Control Tank Level Instrument Calibration.

21. Instrument Maintenance Procedure F-IMP-11.1, Standby Liquid Control Pressure Instrument Calibration.

22. Instrument Maintenance Procedure F-IMP-11.2, Standby Liquid System Pressure Instruments Test and/or Calibration.

23. NYPA Memorandum G. L. Rorke to R. Penny, dated January 6, 1992, documenting the results of a GE calculation showing SLCS capability for a 24 month power uprate cycle.

24. SP-01.04, SLG Sampling and Analysis procedure.

25. MP-59.07, Testing of Relief/Safety Valves (IST).

ATTACHMENT 1
TABLE 1

STANDBY LIQUID CONTROL SYSTEM SURVEILLANCE TEST CHANGES

COMPONENT(S)	PROCEDURE	TS SECTION	CHANGE
Pumps	ST-6B	4.4.A.2	18M to 24M
11 P-2A	ST-6D		18M to 24M
11 P-2B			
Safety Valves		4.4.A.2	
11 SV-39A	ST-6C		18M to 24M
11 SV-39B	MP-59.07		
Check Valves	ST-6D	4.4.A.2	18M TO 24 M
11 SLC-16			
11 SLC-17			
Explosive Valves	MST-11.11	4.4.A.2&3	18M TO 24M
11EV-14A	ST-6D		18M TO 24M
11EV-14B			
Instruments			
(Temperature)	ISP-82.1	4.4.C.3.a	Once per Cycle to 18M
11 TS-50			
11 TS-59			
11 TIC-60			
11 TIC-48			
(Level)	ISP-82	4.4.C.3.a	Once per cycle to 18M
11 LT-45			
11 LI-46			
11 LI-66			
11 LS-47			
11 LS-70			
EPIC point A-1112			

ATTACHMENT 2

TECH SPEC MARK-UPS

3.4 LIMITING CONDITIONS FOR OPERATION

3.4 STANDBY LIQUID CONTROL SYSTEM

Applicability:

Applies to the operating status of the Standby Liquid Control System.

Objective:

To assure the availability of a system with the capability to shut down the reactor and maintain the shutdown condition without control rods.

Specifications

A. Normal Operation

During periods when fuel is in the reactor and prior to startup from a cold condition, the Standby Liquid Control System shall be operable except as specified in 3.4.B below. This system need not be operable when the reactor is in the cold condition, all rods are fully inserted and Specification 3.3.A is met.

4.4 SURVEILLANCE REQUIREMENTS

4.4 STANDBY LIQUID CONTROL SYSTEM

Applicability:

Applies to the periodic testing requirements for the Standby Liquid Control System.

Objective

To verify the operability of the Standby Liquid Control System.

Specification:

A. Normal Operation

The operability of the Standby Liquid Control System shall be verified by performance of the following tests:

1. At least once per month -

   Demineralized water shall be recycled to the test tank. Pump minimum flow rate of 50 gpm shall be verified against a system head of ≥ 1,275 psig.

2. At least once during each operating cycle

   Manually initiate the system, except the explosive valves and

4.4 (cont'd)

pump solution in the recirculation path.

Explode one of three primer assemblies manufactured in same batch to verify proper function. Then install the two remaining primer assemblies of the same batch in the explosive valves.

Demineralized water shall be injected into the reactor vessel to test that valves (except explosive valves) not checked by the recirculation test are not clogged.

Test that the setting of the system pressure relief valves is between 1,400 and 1,490 psig.

3. Disassemble and inspect one explosive valve so that it can be established that the valve is not clogged. Both valves shall be inspected in the course of two operating cycles.

B. Operation with Inoperable Components

From and after the date that a redundant component is made or found to be inoperable, Specification 3.4.A shall be considered fulfilled, and continued operation permitted, provided that:

1. The component is returned to an operable condition within 7 days.

B. Operation with Inoperable Components

When a component becomes inoperable its redundant component shall be verified to be operable immediately and daily thereafter.

3.4 (Cont'd)

C. Sodium Pentaborate Solution

The standby liquid control solution tank shall contain a boron bearing solution with a minimum enrichment of 34.7 atom percent of B-10 that satisfies the volume-concentration requirements of Fig. 3.4-1 at all times when the Standby Liquid Control System is required to be operable and the solution temperature including that in the pump suction piping shall not be less than the temperature presented in Fig. 3.4-2. Tank heater and the heat tracing system shall be ~~operable~~ available whenever the SLCS is required in order to maintain solution temperature in accordance with Fig. 3.4-2. If these requirements are not met, restore the system to the above limits within eight hours or take action in accordance with Specification 3.4.D.

D. If specifications 3.4.A through C are not met, the reactor shall be in at least hot shutdown within the following 12 hours.

4.4 (Cont'd)

C. Sodium Pentaborate Solution

The availability of the proper boron bearing solution shall be verified by performance of the following tests:

1. At least once per month -

Boron concentration shall be determined. In addition, the boron concentration shall be determined any time water or enriched sodium pentaborate is added or if the solution temperature drops below the limits specified by Fig. 3.4-2.

2. At least once per day -

Solution volume and the solution temperature shall be checked.

3. At least once per operating cycle -

a. The temperature and level elements shall be calibrated.

a. ~~b.~~ Enrichment of B-10 (in atom percent) shall be checked.

4. AT LEAST ONCE PER 18 MONTHES

D. Not Used

Amendment No. ~~116~~, 192

3.4 and 4.4 BASES

A. Normal Operation

The design objective of the Standby Liquid Control System is to bring the reactor from full power to cold, xenon-free shutdown assuming that no control rods can be inserted. To do this, the Standby Liquid Control System is designed to inject a quantity of boron which produces a minimum concentration equivalent to 660 ppm of natural boron in the reactor core. Six hundred and sixty ppm boron concentration in the reactor core is required to bring the reactor from full power to a subcritical condition considering:

- o the reactivity insertion due to temperature decrease caused by changing water density,
- o decay of xenon poisoning
- o uncertainties and biases in the analyses and
- o 25% margin for potentially imperfect mixing of the sodium pentaborate solution in the reactor water.

The design basis of the SLCS requires that injection be completed in a time period no less than 23 minutes and no greater than 125 minutes. The upper time limit (125 min) for complete injection of the sodium pentaborate solution was selected to override the rate of reactivity insertion due to cooldown of the reactor following the xenon poison peak. The lower time limit (23 min) is based on the need to allow adequate mixing, so the boron does not circulate in uneven concentrations that could cause local power fluctuations.

The technical specifications assure that the minimum injecting time for the SLC System is 44 minutes and maximum injection time 96 minutes, thus meeting the plant design basis. In addition to meeting its original design basis, the system must also satisfy the Anticipated Transient Without Scram (ATWS) Rule, 10 CFR 50.62 paragraph (c) (4).

The ATWS Rule requires a minimum flow capacity and boron content equivalent in control capacity to 86 gallons per minute of 13 weight percent sodium pentaborate solution. The "equivalent in control capacity" wording was clarified in Generic Letter 85-03. Equivalence can be obtained by increasing the flow, boron concentration, or boron enrichment. For the FitzPatrick plant, the rule is met by using boron enriched to 34.7 atom percent boron-10 and a pumping rate of 50 gpm. The method used to show equivalence with 10 CFR 50.62 is described in NEDE - 31096 - P-A :

$$E/19.8 \times C/13 \times M251/M \times Q/86 \geq 1$$

where

E = boron enrichment = 34.7 atom %
Q = SLCS flow rate = 50 gpm
M = mass of water in reactor vessel and recirculation system at hot rated condition 491,700 lbs. for FitzPatrick plant
M251 = mass of water in vessel and recirculation system at hot rated condition (628,300 lbs.) for 251 - inch diameter vessel plant
C = sodium pentaborate solution concentration (weight percent) greater than or equal to 10 percent

ATWS requirements are satisfied at all concentrations above 10 weight percent for a minimum enrichment of 34.7 atom percent of B-10.

Figure 3.4-1 shows the permissible region of operation on a sodium pentaborate solution volume versus concentration graph. This curve was developed for 34.7% enriched B-10 and a pumping rate of 50 gpm. Each point on this curve provides a minimum of 660 ppm of equivalent natural boron in the reactor vessel upon injection of SLC solution. At a solution volume of 2200 gallons, a weight concentration of 13% sodium pentaborate, enriched to 34.7% boron-10 is needed to meet shutdown requirements. The maximum storage volume of the solution is 4780 gallons which is the net overflow volume in the SLC tank.

Boron concentration, isotopic enrichment of boron-10, solution temperature, and volume are checked on a frequency adequate to assure a high reliability of operation of the system should it every be required. Experience with pump operability indicates that monthly testing is adequate to detect if failures have occurred.

The only practical time to test the Standby Liquid Control System is during a refueling outage and by initiation from local stations. Components of the system are checked periodically as described above and make a functional test of the entire system on a frequency of more than once each refueling outage unnecessary. A test of explosive charges from one manufacturing batch is made to assure that the charges are satisfactory. A continuous check of the firing circuit continuity is provided by pilot lights in the control room.

The relief valves in the Standby Liquid Control System protect the system piping and positive displacement pumps, which are nominally designed for 1,500 psig, from overpressure. The pressure relief valves discharge back to the standby liquid control pump suction line.

B. Operation with Inoperable Components

Only one of two standby liquid control pumping circuits is needed for operation. If one circuit is inoperable, there is no immediate threat to shutdown capability, and reactor operation may continue during repairs. Assurance that the remaining system will perform its function is obtained by verifying pump operability in the operable circuit at least daily.

C. Sodium Pentaborate Solution

To guard against precipitation, the solution, including that in the pump suction piping, is kept at least 10°F above saturation temperature. Figure 3.4-2 shows the saturation temperature including 10°F margin as a function of sodium pentaborate solution concentration. Tank heater and heat tracing system are provided to assure compliance with this requirement. The set points for the automatic actuation of the tank heater and heat tracing system are established based on the solution concentration. Temperature and liquid level alarms for the system annunciate in the control room. Pump operability is checked on a frequency to assure a high reliability of operation of the system should it ever be required.

Once the solution is prepared, boron concentration does not vary, unless more enriched sodium pentaborate or more water is added. Level indications and alarms indicate whether the solution volume has changed which might indicate a possible solution concentration change. The test interval has been established considering these factors.

Boron enrichment (B-10 atom percent) does not vary with the addition of enriched sodium pentaborate material or water to the SLC tank provided 34.7% enriched (B-10 atom percent) is added. Therefore, a check once per operating cycle is adequate to ensure proper enrichment.

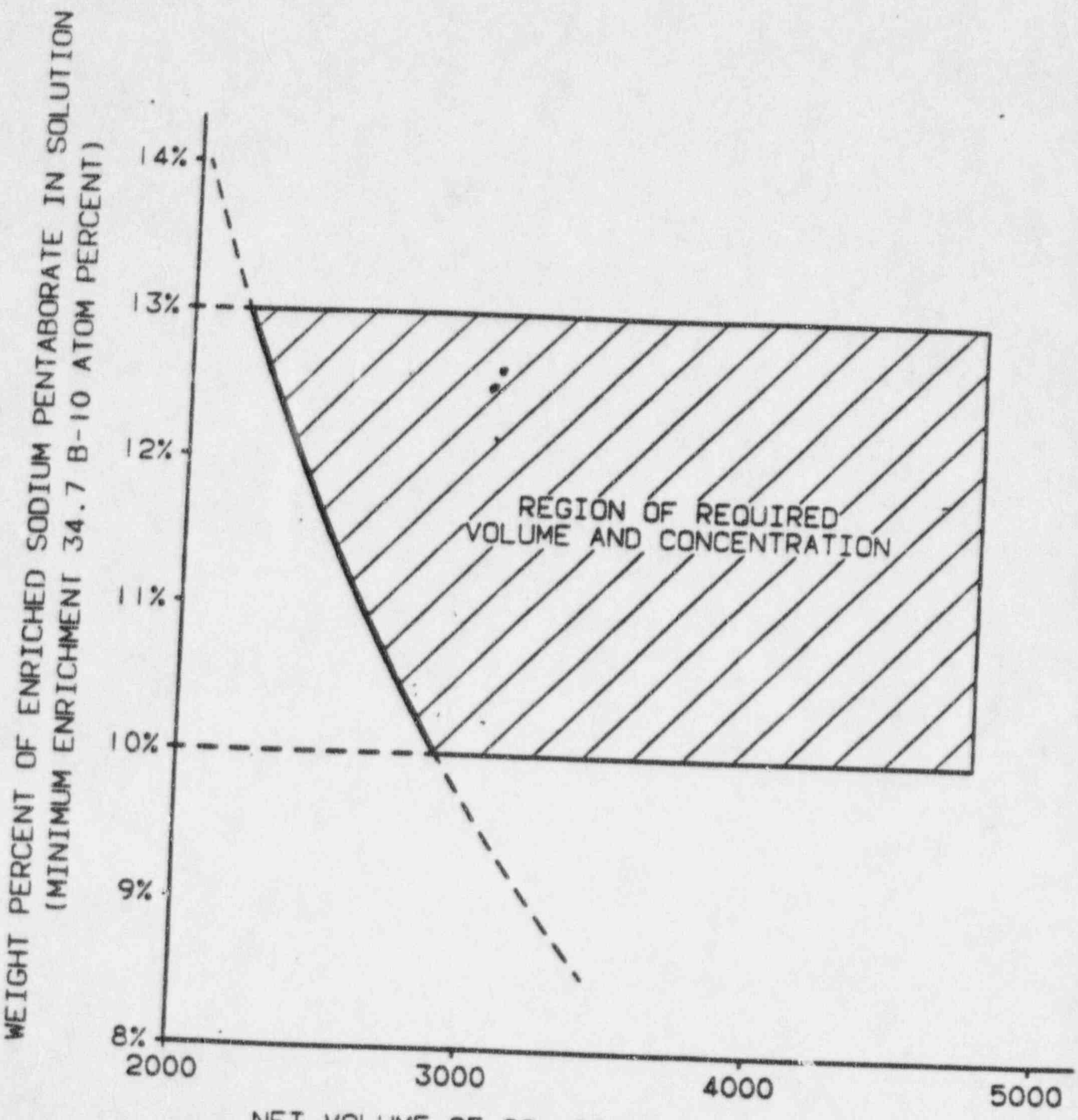
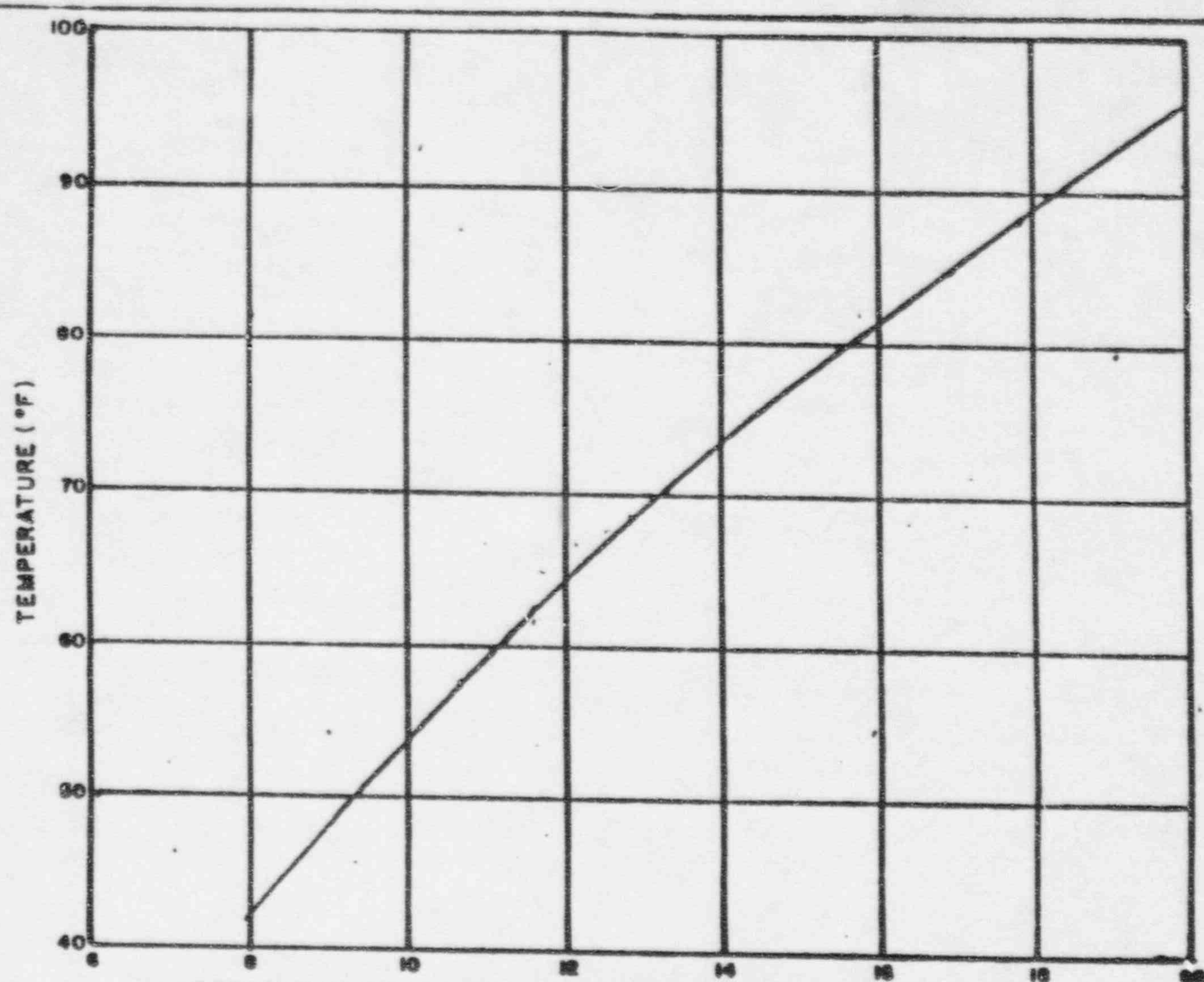


FIG.3.4-1
SODIUM PENTABORATE SOLUTION(MINIMUM 34.7 B-10 ATOM% ENRICHED)
VOLUME CONCENTRATION REQUIREMENTS.



PERCENT ENRICHED SODIUM PENTABORATE BY WEIGHT OF SOLUTION

FIG. 3.4-2

SATURATION TEMPERATURE OF ENRICHED SODIUM PENTABORATE SOLUTION
(INCLUDES 10°F MARGIN)