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0-CY-2310 Revision 24

REACTOR COOLANT SYSTEM SPECIFICATIONS AND FREQUENCIES

APPROVED BY:

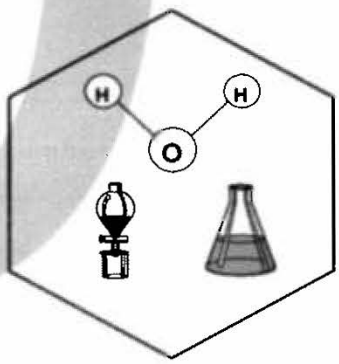
Jim Peters 7/8/14

Procedure Writer / Date

1/15/15

Procedure Owner / Date

Indian Point



Chemistry

PARTIAL REVISION

REVISION SUMMARY

1.0 REASON FOR REVISION

1.1 Revised to meet Rev. 7 of Primary Water Guidelines.

2.0 SUMMARY OF CHANGES

2.1 Revised RCS at-temperature pH to > 7.0 (2.1.5 and Attachment 7).

2.2 Updated Commitment Document 5.1.7 to Rev. 7.

2.3 Revised Attachment 2.

2.4 Attachment 4: Added RCS diagnostic parameters for ammonia and revised zinc parameters.

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Attachments

1.0 PURPOSE

1.1 This procedure establishes the requirements for the sampling, analysis and control of the Reactor Coolant System. It implements both the EPRI PWR Primary Water Chemistry Guidelines and the IPEC Primary Strategic Water Chemistry Plan.

1.2 This procedure applies to the Chemistry control of the Reactor Coolant and Residual Heat Removal Systems.

1.3 As part of license renewal, Entergy credited implementation of the EPRI Chemistry Guidelines as a method for mitigating age related degradation mechanisms for some primary system components. **{Refs 5.1.5 and 5.1.6}**

2.0 PRECAUTIONS AND LIMITATIONS

2.1 Precautions and Limitations

2.1.1 The frequency and specifications for tests other than those required by Technical Specifications or the SPDES permit are recommended by Chemistry Management. The frequency of these tests may be altered at the discretion of Chemistry Management. Analyses with associated NSSS vendor requirements shall be evaluated prior to being altered.

2.1.2 For parameters that do not have a defined frequency or specification Chemistry Management will assign a frequency as dictated by plant conditions or historical trend.

2.1.3 Initially, laboratory analytical results are interpreted by the Watch Chemist or by the Watch Nuclear Plant Operator during their tours. Abnormal trends in the chemistry data either obtained or observed are evaluated by the Chemistry Technician given the status of that system at that time. Any significant abnormality or trend, as well as, out of specification or out of control band chemistry parameter shall be brought to the attention of the Shift Manager, Control Room Supervisor, and Chemistry Management.

2.1.4 Refer to Reference 5.3.4 for Dose Equivalent Iodine (DEI) and Dose Equivalent Xenon (DEX) and associated required actions for radiochemical analyses of RCS.

2.1.5 Prior to entering Mode 1, RCS at-temperature pH shall be greater than 7.0.

2.1.6 Deleted.

2.1.7 Attachment 7, Reactor Coolant Boron/Lithium Specifications, provides the input parameters for calculating the lithium limits based on the boron concentration. These limits are implemented in the chemistry data management system and chemistry technician aids with hardcopy outputs are provided in the event the electronic system is down.

2.1.8 The critical procedures and sample points for monitoring the inhibition of steam generator degradation, as required by Plant Technical Specifications, are located in the Primary Strategic Water Chemistry Plan.

2.1.9 Data consistency checks may be performed using Chemworks Primary pH Calculator OR Smart Chemworks ensuring that the data set has been uploaded at the time of verification.

2.2 General Information

2.2.1 Plant Modes

MODE	TITLE	REACTIVITY	% POWER	T_{ave}
1	Power Ops	≥0.99	>5	NA
2	Startup	≥0.99	≤5	NA
3	Hot Standby	<0.99	NA	≥350
4	Hot Shutdown	<0.99	NA	350 > T_{ave} >200
5	Cold Shutdown	<0.99	NA	≤200
6	Refueling	NA	NA	NA

2.2.2 The Out-Of-Specification Action Guidelines presented in Attachments 5 and 6 are not all-inclusive. Other actions may be appropriate for evaluation in some cases.

2.2.3 Boron/Lithium program is based on a target pH of 7.10 calculated at each unit's Tave at 100% power with a minimum pH of 6.9 during plant startups.

2.2.4 T_{ave} at 0 and 100% power are as follows:

- Unit 2

  0% Power T_{ave} = 545°

  100% Power T_{ave} = 565°

- Unit 3

  0% Power T_{ave} = 550°

  100% Power T_{ave} = 570°

3.0 PREREQUISITES

NONE

4.0 PROCEDURE {Reference 5.1.5 & 5.1.6}

4.1 Reactor Coolant Chemistry Sampling and Analysis

4.1.1 Reactor Coolant chemistry shall be maintained within specifications in accordance with Attachment 2, RCS Control Parameter Specifications.

4.1.2 Reactor Coolant shall be sampled in accordance with Attachment 3, RCS Control Parameter Sampling & Analysis Frequency, and Attachment 4, RCS Diagnostic Parameter Sampling & Analysis Frequency.

4.2 Chemistry Parameters Out Of Specification

4.2.1 IF a parameter is out of specification, THEN PERFORM the following:

- INFORM the Control Room Supervisor (CRS).
- REFER TO Attachment 5, Primary Plant Action Levels, for required action.

4.2.2 IF ANY chemistry parameter listed in this procedure can NOT be maintained within chemistry specifications, THEN INITIATE corrective action as soon as possible per Attachment 6, Primary Plant Corrective Actions.

4.2.3 Per reference 5.1.5 & 5.1.6, RCS Chemistry is required to be returned to within specification in the time specified in reference 5.1.7.

5.0 REFERENCES

5.1 Commitment Documents

5.1.1 Technical Specifications

5.1.2 Technical Requirements Manual

5.1.3 Westinghouse Primary Chemistry Criteria and Specifications WCAP (5-1)

5.1.4 CR-IP3-2005-05471 concerning Crud-Induced Power Shift (CIPS)

5.1.5 IPEC license renewal implementation document NL-07-039, LRS A-3239 for unit 2. LRA Sections A.2.1.40 and B.1.41. (LO-LAR-2011-0174, CA 22).

5.1.6 IPEC license renewal implementation document NL-07-039, LRA Section B.1.31. (LO-LAR-2011-0174, CA 40)

5.1.7 *Pressurized Water Reactor Primary Water Chemistry Guidelines: Volume 1 & 2, Revision 7*. EPRI, Palo Alto, CA: 2014.

5.1.8 Interim Guidance Regarding PWR Primary Water Chemistry Guidelines – Volume 1, Revision 7. EPRI, Palo Alto, CA: 20014. 1014986. EPRI SGMP IG-09-01, April 2, 2009

5.2 Development Documents

5.2.1 NEI 97-06, Primary-Side Water Chemistry, December 1997

5.2.2 IPEC Strategic Primary Water Chemistry Plan

5.2.3 EN-NF-102, Corporate Fuel Reliability

5.2.4 EPRI 1015448, Fuel Reliability Guidelines: PWR Cladding Corrosion and Crud, March 2008

5.2.5 MTLS-06-131 rev. 4,Westinghouse supplement to the EPRI PWR Primary Water Guidelines Revision 6

5.2.6 *Westinghouse PWR Zinc Addition Guidelines,* PE-07-42, Rev. 12, March April 2012

5.2.7 *Pressurized Water Reactor Primary Water Chemistry Guidelines: Volume 1, Revision 7.* EPRI, Palo Alto, CA: 20014.

5.2.8 Westinghouse Letter to Entergy, NF-ECH-12-34 dated May 9, 2012, Entergy *ANO-2, Indian Point Unit 2, Indian Point Unit 3 and WESE-3 Westinghouse Position on EPRI PWR Primary Water Chemistry Guidelines Revised Guidance with Regard to Dissolved Hydrogen Concentration.*

5.2.9 EC 44828, "Option to Remove Secondary Sources from Core Design".

5.3 Interface Documents

5.3.1 Technical Specifications

5.3.2 Technical Requirements Manual

5.3.3 *Pressurized Water Reactor Primary Water Chemistry Guidelines: Volume 1, Revision 7.* EPRI, Palo Alto, CA: 2014.

5.3.4 0-CY-2765, Coolant Activity Limits – Dose Equivalent Iodine/Xenon

6.0 RECORDS AND DOCUMENTATION

NONE

ATTACHMENT 1 **Page 1 of 1**

Attachment deleted

ATTACHMENT 2 **Page 1 of 1**

RCS CONTROL PARAMETER SPECIFICATIONS

Refer to Attachment 6 for guidance while trying to maintain in specification

PARAMETER	RCS TEMPERATURE ≤ 250°F (MODES 4, 5 & 6)	HOLD POINT PRIOR TO EXCEEDING 250°F (MODE 4)	REACTOR SUBCRITICAL & RCS > 250°F (MODES 3 and 4)	HOLD POINT PRIOR TO CRITICALITY (MODE 3)	POWER OPERATION or STARTUP (MODES 1 and 2)	AL1	AL2	AL3
Boron, ppm	As required for reactivity control	As required for reactivity control	As required for reactivity control	As required for reactivity control	As required for reactivity control	None	None	None
Chloride, ppb	≤ 150	<150 (1)	<150	<150	≤ 15	>15	>150	>1500[5]
Fluoride, ppb	≤ 150	<150 (1)	<150	<150	≤ 15	>15	>150	>1500[5]
Sulfate, ppb	None	<150 (1)	<150	<150	≤ 15	>15	>150	>1500[5]
Dissolved Oxygen (DO), ppb	None	<100	<100	<100	≤ 5	>5	>100	>1000[5]
Pressurizer DO, ppb	None	<100	None	None	None	None	None	None
Hydrogen, cc (STP)/kg H_2O	None	None	None	> 15	≥ 30 AND ≤ 50(4)	<30 OR >50	<15	<5
Lithium, ppm	None	None	None	None	Variable - Based on Boron Concentration (Refer to Attachments 7)	Outside Control Band	None	None
Silica ppm (2)	None	None	None	None	< 3	None	None	None
@ Temp pH (3)	None	None	None	None	≥ 7.0	< 7.0	None	None

(1) Pressurizer liquid sample must also meet these values prior to exceeding 250°.
(2) Westinghouse guideline specification, IF specification is not met THEN a fuels examination may be required.
(3) Calculated from RCS Boron, Lithium, Ammonia and RCS Tave at the time of sample.
(4) RCS dissolved hydrogen should be maintained ≤40 cc/kg on a cycle average basis as recommended by Westinghouse fuels. [Ref 5.2.8]
(5) If during startup AL3 levels exceeded immediately reduce temperature to <250°F

ATTACHMENT 3 **Page 1 of 1**

RCS CONTROL PARAMETER SAMPLING & ANALYSIS FREQUENCY

PARAMETER	RCS TEMPERATURE ≤ 250°F (MODES 4 and 5, 6)	REACTOR SUBCRITICAL & RCS > 250°F (MODES 3 and 4)	POWER OPERATION/STARTUP (MODES 1 and 2)
Boron, ppm	8 hours[1]	Daily	Daily
Chloride, ppb	3/7 days [2] AND 3 days max	Three / Week	Three / Week
Fluoride, ppb	1/7 days [2] AND 10 days max	Three / Week	Three / Week
Sulfate, ppb	1/7 days [2]	Three / Week	Three / Week [4]
Dissolved Oxygen (DO), ppb	3/7 days AND 3 days max	Daily	Three / Week
Pressurizer DO, ppb	Daily [3]	Not Required	Not Required
Hydrogen, cc (STP)/kg H_2O	Not Required	Three / Week	Three / Week [5]
Lithium, ppm	Not Required	Not Required	Daily [6]
Silica, ppm	1/7 days[7]	1/7 days[7]	1/7 days[7]

(1) Boron frequency is based on the following criteria:

a. Every 8 hours when in Mode 5 or 6 at Unit 2 based on EC44828, "Option to remove Secondary Source from Core Design".

b. Daily at Unit 3

c. WHEN the RCS/RHR, the Reactor Cavity, AND Refueling Canal are connected, THEN:

- AT UNIT 2, sample the Reactor Cavity AND the Refueling Canal once per 72 hours
- AT UNIT 3, sample the Reactor Cavity once per 72 hours

(2) Frequency should be increased during activities, such as refueling, when the likelihood of contamination is increased.

(3) Initiated during heatup. Pressurizer sampling is terminated when DO < 100 ppb.

(4) Frequency should be increased if evidence of resin ingress is noted (e.g., increasing sulfate concentrations).

(5) Frequency of sampling should be increased during operations that may significantly impact hydrogen concentration (e.g., feed and bleed, purging of pressurizer vapor space) or known periods of hydrogen instability.

(6) Frequency should be increased during operations that may significantly impact lithium concentration (e.g., feed and bleed).

(7) Initiated during heatup. At Unit 2 ONLY, sample daily from RCS >200°F until limit is achieved

RCS DIAGNOSTIC PARAMETERS

RCS DIAGNOSTIC PARAMETERS DURING STARTUP

PARAMETER	Frequency	REACTOR SUBCRITICAL & RCS > 250°F (MODES 3 and 4)
Lithium, ppm as Li	1/8 Hours	(a)
Ammonia	Daily	Variable
Silica	Daily	Variable
Aluminum, ppb	Once prior to securing RHR (<250°F) and once prior to criticality, ~300°F following RFOs	≤ 80
Calcium + Magnesium, ppb		≤ 80
Magnesium, ppb		≤ 40

NOTE (a): <1 ppm while on RHR and ≥ 2 ppm when >350°F.

RCS DIAGNOSTIC PARAMETERS

Power Operation

RADIOCHEMICAL DIAGNOSTIC PARAMETERS

PARAMETER	REQUIRED FREQUENCY	NORMAL FREQUENCY
Gamma Isotopic with Simplified Dose Equivalent Iodine	N/A	4 / Week
Dose Equivalent Iodine (DEI)	1 / 14 Days (1)	1/7 Days
Dose Equivalent Xenon (DEX)	1/7 days (1)	1/7 Days
Decayed Isotopic	N/A	24 hr decay (I-131) Others 1/7 Days (2)
Dissolved Radiogas	N/A	1/7 Days
Decayed Suspended Solids	N/A	1/7 Days
Tritium	1/7 days (3)	1/7 Days
Total RCS Activity Summary	N/A	1/7 Days (NuclearIQ)

(1) Tech Spec 3.4.16 and Reference 5.3.4
(2) Various RCS decay counts may be prescribed by Chemistry Management
(3) Required by UFSAR

CHEMICAL DIAGNOSTIC PARAMETERS

PARAMETER	FREQUENCY
Conductivity	Daily (4)
Total Suspended Solids	1/7 Days (4)
Silica	1/7 Days (4) (5)
Boron-10	Every 60 Days, Following Trips, and Prior to Startup from Refueling
Iron	1/31 Days (6) (7)
Nickel	1/31 Days (6) (7)
Ammonia	1/31 Days

(4) EPRI Guidelines
(5) Weekly until < 1ppm, then monthly.
(6) Frequency increases to weekly 3 months prior to start of refueling outage.
(7) Required per Reference 5.1.4.

RCS DIAGNOSTIC PARAMETERS

RCS Sampling Prior To Initiating Zinc Addition

Parameter	Frequency	Expected Value [1]
Total Nickel	1/7 Days	< 2 ppb, first zinc cycle ≤ 6 ppb, subsequent zinc cycles
Silica	1/7 Days	≤ 2 ppm

RCS Sampling During Zinc Addition

Parameter	Frequency [2]	Target Control Range	Action Level
Zinc	1/day until target reached and stable then weekly	10 to 20 ppb	< 10 ppb [3] or >20 ppb [3]
Total Nickel	1/7 Days	≤ 6 ppb	> 6 ppb [4]
Silica	1/7 Days	≤ 2 ppm	> 2 ppm [5]

(1) Average of 2 consecutive samples, taken at least two days apart.
(2) Increased sample frequency to daily during at-power plant or zinc transients. Westinghouse should be notified if zinc samples averaged over 2 days exceed 80 ppb.
(3) The zinc injection rate (grams/hr) should be adjusted to restore zinc within target control range. If zinc samples averaged over 2 days exceed 80 ppb, contact Westinghouse for re-evaluation and to define any additional actions.
(4) If average of 2 successive samples results in >6 ppb nickel, evaluate for possible CIPS by evaluating flux map. Contact the fuel vendor to determine if additional actions are required.
(5) If average of monthly samples results in >2 ppm silica, suspend zinc addition and contact the fuel vendor to determine if additional actions are required.

RCS / RHR Following Fill & Vent to Reactor Critical

Parameter	Frequency
Corrosion Products [6]	Daily
Mixed Bed DF [7]	Daily
Hydrazine, ppb	As required
Ammonia, ppb	1 per 3 days

(6) Analyze for elemental Fe and Ni from ≥150°F until 500°F. Sample may be drawn on a predetermined schedule and preserved for analysis at a later time. Analyze for isotopic Co-58, Co-60, Mn-54 and Cr-51.
(7) Sample mixed bed effluent chloride and sulfate. Calculate DF from daily RCS/RHR sample.

ATTACHMENT 5 **Page 1 of 1**

PRIMARY PLANT ACTION LEVELS

Action Level 1

a) Efforts should be made to bring the parameter within the appropriate limit within seven days.

b) If the parameter has not been restored to below the Action Level 1 value within seven days, a technical review shall be performed and a program for implementing corrective measures instituted. Such a program may require equipment additions or modifications over the long term.

Action Level 2

a) Efforts should be made to bring the parameter within the appropriate Action Level 2 value within 24 hours.

NOTE

IF the chemistry is improved to within the requirements of Action Level 2 prior to plant shutdown, THEN full power operation may be resumed.

b) If the parameter has not been restored to below the Action Level 2 value within 24 hours, an orderly shutdown shall be initiated and the plant shall be brought to a coolant temperature < 250°F (121°C) as quickly as permitted by other plant constraints.

c) Following a unit shutdown caused by exceeding the time limit on an Action Level 2 value, a technical review of the incident should be performed and appropriate corrective measures taken before the unit is restarted.

Action Level 3

a) Rapid shutdown shall be initiated with the unit in Mode 3 within 2 hours, then cool RCS to less than 250°F as rapidly as plant conditions permit.

b) Following a unit shutdown caused by entering an Action Level 3 condition, a formal technical review of the incident shall be performed and appropriate corrective measures taken before the unit is restarted.

PRIMARY PLANT
CORRECTIVE ACTIONS

REACTOR COOLANT SYSTEM	
Parameter Out of Range	Corrective Actions
Chloride/Fluoride	1. CHECK ion exchange beds in purification system for flow and removal efficiencies. 2. IF indicated, THEN request Operations place the standby mixed bed Demineralizer in service. 3. Request Operations to INCREASE letdown and charging flow. 4. CHECK for high RCS ammonia or conductivity that may cause chloride or fluoride release from resin. 5. CHECK makeup water purity. 6. ISOLATE makeup water source or change to alternate source if required. 7. SEEK other potential sources of fluoride.
Sulfate	1. CHECK for indications of resin released from the purification system. 2. CHECK ion exchanger removal efficiency and isolate if necessary. 3. CHECK makeup water purity.
Lithium	1. CHECK to ensure reactor coolant dilution OR boration is NOT in progress. 2. ENSURE that a lithiated mixed bed is in service. 3. VERIFY flow through cation OR other purification ion exchangers. 4. ADJUST lithium as required to bring within station control program.

PRIMARY PLANT CORRECTIVE ACTIONS

REACTOR COOLANT SYSTEM	
Parameter Out of Range	Corrective Actions
Hydrogen	1. IF RCS hydrogen is low THEN INCREASE hydrogen pressure in the VCT AND/OR INCREASE hydrogen purity in the VCT. INCREASE sample frequency to assess adequacy of actions. 2. Ensure letdown flow rate is sufficient to increase hydrogen concentration in the RCS. 120 gpm is recommended especially during large manual dilutions. 3. CHECK for indications of leaking valves or check for air ingress to the charging system. 4. IF RCS hydrogen is high, THEN DECREASE hydrogen pressure in the VCT. CONSIDER venting pressurizer gas space via sample line. INCREASE sample frequency to assess adequacy of actions.
Dissolved Oxygen	1. VERIFY hydrogen concentration. 2. CHECK for air leaks into CVCS. 3. IF hydrogen regulator to VCT is in service, THEN request Operations to INCREASE VCT hydrogen pressure. 4. IF nitrogen regulator to the VCT is in service, AND RCS temperature is less than 180°F, THEN consider hydrazine addition to reduce oxygen concentration.

(1) Following startup or power changes restore lithium to specifications by xenon equilibration.

ATTACHMENT 7 **Page 1 of 1**

REACTOR COOLANT BORON / LITHIUM SPECIFICATIONS

NOTE

Prior to 100% power and xenon equalization, Chemistry Management will calculate the lithium necessary to maintain at least a 7.0 at-temperature pH.

During full power operations the reactor coolant system (RCS) $pH_{(t)}$ will be coordinated at a target value of 7.10 pH units with a maximum target lithium value of 3.5 ppm. The RCS $pH_{(t)}$ will be calculated using the RCS average temperature for each unit and the methodology specified by EPRI SGMP interim guidance [Ref 5.1.8]. This can be satisfied using the pH calculator in EPRI's Chemworks Tools version 3.3 or later. Chemistry Technician Aids for each unit are available in the event that computerized limits are not available. During plant startups, the RCS $pH_{(t)}$ will be maintained greater than 6.9 units and lithium will not exceed 5 ppm.

The lithium limits will be established consistent with the EPRI guidelines as follows: For [Li] > 3.0 ppm, maintain lithium at the target value within ± 5% of lithium concentration until lithium reaches 3.0 ppm, and then at ± 0.15 ppm until [Li] decreases to 1.25 ppm. For [Li] < 1.25 ppm until the end of the operating cycle, maintain lithium at the target value within ± 12% of lithium concentration.

The lithium administrative control band will be established as follows: For [Li] > 3.0 ppm, maintain lithium at the target value within ± 3.33% of lithium concentration until lithium reaches 3.0 ppm, and then at ± 0.10 ppm until [Li] decreases to 1.25 ppm. For [Li] < 1.25 ppm until the end of the operating cycle, maintain lithium at the target value within ± 8% of lithium concentration.