

NRC REGION III
INITIAL LICENSE EXAM
JOB PERFORMANCE MEASURE

JPM: RO ADMIN 1B

TITLE: PERFORM A PCS LEAK RATE

CANDIDATE: _____

EXAMINER: _____

JOB PERFORMANCE MEASURE
DATA PAGE

Task: Perform Primary Coolant System Leak Rate Calculation (DWO-1)

Alternate Path: N/A

Facility JPM #: NEW

K/A: 2.1.25 Importance: RO: 3.9

K/A Statement: Ability to interpret reference materials, such as graphs, curves, tables, etc.

Task Standard: Correctly calculate Primary System Leakage Calculation using DWO-1, Attachment 8, PCS Inventory Form

Preferred Evaluation Location: ANY

Preferred Evaluation Method: Perform Simulate

References: DWO-1, OPERATOR'S DAILY/WEEKLY ITEMS MODES 1, 2, 3, AND 4

Validation Time: 30 minutes Time Critical: NO

Candidate: _____

Time Start: _____ Time Finish: _____

Performance Time: _____ minutes

Performance Rating: SAT _____ UNSAT _____

Comments:

Examiner: _____
Signature

Date: _____

EXAMINER COPY ONLY

Tools/Equipment/Procedures Needed:

- DWO-1, attachment 8, PCS Inventory Form completed for TIME 1
- DWO-1, section 5.1, Primary System Leakage Calculation
- DWO-1, attachment 13, Subcooled Specific Volumes
- PPC trend plot 104 (PCS Leak Indicators)

Also see **Simulator Operator Instructions** (last page of this document).

READ TO CANDIDATE

DIRECTION TO CANDIDATE:

I will explain the initial conditions, and state the task to be performed. All control room steps shall be performed for this JPM, including any required communications. I will provide initiating cues and reports on other actions when directed by you. Ensure you indicate to me when you understand your assigned task. To indicate that you have completed your assigned task return the handout sheet I provided you.

INITIAL CONDITIONS:

- A DWO-1, PCS Leak Rate (Technical Specification Required), was started 3 hours ago (TIME 1 = 0)
- DWO-1, Attachment 8, PCS Inventory Form, is complete through Step 5.1.6.k. for TIME 1
- A 25 gallon PMW addition was made to the PCS during this leak rate
- No Boric Acid Additions were made
- Zinc addition is 2.36 liters/day (from the Shift Manager's log)
- Charging Pump Seal leakage (total) is 15 ml/min
- CRDM Seal leakage is 10ml/min
- No known leakage sources outside the PCPB
- No known leakage sources inside the PCPB

INITIATING CUES:

The CRS directs you to complete the PCS Leak Rate, DWO-1, Attachment 8, PCS Inventory Form.

Proc. Step	TASK ELEMENT 1	STANDARD	Grade
n/a	Obtain DWO-1, Attachment 8, PCS Inventory Form	Operator obtains Working Copy of DWO-1, Attachment 8	S U
Comment: Notes: <i>Evaluator provides candidate with the PCS Inventory Form (Attachment 8) Working Copy with the TIME 1 data entered, DWO-1, section 5.1.6 through 5.1.9, and a copy of PPC trend plot 104 (PCS Leak Indicators).</i>			

Proc. Step	TASK ELEMENT 2	STANDARD	Grade
5.1.6.I	<u>WHEN</u> at the end of test period, <u>THEN REPEAT</u> data taking in accordance with Steps 5.1.6.a through 5.1.6.k	Operator locates Step 5.1.6.a to start data entry on Att. 8	S U
Comment:			

Proc. Step	TASK ELEMENT 3	STANDARD	Grade
5.1.6.a	RECORD time of data recording on Att. 8, Step 1.a	<ul style="list-style-type: none"> ▪ + 3 hours entered in Att. 8, Step 1.a, TIME 2 ▪ 180 entered in Att. 8, Step 1.a, DELTA TIME 	S U
Comment: Notes: <i>If operator wants to know the time that should be entered or current time, plus (+) 3 hours.</i>			

Proc. Step	TASK ELEMENT 4	STANDARD	Grade
5.1.6.b.1	OBTAIN Pressurizer level (L_{PZR})... AND RECORD on Att. 8, Step 1.b: 1. PPC Point LPRZC (record to the nearest 0.01%)	<u>56.44</u> entered in Att. 8, Step 1.b	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 5	STANDARD	Grade
5.1.6.c.1	OBTAIN Pressurizer pressure (P_{PZR}) AND RECORD on Att. 8, Step 1.c: 1. PPC Point PRZBE (record to the nearest 1 psia)	<u>2061</u> entered in Att. 8, Step 1.c	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 6	STANDARD	Grade
5.1.6.d.1	OBTAIN Volume Control Tank level (L_{VCT}) from... AND RECORD on Att. 8, Step 1.d: 1. PPC Point LTC0205 (record to the nearest 0.01%)	<u>70.68</u> entered in Att. 8, Step 1.d	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 7	STANDARD	Grade
5.1.6.e.1	OBTAIN PCS average coolant temperature (T_{AVE}) from.... AND RECORD to the nearest 0.01°) on Att. 8, Step 1.e: 1. PPC Point TAVG	<u>559.79</u> entered in Att. 8, Step 1.e	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 8	STANDARD	Grade
5.1.6.f	IF MODE 1, 2 or 3 AND Pressure is between 2055 and 2065 psia (inclusive), THEN RECORD 0.18201 ft ³ for Pressurizer Vapor Space specific volume on Att. 8, Step 1.f	<u>0.18021</u> entered in Att. 8, Step 1.f	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 9	STANDARD	Grade
5.1.6.g	IF MODE 1, 2 or 3 AND Pressure is between 2055 and 2065 psia (inclusive), THEN RECORD 0.02595 ft ³ /lbm for Pressurizer Liquid Space specific volume on Att. 8, Step 1.g	<u>0.02595</u> entered in Att. 8, Step 1.g	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 10	STANDARD	Grade
5.1.6.h	RECORD 0.01616 ft ³ /lbm for Volume Control Tank specific volume on Attachment 8, Step 1.h.	<u>01616</u> entered in Att. 8, Step 1.h	S U
<p>Comment: NOTE: This step has been completed previously</p>			

Proc. Step	TASK ELEMENT 11	STANDARD	Grade
5.1.6.i	DETERMINE Primary Coolant System specific volume from Attachment 13, "Subcooled Specific Volume," AND RECORD on Att. 8, Step 1.i	<u>0.021706</u> entered in Att. 8, Step 1.i	S U
<p>Comment: CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 12	STANDARD	Grade
5.1.6.j	<p>CALCULATE Pressurizer Vapor Space Volume (V_{GPZR}) to the nearest 0.1 ft³ AND RECORD on Att.8, Step 1.j</p> $V_{GPZR} = (94.3\% - L_{PZR}) (14.370 \text{ ft}^3/\%) + 182.20 \text{ ft}^3$	<u>726.2</u> entered in Att. 8, Step 1.j	S U
<p>Comment: CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 13	STANDARD	Grade
5.1.6.k	CALCULATE Pressurizer Liquid Space Volume (V_{FPZR}) to the nearest 0.1 ft ³ AND RECORD on Att.8, Step 1.k $V_{FPZR} = 1547 - V_{GPZR}$	<u>820.8</u> entered in Att. 8, Step 1.k	S U
<p>Comment:</p> <p>CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 14	STANDARD	Grade
5.1.6.m	<p><u>IF</u> Primary Makeup Water was added during performance of the test <u>THEN</u>:</p> <ol style="list-style-type: none"> 1. DETERMINE the total ... AND RECORDon Att. 8, Step 1.m.1 2. CALCULATE mass added AND RECORD on Att. 8, Step 1.m.3 	<p><u>25.0</u> entered in Att. 8, Step 1.m.1</p> <p><u>208.2</u> entered in Att. 8, Step 1.m.3</p>	S U
<p>Comment:</p> <p>CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 15	STANDARD	Grade
5.1.6.n	<u>IF</u> Boric Acid was added during performance of the test <u>THEN</u> :	<p><u>0</u> entered in Att. 8, Step 1.n.1</p> <p><u>0</u> entered in Att. 8, Step 1.n.3</p>	S U
<p>Comment:</p> <p>Note: No Boric Acid Added</p>			

Proc. Step	TASK ELEMENT 16	STANDARD	Grade
5.1.6.o	<p><u>IF</u> the Zinc Addition was in service during the performance of the test, <u>THEN</u>:</p> <p>2. <u>IF</u> Zinc addition rate is less than or equal to 4 liters/day, <u>THEN</u> ENTER 0.0 on Att. 8, Step 1.o.4 AND GO TO Step 5.1.6.p</p>	<u>0</u> entered in Att. 8, Step 1.o.4	S U
<p>Comment: Note: 2.36 liters/day given in Initial Conditions from Shift Manager's Log</p>			

Proc. Step	TASK ELEMENT 17	STANDARD	Grade
5.1.6.p	<p>CALCULATE Total Mass added <u>AND</u> RECORD on Att. 8, Step 1.p Total Mass added = 1.m.3 + 1.n.3 + 1.o.4</p>	<u>208.2</u> entered in Att. 8, Step 1.p	S U
<p>Comment: CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 18	STANDARD	Grade
5.1.6.q	<p>CALCULATE Total Uncorrected Leakage <u>AND RECORD</u> to the nearest 0.001 gpm per Att. 8, Step 1.q</p>	<u>.031</u> entered in Att. 8, Step 1.q	S U
<p>Comment: CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 19	STANDARD	Grade
5.1.7.a	RECORD Charging Pump seal leakage in ml/min on Att. 8, Step 2.a	<u> 15 </u> entered in Att. 8, Step 2.a	S U
Comment: Note: 15 ml/min Charging Pump seal leakage given in Initial Conditions CRITICAL STEP			

Proc. Step	TASK ELEMENT 20	STANDARD	Grade
5.1.7.b	CONVERT Charging Pump seal leakage to gpm AND RECORD to the nearest 0.001 gpm per Att. 8, Step 2.a	<u> 0.004 </u> entered in Att. 8, Step 2.a	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 21	STANDARD	Grade
5.1.7.c	IF any primary coolant leakage sources outside of Primary Coolant Pressure Boundary	<u> 0 </u> entered in Att. 8, Step 2.b	S U
Comment: Note: No other leakage sources outside the PCPB given in Initial Conditions.			

Proc. Step	TASK ELEMENT 22	STANDARD	Grade
5.1.7.d	CONVERT primary coolant leakage sources outside of the Primary Coolant Pressure Boundary ...	<u> 0 </u> entered in Att. 8, Step 2.b	S U
Comment:			

Proc. Step	TASK ELEMENT 23	STANDARD	Grade
5.1.7.e	CALCULATE leakage which affects PCS leakrate calculations and is outside of the Primary Coolant Pressure Boundary AND RECORD to the nearest 0.001 gpm per Att. 8, Step 2.d	<u>.004</u> entered in Att. 8, Step 2.c	S U
<p>Comment:</p> <p>CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 24	STANDARD	Grade
5.1.7.f	CALCULATE Corrected PCS Leakage AND RECORD to the nearest 0.001 gpm per Att.8, Step 2.d (Att. 8, Step 1.q – Att. 8, Step 2.c)	<u>0.027</u> entered in Att. 8, Step 2.d	S U
<p>Comment:</p> <p>CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 25	STANDARD	Grade
5.1.8.a	RECORD the most recent CRDM seal leakage	<u>10</u> entered in Att. 8, Step 3.a	S U
<p>Comment:</p> <p>Note: 10 ml/min CRDM Seal Leakage given in Initial Conditions</p> <p>CRITICAL STEP</p>			

Proc. Step	TASK ELEMENT 26	STANDARD	Grade
5.1.8.b	COVERT CRDM seal leakage to gpm AND RECORD to the nearest 0.001 gpm per Att. 8, Step 3.a	<u>.003</u> entered in Att. 8, Step 3.a	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 27	STANDARD	Grade
5.1.8.c	IF any primary coolant leakage sources inside the Primary Coolant Pressure Boundary	<u>0</u> entered in Att. 8, Step 3.b	S U
Comment: Note: No known leakage sources inside the PCPB given in Initial Conditions.			

Proc. Step	TASK ELEMENT 28	STANDARD	Grade
5.1.8.d	CONVERT primary coolant leakage sources inside of the Primary Coolant Pressure Boundary	<u>0</u> entered in Att. 8, Step 3.b	S U
Comment:			

Proc. Step	TASK ELEMENT 29	STANDARD	Grade
5.1.8.e	CALCULATE Identified PCS Leakage AND RECORD to the nearest 0.001 gpm per Att. 8, Step 3.c (Att. 8, Step 3.a + Att. 8, Step 3.b)	<u>0.003</u> entered in Att. 8, Step 3.c	S U
Comment: CRITICAL STEP			

Proc. Step	TASK ELEMENT 30	STANDARD	Grade
5.1.9.a	CALCULATE Unidentified PCS Leakage AND RECORD to the nearest 0.011 gpm per Att. 8, Step 4.a (Att. 8, Step 2.d – Att. 8, Step 3.c)	<u>0.024 (0.020 - 0.028)</u> entered in Att. 8, Step 4.a	S U
Comment: EVALUATOR QUE: At the completion of Attachment 8, inform the operator that all logging requirements will be completed once Attachment 8 has been reviewed by an SRO. CRITICAL STEP			

END OF TASK

CANDIDATE CUE SHEET

(TO BE RETURNED TO EXAMINER TO UPON COMPLETION OF TASK)

INITIAL CONDITIONS:

- A DWO-1, PCS Leak Rate, was started 3 hours ago (Technical Specification Required)
- DWO-1, Attachment 8, PCS Inventory Form, is complete through Step 5.1.6.k. for TIME 1
- A 25 gallon PMW addition was made to the PCS
- No Boric Acid Additions were made
- Zinc addition is 2.36 liters/day (from the Shift Manager's log)
- Charging Pump Seal leakage (total) is 15 ml/min
- CRDM Seal leakage is 10ml/min
- No known leakage sources outside the PCPB
- No known leakage sources inside the PCPB

INITIATING CUES:

The CRS directs you to complete the PCS Leak Rate, DWO-1, Attachment 8, PCS Inventory Form.

SIMULATOR OPERATOR INSTRUCTIONS

- NONE

PCS INVENTORY FORM

Date: Today

TECHNICAL SPECIFICATION REQUIRED
INFORMATION ONLY



1. TOTAL UNCORRECTED LEAKAGE CALCULATION
(Section 5.1.6)

	PARAMETER	TIME 1	TIME 2	DELTA TIME
a.	Leakrate Duration	-0000	+0300	= min
b.	Pressurizer Level (L_{PRZ}) PPC PT LPRZC, LT_0101A_D, LIC-0101A or LIC-0101B	56.45%	56.44%	
c.	Pressurizer Pressure (P_{PRZ}) PPC PT PRZBE, PR-0101A/B	2061 psia	2061 psia	
d.	Volume Control Tank Level (L_{VCT}) PPC Point LTC0205 or LIC-0205	70.10%	70.68%	
e.	PCS Avg Coolant Temperature (T_{AVE}) PPC PT TAVG, TYT_0100, TYT_0200A or Reactor Reg #___	559.79°F	559.79°F	
f.	Pressurizer Vapor Space Specific Volume $V_{g_{PZR}} @ P_{PRZ}$	0.18021 ft ³ /lb _m	0.18021 ft ³ /lb _m	
g.	Pressurizer Liquid Space Specific Volume $V_{f_{PZR}} @ P_{PRZ}$	0.02595 ft ³ /lb _m	0.02595 ft ³ /lb _m	
h.	Volume Control Tank Specific Volume $V_{f_{VCT}}$	0.01616 ft ³ /lb _m	0.01616 ft ³ /lb _m	
i.	Primary Coolant System Specific Volume $V_{f_{PCS}} @ P_{PRZ} \& T_{AVE}$	0.021706 ft ³ /lb _m	0.021706 ft ³ /lb _m	
j.	Pressurizer Vapor Space Volume (V_{GPZR}) $V_{GPZR} = (94.3\% - L_{PRZ}) (14.370 \text{ ft}^3/\%) + 182.20 \text{ ft}^3$	726.1 ft ³	726.2 ft ³	
k.	Pressurizer Liquid Space Volume (V_{FPZR}) $V_{FPZR} = 1547 \text{ ft}^3 - V_{GPZR}$	820.9 ft ³	820.8 ft ³	
l.	Repeat data at the end of the time period			

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PCS INVENTORY FORM

m. Primary Makeup Water Addition

1.	Volume (FIC-0210A)	25 gal
2.	Specific Volume of water at room temperature	0.01605 ft ³ /lb _m
3.	Mass added = volume (gal) x 0.13368 ft ³ /gal ÷ 0.01605 ft ³ /lb _m	208.2 lb _m

n. Boric Acid Solution Addition

1.	Volume (FIC-0210B)	0 gal
2.	Specific Volume of water at 160°F	0.01639 ft ³ /lb _m
3.	Mass added = volume (gal) x 0.13368 ft ³ /gal ÷ 0.01639 ft ³ /lb _m	0 lb _m

o. Zinc Addition

1.	Zinc Injection Rate: (<u>2.36</u> liters/day x 0.000183) [conversion units are gal day/liter min]	0 gpm
2.	Leak rate duration from 1.a	180 min
3.	Specific Volume of water at room temperature	0.01605 ft ³ /lb _m
4.	Mass added = injection rate (gpm) x leakrate duration (min) x 0.13368 ft ³ /gal ÷ 0.01605 ft ³ /lb _m	0 lb _m

p. Total Mass added = 1.m.3 + 1.n.3 + 1.o.4 208.2 lb_m

q. Total Uncorrected Leakage Calculation 0.031 gpm

$$\left(\frac{\text{Total}_{PCS} \text{ Leak}_{Rate}}{\text{Time}} \right) = \frac{0.1201}{\left[\left(-9136.8 \left(\frac{1}{Vf_{PCS\ 2}} - \frac{1}{Vf_{PCS\ 1}} \right) \right) - \left[\left(\frac{V_{GPZR\ 2}}{Vg_{PZR\ 2}} + \frac{V_{FPZR\ 2}}{Vf_{PZR\ 2}} \right) - \left(\frac{V_{GPZR\ 1}}{Vg_{PZR\ 1}} + \frac{V_{FPZR\ 1}}{Vf_{PZR\ 1}} \right) \right] - 4.588 \left(\frac{L_{VCT\ 2}}{Vf_{VCT}} - \frac{L_{VCT\ 1}}{Vf_{VCT}} \right)} + \text{Total Mass Added} \right]}$$

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PCS INVENTORY FORM

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PCS INVENTORY FORM

$$\left(\begin{array}{l} Total_PCS \\ Leak_Rate \end{array} \right) = \frac{0.1201}{a} \left[\left(-9136.8 \left(\frac{1}{i_2} - \frac{1}{i_1} \right) \right) - \left[\left(\frac{j_2}{f_2} + \frac{k_2}{g_2} \right) - \left(\frac{j_1}{f_1} + \frac{k_1}{g_1} \right) \right] - 4.588 \left(\frac{d_2}{0.01616} - \frac{d_1}{0.01616} \right) + p \right]$$

$$\left(\begin{array}{l} Total_PCS \\ Leak_Rate \end{array} \right) = \frac{0.1201}{180} \left[\left(-9136.8 \left(\frac{1}{.021706} - \frac{1}{.021706} \right) \right) - \left[\left(\frac{726.2}{.18021} + \frac{820.8}{.02595} \right) - \left(\frac{726.1}{.18021} + \frac{820.9}{.02595} \right) \right] - 4.588 \left(\frac{70.68}{0.01616} - \frac{70.10}{0.01616} \right) + 208.2 \right]$$

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PCS INVENTORY FORM

2. LEAKAGE CORRECTION CALCULATION
(Section 5.1.7)

a.	Charging Pump Seal Leakage: (<u> 15 </u> ml/min x 0.0002642 gal/ml)	0.004 gpm
b.	Other known leakage sources outside the PCPB; list source and rate: Source: Rate: (<u> 0 </u> ml/min x 0.0002642 gal/ml)	0 gpm
c.	Leakage outside the PCPB which affects the PCS leakrate calculation: (2.a + 2.b)	0.004 gpm
d.	Corrected PCS Leakage: (1.q - 2.c)	0.027 gpm

3. IDENTIFIED PCS LEAKAGE CALCULATION
(Section 5.1.8)

a.	CRDM Seal Leakage: (<u> 10 </u> ml/min x 0.0002642 gal/ml)	0.003 gpm
b.	Other known leakage sources inside the PCPB; list source and rate: Source: Rate: (<u> 0 </u> ml/min x 0.0002642 gal/ml)	0 gpm
c.	Identified PCS Leakage: (3.a + 3.b)	0.003 gpm (If >10.0 gpm - refer to Step 5.1.10b)

4. UNIDENTIFIED PCS LEAKAGE CALCULATION
(Section 5.1.9)

a.	Unidentified PCS Leakage: (2.d - 3.c)	0.024 gpm (If ≥ 0.05 gpm, refer to Steps 5.1.9b through 5.1.9f, 5.1.10b) (If >1.0 gpm - refer to Step 5.1.10b)
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5. PCS LEAKAGE CALCULATION COMPLETION
(Section 5.1.10)

- a.1 Record positive values (≥ 0 gpm) as calculated on Attachment 1, Step 5.1.
- a.2 Record negative values (< 0 gpm) as 0 gpm on Attachment 1, Step 5.1.

Operator Signature/ Today /
 _____ / _____
 Calculated By Date Reviewed By Date

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