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R. H. LEASBURG
VICE PRESIDENT
NUCLEAR OPERATIONS

April 23, 1982

Mr. Harold R. Denton
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Serial No. 118
PSE&CS/DPB: jdm
Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Gentlemen:

REQUEST FOR ADDITIONAL INFORMATION
REACTOR COOLANT SYSTEM VENTS (ITEM II.B.1)
SURRY POWER STATION UNITS 1 AND 2

The attached responses concerning the Reactor Coolant System Vents are provided in reply to your request for additional information dated February 22, 1982. Please advise if further information is required.

Very truly yours,

R. H. Leasburg

Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
Office of Inspection & Enforcement
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Mr. R. C. DeYoung, Director
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Division of Reactor Operations Inspection
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REQUEST FOR ADDITIONAL INFORMATION

FOR

SURRY 1 & 2

1. Submit operating guidelines for reactor operator use of the reactor vessel head and pressurizer venting system including the following:

   a. Guidelines to determine when the operator should and should not manually initiate venting, and information and instrumentation required for this determination (reference NUREG-0737 Item 11.B.1 Clarification A.(2)). The guidelines to determine whether or not to vent should cover a variety of reactor coolant system conditions (e.g., pressures and temperatures). The effect of the containment hydrogen concentration on the decision to vent or to continue venting should also be addressed considering the balance between the need for increased core cooling and decreased containment integrity due to elevated hydrogen levels.

   b. Methods for determining the size and location of a noncondensible gas bubble (reference Position (2) and Clarification A.(2)).

   c. Guidelines for operator use of the vents, including information and instrumentation available to the operator for initiating or terminating vent usage (reference Position (2)).

   d. Required operator actions in the event of inadvertent opening, or failure to close after opening, of the vents including a description of the provisions and instrumentation necessary to detect and correct these fault conditions (reference Position (2) and Clarification A.(2)).

   e. Methods which in lieu of venting will assure that sufficient liquid or steam will flow through the steam generator U-tube region so that decay heat can be effectively removed from the reactor coolant system (reference Clarification C.(2)).

Response: a. It is our intention to operate the RCS Head Vent System in accordance with the recently developed W Function Restoration Guideline, FR-I.3. A copy of this generic guideline is provided for reference as Attachment I. Engineering basis for the guideline is included in a generic background document also supplied by W.

1. The guideline background document lists, in addition to RVLIS, four symptoms which should cause the operator to suspect the presence of voids in the RCS. The conditions are covered as part of Operator Training.

2. The guideline checks RCS stability, attempts to collapse the void, checks pressurizer conditions, and RCS subcooling prior to vent operations.

3. Instrumentation required for plant response is presently available with the exception of RVLIS. A temporary alternative method for detecting and sizing voids has been provided in the background document. See Attachment II.

Hydrogen indication and control equipment are available at present. Step 11 of the guideline addresses containment H_2 concentration and calculation of vent time based on the conservative assumption of the void consisting of 100% Hydrogen. Termination due to Hydrogen concentration is addressed in Step 12.

b. RVLIS is required to absolutely determine if the void is in the reactor head. The methods described in Attachment II are valid for determination of void existance and size, but do not discriminate as to location. At present the use of the pressurizer vent is not addressed in generic guidelines.

c. Guidelines for vent initiation are provided in Steps 1 thru 11 of FR-I.3. Termination criteria are reviewed in Step 12 prior to venting. In Step 13 venting is stopped when RVLIS indicates a full or stable level or when any of the criteria of Step 12 are reached. Instrumentation, with exception of RVLIS, is presently available and operable.

d. The generic guideline does not address inadvertant opening of vent valves as such. In Step 13 the operator is instructed to maintain redundant valves closed while not being operated. This would preclude a single failure from opening a flow path.

The capability of local manual isolation is provided.

Should the above methods fail, it is anticipated that the event would be detected and handled as a small break LOCA in accordance with existing plant procedures. Present instrumentation is appropriate for this condition.

e.1. The caution prior to Step 1 of the guideline attempts to maintain void stability by leaving RCPs in their present condition. Tripping RCPs could result in gases collecting in S/G U-tubes, while starting a RCP would disperse gases collected in the head or pressurizer and make removal difficult.

2. An attempt is made to collapse steam voids prior to any venting operation.

3. Pressurizer level is monitored and maintained throughout the operation. SI is initiated if level cannot be maintained.

4. RCS subcooling is maintained greater than 50°F.

5. RCS pressure decreases are limited to 200 psi for subcooling and RCP NPSH considerations.

6. If during venting any RCPs stop, the venting is to continue. This minimizes the amount of gas which will collect in S/G U-tubes while natural circulation establishes itself.

2. Demonstrate that the reactor vessel head and pressurizer venting system flow restriction orifices are smaller than the size corresponding to the definition of a loss-of-coolant accident (10 CFR Part 50, Appendix A) by providing the pertinent design parameters of the reactor coolant makeup system and a calculation of the maximum rate of loss of reactor coolant through the vent orifices (reference NUREG-0737 Item 11.B.1 Clarification A.(4)).

Response: The orifices on the vent system are 3/8 inch I.D. Per the Westinghouse system design basis the mass flow through a 3/8 inch break is within the capacity of the normal makeup water system.

3. The following items apply to the portions of the reactor vessel head and pressurizer venting system that form a part of the reactor coolant pressure boundary, up to and including the second normally closed valve (reference NUREG-0737 Item 11.B.1 Clarification A.(7)):

   a. Verify that the piping, valves, components, and supports designated QA Category 1 on your drawings are classified Seismic Category 1 and Safety Class 2 (Safety Class 1 where the size corresponds to the 10 CFR Part 50 Appendix A definition of a loss-of-coolant accident).

   b. Provide the design temperature and pressure of the piping, valves, and components.

   c. Describe the existing methods and instrumentation that has been provided to detect and measure reactor vessel head and pressurizer vent isolation valve seat leakage (reference Appendix A to 10 CFR Part 50, General Design Criterion 30).

   d. Describe the materials of construction and verify that they are compatible with the reactor coolant chemistry and will be fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."

Response: a. The piping, valves, and supports designated QA Category 1 are classified Seismic Category 1 and Safety Class 1 or 2 where appropriate.

b. The design conditions of the piping and valves are 650°F, 2485 psig.

c. Leakage is detected by an increase in the amount of makeup required to maintain a normal level in the pressurizer. Leakage inside the containment is drained to the containment sump where it is monitored. Leakage is also detected by measuring the airborne activity of the containment atmosphere and monitoring the containment pressure.

d. The piping and valve material in contact with reactor coolant water is austenitic stainless steel. The material in contact with the reactor coolant is compatible with the attached chemistry.

A. Reactor Coolant Water

Electrical Conductivity	$<$ 0 to 40 uMhos/cm at 25^oC
Solution pH	4.2 to 10.5 at 25^oC
Oxygen	$<$ 0.005 ppm
Chloride	$<$ 0.15 ppm
Fluoride	$<$ 0.15 ppm
Hydrogen	25 to 50 cc(STP) Kg H_2O
Suspended Solids	$<$ 1.0 ppm
pH Control Agent (Li^7OH)	0.7 to 2.2 ppm Li
Boric Acid	0 to 4000 ppm B
Silica	$<$ 0.2 ppm
Aluminum	$<$ 0.05 ppm
Calcium	$<$ 0.05 ppm
Magnesium	$<$ 0.05 ppm

B. Reactor Coolant Makeup Water

Cation Conductivity	$<$ 1 uMhos/cm at 25^oC
Solution pH	6.0 to 8.0 at 25^oC
Oxygen	$<$ 0.10 ppm
Chloride - Fluoride	$<$ 0.10 ppm
Total Solids	$<$ 1.0 ppm
Suspended Solids	$<$ 0.10 ppm
Silica	$<$ 0.10 ppm
Potassium	$<$ 0.01 ppm
Sodium	$<$ 0.01 ppm
Aluminum	$<$ 0.02 ppm
Calcium	$<$ 0.02 ppm
Magnesium	$<$ 0.02 ppm

4. Verify that the following reactor vessel head and pressurizer venting system failures have been analyzed and found not to affect the essential operation of safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident:

a. Seismic failure of venting system components that are not designed to withstand the safe shutdown earthquake.

b. Postulated missiles generated by failure of venting system components.

c. Fluid sprays from venting system component failures. Sprays from normally unpressurized portions of the vents that are Seismic Category 1 and Safety Class 1, 2 or 3 and have instrumentation for detection of leakage from upstream isolation valves need not be considered.

Response: a. All components and piping in the RCS Vent system have been designed to withstand a safe shutdown earthquake.

b,c. Per NRC Branch Technical Position MEB 3-1, it is not necessary to postulate breaks in piping of diameter one inch or less. Therefore, jet impingement, pipe whip, or missile analysis is not required.

5. Verify that any nearby structures, systems, and components essential to safe shutdown of the reactor or mitigation of the consequences of a design basis accident are capable of withstanding the effects of the anticipated mixtures of steam, liquid, and noncondensible gas discharging from the reactor vessel head and pressurizer venting system.

Response: The spray from both the RCS and Pressurizer Vent Systems are directed into the refueling cavity such that they do not impinge on any components. The pressurizer vent system discharge is directed straight down into the refueling cavity. The RCS Vent System discharge is directed at a 45° angle into the refueling canal from the reactor vessel head. The attached sketch (Attachment III) details the approximate location of the vent system discharge for both units. All components in this area were originally designed or have been qualified to withstand the effect of a LOCA, therefore, no additional analysis need be performed.

6. Verify that operability testing of the reactor vessel head and pressurizer venting system valves will be performed in accordance with subsection IWV of Section XI of the ASME Code for Category B valves (reference NUREG-0737 Item 11.B.1 Clarification A.(11)).

Response: Operability testing will be in accordance with subsection IWV of Section XI of the ASME Code for Category B valves.

7. Verify that all displays (including alarms) and controls, added to the control room as a result of the TMI Action Plan requirement for reactor coolant system vents, have been or will be considered in the human factors analysis required by NUREG-0737 Item 1.D.1, "Control-Room Design Reviews."

Response: The controls and displays added to the control room by this modification will be considered in a human factors analysis to be conducted at a later date in accordance with NUREG-0737 Item 1.D.1.

Number:	Symptom/Title:	Revision No./Date
FR-1.3	RESPONSE TO VOID IN REACTOR VESSEL	Basic 1 Sept. 1981

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
	Caution *Do not stop any running RCPs or start any stopped RCPs until completion of this guideline.*	
1	**Record RCS Pressure - ______ PSIG**	
2	**Verify SI System - NOT IN OPERATION**	IF SI system is in operation, THEN go to step 9.
3	**Check Stable RCS Conditions:**	
	a. Pressurizer level - STABLE BETWEEN 40% AND 60%	a. Manually adjust letdown and charging.
	b. RCS pressure - STABLE	b. Operate heaters and spray.
	c. RCS hot leg temperature - STABLE	c. Adjust steam dump.
4	**Try To Collapse Void In Reactor Vessel:**	
	a. Turn on pressurizer heaters to increase pressure by 50 psi	
	b. Maintain balanced charging and letdown flow	
	c. Maintain pressurizer level - GREATER THAN 20%	c. IF level less than 20%, THEN turn off pressurizer heaters AND return to step 3.
5	**Verify Void Collapse In Reactor Vessel:**	
	a. Reactor vessel level - RISING TO FULL	a. IF level not rising, THEN go to step 6.
	b. Reactor vessel level - FULL	b. IF level not full, THEN go to step 6.
	c. Return to procedures in effect	
6	**Isolate Letdown.**	

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
7	**Check Pressurizer Conditions:**	
	a. Pressurizer level – GREATER THAN 10%	a. Increase charging flow. IF level cannot be maintained above 10% with maximum charging, THEN manually initiate SI and go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.
	b. Pressurizer level – BETWEEN 20% AND 90%	b. Adjust charging flow.
	c. RCS pressure – GREATER THAN OR EQUAL TO PRESSURE RECORDED IN STEP 1	c. Energize heaters. IF pressure decreasing in an uncontrolled manner, THEN manually initiate SI and go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.

NOTE *Venting of the RPV may result in RCS pressure decreasing below SI initiation setpoint.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8	**Check Low Pressurizer Pressure SI Signal Status:**	
	a. Pressurizer SI signal – BLOCKED	a. Manually block.
9	**Check RCS Subcooling:**	
	a. RCS subcooling – GREATER THAN (1) °F	a. IF less than (1) °F, THEN increase steam dump. IF (1) °F subcooling cannot be obtained, THEN go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.

(1) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables, PLUS 50°F.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
10	**Prepare Containment For Reactor Vessel Venting:** a. Isolate containment: 1) [Enter plant specific list] b. Start containment air circulation equipment: 1) [Enter plant specific list] c. Verify hydrogen control equipment available: 1) [Enter plant specific list]	
11	**Determine Maximum Allowable Venting Period:** a. Containment Hydrogen concentration – LESS THAN (1) %	a. Reduce hydrogen concentration: [Enter plant specific means]
	b. Calculate maximum venting PERIOD ______. (See graph on page 5)	

Caution *IF ANY vent termination criterion in step 12 is reached or exceeded while venting, immediately stop venting.*

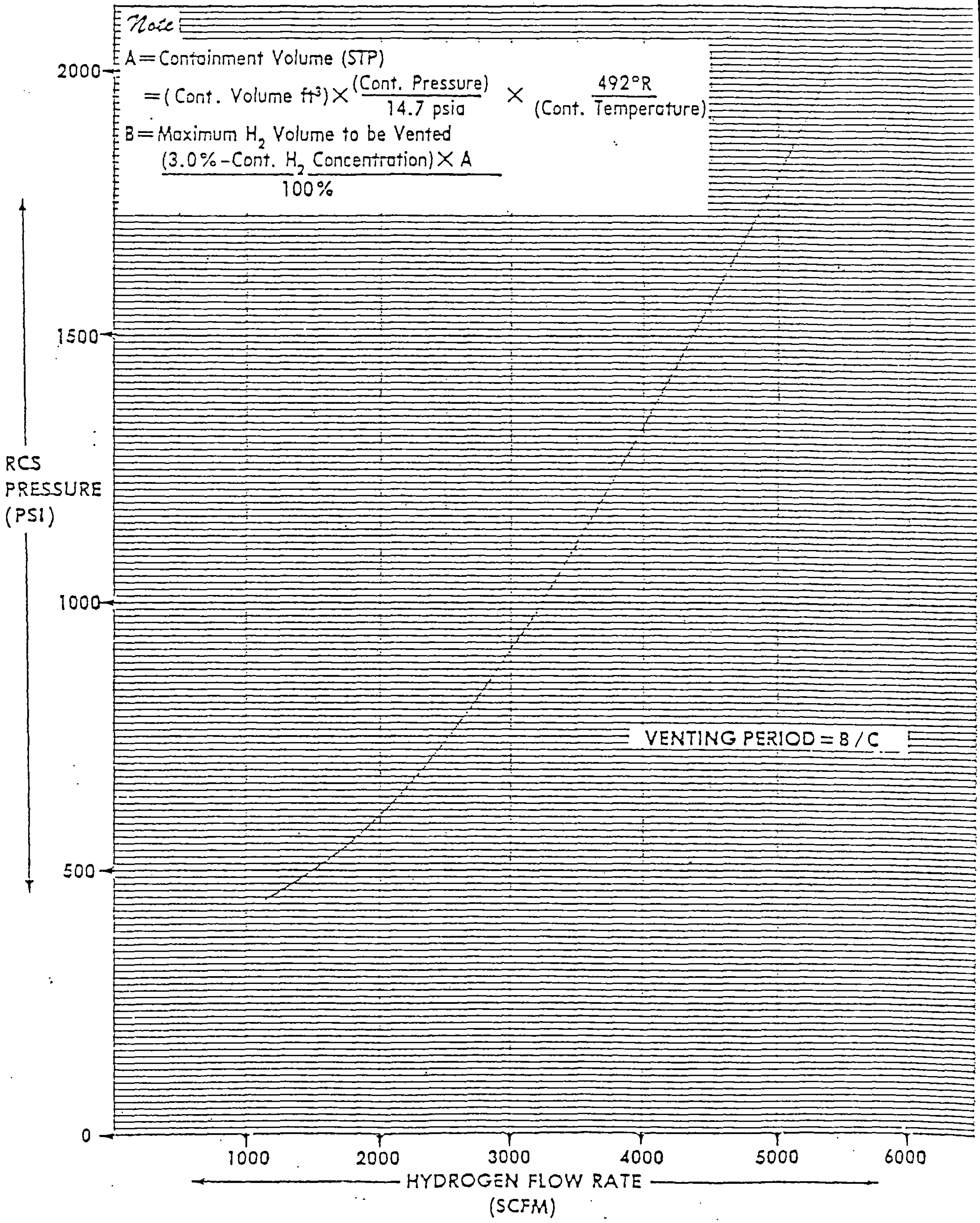
STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
12	**Review RPV Vent Termination Criteria With Control Room Personnel:** • Containment hydrogen concentration – GREATER THAN 3% BY VOLUME • RCS subcooling – LESS THAN (2) °F • Pressurizer level – LESS THAN 20% • RCS pressure – DECREASES BY 200 PSI • Venting period – GREATER THAN PERIOD CALCULATED IN STEP 11.	

(1) Enter plant specific value.
(2) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13	**Vent Reactor Vessel**	
	a. Open valves in one vent path	a. IF either of series valves in selected path fails to open, THEN close both valves and open valves in second path.
	b. Close both valves when: 1) Reactor vessel level – FULL OR STABLE –OR– 2) Any termination criterion of step 12 is reached	
	c. IF venting stopped because of ANY criteria in step 12, THEN return to step 7.	
14	**Check Pressurizer Level - STABLE**	Adjust injection and letdown, as required.
15	**Return To Guideline In Effect**	

-END-

Number:	Symptom/Title:	Revision No./Date:
FR-1.3	RESPONSE TO VOID IN REACTOR VESSEL (Cont.)	Basic 1 Sept. 1981



ATTACHMENT II

4.0 ADDITIONAL INFORMATION FOR PLANTS WITHOUT A REACTOR VESSEL LEVEL INSTRUMENTATION SYSTEM

The information provided herein contains a method for detecting and sizing voids in the RCS. No discrimination between voids in the reactor vessel and voids in the steam generators can be made. For plants without a reactor vessel level system, this method can serve a critical safety monitor function, as well as confirming the success of void removal operations.

If gases are present in the reactor coolant system, then the pressurizer pressure and level controls will not respond as they normally would. The total gas volume can be estimated by performing a routine pressurizer control operation and then comparing the expected results with the actual results. This is the technique utilized in the following steps. If the safety injection system is in service, then the following steps are not applicable since normal pressurizer control will not be maintained. The recommended steps, followed by a brief explanation if needed, are given below.

1. Achieve a constant pressurizer level and pressure condition, with normal controls being maintained.

2. Place the RCS wide range or pressurizer pressure and the pressurizer level on trend recorders. The scale should be 150 psig pressure and 10% of span for level.

   System pressure and level are placed on trend recorders to achieve better accuracy for recording their values. The transient is not expected to exceed a 150 psi or 10% of span change in RCS conditions.

3. Record the following parameters.

RCS Pressure	=	__________	PSI
PZR Level	=	__________	%
Charging Rate	=	__________	GPM
Seal Injection Flow	=	__________	GPM
Seal Leakoff Low	=	__________	GPM
Time	=	__________	

These recordings will become the initial parameters in the following calculation.

4. Isolate the RCS letdown flow, turn off all pressurizer heaters, and terminate the pressurizer spray by placing the spray control in manual and zeroing the demand signal. A condition is established where the pressurizer level will change only as a result of mass being injected into the RCS.

5. Allow the RCS charging flow to either increase RCS pressure 100 psi or increase pressurizer level 5% of span.

6. Record the RCS pressure, pressurizer level and time.

RCS Pressure	=	__________	PSI
PZR Level	=	__________	%
Time	=	__________	

These recordings will become the final parameters in the following calculation.

7. Reinitiate RCS letdown flow and restore normal pressurizer pressure and level control.

8. Calculate the initial and final pressurizer vapor space volumes.

Initial Vapor Volume = (1-PZR Level % X Total Cylindrical PZR Vol. FT^{*3}) + (Upper Spherical Volume FT^3)

= __________ FT^3

Final Vapor Volume = (Initial Volume) + (Δ PZR Level X Total Cylindrical Volume*)

= __________ FT^3

*Pressurizer volume less upper and lower spherical dome volumes.

9. Determine the total charged volume into the RCS.

Charged Volume = (Charging + Seal Injection - Seal Leakoff GPM) X

$$(\text{Time}) \times \left(\frac{1}{7.45\frac{GAL}{FT^3}}\right)$$

= __________ FT^3

10. Determine the expected pressurizer level change.

$$\text{Expected } \Delta \text{ level} = (\text{Charging Volume } FT^3) \times \left(\frac{100\%}{\text{Total PZR Volume } FT^3}\right)$$

= __________ %

11. If the actual pressurizer level change is less than the expected level change then a gaseous void exists in the reactor coolant system. Perform the following step to determine the volume of the RCS void.

If the actual pressurizer level change is less than the expected change (or if no level change was witnessed) then gaseous voids exist in the reactor coolant system. This is a result of the gaseous voids contracting when the pressure was increased by the charging flow. This will limit or prevent a normal pressurizer level increase. The void contraction may even be large enough to cause an actual decrease in the pressurizer level.

Step 12 should then be performed to estimate the total volume of the gas voids in the RCS.

12. The initial and final RCS gaseous void volumes can be calculated from the following equations.

$$\text{Initial RCS Void} = \frac{(\text{Initial Vapor Volume})-(\text{Final Vapor Volume})-(\text{Charged Volume})}{\left(1 - \frac{\text{Initial Pressure}}{\text{Final Pressure}}\right)}$$

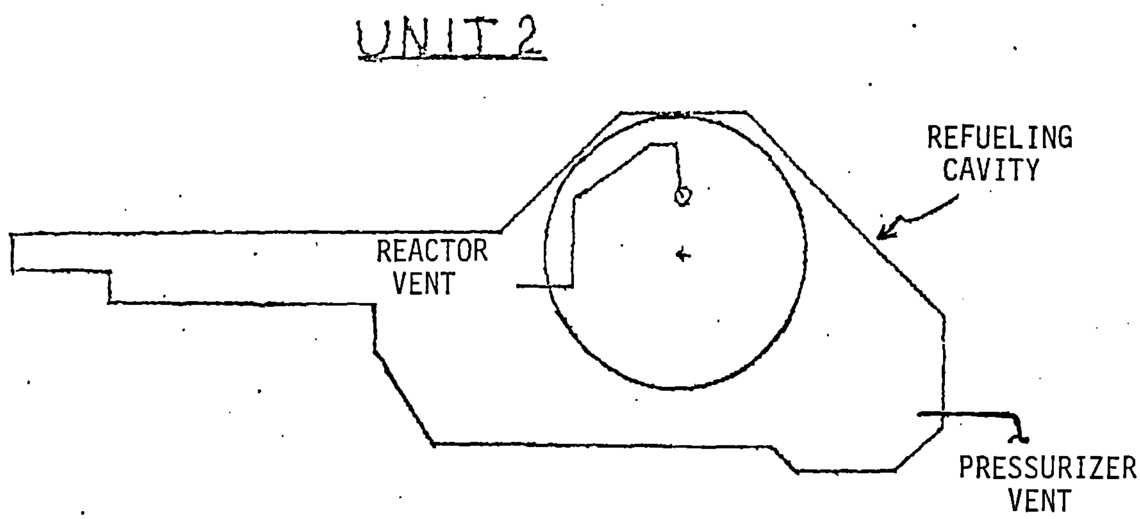
= ____________ FT^3

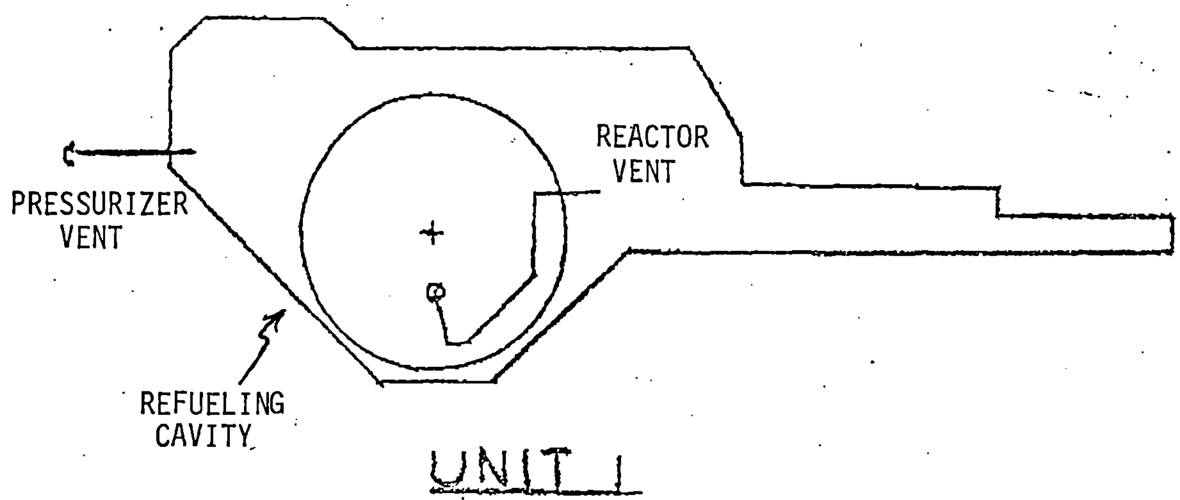
$$\text{Final RCS Void} = \frac{(\text{Initial RCS Void}) \times (\text{Initial Pressure})}{(\text{Final Pressure})}$$

= ____________ FT^3

The RCS void volume contraction is equal to the change in pressurizer level converted to volume. Also the ratio of final void volume to initial void volume is equal to the ratio of initial RCS pressure to final RCS pressure. From these two equations the two unknowns (initial and final RCS void volume) can be determined by inserting one equation into another. The initial void volume is calculated first and then fit into the volume/pressure ratio to determine the final void volume.

ATTACHMENT III





RCS VENT SYSTEM DISCHARGE POINTS

SURRY UNITS 1 AND 2