# BACKGROUND INFORMATION

# FOR

# PRESSURIZER VENTING OPERATION

REVISION 0

MARCH 1981

# PRESSURIZER VENTING OPERATION

## I. GENERAL DISCUSSION

### A. PURPOSE

The operator actions and precautions specified in this guideline are those instructions necessary to vent non-condensible gases from the pressurizer vapor space.

If an RCS depressurization is required by another instruction and pressurizer spray and power operated relief valves are not available, then the pressurizer vent system may be used for the depressurization.

### B. INITIAL CONDITIONS

The CAUTION warns the operator that the pressurizer vent system is not designed for and should not be used as the primary means to mitigate an inadequate core cooling event. The vent flowpath is not sized to provide this capability and should only be used in conjunction with the Inadequate Core Cooling Guidelines.

The NOTE indicates that the pressurizer level and pressure requirements throughout the guideline do not include error allocations due to an adverse containment environment. Therefore, it is assumed that containment temperature is near normal opeating conditions.

The CAUTION warns the operator that any venting operation should be performed under a stable plant condition and the venting while safety injection is running may result in the undesirable condition of a water-solid pressurizer.

1. A larger than normal concentration of non-condensible gases is present in the pressurizer vapor space.

2. Variations from the normal pressurizer pressure and level response due to normal charging and spraying operations may be observed.

3. If non-condensible gases are present in the vapor space, then spraying will not condense the gases and the normal depressurization will not occur.

4. Gases in the reactor coolant system may result from several types of plant events. An accumulator tank discharge or a core uncovery may result in non-condensible gases (e.g. nitrogen and hydrogen) being trapped in the RCS. Inadvertent gas addition to the vapor space is another event which would result in non-condensibles collecting in the pressurizer.

5. If an RCS depressurization is required by another operating instruction, then the pressurizer vent may be used if the normal spray or PORV's are either not available or if their use is undesirable.

6. If gases are also present in the RCS and the reactor vessel head, then the head should be vented prior to venting the pressurizer. If the pressurizer was vented first, the depressurization may result in the vessel head gas bubble expanding to the point where natural circulation core cooling may be disturbed.

C. IMMEDIATE ACTIONS

None

## II. BASIS FOR SUBSEQUENT ACTIONS

The NOTE identifies certain steps (marked by an asterisk) which are not applicable if the pressurizer is being vented because large quantities of non-condensible gases are preventing an RCS depressurization.

1. Once non-condensible gases are detected or suspected in the RCS, then any changes being made to the primary system should be terminated and a steady-state condition should be established. This step refers to events like a POST-LOCA cooldown, a normal plant cooldown, or a plant recovery from a design basis event.

*2. If a large amount of gases are not detected in the vapor space, then there is no need to vent the pressurizer unless the vent system is being used as an alternate depressurization method.

3. The venting operation will result in pressurizer gases being vented to the containment. Therefore the containment purge and exhaust system should be isolated to prevent the release of any radioactive gases to the environment. All available containment air circulation equipment should be started to prevent any hydrogen from forming a gas pocket and to ensure a representative hydrogen concentration is obtained in Step 5.

4. Increasing the reactor coolant sub-cooling 50°F above the minimum plant specific value ensures that reactor coolant sub-cooling will be maintained over the entire range of RCS operating conditions if the venting operation is terminated following a 200 psi decrease in RCS pressure. The preferred method of obtaining the additional sub-cooling is increasing RCS pressure since this will aid in condensing any steam bubble present. If the additional 50°F sub-cooling is already established then proceed to Step 5.

The NOTE indicates that if RCS pressure is less than 350°F and the venting is being performed to initiate Residual Heat Removal operation, then additional sub-cooling is not required and the actions of Step 4 are not applicable.

5. The actions of Appendix A "Venting Time Period" determine the maximum allowable time period for venting which will limit the containment hydrogen concentration to less than 3 volume percent. This limit is required to prevent a potentially explosive hydrogen concentration from being developed inside the containment.

6. This step and the following CAUTION warns the operator that RCS pressure will decrease during the venting and if initial pressure is near the low pressure safety injection actuation setpoint, then SI may be automatically initiated during the venting. The operator is instructed to block the low pressure SI actuation if and/or when the block permissive is energized to prevent an inadvertent SI.

*7. Charging flow is increased to maximum to limit the net mass depletion of the RCS during the venting period. A second charging pump should be started if it will provide additional make-up flow.

The NOTE alerts the operator that the pressurizer level will increase during the vapor space venting due to water entering the pressurizer to replace the net vapor mass removed by the venting.

8. Both isolation valves in one vent flowpath must be opened to initiate the venting operation. The NOTE instructs the operator to close both isolation valves in the flowpath if one or both of the valves fail to open. The isolation valves in the redundant flowpath should then be opened. This prevents two flowpaths being open if the failed valve suddenly opens.

9. The venting operation is terminated when enough gases have been removed to restore normal pressurizer control or when the time limit determined in Step 5 is met. Note, that if the pressurizer is being vented to initiate RHR operation, then the pressurizer venting does not have to be terminated when pressure decreases by 200 psi.

10. Normal pressurizer pressure and level control is restored after the completion of the venting. A stable level and pressure should be maintained while it is determined if further venting is required.

11. If the venting was terminated prior to removing enough gases to restore normal pressurizer control or to reduce pressure to the required condition, then the operator should return to Step 4 and repeat the venting operation.

    The NOTE alerts the operator that if the time period for venting determined in Appendix A is met before normal pressurizer level control is restored then the containment hydrogen concentration must be reduced and a new venting period calculated prior to performing additional venting. The hydrogen concentration could be reduced through the use of the containment hydrogen re-combiners or by the purge and exhaust system if radioactive gas concentrations are within limits. The new venting period will be based upon the reduced hydrogen concentration.

12. The operator should return to the appropriate operating instruction following the successful completion of the venting of the pressurizer vapor space.

## III. BASIS FOR APPENDIX A "VENTING TIME PERIOD"

During a core uncovery event, there exists the potential for a significant amount of hydrogen generated in the core which could be trapped in the reactor vessel head and released to the containment atmosphere during the venting operation. The containment hydrogen concentration is limited to less than 4 volume percent to prevent a potential explosive mixture with oxygen, therefore, the amount of hydrogen that can be vented to the containment is restricted. A maximum allowable time period for venting is determined to limit the containment hydrogen concentration.

1. The total containment volume in cubic feet is first determined and then converted to standard temperature and pressure conditions. Note that the pressure term for the conversion is only applicable to sub-atmospheric containments and can be deleted for the remaining plants.

2. The containment hydrogen concentration is then determined in volume percent units. This value can be found by direct sampling or by hydrogen monitors. Sufficient time should be allowed for the air circulation equipment to mix the containment atmosphere prior to sampling in order to determine a representative concentration.

   The NOTE identifies to the operator that the containment hydrogen concentration will be insignificant if there has been no leakage from the RCS to the containment. The operator may assume the $H_2$ concentration to be 0 volume percent.

3. The maximum volume of hydrogen that can be vented is calculated which will limit the containment hydrogen concentration to less than 3 volume percent.

4. The maximum allowable venting period is then determined from curve #1 (RCS Pressure vs. Hydrogen Flow Rate). This curve was generated from a calculation which determined the flow rate of hydrogen at various RCS pressures through a 3/8" orificed line. The calculation assumed pure hydrogen which is conservative since the gaseous void in the vessel head will probably be some mixture of gases including steam.

ATTACHMENT 3
TO AEP:NRC:0584