ATTACHMENT 1

PROPOSED CHANGE TO LCO 4.2.7 AND LCO 4.2.9

AND BASIS

Specification LCO 4.2.7 - PCRV Pressurization Limiting Conditions for Operation

The PCRV shall not be pressurized to more than 100 psia unless:

a) The PCRV safety valve installation is operable and there is less than 5 psig between the rupture disc and relief valve, and both inlet block valves are locked open.

b) All primary and secondary penetration closures and hold-down plates are in place and operable per Specification LCO 4.2.9.

c) The interspaces between the primary and secondary penetration closures are maintained at a pressure greater than primary system pressure with purified helium gas or;

d) The interspaces between the primary and secondary penetration closures are maintained at a pressure greater than primary system pressure with purified helium gas, with the exception of all or some of the steam generator penetrations. The interspaces between the primary and secondary steam generator penetration closures for either or both loops may be maintained at a pressure greater than cold reheat steam pressure, but less than primary coolant pressure, with purified helium gas.

e) One set of rupture discs and safety valves protecting each steam generator and circulator penetration is operable, and there is less than 5 psig between the rupture discs and the relief valves.

When the PCRV is pressurized to more than 100 psia, corrective action shall be initiated at the onset of any condition exceeding the limits. If corrective action is not successful within 12 hours, the reactor, if operating, shall be put in a shutdown condition, followed by PCRV depressurization to less than 100 psia.

Basis for Specification 4.2.7

The PCRV safety valve installation (consisting of two parallel systems, each of which has a manual block valve and a rupture disc mounted upstream of the safety valves and which discharge to the atmosphere via a single particulate filter) provides the ultimate protection against overpressuring the PCRV. A single, manually-operated block valve is provided between the PCRV and each rupture disc so that necessary maintenance and/or testing of the discs and safety valves can be performed after shutdown and depressurization of the plant. Redundant instrumentation, as well as mechanical locks on the valve, ensure that the valves will always be open when the PCRV is pressurized.

The secondary closure normally serves two purposes related to plant safety: (1) to form an interspace between the inner and outer closures that can be maintained above primary coolant pressure with clean helium to positively prevent any small normal leakage of contaminated helium from the primary coolant system through the primary closure, and (2) to eliminate the possibility of a large primary coolant system leak as a result of any failure of a primary closure. In this latter function, the secondary closures are considered to be a form of secondary containment since, as in most power reactor plants, the secondary containment prevents escape of radioactivity in the event of a primary coolant system rupture corresponding to a failure of the PCRV primary closures. Since no credible accident of the PCRV liner, reinforcement, and concrete can result in significant leakage, the secondary closures of the PCRV penetrations thus constitute secondary containment of the primary coolant system.

As long as penetration interspace pressure is maintained above primary coolant pressure, any leakage into the Reactor Building will be purified helium and will thus have no radiological consequences. | Penetration pressurizing gas is normally obtained from the helium | purification system, or alternately, from the high pressure helium supply tanks of the helium storage system.

| Because of the potential of leakage of purified helium gas from | the steam generator penetration interspace into the cold reheat steam | system within the penetration, the steam generator interspaces may be | maintained at a pressure greater than cold reheat steam pressure, but | less than primary coolant pressure. In this mode of operation, | reducing the driving force for leakage significantly reduces leakage | of purified helium gas to the cold reheat system. Reducing the | quantity of purified helium in the cold reheat steam allows the | maintenance of condenser vacuum required for normal plant power | operation. The cold reheat steam pressure varies with plant load, | but is always at least 50 psi below primary coolant pressure. | Therefore, there exists the potential for contaminated helium gas | leakage across the primary closure and into the reheat steam system.

| Primarily, noble gases would be stripped from the steam by the condenser air ejector and ultimately exhausted out the plant stack. Consequently, when operating in this mode, more stringent leak tightness has been specified for the steam generator primary closures in LCO 4.2.9. With the radiation monitoring required by LCO 4.2.9, the integrity of the primary closure is adequately demonstrated.

The steam generator and helium circulator penetrations are provided with rupture discs and safety valves to prevent overpressure should a process line rupture within the penetration. (These are the only penetrations which contain process fluids at pressures high enough to require such protection.) Separate overpressure protection trains are provided for a) the six steam generator module penetrations of each loop and b) each of the four helium circulator penetrations. Each train consists of a pair of rupture discs, each of which is upstream of a safety valve with the two rupture disc-safety valve combinations piped in parallel. A block valve is provided at the inlet to each rupture disc. The block valves serving each pair of rupture discs and associated safety valves are interlocked so that only one valve can be closed at any time. Design basis for the circulator penetration interspace safety valves is the rupture of a bearing water supply line. Design basis for the steam generators penetration interspaces is rupture of a subheader (35 pounds per second of superheated steam at 1000°F).

Specification LCO 4.2.9 - PCRV Closure Leakage, Limiting Conditions for Operation

a) When operating under paragraph 4.2.7.c. of LCO 4.2.7, the total helium leakage through all primary closure seals in any penetration group I through VIII shall not exceed an equivalent leak rate of 400 pounds per day at a differential pressure of 10 psi. The total helium leakage through all secondary closure seals shall not exceed an equivalent leak rate of 400 pounds per day at a differential pressure of 688 psi.

b) When operating under paragraph 4.2.7.d. of LCO 4.2.7, the total helium leakage through all the primary closure seals in any penetration group I, II, V, VI, VII, or VIII shall not exceed an equivalent leak rate of 400 pounds per day at a differential pressure of 10 psi.

The total helium leakage through all the primary closure seals in steam generator penetration groups III and IV combined, which may be operated below primary coolant pressure, but above cold reheat steam pressure, shall not result in the release of greater than 1.4 curies per day. These potential radioactive gas releases shall be monitored by the condenser air ejector monitor channel 31193. When either or both of steam generator interspace groups III and IV are being maintained below primary coolant pressure, and the condenser air ejector monitor becomes inoperable, effluent releases via this pathway may continue for up to

30 days, provided grab samples are taken at least once per eight hours and these samples are analyzed for noble gas gross activity within 24 hours. When determining the curie per day leak rate, the flow rate of the condenser air ejectors shall be assumed to be at its maximum capacity of 15 cfm for each of the operating ejectors. Additionally, whenever either or both steam generator interspace groups III and IV are maintained below primary coolant pressure, the penetration shall be monitored for gross activity by the corresponding activity monitor 2263 or 2264. An unexplained increase in gross activity of greater than 25% shall be cause to determine the leak tightness of the primary closure seals. Should activity monitor 2263 or 2264 become inoperable while the corresponding loop steam generator penetration interspace is being operated below primary coolant pressure, then grab samples will be taken once every eight (8) hours and analyzed within 24 hours.

The equivalent leak rate in group III or IV shall not exceed 400 pounds per day at a differential pressure of 10 psi in the absence of an interspace gas leak pathway to the reheat steam system or 700 pounds per day with an interspace gas leak pathway to the reheat steam system.

The total helium leakage through all the secondary closure seals shall not exceed an equivalent leak rate of 400 pounds per day at a differential pressure of 688 psi.

Basis for Specification LCO 4.2.9

Penetration closure interspace volumes are normally maintained at a pressure greater than the primary coolant pressure by supplying them with clean helium from either the high pressure helium storage tanks or from the helium purification system; therefore, any leakage through either the primary or secondary closure seals will be clean helium.

The normal gas supply to all the penetration closure interspaces is from the helium purification system and is continuously monitored for flow so that an increase in closure leakage can be sensed and alarmed. The penetration closure interspaces are supplied with pressurizing gas in groups through the arrangement of the purified helium piping. The grouping of the penetrations is as follows:

Group I:	All penetrations in the top head of the PCRV (37 - control rod drive, 2 - high temperature filter-absorber, and 1 - top access).
Group II:	All instrument penetrations (20) plus the bottom access penetration.
Group III:	The six steam generator penetrations, Loop I.
Group IV:	The six steam generator penetrations, Loop II.
Group V-VIII:	Each helium circulator penetration.

To prevent the possible loss of all helium coolant by way of the helium purification system due to a complete failure of a secondary closure, the piping supplying pressurizing gas to the failed closure is automatically isolated if the pressurization gas flow exceeds 275 pounds per hour.

The leakage rate limitations for the primary closures are based on a differential pressure of 688 psi, which would be the differential pressure across a primary closure in the event a secondary closure should fail.

The calculated permissible leakage rate across the primary closure would be well in excess of 1145 pounds per hour at a differential pressure of 688 psi. Converting the 1145 pounds per hour leakage rate to normal operating conditions of 10 psi differential pressure indicates an operating limiting leakage rate of 400 pounds per day, or 16.7 pounds per hour. This leakage flow can readily be detected on the pressurizing gas flow indicator. It is assumed that under these conditions, the entire inventory of primary coolant would leak through the primary closure. (The associated activity release would be similar to that release resulting from the maximum credible accident (MCA) discussed in Section 14.8 of the FSAR.) Assuming the design primary coolant activity, and assuming a dilution factor of 2.7×10^3 sec/m^3, the resultant dose is at least an order of magnitude less than the limits of 10 CFR 100 at the exclusion area boundary.

| Because of a potential leak pathway of steam generator penetration interspace gas to the reheat steam system within a steam generator penetration, the steam generator penetrations may be operated below primary coolant pressure but above cold reheat steam pressure. Cold reheat steam pressure varies with plant load, but will be at least 50 psi below primary coolant pressure. When operating in this mode, there exists a potential effluent pathway of

| primary coolant leakage across the primary closure and into the | reheat steam system. The helium, plus primarily noble gases, would | be removed by the condenser air ejector and exhausted out the plant | stack. The release of noble gases via this effluent pathway shall be | limited to 10% of the design objective for the plant's radioactive | gas releases of 4160 curies per year as stated in the Basis for | Specification LCO 4.8.1. This equates to 1.4 curies per day based | upon a plant capacity factor of 0.8 (292 days operation per year). | The quantity of primary coolant leakage to stay within this limit | will vary with the magnitude of circulating activity. At design | circulating activity, about 0.6 pounds per day could leak via this | leakage path. At circulating activity levels, which the plant has | operated to date, about 60 pounds per day leakage could occur. | Therefore, this activity release limit imposes a much more stringent | leak tightness of the primary closures than 400 pounds per day at | 10 psi differential pressure. The condenser air ejector radiation | monitor has a lower level of detectability, about 1/100 of the stated | release limit. Therefore, monitoring of any releases is assured, | which in turn provides an adequate check on the integrity of primary | closures. Monitoring of the interspace gas with activity | monitors 2263 and 2264 provides a check of the primary closure leak | tightness in the event a primary closure leaks but is not accompanied | by a leak path into the reheat steam system.

Secondary seal leakage during normal operation is leakage of clean helium. The secondary seal leakage is limited to 400 pounds per day at the normal operating differential pressure of 688 psi to

| assure compliance with LCO 4.2.7, which specifies pressurization of | the penetration interspaces, except the steam generator penetration interspaces, to greater than primary system pressure.

ATTACHMENT 2

SAFETY ANALYSIS

SAFETY ANALYSIS SUPPORTING PCRV AUXILIARY PIPING SYSTEM MODIFICATION AND OPERATION FOR THE STEAM GENERATOR PENETRATION INTERSPACES

INTRODUCTION

Since mid-1980, the Fort St. Vrain plant has been experiencing purified helium leaking in the Loop 2 steam generator penetration interspace system. This leakage path is internal to the Loop 2 penetrations and is occurring between the purified helium interspace and the cold reheat steam piping internal to the penetration. At that time, relief was requested and granted to LCO 4.2.9 to allow purified helium leakage for the steam generator interspaces up to 700 pounds per day as opposed to the previous 400 pounds per day limit. The basis for the original 400 pounds per day limit was for primary closure integrity and not the leak path being experienced. Plant operation within the leakage limit of 700 pounds per day and generally less than 400 pounds per day continued until October, 1981. In October, 1981, during rise-to-power testing, the leak rate increased and exceeded 700 pounds per day. In order to complete the rise-to-power testing, temporary relief was requested and granted to operate steam generator module B-2-3 interspace at below primary coolant pressure, but above cold reheat steam pressure. The purified helium header piping was modified, and the rise-to-power testing successfully completed to 100% power in November, 1981, with module B-2-3 interspace maintained at slightly greater than cold reheat steam pressure. Helium leakage stayed within 700 pounds per day limit with no detectable leakage of primary coolant across the primary closure of module B-2-3. (A primary closure leak, which in turn leaks into the reheat steam system, would have been detected and alarmed by the condenser air ejector radiation monitor if the leak rate reached about 1.4 pounds per day.) Additional testing, which is somewhat quantitative, indicates that the largest penetration interspace gas leak to the reheat steam system is in module B-2-3, but that smaller leaks exist in modules B-2-2 and B-2-6. Similar testing has not been performed on Loop 1 steam generator penetrations.

It is requested that LCO 4.2.7 and LCO 4.2.9 be amended per the attachments to permit either or both Loop 1 and Loop 2 steam generator penetration interspaces to be maintained at purified helium header pressure or below primary coolant pressure, but above cold reheat steam pressure. This safety analysis will describe the system modification, the limitations on environmental impact due to the potential for primary coolant leakage, and the means available for monitoring.

DISCUSSION

1. Modified System Description

The PCRV auxiliary piping system for the steam generator penetration interspaces has been modified as shown in the attached sketch. Pressure control valves PCV-11379 and PCV-11380 have been added on the inlet side for each steam generator loop. This permits the penetration interspaces for either or both steam generator loops to be maintained above cold reheat steam pressure or above primary coolant pressure as the situation requires. Sample lines have been added to each module penetration interspace, and in turn routed to activity monitors 2263 for Loop 1 and 2264 for Loop 2. Each sample line contains an individual flow control/block valve. Normally, these activity monitors will be sampling all penetration interspaces that are being maintained below primary coolant pressure, but above cold reheat steam pressure. However, the interspace gas from each penetration can be separately directed to the activity monitor for diagnostic testing. The discharge flow from the activity monitors will be routed to the gas waste system. All other features of the PCRV auxiliary piping system for the steam generator penetration interspaces remain unchanged by this modification.

2. Potential Environmental Impact and Limitations

When either or both steam generator loop penetration interspaces are being operated below primary coolant pressure, but above cold reheat steam pressure, there exists a potential for primary coolant leakage across the primary closure into the penetration interspace. Assuming an interspace gas leak to the reheat steam system (which would be the reason for operating the interspaces below primary coolant pressure), the potential exists for primarily noncondensible noble gases to be removed by the condenser air ejector and discharged at the plant stack. This potential requires primary closures for the steam generator penetrations to be leaking. If there is no primary closure leakage (and none are currently known to exist), then there would be no off-site environmental impact.

The purpose of this section of this safety analysis is to establish a limit on off-site fission product releases via the release path- described above which does not compromise existing accident analyses related to primary closure leak rates and is not inconsistent with practices as applied to light water reactors (LWR's).

Pressurized water reactors (PWR's) commonly experience primary coolant leakage at the steam generators. Primarily noble gases in the secondary coolant are removed at the condenser air ejector and discharged to the environment from the plant stack. In a survey of five operating plants, NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," reported that the monthly average primary/secondary leakage varied from 0 to 830 pounds per day with an average for the five plants of 98 pounds per day over a 3 1/2 year period. The PWR-GALE Code specifies that 100 pounds per day for primary/secondary leakage be used for this one effluent path in demonstrating compliance (in PSAR's and FSAR's) to 10CFR50, Appendix I criteria. However, 10CFR50, Appendix I was prepared specifically for LWR's and has not been applied to Fort St. Vrain. Instead, the Fort St. Vrain Technical Speacification in the Basis for LCO 4.8.1, Radioactive Gaseous Effluents, states the design objective for the plant's radioactive gas releases is 4150 curies per year. This design objective, in conjunction with Fort St. Vrain meteorology, would also satisfy 10CFR50, Appendix I criteria as applied to LWR's.

It is proposed in the amended LCO 4.2.9 to limit the release of noble gases via this one effluent pathway to 10% of the Fort St. Vrain plant design objective of 4160 curies per year. This equates to 1.4 curies per day based upon a plant capacity factor of 0.8 (202 days operation per year). Based upon plant operation to date, all gaseous releases, including the upper limit proposed for the condenser air ejector pathway, will remain well within the plant design objective of 4160 curies per year. The only detectable gaseous effluent path is the gas waste system and releases have been less than 400 curies per year.

2.1 Allowable Primary Closure Leakage

The quantity of primary closure leakage consistent with the above release limit, which in turn escapes to the reheat steam system and is ultimately discharged to the environment by the condenser air ejector, will vary directly with the magnitude of the primary coolant activity. The calculations were performed using "design" circulating activity for 105% of rated power. Since current circulating activity is about 1% of the "design" value, leakage rates can be easily calculated.

Following are the bases used to calculate the primary closure leak rate consistent with the release of 1.4 curies per day, and the resultant whole body gamma dose at the exclusion area boundary.

(1) Annual average dilution factor at the exclusion area boundary: 1.37×10^{-6} sec/m^3 (Reference FSAR Section 14.12.8.3).

(2) Annual average wind speed: 3.67 meters per second (Reference FSAR, Section 14.12.8.3).

(3) Primary coolant activities: 879 MW(t) design values (Reference Table 3.7-1 of FSAR).

(4) Primary circuit helium inventory: 700 pounds of helium (Reference FSAR, Section 4.2.1).

(5) Average gamma decay energies and half lives: Table 1, GA-A12499 (LTR-4).

(6) Dose rate equation: $DR_{\gamma i} = 0.25\ \bar{E}_{\gamma i} X_i$ and $DR_{\beta i} = 0.23\ \bar{E}_{\beta i} X_i$ (Reference Regulatory Guide 1.3).

(7) Distance to the exclusion area boundary: 590 meters (Reference FSAR, Table 14.12-1).

(8) Plant capacity = 0.8 (292 days operation per year)

The noble gas nuclides and their decay products for "design" circulating activity are shown in Table 1. The total primary coolant activity for noble gases is 17014 curies. With a primary coolant helium inventory of 7370 pounds, each pound of helium contains 2.3 curies. To maintain the off-site releases due to this one effluent pathway within the proposed limit of 1.4 curies per day, up to 0.61 pounds per day could leak across the primary closure into the reheat steam and ultimately be exhausted out the condenser air ejector. Correspondingly, at current circulating activity, which is about 1% of "design," about 61 pounds per day could be released via this same pathway. The resultant annual exclusion area boundary whole body gamma dose and beta skin dose, based upon the release of 1.4 curies per day and a plant capacity factor of 0.8, is 0.14 millirad and 0.06 millirad, respectively.

The thyroid dose consistent with the leakage of 0.61 pounds per day primary coolant at "design" activity and a plant capacity factor of 0.8 was also investigated. The annual thyroid dose is not limiting being only 5.2×10^{-6} millirads.

It can be seen from the preceding calculations that the off-site doses for this one effluent pathway are negligibly small, and that a much more stringent requirement on leak tightness of the steam generator primary closures is imposed. With the absence of this potential effluent pathway, the limit on steam generator primary closure leakage for each loop is 400 pounds per day at a differential pressure of 10 psi. With the existence of the effluent pathway, the leakage limit is reduced to not exceed about 60 pounds per day with a differential pressure across the primary closure which will always be at least 50 psi. Therefore, the accident consequences of a secondary closure failure as discussed in the Basis for LCO 4.2.9 are not compromised.

2.2 Secondary Coolant Activity

Fort St. Vrain Technical Specification LCO 4.3.8 limits secondary coolant activity level to 0.009 microcuries per cubic centimeter of I-131 and 6.8 microcuries per cubic centimeter of tritium. The basis for these is to limit off-site doses in the event of an accident involving loss of outside power, main turbine trip, and failure of one diesel generator to start (FSAR, Section 10.3.2). In that event, about 52,000 gallons of secondary coolant would be vented to the atmosphere as steam.

Calculations indicate that these secondary coolant activity limits will not be approached for the limiting case of 0.61 pounds per day leakage of primary coolant at "design" activity levels entering the reheat steam system. For I-131 and neglecting any removal by the demineralizers or condenser air ejector, 1064 pounds per day of primary coolant leakage at "design" activity would have to occur to reach the LCO limit. The corresponding leakage rate for the tritium LCO limit would be 48,060 pounds per day.

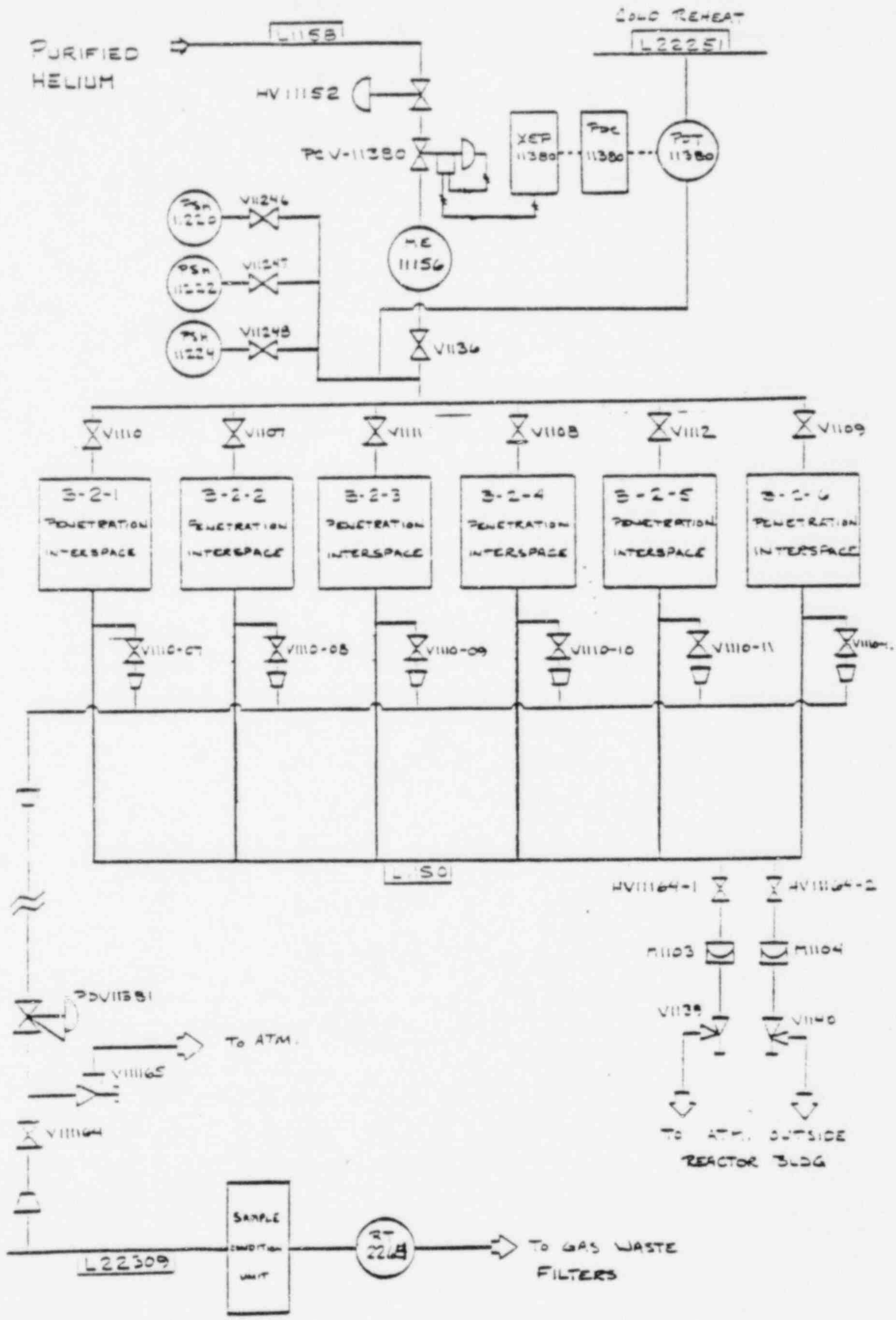
3. Monitoring

There are a number of plant radiation monitors which potentially could be utilized to monitor effluent releases of primary coolant leakage into the reheat steam system. These are the loop header radiation monitor channels 93250-10, 93251-10, 93252-10, 93250-11, 93251-11, and 93252-11; loop header activity monitor channels 2263 and 2264 (also know as "loop header condensate monitors"); air ejector monitor channel 31193; and the ventilation exhaust gas monitor 7324-1. These monitors are all discussed in FSAR, Section 7.3.5.

The loop header radiation monitors are part of the plant protection system and are designed to stay on scale at primary coolant leak rates of 1 to 3 pounds per second with the primary coolant at "design" activity levels. These monitors will not be useful for monitoring releases at the imposed low limit of 1.4 curies per day. The remaining radiation monitors all have about the same degree of sensitivity, but their capability to monitor will vary with the dilution of the sample. The piping for activity monitors 2263 and 2264 has been modified as previously described in the modified system description. They will be primarily used to monitor the activity of the steam generator interspace gas. The capability for monitoring the hot reheat header activity will be retained. With an instrument range of 10^{-5} to 10^{-1} $\mu Ci/cm^3$, they will be quite adequate for this service.

The air ejector monitor has an instrument range of 5×10^{-6} to 5×10^{-2} $\mu Ci/cm^3$. The ventilation exhaust monitor has an instrument range of 1×10^{-6} to 1×10^{-2} $\mu Ci/cm^3$. The ventilation exhaust flow rate is typically about 32,000 cfm. The air ejector flow rate is 15 to 30 cfm, depending on whether one or both air ejector trains are in operation. The air ejector monitor will, therefore, be more sensitive by about three orders of magnitude due to less dilution of the sample. The plant ventilation monitor is not suitable for monitoring the low release rate of up to 1.4 curies per day because of greater dilution. This monitor does have the capability of detecting .001 MPC based upon the annual average dilution factor. It would, therefore, serve as a backup should there be a sudden release far in excess of 1.4 curies per day.

The air ejector monitor, assuming maximum dilution with both air ejector trains operating and a fluid transport time of 1.5 minutes, has a lower level of detectability of 0.014 pounds per day primary coolant leakage at "design" activity level into the reheat steam system. At current primary coolant activity levels which are only 1% of design activity level, the lower level of detectability is 1.4 pounds per day. The monitor, which has a range of four orders of magnitude, will remain on scale at the limiting release level of 1.4 curies per day.



LOOP II SHOWN (LOOP I TYPICAL)

TABLE 1

879 MW(t) Noble Design Activities - from FSAR Tab. 3.7-1

Nuclide	Halflife	Primary Coolant Activity (Ci)	Buildup + Decay (1) (Ci)	$\bar{E}_\gamma$ (MeV)	$A\bar{E}_\gamma$ (Ci MeV)	$\bar{E}_\beta$(MeV)	$A\bar{E}_\beta$ (Ci MeV)
Kr-83m	112m	1780	1751	4.14-2	72.5	------	------
Kr-85m	4.4h	2080	2065	1.86-1	384	0.229	472.9
Kr-85	10.3y	4	4	2.20-3	.01	0.229	0.9
Kr-87	78m	2810	2744	7.64-1	2096	1.375	3773
Kr-88	2.8h	4200	4154	2.03	8433	0.307	1275.3
Rb-88	17.8m	N/A(2)	436	6.77-1	295	2.00	872
Kr-89	3.2m	1240	694	2.11	1464	1.279	887.6
Rb-89	15.4m	N/A(2)	113	2.25	254	0.896	101
Xe-133m	2.3d	30.1	30.1	2.33-1	7	------	------
Xe-133	5.27d	726	726	8.2-2	59.5	0.1005	73
Xe-135m	15.3m	1100	974	5.26-1	512	------	------
Xe-135	9.13h	1500	1498	2.62-1	392	0.303	454
Xe-137	3.9m	686	426	1.88-1	80	1.813	772.3
Xe-138	17m	858	769	2.18	1676	0.457	351.4
		Σ=17,014	Σ=16,384		Σ=15,727		Σ=9034

(1) Based upon time to reach EAB of 161 sec

$$\frac{\text{590m EAB distance}}{\text{3.67 m/sec wind speed}} = 161 \text{ sec}$$

(2) Not applicable since activity of this nuclide in the primary coolant which enters the secondary will be negligibly stripped from the steam by the air ejector.