MONITORING OF THE RADIOACTIVE GASEOUS WASTE MANAGEMENT SYSTEM

PROCEDURE USAGE REQUIREMENTS-		SECTIONS
Continuous Use:	Procedure must be open and readily available at the work location. Follow procedure step by step unless otherwise directed.	NONE
Reference Use:	Procedure or applicable section(s) available at the work location for ready reference by person performing steps.	ALL ATTACHMENTS
Information Use:	Available on plant site for reference as needed.	ALL SECTIONS

INFORMATION USE

1.0 PURPOSE

This procedure provides instructions for monitoring the Gaseous Waste Management System in accordance with the Technical Requirements Manual.

2.0 DEFINITIONS

2.1 Xe-133 equivalence - Equivalent activity derived by multiplying the activity of the nuclide of interest by its dose factor.

2.2 Dose factor - factor assigned to each nuclide of interest that is a ratio of the dose derived from an equivalent amount of Xe-133.

3.0 PRECAUTIONS

3.1 Follow appropriate Radiological Control practices when handling radioactive samples.

3.2 Transfer of samples to a counting vial should be done in the laboratory hood.

3.3 The Technical Requirements Manual for the Gaseous Waste Processing System requires that:

3.3.1 The concentration of oxygen in the Gaseous Waste Processing System shall be limited to less than or equal to 2% by volume whenever the hydrogen concentration exceeds 4% by volume.

3.3.2 With the concentration of oxygen in the Gaseous Waste Processing System greater than 2% by volume but less than or equal to 4% by volume, reduce the oxygen concentration to the above limits within 48 hours.

3.3.3 With the concentration of oxygen in the Gaseous Waste Processing System greater than 4% by volume and the hydrogen concentration greater than 4% by volume, immediately suspend oxygen additions and all additions of waste gases to the system and reduce the concentration of oxygen to less than or equal to 4% by volume, then reduce the oxygen concentration to less than or equal to 2% by volume within 48 hours.

3.4 The Technical Requirements Manual for the Gaseous Waste Processing System requires that:

3.4.1 The quantity of radioactivity contained in each gas decay tank shall be limited to less than or equal to 2.0 E+5 Curies of noble gases (as Xe-133 equivalent).

3.4.2 With the quantity of radioactive material in any gas decay tank exceeding the above limit, immediately suspend all additions of radioactive materials to the tank and within 48 hours reduce the tank contents to within the limit. Submit required reports, refer to applicable Chemistry procedures.

3.5 Table 1 of this procedure contains ODCM table 3-1 and Technical Requirement Manual section 13.12.1 with required actions.

3.6 Hydrogen is a colorless, odorless gas that burns with a non-luminous flame, which can be invisible under bright light. At atmospheric conditions, hydrogen gas is combustible ranging from 4% to 74% by volume. Hydrogen has a lower explosive limit of 13% in air at atmospheric pressure.

3.7 Before breaching a hydrogen related system, the system should be purged and atmospheric concentrations verified below the LEL. Also, when working on a hydrogen related system, use non-sparking tools when the possibility of exceeding LEL exists.

4.0 PROCEDURE

4.1 SYSTEM DESCRIPTION

4.1.1 The Gaseous Waste Processing System (GWPS) is designed to collect, process, and store gaseous wastes generated by plant operations. The system is designed to assure that the release of gaseous effluents from the plant and expected offsite doses are as low as reasonably achievable (ALARA) as defined in Appendix I of 10CFR50.

4.1.2 The GWPS is controlled from the waste processing panel. The GWPS consists mainly of two closed loops comprised of a waste gas compressor, a catalytic hydrogen recombiner and seven waste gas decay tanks (GDTS) to accumulate the fission product gases.

4.1.3 Two waste gas compressor packages are provided to circulate gases around each GWPS system loop. One is normally in use and the other on a standby basis.

4.1.4 Three catalytic hydrogen recombiners are provided for the two units. One recombiner per unit is used in each main process loop to remove hydrogen from the hydrogen-nitrogen fission gas mixtures by oxidation to water vapor. The units are self-contained and are designed for continuous operation.

4.1.5 The Waste Gas Decay tanks are of the vertical cylindrical type constructed of carbon steel. There are a total of 16 waste decay tanks. Seven are used by each unit during normal operation; the remaining two are shared between the two units and are used for shutdown and startup.

4.1.6 The oxygen concentration of the Waste Gas System is monitored and controlled to ensure that a flammable hydrogen-oxygen mixture does not occur. The GWPS is provided with two analyzers to monitor oxygen concentrations. One is between the oxygen supply and the hydrogen recombiner package, and one is downstream of the hydrogen recombiner. When the hydrogen concentration is above the lower flammability limit of 4 percent, the minimum concentration of oxygen necessary for deflagration is 5 percent. The control function assigned to these analyzers is to automatically terminate the oxygen supply before reaching GWPS oxygen concentrations favorable for hydrogen flammability. Each hydrogen recombiner package also includes two hydrogen analyzers. One monitors the process stream entering the hydrogen recombiner, and one monitors the discharge stream.

4.1.7 During normal power operation, nitrogen gas with entrained fission gases is continuously circulated around each GWPS process loop by one of the two waste gas compressors in the loop. Fresh hydrogen gas is charged to the VCT, where it is mixed with fission gases which have migrated from the reactor coolant into the VCT gas space. The contaminated hydrogen gas is continuously vented from the VCT into the circulating nitrogen stream to transport the fission gases into the GWPS. The resulting mixture of nitrogen-hydrogen fission gas is pumped by the waste gas compressor to the hydrogen recombiner, where enough oxygen is added to reduce the hydrogen to a low residual concentration by oxidation to water vapor on a catalytic surface. After the water vapor is removed, the resulting gas stream is circulated to a normal operation GDT and back to the waste gas compressor suction to complete the circuit. Refer to Figure 1 for a schematic of the Gaseous Radioactive Waste System.

4.1.8 Each normal operation GDT is capable of being isolated, and only one tank is valved into operation in each process loop at any time. This minimizes the amount of radioactive gases that could be released as a consequence of any single failure, such as the rupture of any single tank or connected piping. By alternating the use of these tanks, the accumulated activity from one unit is distributed among all seven normal operation GDTs in the process loop.

4.1.9 Radiation detector RE-0013 is located adjacent to the pipe in the recirculation loop of the inservice Waste Gas Decay Tank. This monitor has been calibrated to allow the determination of the inservice Waste Gas Decay Tank radioactivity inventory.

4.1.10 With continued plant operation, pressure in the normal operation will gradually increase as non-removable gases accumulate in the system. The initial system equipment lineup will be from the waste gas compressor to the hydrogen recombiner and then to the normal operation GDT. As the normal operation GDT pressure builds up, compensation must be made by periodic adjustment of the hydrogen recombiner backpressure control valve. When the normal operation GDT pressure reaches approximately 20 psig, the backpressure control valve will be fully open, so that no more adjustment can be made. At this time, the appropriate bypass lines are opened to line up the equipment for flow from the waste gas compressor to the normal operation GDTs and then to the hydrogen recombiner. The hydrogen recombiner backpressure control valve is reset as required for the new arrangement, and the normal operation GDT pressure indicators are switched by Operation Department to read high range. This arrangement is suitable for operation up to 100 psig.

4.1.11 Degassing operations are different than normal operations of the WGPS.

During normal operation, the fission gasses that escape from the RCS into the VCT vapor space are started on the removal process by adding hydrogen to the VCT vapor space then by using nitrogen, basically as a carrier gas. The mixture of hydrogen and fission gasses are routed through the waste gas compressor and the catalytic recombiners.

Degassing operations differ from normal operations in that a system or component has unwanted gasses removed by a procedure not ordinarily used in routine operation. Examples would be the degassing of the recycle hold up tank; degassing the RCS in preparation for removing the pressure vessel top; degassing the reactor coolant drain tank; or other operations controlled degassing procedures.

When actions refer to degassing, these are the types of operations referred to. The type of operation: (i.e. degassing or routine operation) determines the sampling frequency if an active LCO is in place against WGPS. The Shift Supervisor will determine the type of operation that we are under (degassing or routine operation) and Chemistry will schedule the sampling frequency to satisfy the LCO action statement accordingly.

4.2 FREQUENCY OF RADIOACTIVITY INVENTORY DETERMINATION

4.2.1 The determination of the radioactivity inventory of tanks in the GWPS will be made at the frequency prescribed in Procedure 30025-C, "Periodic Analysis Scheduling Program".

4.2.2 Each tank that has been in service during the previous 24 hours and is not presently in service, needs to have its inventory determined from the historical (10) minute data recorded by the PERMS system for RE-0013. The (10) minute average used shall be from the three hour period prior to tank switchover or the waste gas system being shutdown, with the period 30 minutes prior to tank switchover or the waste gas system being shutdown being preferred.

4.2.3 In the event that RE-0013 is out of service, the Gas Decay Tanks that have been in service in the previous (24) hours must be sampled and analyzed for contained radioactivity, as outlined in subsection 4.3.3 of this procedure.

4.3 WASTE GAS DECAY TANK RADIONUCLIDE INVENTORY DETERMINATION

4.3.1 The Gain factor for PERMS monitor RE-0013 was determined by calculating the monitor response for Xe-133. The response to obtain the maximum allowable activity per tank would exceed the maximum range of the detector; therefore if the monitor is on scale and exceeding the Alarm Set points, the total activity in the individual tank is still below the allowable limits of 2.0 E+5 curies

4.3.2 Use attachments 1 or 2 to determine the waste gas radionuclide inventory.

4.4 SYSTEM SPECIFICATIONS

The system specifications and corrective actions for the Gaseous Waste Processing System are:

Parameter	Specification	Corrective Actions
Oxygen	2% when H_2 4%	Reduce the oxygen concentration to within limits (see Notes A & B)
Hydrogen	Monitor with O_2 concentration	

Parameter	Specification	Corrective Actions
Total Contained Radioactivity	2.0 E+5 Ci noble gases (as Xe-133)	Suspend all additions of radioactive materials to the tank and, within 48 hours, reduce the tank contents to below the limit.

Note A) With the concentration of oxygen in the Gaseous Waste Processing System greater than 2% by volume but less than or equal to 4% by volume, reduce the oxygen concentration to the above limits within 48 hours.

Note B) With the concentration of oxygen in the Gaseous Waste Processing System greater than 4% by volume and the hydrogen concentration greater than 4% by volume, immediately suspend oxygen additions and all additions of waste gases to the system and reduce the concentration of oxygen to less than or equal to 4% by volume, then reduce the oxygen concentration to less than or equal to 2% by volume within 48 hours.

4.5 CALCULATION OF Xe-133 EQUIVALENT ACTIVITY

4.5.1 Calculate Xe-133 Equivalence using the Attachment 3 to the procedure.

4.6 SYSTEM MONITORS

The GWPS is normally monitored by on-line hydrogen and oxygen monitors. A minimum of the inlet hydrogen monitor and two oxygen monitors per recombiner are required by the Technical Requirements Manual

4.6.1 Oxygen Monitors

4.6.1.1 Action B.1 and B.2 - With the outlet Oxygen Monitor Channel inoperable, operation of the system may continue provided grab samples are taken and analyzed at least once per 24 hours and the oxygen concentration remains less than 1 percent.

4.6.1.2 Action A.1 - With the Inlet Oxygen Monitor Channel inoperable, operation may continue if inlet hydrogen monitor is OPERABLE.

4.6.1.3 Action D.1 and D.2 and D.3 - With both oxygen channels or both the inlet oxygen and inlet hydrogen monitors inoperable, suspend oxygen supply to the recombiner. Addition of waste gas to the system may continue provided grab samples are taken and analyzed at least once per 4 hours during degassing operations or at least once per 24 hours during other operations and the oxygen concentration remains less than 1 percent.

4.6.2 Hydrogen Monitors

4.6.2.1 Action D.1 and D.2 and D.3 - With one or more hydrogen monitors inoperable, suspend oxygen supply to the recombiner. Addition of waste gas to the system may continue provided grab samples are taken and analyzed at least once per 4 hours during degassing operations or at least once per 24 hours during other operations and the oxygen concentration remains less than 1 percent.

5.0 REFERENCES

5.1 VEGP Technical Requirements Manual

5.2 NUREG 1.109 Oct 1977 Revision 1

5.3 PROCEDURES

5.31 35516-C, "Operation Of The Nuclear Sampling System-Gaseous"

5.3.2 33035-C, " Gamma Spectroscopy For Radiochemistry"

5.3.3 30170-C, "Chemistry Department Interface Agreements"

5.3.4 30090-C, "Chemistry Technical Specifications Surveillance Performance Coordination"

5.4 ODCM

END OF PROCEDURE TEXT

DATA SHEET 1

UNIT ____

GDT #_____

A. **PERMS MONITOR RE-0013 METHOD**

Date/Time of reading _____

	CURRENT	10 MIN AVG
RE-0013 reading _____uci/cc	[ ]	[ ]

GDT EQUIV Xe 133 Calculation:

(RE-0013 reading in uci/cc) x 1.699 E +01 $\frac{ccCi}{\mu ci}$

TOTAL CURIES Xe 133 EQUIV _____

[ ] Yes [ ] No Monitor operable (RE-0013)

Calculated by: _____ Date _____

Reviewed by: _____ Date _____

DATA SHEET 2 Sheet 1 of 1

TOTAL EQUIVALENT Xe-133

UNIT ____

GDT #_____

B SAMPLING AND ANALYSIS METHOD

EQUIVALENT XENON-133 ACTIVITY WORKSHEET

NUCLIDE	ACTIVITY uCi/cc		DOSE FACTOR		EQUIVALENT Xe-133
Ar-41		X	3.01E+1	=	
Xe-131M		X	3.11E-1	=	
Xe-133		X	1.00	=	
Xe-133M		X	8.54E-1	=	
Xe-135		X	6.16E0	=	
Xe-135M		X	1.06E+1	=	
Xe-137		X	4.83E0	=	
Xe-138		X	3.00E+1	=	
Kr-83M		X	2.57E-4	=	
Kr-85		X	5.48E-2	=	
Kr-85M		X	3.98E0	=	
Kr-87		X	2.01E+1	=	
Kr-88		X	5.00E+1	=	
Kr-89		X	5.65E+1	=	

EQUIVALENT Xe-133 ACTIVITY

Date/Time of Sample _____

Gas Decay Tank Pressure _____PSIG

Equivalent Xe-133 Activity _____uCi/cc

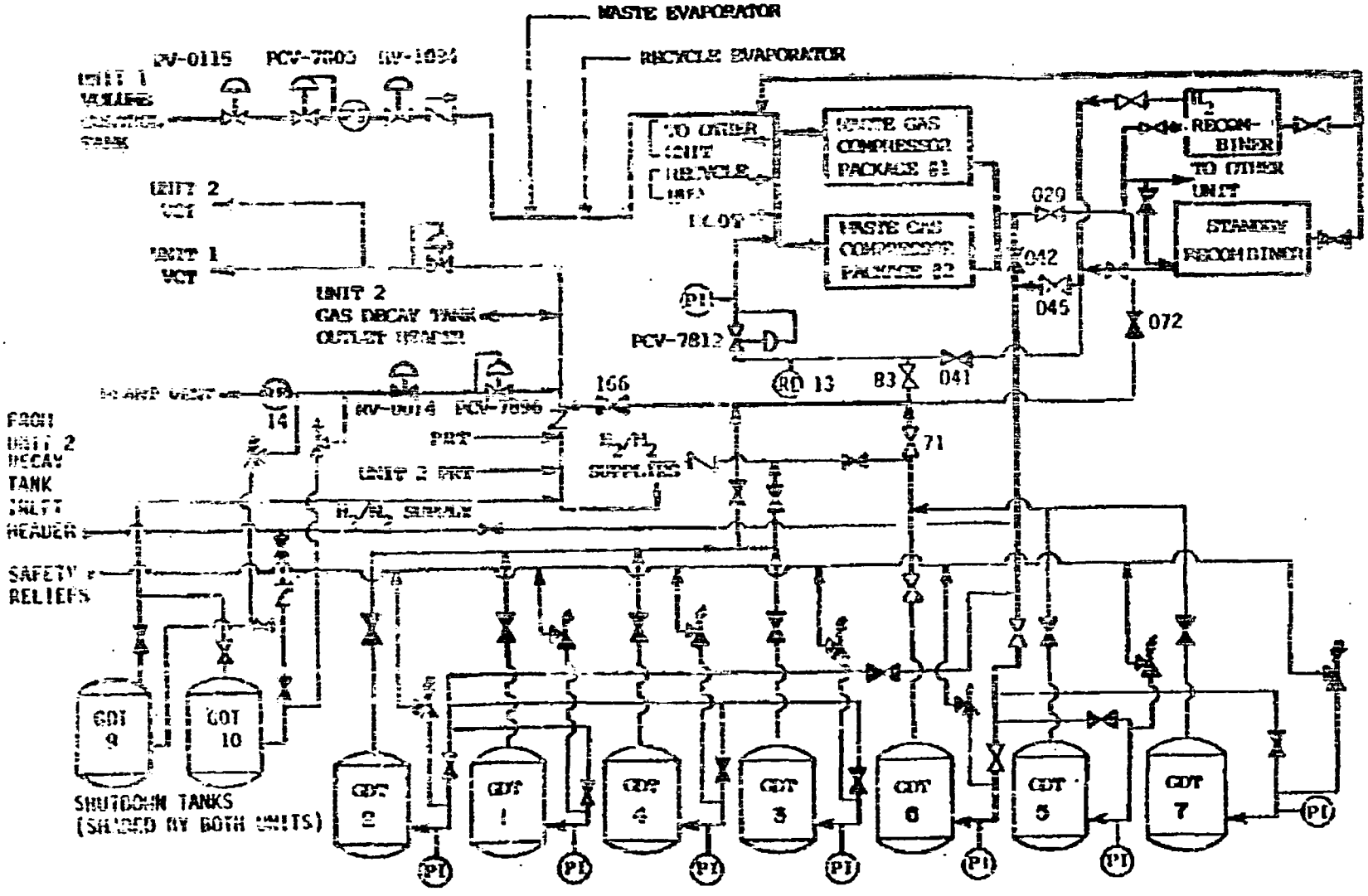
TOTAL EQUIVALENT Xe-133 CALCULATION:

$$\left[1.699\ E+07 cc\right]\left[\frac{\left(GDT\ psig+14.7\right)}{14.7}\right]\left[Equivalent\ Xenon\right]\left[1.0\ E-06\ {}^{Ci}/_{\mu ci}\right]$$

TOTAL CURIES Xe-133 EQUIV_____

Calculated by: _____Date _____

Reviewed by: _____Date _____



GASEOUS RADIOACTIVE WASTE SYSTEM LINED UP FOR LOW PRESSURE OPERATION TO TANK 6
UNIT 1 (UNIT 2 IDENTICAL)
FIGURE 1

TABLE 1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
ODCM and TECHNICAL REQUIREMENTS MANUAL ACTIONS

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1.	GASEOUS WASTE PROCESSING SYSTEM note1			
a.	Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (ARE-0014) (Common)	1	***	45
b.	Effluent System Flow Rate Measuring Device (AFT-0014) (Common)	1	***	46
2.	GASEOUS WASTE PROCESSING SYSTEM Explosive Gas Monitoring System note 2			
a.	Hydrogen Monitor	1/recombiner	**	D
b.	Oxygen Monitor	2/recombiner	**	D or B
3.	CONDENSER AIR EJECTOR AND STEAM PACKING EXHAUST SYSTEM note 1			
a.	Noble Gas Activity Monitor (RE-12839C)	1	***	47
b.	Iodine Sampler (RE-12839B)	1	***	51
c.	Particulate Sampler (RE-12839A)	1	***	51
d.	Flow Rate Monitor (FT-12839) (FT-12862)	1	***	46
e.	Sampler Flow Rate Monitor (FI-13211)	1	***	46

note 1- ODCM requirements

note 2- Technical Requirements Manual requirements

REFERENCE USE

Sheet 1 of 1

ATTACHMENT 1

1.0 WASTE GAS DECAY TANK RADIONUCLIDE INVENTORY DETERMINATION

1.1 Perms Monitor RE-0013 Method

1.1.1 ENSURE PERMS monitor RE-0013 is in operation, if not use the Grab Sampling Methodology

1.1.1.1 RE-0013 must be operational using the following parameters:

a. GAIN FACTOR = 3.70E-02 μCi Xe-133/cc/cpm

b. HIGH ALARM = 2.35×10^3 μCi Xe-133/cc

c. ALERT ALARM = 2.35×10^2 μCi Xe-133/cc

1.1.2 ENSURE PERMS monitor RE-0013 is not in alarm, if it is in alarm use the Grab Sampling Methodology

1.2 If the current reading and the latest (10) minute readings indicate 0.00E+00, observe the previous (6) ten minute averages.

1.3 If these previous readings are also 0.00E+00 and the channel is operating normally (i.e. no low fail alarms, top of scale alarms, power failure) then these zero readings may be used. Refer to 1.5 below.

1.4 Record the current monitor reading or the latest (10) minute average (μCi/cc) and the tank number of the in-service tank of Data Sheet 1.

1.5 Check if current reading or (10) minute average is used on Data Sheet 1.

NOTE

A separate data sheet must be used for each tank in service in the previous 24 hours.

1.6 Calculate contained Xe-133 activity using the formula on Data Sheet 1.

1.7 When using the zero reading for this calculation, log ≤5.1 curies because the total activity of the tank will be ≤5.1 curies.

REFERENCE USE

Sheet 1 of 1

ATTACHMENT 2

1.0 Waste Gas Decay Tank Sampling Method

NOTE

All GDT's in service in the previous 24 hours shall be sampled for contained activity.

1.1 Prior to sampling Gas Decay Tanks (GDT's), contact Operations Department to verify which GDT is in service and what GDT's have been in service in the previous 24 hours.

1.2 Sample Location

1.2.1 Samples of the GWPS are collected locally on "B" level of the Aux Building in accordance with Procedure 33015-C "Obtaining Gaseous Samples for Radioactivity Analysis."

1.2.2 Samples of the GWPS are collected at the Nuclear Sampling System Gaseous Sample Panel 1211-P5-NSG in accordance with Procedure 35516-C "Operation Of The Nuclear Sampling System - Gaseous"

1.3 Determine the Xe-133 equivalent activity per Attachment 3 of this procedure.

REFERENCE USE

Sheet 1 of 1

ATTACHMENT 3

1.0 CALCULATION OF Xe-133 EQUIVALENT ACTIVITY

1.1 Analyze a gas decay tank sample in accordance with Procedure 33035-C, "Gamma Spectroscopy For Radiochemistry".

NOTE

Normal method is option from menu on the gamma spectroscopy system. The manual method provided here is not routinely used. The computer-generated data sheet may be used for documentation in lieu of Data Sheet 2.

1.2 Use the gamma spectroscopy computer program to calculate the Xe-133 equivalence or;

1.2 Calculate the Xe-133 equivalence manually.

1.2.1 Enter uci/cc of each nuclide reported from the gamma spectrum analysis in column 2 of Data Sheet 2, Equivalent Xenon Activity Worksheet.

1.2.2 Multiply the activity by the appropriate dose factor for the nuclide of interest and enter the product in the right hand column.

1.2.3 Total the values in the right-hand column for Equivalent Xe-133 activity

1.2.4 Multiply the equivalent Xe-133 activity by the volume of gas in the Decay Tank

$$\frac{[1.699\ E7\ cc(\ psig\ \text{tank} + 14.7)]}{(14.7)}$$

1.2.5 Multiply by 1 E-6; this will give the total Xe-133 equivalent activity in Curies for the Gas Decay Tank. (See Data Sheet 2)

1.2.6 Notify laboratory supervision of any out-of-specification conditions.

1.2.7 Report analysis results to Operations in accordance with applicable Chemistry procedures, or a phone call to Operations will suffice as an alternative.