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Overview of the Emergency Information Network

The Emergency Information Network (EIN) at TMI is a LAN based system that allows emergency organization personnel to view information on plant conditions and offsite dose projections during a plant emergency. Because it is a LAN based system, the same information can be viewed from any of the major emergency facilities. The ability of the different facilities to share common data during an emergency enhances communications within the emergency team, and minimizes the potential for conflicting information.

The heart of the EIN is the Continuous Online Assessment System or **COLA**. The COLA produces a new dose projection every 4 to 6 minutes and displays it on the EIN. This is accomplished by a central "Host Computer" retrieving Met Data, RMS readings, RCS Activity, Iodine Spiking Factors, and plant information such as pressures, temperatures, flowrates etc from the plant's computer system. This information is used to produce a separate dose calculation for each of TMI's release pathways that are then added together for a complete dose projection from TMI. The dose projection is then sent to the Local Area Network (LAN) and is available for review by Emergency Management Personnel. Since the host computer automatically runs dose projections every 4 to 6 minutes, the RAC cannot produce a dose projection any time he/she wishes using the COLA.

In addition to the COLA, the EIN also provides the capability to run manual versions of the code. The Manual Codes are located on the hard drives of the dose projection computers in the emergency response facilities and are independent of the LAN system. As a result, they can be used if the LAN system is not operational for some reason. Because the manual codes are independent of the LAN system, the results are NOT displayed on the network.

Therefore, information that is important to other personnel such as the Group Leader R&EC must be faxed to them. The two versions of the manual code available on the EIN menu are:

1. Manual Code – used to perform dose projections out to 30 miles. IREO personnel performing manual dose projections would use this code.
2. Quick Code – a simplified manual code that would be used by the GRCS during the first hour if the COLA is not functional. Only an RMS reading and met data are required for entry.

The Manual Codes can be used for some of the following reasons:

1. To perform a dose projection if the COLA is out of service
2. To perform dose projections between COLA dose projections
3. To perform a "What If" dose projection.
4. To perform a dose projection if the data being retrieved by the COLA is considered inaccurate (i.e., a bad RMG-25 reading).
5. To perform a dose projection if the release is not properly monitored by an RMS monitor.
6. To compare or validate the COLA dose projection for any other reason.

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A much more detailed description of Manual Code calculations is discussed later in this manual

The third dose projection component of the EIN is the MIDAS Plume Plot System. The COLA calculated source term leaving the plant is automatically imported into the MIDAS program, which produces plume plots. MIDAS calculates dose projections differently than the RAC codes. The RAC code is a straight-line gaussian model. That means it takes the source term leaving the plant at that moment and calculates the dose based on the most current met conditions. It ignores releases of radioactivity that occurred prior to the most current dose projection. It projects the doses that will be seen offsite if things do not change. The MIDAS code is a particle in cell model. That means it models the offsite doses by tracking the activity released every 15 minutes and coupling that activity with the met data for that 15 minutes. As a result, it more closely approximates dose rates that should currently be seen offsite. As a result, the MIDAS Plume Plots are used for comparison with field team and Reuter Stokes data. The EAC compares field team data it receives with the MIDAS Plume Plots. In addition, the EIN provides an option which displays a comparison of MIDAS projected doses with actual Reuter Stokes monitor readings. This comparison is used to check that the source term produced by the COLA is reasonable based on what we are seeing in the field. The MIDAS Program can be run off the "C" drive by EACC personnel with manual input of source terms when the COLA is out of service.

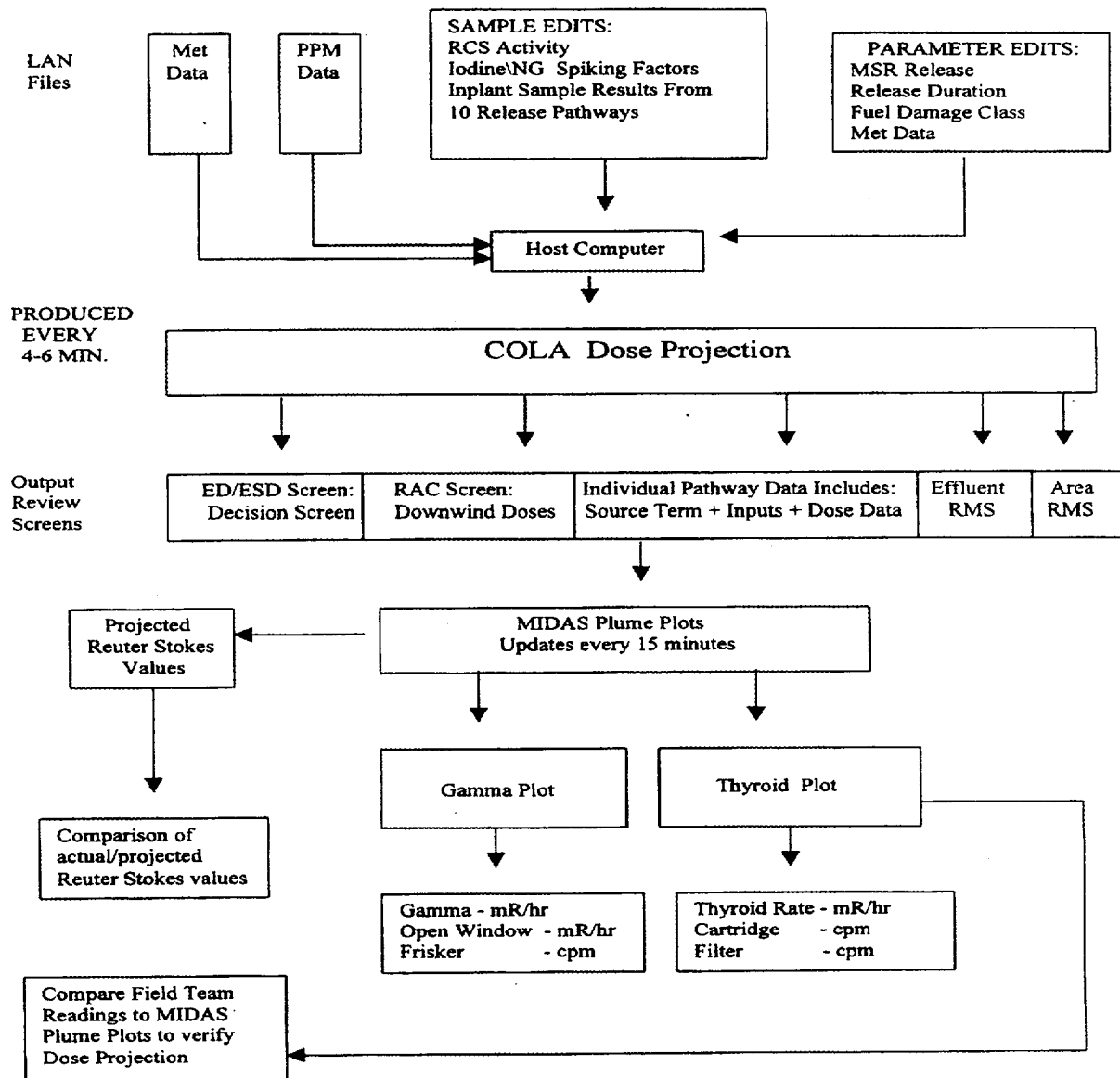
Finally, the EIN also displays effluent RMS and plant area monitor readings. It also provides a listing of the parameter values that were used in calculating the dose projection for each pathway. A schematic illustration of the EIN appears on the next page.

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Emergency Information Network Block Diagram



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Emergency Information Network Block Diagram Description

The Host Computer, located on the 1st floor of the OSF, produces the COLA dose projection screens by retrieving a lot of different information that resides on the LAN. This information includes:

1. Plant Performance Monitor (PPM) Data – Includes all of the data residing on the PPM such as RMS data, Condenser flow rates, Condenser vacuum, RCS temperature/pressure, OTSG pressures, OTSG levels etc.
2. Met Data – Retrieves wind speed, wind direction, delta temperature directly from the Met Tower. Updated every 15 minutes.

Sample Edit Screen

1. RCS Activity – Retrieves the default RCS Activity entered into the Sample Edit screen by Rad Engineering or the edited RCS Activity entered by RAC/Rad. Eng. Support personnel into the Sample Edit screen.
2. Iodine/NG Spiking Factors – Retrieves the default Spiking Factors entered into the Sample Edit screen by Rad Engineering or the edited Spiking Factors entered by RAC/Rad. Eng. Support personnel into the Sample Edit screen. The Nuclear Engineering Group determines the default spiking factors.
3. In-plant Sample Results – The sample results from TMI 1's 10 release pathways may be entered into this screen by RAC/Rad. Eng. Support personnel. Examples are MAP – 5/sample panel results for RMA-5, 8, 9, effluent pathways and CATPASS samples for the Design Basis Leakage pathway.

Parameter Edit Screen

1. MSR Release – The default MSR position is closed but should a release occur through this pathway an open MSR position can be indicated by using this screen.
2. Release Duration – 8 hours is the default release duration but can be edited by RAC/Rad. Eng. Support personnel.
3. Fuel Damage Class – The COLA automatically determines the Damage Class from the RCS Temperature (average of the 5 highest incores). If plant conditions warrant it, RAC/Rad. Eng. Support personnel can edit the Damage Class.
4. Met Data – If the COLA is retrieving inaccurate Met Data from the Met Tower, this screen can be used to input the correct information.

The COLA, after retrieving all of this information, calculates a new dose projection every 4 to 6 minutes and displays the associated screens on the LAN. The only information that is not updated within the 4 to 6 minute run is the Met Date, which is updated every 15 minutes. All of the information on the Emergency Information Network is retrieved by the Host Computer and displayed on the LAN. The COLA dose projection includes the following screens:

1. ED/ESD Screen
RAC Screen
Individual pathway Data

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4. Parameter Edit Screen
5. Sample Edit Screen

The Host Computer then uses the source term from the dose projection to produce a new MIDAS Plume Plot every 15 minutes. The MIDAS program produces a Beta/Gamma plot and a Thyroid Plot. These plots are produced in three different map sizes, island view, 2.5 mile view, and 6 mile view. The primary purpose of MIDAS is to verify the dose projection.

The MIDAS program then produces the projected Reuter Stokes values again every 15 minutes. These projected Reuter Stokes values can be compared to the actual Reuter Stokes values as another confirmation of the dose projection. This is possible since MIDAS uses the same source term as the COLA dose projection and then produces the Reuter Stokes projected values.

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**Emergency Information System Main Menu
(Typical)**

EMERGENCY INFORMATION NETWORK			
1A. ED/ESD SCREEN	1B. RAC SCREEN	1C. PARAMETER EDITS	1D. SAMPLE EDITS
2A. MIDAS PLUME PLOTS	2B. FIELD TEAM DATA		
2C. AIR SAMPLE CALC	2D MIDAS Plume Plot Edit (EACC Only)		
3. REUTER STOKES FIELD DATA AND MIDAS CALCULATION COMPARISON			
4. INDIVIDUAL PATHWAY DATA * SOURCE TERM * INPUT DATA * DOSE DATA			
5. EFFLUENT RMS			
6. AREA GAMMA AND LIQUID RMS			
7. DELETED			
8. QUICK CODE			
9. MANUAL CODE			
10. EXIT TO DOS			
ENTER THE APPLICATION NUMBER:			

This is the main menu for the Emergency Information Network. Each selection will be discussed in detail in the subsequent pages.

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ED/ESD Screen (1A) (Typical)

ACTIONS TO BE TAKEN BASED UPON THIS DOSE CALCULATION:

Declare an ALERT per A1.1 (5.40E+01) mRem/Hr CDE)

Do NOT Issue A Protective Action Recommendation

Most Limiting Dose (Rate)	Dose Type	Location	Presently at Percent of Next Limit
1.71E+01 mRem	TEDE	1 Mile	17%
4.32E+02 mRem	CDE	1 Mile	86%

RELEASE PATHWAY CONTRIBUTION TO MOST LIMITING DOSE using CDE Dose

CONDENSER OFFGAS	0.0%	B OTSG ADV	100.0%
RX BLDG DESIGN BASIS LEAKAGE	0.0%	B OTSG MSR	0.0%
EMERGENCY FEED PUMP EXHAUST	0.0%	STATION VENTILATION	0.0%
A OTSG ADV	0.0%	RX BLDG PURGE EXHAUST	0.0%
A OTSG MSR	0.0%	ESF EXHAUST	0.0%

WIND SPEED (MPH): 5.0 WIND DIRECTION (DEG FROM): 90 DELTA TEMP (DEG): -1.00
STABILITY CLASS (A TO G): C RELEASE DURATION (HRS): 8 NRC CLASS (1-10): 1

CURSOR LEFT (BACKWARD) CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)

1. The ED/ESD Screen provides the **Radiological Emergency Action Level (EAL)** for the event straight out of the Emergency Classification and Basis procedure. It also provides the most limiting dose or dose rate that required entry into the EAL.
2. Prompts a **Protective Action Recommendation (PAR)** if a General Emergency is declared. If a Site Area Emergency is declared, the message will prompt RAC personnel to review the PAR Logic Diagram.
3. **Most Limiting Dose (Rate)** provides the highest integrated Total Whole Body Dose/Dose Rate (TEDE) or Child Thyroid Dose/Dose Rate (CDE) based on the latest dose projection. The Most Limiting Dose (Rate) is the summation of all 10 of TMI's release pathways and shows the downwind location of the highest dose or dose rate. Dose rates are shown for dose projections requiring less than an Alert classification. Integrated dose is displayed for dose projections requiring an Alert classification or above (i.e., approaching a Site Area or General Emergency).
4. **Presently at PerCent of Next Limit** provides the user with an indication of how close the dose projection is to approaching the next emergency classification level that would require escalation of the event. The most limiting type of dose is highlighted.
5. Displays TMI's 10 release pathways in % of dose contribution. The pathway with the highest % doses will be highlighted on the screen. The screen also displays which type of dose (TEDE or CDE) is being used to calculate the percentages.

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6. Provides **Met Date**: Wind Speed, Wind Direction (degrees from), Delta T, and Stability Class (A to G). This information is updated every 15 minutes from the Met Tower. The Met Data is also the average of all of the readings taken over 15 minutes from the Met Tower. If the Met Tower stops transmitting to the LAN, inaccurate Met Data will display on this screen and will be used by the COLA. Editing of the Met Data is then required and will be discussed in the "Parameter Edits" screen section.
7. Provides **Release Duration** default (8 hours). This parameter can be edited and will also be discussed in the "Parameter Edits " screen section. Protective Action Guidelines (PAGs) are based on the integrated dose at the site boundary therefore a conservative release duration would cause a conservative dose projection.
8. **Fuel Damage Class** is calculated automatically by the COLA using PPM data that uses the average of the 5 highest incore detectors. If the calculated Fuel Damage Class is not accurate based on plant conditions (i.e. mechanical fuel damage would not affect the incore detectors) editing can be performed . This will also be discussed in the "Parameter Edits" section.

RAC Screen (1B) (Typical)

TOTAL DOSE FROM ALL PATHWAYS IN MREM		
TIME: 07:23:18 DATE: 01-13-1998 CALCULATION #: 1		
<u>DISTANCE</u>	<u>COMMITTED DOSE EQ (MREM)</u>	<u>TOTAL EFFECTIVE DOSE EQ (MREM)</u>
Site Boun.	1.5E-01	1.0E-02
Ex. Area	1.0E-01	6.5E-03
1 MILE	3.5E-02	2.6E-03
2 MILE	1.4E-02	1.2E-03
5 MILE	3.4E-03	2.6E-04
10 MILE	1.4E-03	1.0E-04
HIGHLIGHTED DOSES ARE MAXIMUM VALUES		
CURSOR LEFT (BACKWARD) CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)		

The **RAC Screen** lists the "Total Dose from All 10 Pathways. This screen displays the Committed Dose Equivalent CDE (Child Thyroid) and Total Effective Dose Equivalent TEDE in ranges from the Site Boundary out to 10 miles. If RAC personnel suspect that significant doses are present outside of 10 miles, then the Manual RAC Code must be used since it can calculate doses beyond 10 miles. The downwind location with the most limiting dose is highlighted on the screen.

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Parameter Edits Screen (1C)

SELECT PARAMETER EDITS		
Minimum: 0	Default: 0	Maximum: 1
PARAMETER EDITS		
<u>PARAMETER NAME</u>	<u>PARAMETER VALUE</u>	<u>ACTIVE EDIT</u>
MSR RELEASE	0 (1 IS OPEN)	0 (1 IS ACTIVE)
RELEASE DURATION	8 (0-99 HOURS)	0 (1 IS ACTIVE)
DAMAGE CLASS	1 (CLASS 1-10)	0 (1 IS ACTIVE)
WIND SPEED	4 (2-99 MPH)	0 (1 IS ACTIVE)
WIND DIRECTION	210 (0-360 DEG)	0 (1 IS ACTIVE)
DELTA TEMP	-1.1 (-10 TO +10 DEG)	0 (1 IS ACTIVE)
F1: Next F2: Prev	Alt F10: Abort	F10: Done

1. **MSR Release** – This option allows RAC personnel to indicate to the COLA whether a Main Steam Relief Valve is open. A "1" entered in the parameter value indicates that a valve is open and a "0" indicates a closed position. The COLA will then calculate the flow rate based on the main steam pressure obtained from the PPM. This option is only accurate if ONE MSRV is open. In the unlikely event that more than one valve is stuck open the Manual RAC Code must then be used. The Manual Code allows inputs for the position of all of the MSRVs and ADVs. Also the COLA always uses RMG-26 or RMG -27. If this RMS monitor is isolated, which occurs when MSV 2A or 2B are closed, then the Manual Code (Contingency Calculation) must be used. An operator must be sent up to the Intermediate Building roof to visually check the valve to verify whether a MSRV is really open. This requirement is incorporated into plant procedures.
2. **Release Duration** – This edit option is probably the one most often changed by the RAC. Eight hours is the default release duration used by the COLA. Anytime you want to enter another release duration other than 8 hours simply select a number from 1-99 and enter it in the Parameter Value. Since this option has a direct effect on the integrated dose released from TMI, the number used must always come only from the Emergency Director. If you suspect the ED is giving you a conservative value for release duration question him on it.
3. **Fuel Damage Class** – This very important parameter is calculated by the COLA, using the average temperature of the 5 highest incore detectors. However if you don't think this calculation is accurate, the parameter can be edited by selecting 1 through 10 and entering it as the Parameter Value. One example of the need to edit would occur if the core suffered mechanical damage unrelated to temperature and pressure. A Damage Class of 2, 3, or 4 would then be entered as the Parameter Value.

Keep in mind that once core damage occurs it can never be repaired. The COLA calculated damage class may decrease based on the cooling of the core but the previously higher Damage Class must continue to be used by using the editing option.

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The purpose of the Fuel Damage Class is to determine what percentage each of the 10 noble gas and 5 iodine isotopes contribute to the total RCS activity. The total RCS activity is not important since the activity leaving the plant is being directly measured by an RMS monitor for all COLA calculations. If the COLA uses damage class 1, then the current RCS activity that was entered on the LAN or the edited RCS Activity will be used. If Damage Class 2 through 10 is either calculated by COLA or manually edited, then the RCS activities listed in the EDCM for each Damage Class will be used in the calculation of the source term. Also the noble gas and iodine Spiking factors are only used when the Damage Class is 1. Damage Class 1 with a spike is considered to be Damage Class 1A.

Also the Damage Class can determine how much offsite CDE Child Thyroid Dose will occur as compared to the offsite TEDE Whole Body Dose, i.e., if the Damage Class is 1 through 4 the NG to iodine ratio is approximately 5 to 1. When the Damage Class increases to 5 through 10 the NG to iodine ratio changes drastically to 0.63. Therefore an increase to Damage Class 5 or above will cause a significant increase in the Child Thyroid Dose as compared to the TEDE Whole Body Dose

4. **Wind Speed** – Enter 1 – 99 as the Parameter Value
Wind Direction – Enter 0 – 360 as the parameter value
Delta Temp – Enter – 10 - + 10 as the parameter value

Bear in mind that the COLA will retrieve Met Data from the Met Tower whether the data is accurate or not. This could occur if the Met Tower goes out of service (0's would be displayed by the COLA). This also would render the weather charts in the Control Room inaccurate. If this occurs contact the EACC for the correct Met Data to input in the Parameter Edits.

Another problem might be that the met tower is operational, but has stopped communicating with the host computer. In this case the host computer will continue to use the last met data it received from the tower. The user should be alert to the fact that met data that does not change at all over the course of 30 to 45 minutes may indicate that the communication has broken down. Control room instrumentation should be checked to verify that the met data is accurate.

Active or inactive Parameter Edits - Placing a "1" in the Parameter Edit box will cause the entered Parameter Value to be used by the COLA or to be active. Therefore a "0" would cause the value to be inactive. **Remember that once a value is made active, it stays that way until the inactive option is chosen.**

After all of the editing of the Parameter Edits screen is completed and the selections made active, hit the F10 key to close out the screen.

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Sample Types (1D)

SELECT TYPE OF SAMPLE DATA		
Minimum: 1	Default: None	Maximum: 12
<u>ACTIVE</u>	<u>SAMPLE TYPE</u>	
NO 1.	CONDENSER OFFGAS PATHWAY	
NO 2.	REACTOR BUILDING DESIGN BASIS LEAKAGE PATHWAY	
NO 3.	EMERGENCY FEEDPUMP EXHAUST PATHWAY	
NO 4.	ALPHA OTSG ADV PATHWAY	
NO 5.	BRAVO OTSG ADV PATHWAY	
NO 6.	ALPHA OTSG MSR PATHWAY	
NO 7.	BRAVO OTSG MSR PATHWAY	
NO 8.	STATION VENTILATION PATHWAY	
NO 9.	REACTOR BUILDING PURGE PATHWAY	
NO 10.	ESF VENTILATION PATHWAY	
NO 11.	REACTOR COOLANT BASELINE ACTIVITY	
NO 12.	REACTOR COOLANT SPIKING FACTORS	
ENTER CHOICE (1 THRU 12)		
F1: Next	F2: Prev	Alt F10: Abort F10: Done

The first 10 selections are TMI's 10 release pathways. Isotopic results from in-plant samples such as CATPASS, or RMA-5, RMA-8, RMA-9 sample panels can also be entered into these screens. MAP-5 samples cannot be input into the COLA, as there are no noble gas results. MAP-5 sample calculations must be performed using the manual codes. These samples provide a more refined dose projection than ones calculated from RMS data since they provide a GELI analysis of each isotope. The concentration obtained from these samples is combined with the release rate to calculate the source term leaving the plant. It is recommended that in-plant samples be obtained as practicable and entered into the sample edit screen.

- Condenser Offgas Pathway** – accepts RMA-5 sample panel marinelli beaker/iodine pre-filter sample results.
 - Reactor Building Design Basis Leakage Pathway** – Accepts CATPASS sample results.
- Emergency Feed Pump Exhaust Pathway** – Sample Edit Screen inactive at this time.

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4. **Alpha OTSG ADV Pathway** - Sample Edit Screen inactive at this time.
5. **Bravo OTSG ADV Pathway** - Sample Edit Screen inactive at this time.
6. **Alpha OTSG MSR Pathway** - Sample Edit Screen inactive at this time.
7. **Bravo OTSG MSR Pathway** - Sample Edit Screen inactive at this time.
8. **Station Ventilation Pathway** - accepts RMA-8 sample panel marinelli beaker/iodine pre-filter sample results.
9. **Reactor Building Purge Pathway** - accepts RMA-9 sample panel marinelli beaker/iodine pre-filter sample results.
10. **ESF Ventilation Pathway** – Accepts iodine and noble gas sample results.

The 10 pathway sample edit screens, once sample results are entered, must be made active in order to be used by the COLA.

11. **Reactor Coolant Baseline Activity** – This is where RCS sample results are entered for use by the COLA. Rad Engineering updates the default RCS activities on this screen as RCS changes during the core life. RCS sample results are only used in the COLA dose projection if the Fuel Damage Class is 1. If the core damage is Damage Class 2 through 10, the COLA will use the RCS activities listed in the EDCM. Since the RCS activities listed in the EDCM are conservative it would be justified to request a Post Accident RCS Sample and input the results in the Sample Edit screen. You would then have to edit the Damage Class to 1 in order for the results to be used by the COLA. One major difference between this screen and the 10 pathway screens are the results are always active.
12. **Reactor Coolant Spiking Factors** – Normally the spiking factors, which are determined by the Nuclear Engineering Group, are entered onto the LAN by Rad Engineering. If these values are considered inaccurate, then the spiking factors may be edited using this screen. Remember that spiking factors are only used when the Damage Class is 1 AND the plant is at 0% power. One major difference between this screen and the 10 pathway screens is the results are always active.

To use this screen, select the release pathway and hit the F10 key to reach the actual isotopic input screen. Also you can select either the RCS activity or spiking Factors screen and then hit the F10 key for these inputs. Remember that the RCS activity and spiking factors screens are always active and used by the COLA, therefore the results in these two screens must always be accurate and up to date. If Post Accident RCS results are being used, ensure the spiking factors on this screen are set to 1, or the code will erroneously spike the sample results.

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Effluent Sample Screen

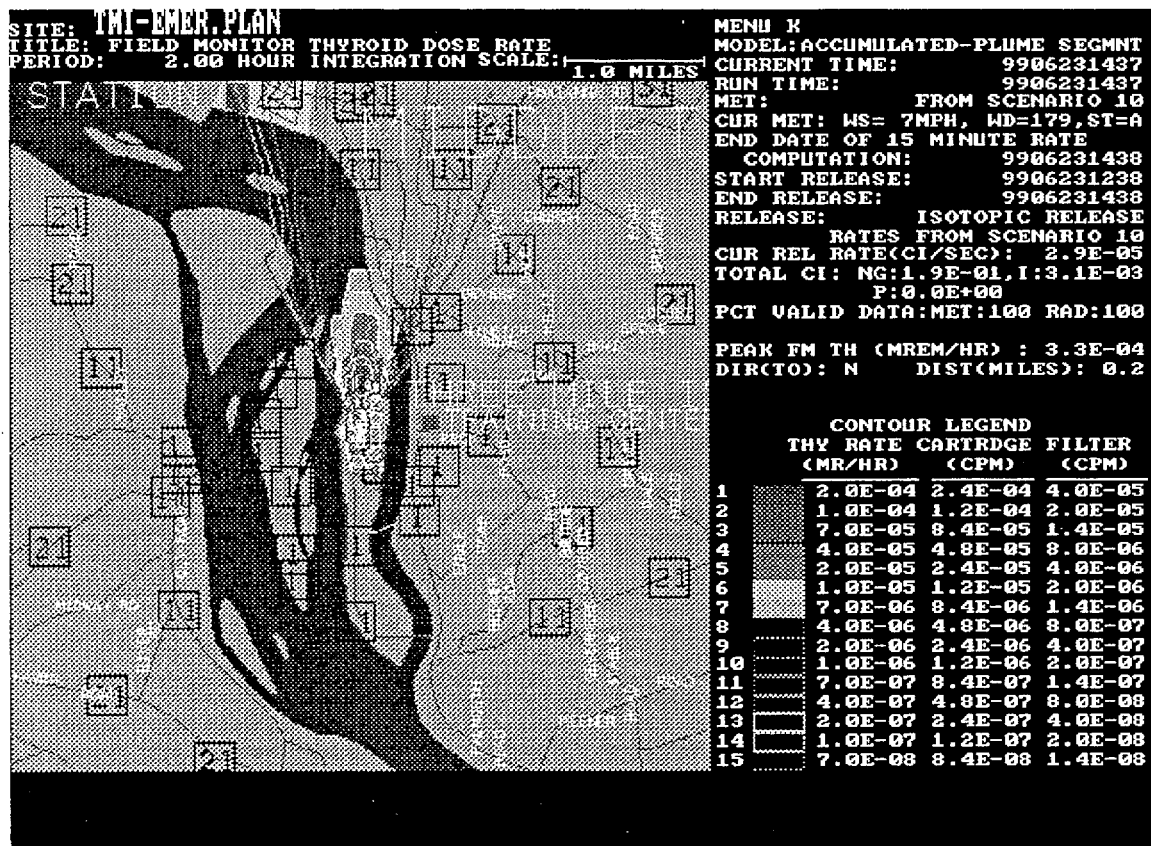
Entry MUST be Y or N			
RADIONUCLIDE CONCENTRATIONS IN UCI/CC			
<u>NOBLE GAS ISOTOPES</u>		<u>RADIOIODINE ISOTOPES</u>	
KR_85M	0.00E+00	I_131	0.00E+00
KR_85	0.00E+00	I_132	0.00E+00
KR_87	0.00E+00	I_133	0.00E+00
KR_88	0.00E+00	I_134	0.00E+00
XE_131M	0.00E+00	I_135	0.00E+00
XE_133M	0.00E+00		
XE_133	0.00E+00		
XE_135M	0.00E+00		
XE_135	0.00E+00		
XE_138	0.00E+00	Make Active(Y/N)	N
Enter values for only those nuclides designed to be collected by the analysis.			
If these values are <MDA then enter the MDA value, not a zero.			
Enter a zero value for nuclides not designed to be collected by the analysis			
F1: Next	F2: Prev	Alt F10: Abort	F10: Done

The bottom statement on this screen may need some clarification. i.e. MAP-5 sample results only include the 5 iodine isotopes but not the 10 noble gas isotopes. As a result, the COLA will not calculate a noble gas source term from a MAP-5 sample. The COLA can only use pre-filter marinelli sample results or CATPASS results, where both noble gases and iodines are analyzed, to calculate the TEDE dose properly. If the MAP-5 sample is input into the COLA, the COLA will calculate the correct thyroid dose.

To enter sample results first select the release pathway and hit the F10 key. Enter the isotopic sample results for each isotope. When all 15 isotopic results are entered hit the F10 key and select "Y" to make the screen active. Hit the F10 key again to close out the screen.

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MIDAS Plume Plots (2A)



MIDAS Screen - The primary purpose of the MIDAS Screen is to compare field team readings and to indicate the plume location in order to send out field monitoring teams. If the field monitoring team results match up with this screen, then the accuracy of the dose projection is confirmed. The Group Leader R&EC is in charge of the dose assessment process and will determine which dose projection/field team ratio is acceptable to confirm the dose projection and possible PAR.

Both the dose projection model and the MIDAS Program use the same source term and should be in reasonable agreement if the COLA calculations are correct. The COLA dose projection source term is automatically used by MIDAS, however if the Manual Code is used by RAC personnel, the source term results must be provided to the EACC in order to be added to MIDAS.

The MIDAS Program provides a snapshot that takes into account residual airborne radiation for a 2 hour block of time. It uses 8, 15 minute sets of Met Data and is updated with a new set of data every 15 minutes. A new MIDAS Plume Plot snapshot is also updated every 15 minutes with the oldest Met Data set being eliminated and the new set of data added. As you can see MIDAS uses a different dispersion model than the RAC dose projection program, which projects the highest dose for the current time. This is why the COLA or Manual dose projection and not MIDAS is used for comparison to the PAGs and possible PAR. A PAR only looks at what the predicted integrated dose is for the future time of the release duration, not what has been released in the past. MIDAS includes past radioactivity in the atmosphere in its plume plots.

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Because the dose projection model and MIDAS use the same source term but different dispersion models (15 minutes vs. 2 hours), their results will most likely not match up. Since both programs use the same source term, if the field monitoring team results match up with MIDAS the dose projection is confirmed. If the results are unacceptable an investigation among dose assessment personnel is prudent. Here are some potential problems:

1. Did the Field Team really find plume centerline
2. Is there an unusual release pathway that is not indicated on the COLA
3. Is the COLA using inaccurate information such as Met Data, RMS, flow rates
4. Are RMG 26 or RMG 27 results being incorrectly used by the COLA.
5. Is the Manual Code in use with more than one release pathway occurring from TMI.

Another difference between the dose projection and MIDAS is that MIDAS uses precipitation (wet deposition) in its calculation unlike the RAC Code models.

Midas normally uses the same source term and met data as the COLA dose projection program. MIDAS automatically retrieves these parameters when the COLA is valid. However if the Manual Dose Projection model is used the source term and met data are not automatically added to MIDAS by the Host Computer. EACC personnel must then use the "Stand Alone MIDAS" program to add met data and source term data. RAC personnel must then provide the source term results from the manual dose projection to the EACC. EACC personnel can get the met data inputs from the LAN that need to be added to MIDAS. If LAN is down, a Meteorologist or the National Weather Service can be contacted. Also if the manual dose projection program is being used and the release is a Buoyant Plume Rise the release height found on the downwind dose results must be faxed to the EACC. This is only for releases via a MSRV or ADV.

MIDAS produces the following plots:

1. Gamma Plot - Readings = Gamma - mR/hr
 Open Window - mR/hr
 Frisker - cpm
2. Child Thyroid Plot - Readings = Thyroid Rate - mR/hr
 Cartridge - cpm
 Filter - cpm

Note that the cartridge and filter count rates are based on a standard 300 liter air sample.

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Air Sample Calculation (2C)

Offsite Iodine Air Sample Analysis		
Inputs		
Location	----->	ENE11
Date	----->	2/3/98
Time	----->	1100
Inputs		
Background (cpm)	----->	50
Flow Rate (LPM)	----->	29
Sample Run (min)	----->	11
Gross Cartridge (cpm)	----->	300
Gross Particulate (cpm)	----->	50
Outputs ENTER TO QUIT		
Concentration (uCi/cc)		
Thyroid Dose Rate (mrem/hr)		

The **Air Sample Calculation Screen** is used to convert iodine and particulate results in net cpm to thyroid dose rate. The results displayed in the fields in the above screen are transmitted from the onsite/offsite field monitoring teams. The thyroid dose rate is multiplied by the release duration in hours to provide the integrated thyroid dose. The thyroid dose is then compared to the MIDAS Plume Plots to confirm the dose projection.

To use this screen:

1. Select the 2C option from the EIN
2. Enter the results in each field and hit the "Enter" key.
3. Once the screen inputs are complete hit the "enter" key again
4. This will put you back on the EIN, print a copy of the results and clear the Air Sample Calculation Screen for future use.

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Offsite Field Monitoring Team Data (2B)

Date:				Measurements		
Time	Field Team	Distance Miles	Monitoring Location	Whole Body mR/hr	Thyroid mRem/hr	Dose Projection Agreement?
_____	_____	_____	_____	_____	_____	_____

Offsite Field Monitoring Team Data – This screen is used to add the results from the Field monitoring Team to the Emergency Information Network. EACC personnel for the offsite team results usually add this data to this screen. RAC personnel can also use the screen when the RAC computer is available. The information on this screen must be manually added. It is not automatically retrieved. To add information from the Emergency Information Network Main Menu perform the following:

1. Exit to DOS
2. At the Y: prompt type in **fielddat.bat** and press enter.
3. After entering the DOS screen, use the arrow keys to maneuver around to add the information required for this screen: Time, Field Team Designation, Downwind Distances in miles ,REMP Map Monitoring Location, Whole Body Dose mR/hr, Thyroid Dose mR/hr, and Dose Projection Agreement

After entering the appropriate information select File, select Save, and select Exit to leave the screen.

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Reuter Stokes Data and MIDAS Calculation Comparison (3)

COMPARISON OF RS MONITOR ACTUAL VICE MIDAS CALCULATED VALUES			
MONITOR	ACTUAL 01/08 08:09	MIDAL 01/08 10:56	CONFIRMATION?
MIDDLETOWN	0.0083	0.0000	NOT AFFECTED
NORTH GATE TMI	0.0058	0.0000	NOT AFFECTED
MIDDLETOWN SUB	0.0062	0.0000	NOT AFFECTED
ALWINE FARM	0.0087	0.0000	NOT AFFECTED
VISITORS CTR	0.0077	0.0000	NOT AFFECTED
500 KVA SUB	0.0077	0.0000	NOT AFFECTED
BECKER FARM	0.0077	0.0000	NOT AFFECTED
FLAMOUTH SUB	0.0069	0.0000	NOT AFFECTED
CLY SUBSTATION	0.0061	0.0000	NOT AFFECTED
TMI WAREHOUSE	0.0068	0.0000	NOT AFFECTED
TMI MDCT	0.0079	0.0000	NOT AFFECTED
GOLDSBORO	0.0064	0.0000	NOT AFFECTED
TMI INTAKES	0.0070	0.0000	NOT AFFECTED
FAIRVIEW TWP	0.0071	0.0000	NOT AFFECTED
HPG AIRPORT	0.0080	0.0000	NOT AFFECTED
CRAWFORD STATION	0.0091	0.0000	NOT AFFECTED
CURSOR LEFT (BACKWARD) CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)			

Reuter Stokes Field Data and MIDAS Calculation Comparison - The Reuter Stokes screen provides actual readings from 16 ion chamber monitors located in each of the 16 sectors surrounding TMI. These readings are updated every 4 hours until any monitor exceeds 0.08 mR/hr (80 µR/hr) which increases the updates to every 15 minutes.

The primary purpose of this screen is to quickly obtain onsite/offsite doses in order to verify the dose projection. The system is set up to compare the actual monitor readings to the MIDAS projected monitor readings when any monitor exceeds 0.020 mR/hr (20 µR/hr). The third column on this screen, "CONFIRMATION" is not operational and should be ignored.

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Individual Pathway Data - Source Term/Input Data/Dose Data (4)

RELEASE PATHWAY INFORMATION	
CONDENSER OFFGAS	D1 DOSE I1 INPUTS S1 SOURCE TERM
RX BUILDING DESIGN BASIS LEAKAGE	D2 DOSE I22 INPUTS S2 SOURCE TERM
EMERGENCY FEED PUMP EXHAUST	D3 DOSE I3 INPUTS S3 SOURCE TERM
A OTSG ADV DIRECT	D4 DOSE I4 INPUTS S4 SOURCE TERM
A OTSG MSR DIRECT	D5 DOSE I5 INPUTS S5 SOURCE TERM
B OTSG ADV DIRECT	D6 DOSE I6 INPUTS S6 SOURCE TERM
B OTSG MSR DIRECT	D7 DOSE I7 INPUTS S7 SOURCE TERM
STATION VENTILATION	D8 DOSE I8 INPUTS S8 SOURCE TERM
RX BUILDING PURGE EXHAUST	D9 DOSE I9 INPUTS S9 SOURCE TERM
ESF EXHAUST	D10 DOSE I10 INPUTS S10 SOURCE TERM
RETURN TO MAIN MENU	P1
ENTER THE APPLICATION NUMBER:	

To retrieve individual pathway information, select the pathway, such as the Reactor Building Design Basis Leakage. Select D2 for dose, I2 for inputs, and S2 for source term. P1 returns to the Emergency Information Menu. Listed are the 10 release pathways from TMI-1.

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**Individual Release Pathway Dose Screen (D[1-10])
(Typical)**

CONDENSER OFFGAS DOSE IN MREM (PATH #1)		
TIME: 05:33:46 DATE: 01-15-1998 CALCULATION #: 1		
DISTANCE	COMMITTED DOSE EQ (MREM)	TOTAL EFFECTIVE DOSE EQ (MREM)
Site Boun.	6.2E-06	1.7E-06
Ex. Area	4.0E-06	1.1E-06
1 MILE	1.3E-06	3.4E-07
2 MILE	5.0E-07	1.3E-07
5 MILE	1.2E-07	2.8E-08
10 MILE	5.2E-08	1.1E-08
HIGHLIGHTED DOSES ARE MAXIMUM VALUES		
CURSOR LEFT (BACKWARD) CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)		

Individual Release Pathway Dose Screen - Lists the downwind doses from the Site Boundary out to 10 miles for the individual pathway selected. Whole Body (TEDE) and Child Thyroid (CDE) integrated doses are listed with the highest downwind dose location highlighted.

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Pathway Specific PPM Data (I[1-10])

RX BLDG DESIGN BASIS LEAKAGE (PATH #2) INPUT DATA	
TIME: 05:33:46 DATE: 01-15-1998 CALCULATION #: 1	
PATHWAY SPECIFIC PPM DATA	
RB SPRAY L2825 (0 ON, 1 OFF)	1.0E+00
RB SPRAY L2827 (0 ON, 1 OFF)	1.0E+00
RB PRESS (PSIG)	1.1E-01
RMA2 GAS (CPM)	6.1E+02
RMA2 IOD (CPM)	1.3E+02
RMG22 (R/HR)	9.8E-01
RMG23 (R/HR)	9.7E-01
CURSOR LEFT (BACKWARD) CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)	

Pathway Specific PPM Data – The screen displayed for the Designed Basis Leakage shows the inputs or PPM Data that was used by the COLA to calculate this individual pathway source term. Remember the COLA calculates each of the 10 pathways individually and adds them up for the most limiting dose. In this example RMG 22/23, along with the RB Pressure, are used as PPM inputs to calculate the source term. It also displays the closed position of the RB Spray system that can be used by operations, when conditions warrant it, to reduce the airborne atmospheric concentration of iodines in the Reactor Building after a LOCA.

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Isotopic Release Rates (S[1-10])

RELEASE PATH #2 RX BLDG DESIGN BASIS LEAKAGE			
TIME: 05:33:46DATE: 01-15-1998 CALCULATION #: 1			
ISOTOPIC RELEASE CONCENTRATIONS IN UCI/SEC			
NOBLE GAS NUCLIDES		RADIOIODINE NUCLIDES	
KR85M	9.1E-02	I131	1.4E-02
KR85	5.8 E-08	I132	1.2E-01
KR87	2.9E-01	I133	2.01E-01
KR88	3.2E-01	I134	6.5E-01
XE131M	5.8E-08	I135	3.8E-01
XE133M	5.8E-08		
XE133	1.2E-01	TOTAL RI = 1.4E=01	
XE135M	2.1E-01		
XE135	9.9E-01		
XE138	5.8E-08		
TOTAL NG = 2.0E+00			
CURSOR LEFT (BACKWARD)CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)			

Isotopic Release Rates - This screen shows the individual source term for the Design Basis Leakage release pathway. The results are listed for the 10 noble gas and 5 iodine isotopes used in the dose projection process. Also listed are the totals for the noble gas and iodine isotopes. This information is frequently requested by the State BRP so they can verify our dose projections using their own dose projection model.

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Effluent RMS (5)

EFFLUENT RMS READINGS				
TIME: 07:55:39 DATE: 01-16-1998 CALCULATION #: 1				
RADIATION MONITORING SYSTEM				
RELEASE PATHWAY	MONITOR NAME	VALUE	STATUS	UNITS
CONDENSER OFFGAS	RM-A5(G) LOW	3.4E+01	NORMAL	CPM
	RM-A15(G) LOW	3.7E+01	NORMAL	CPM
	RM-A5(G) HIGH	1.9E+01	NORMAL	CPM
	RM-G25	-.2 E-01	NORMAL	MR/HR
STA VENTILATION	RM-A8(G) LOW	4.6E+01	NORMAL	CPM
	RM-A8(I) LOW	1.6E+01	NORMAL	CPM/MIN
	RM-A8(G) HIGH	1.8E+01	NORMAL	CPM
RB PURGE	RM-A9(G) LOW	3.9E+01	NORMAL	CPM
	RM-A9(I) LOW	4.6E+01	NORMAL	CPM/MIN
	RM-A9(G) HIGH	2.4E+01	NORMAL	CPM
	RM-G24	-.2E+00	NORMAL	MR/HR
DIRECT OTSG	RM-G26	2.8E+01	NORMAL	CPM
	RM-G27	3.6E+01	NORMAL	CPM
CURSOR LEFT (BACKWARD)CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)				

The **Effluent RMS Screen** is updated from the Plant Performance Monitor (PPM) every 4 – 6 minutes. The screen displays the associated RMS effluent monitors by release pathway. This screen can be very useful to help validate the release pathway during evaluation of the COLA dose projection. It also can be helpful to trend RMS data since these screens are saved once any Radiological EAL is reached. This screen provides a "quick look" to see if any other release pathway RMS are increasing which could possibly affect the dose projection.

1. Normal RMS reading = gray background
2. Alert RMS reading = green background
3. High alarm reading = red background
4. Off scale reading = black background

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Area Gamma and Liquid RMS Screen (6)

AREA GAMMA AND LIQUID RMS		
TIME: 10:55:50 DATE: 01-16-1998 CALCULATION #: 1		
AREA MONITORS=MR/HR : RMG22/23=R/HR : LIQUID RMS=(CPM)		
RX BUILDING	RM-G22 9.8 E-01 NORMAL	RMG-23 9.7E-01 NORMAL
	RM-G6 2.8E+02 NORMAL	RM-G7 5.2E+01 NORMAL
	RM-G5 5.5E-01 NORMAL	
AUX BUILDING	RMG-10 6.0E-02 NORMAL	RMG-11 2.6E-01 NORMAL
	RMG-12 8.0E-02 NORMAL	RMG-13 9.0E-02 NORMAL
	RMG-14 8.0E-02 NORMAL	RMG-15 9.0E-02 NORMAL
FH BUILDING	RMG-9 1.3E+00 NORMAL	
CONTROL TOWER	RMG-1 8.0E-02 NORMAL	RMG-2 5.0E-02 NORMAL
	RMG-3 1.6E-01 NORMAL	RMG-4 6.0E-02 NORMAL
SELECT LIQUID	RML1L 4.2E+03 NORMAL	RML1H 3.6E+01 NORMAL
CURSOR LEFT (BACKWARD)CURSOR RIGHT (FORWARD) ALT-H (HARDCOPY) HOME (EXIT)		

The **Area Gamma and Liquid RMS Screen** displays the associated area gamma monitors by building along with selected liquid monitors. This screen is also very useful for evaluating in plant dose rates prior to sending personnel reentry teams into the plant. Area gamma monitor readings are useful to verify improving or degrading plant conditions.

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Screen (7)

This screen is reserved for future use.

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Quick Code (8)

Minimum: 1	Default: None	Maximum: 9
Input Data		
Release via Condenser Offgas		
1. RMA5 LOW OR RMA15	2. RMA5 HIGH	3. RMG25
Release via ADV or MSR		
4. RMG26 OR RMG27		
Release via Reactor Building Purge		
5. RMA9 LOW	6. RMA9 HIGH	7. RMG24
Release via Station Ventilation		
8. RMA8 LOW	9. RMA8 HIGH	
Enter Radiation Monitor Selection (1 thru 9) _____		
Enter the Monitor Reading (1 thru 10 million) _____		
Enter the Wind Speed in MPH (1 thru 100) _____		
Enter the Wind Direction in Degrees From (1 thru 360) _____		
Enter the Delta Temperature in Degrees F (-9 to 10) _____		
F1: Next	F2: Prev	Alt F10: Abort F10: Done

The **Quick Code** was designed with the on shift GRCS in mind. In the first hour of an event if the COLA goes out of service the GRCS has two options to produce a dose projection, the Manual RAC Code or the Quick Code. It takes time to gather all of the inputs for the Manual RAC Code and the luxury of time may not be available. As you can see above, the Quick Code inputs are all on one screen and consist of the RMS monitor and reading associated with the release pathway and met data. Default flow rates for each pathway are used in the Quick Code. As with the Manual RAC Code the Quick Code can only handle one release pathway. **Also this code produces very conservative results during core damage situations as it uses a 1-1 iodine to noble gas ratio.**

An alternative to use of the Quick Code is to use the Excel spreadsheet RAC Spreadsheet. It is described in the following section. With only a few additional inputs, it produces a less conservative but more realistic, dose projection than the Quick Code.

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Manual RAC Code (9)

The **Manual RAC Code** is an option on the Emergency Information Network that will produce a dose projection based on user input, rather than data from the plant computer. The Manual RAC Code can be used for some of the following reasons:

1. To produce a dose projection if data being retrieved by the COLA is considered inaccurate (i.e. a bad RMG-25 reading or met data).
2. To perform a "What If" dose projection
3. Having a release through the MSRV's with MSV 2A/2B in the closed position since the COLA automatically uses RMG-26/27.
4. Multiple MSRV's are stuck open at the same time.
5. RB Design Basis Leakage release with RMG 22/23 out of service.
6. To compare or validate the dose projection for any other reason.
7. To estimate offsite doses beyond 10 miles.

Results from the Manual Code are not displayed on the LAN therefore they must be faxed to the EACC. Also if the Manual RAC Code is used, the source term results must be faxed to the EACC so they can be entered into the MIDAS program. If the COLA is inaccurate then the MIDAS results produced from the COLA source term is inaccurate. The Manual Code source term results must be entered into MIDAS in this situation. In addition, if the COLA is inaccurate then the Group Leader RE&C, the EAC, and the state BRP representative must be notified that the COLA displays are not accurate.

One disadvantage of the Manual Code is that it can handle only one release pathway at a time. If two release pathways are significant, each one must be run separate and the results added together.

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RAC Spreadsheet

An alternative method for performing dose projections is to use the Excel spreadsheet RAC Spreadsheet. The spreadsheet is available via a shortcut from the desktop of the RAC computer. It is loaded into the RAC Computer as a "Read Only" file from the computer's hard drive. As a result, it is available for use even if the LAN is down. During the process of loading, the spreadsheet imports plant parameter data, meteorological data, and Reuter Stokes data from the LAN drives. If the LAN is down, an error message will appear informing the user that the data is not available and must be input manually. The main menu of the spreadsheet is shown below:

TMI Radiological Assessment Spreadsheet						Advanced Features
Version XXXX.XX.XX						
Primary-to-Secondary Leak						
Condenser Offgas Releases			Direct-to-Atmosphere Steam Releases			
Using RMS	Using Leak Rate	Using Sample	Using RMS	Using Leak Rate	Steam Line Break	
Reactor Building Releases - Loss of Coolant Accident						
Stuck Open Purge Exhaust Valve			Design Basis Leakage			
Using RMS	Using Leak Rate	Using Sample	Using RMS	Using Leak Rate	Using Sample	
Containment Failure or Stuck Open Purge Inlet Valve				View Effluent RMS Data		View Area RMS Data
Using RMS	Using Leak Rate	Using Sample				
Station Vent Releases						Fast Dose Projection 1 Pull in PPM and Met Data 2 Get PPM Based Dose Projection 3 Get Reuter Stokes Data
Loss of Coolant Accident in Auxiliary/Fuel Handling Building						
Using RMS	Using Leak Rate	Using Sample				
Fuel Handling Accidents (Using			Waste Gas Decay Tank			
Reactor Building	Fuel Handling Building		WGD Rupture			

To utilize the spreadsheet, the user selects the pathway/calculation type by clicking the computer's mouse on the button for that pathway. In addition to calculation pathways, other options include:

- The "Update Plant Data" button retrieves the latest plant parameter, meteorological and Reuter Stokes data stored on the LAN drives. **Prior to performing a new dose projection, the user should select this option to ensure the most recent data is used.**
- The "Total Dose Using RMS" button is used to find the total offsite dose for pathways monitored by the RMS system. This total dose projection will only be accurate if RMS data is valid and RMS monitors the release pathway.

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RAC Spreadsheet (Cont'd)

- The "Reuter Stokes Data" button provides a display and/or printout of the most recent Reuter Stokes data available on the LAN.
- The "View Effluent RMS Data" button provides a display and/or printout of the most recent RMS effluent monitor data and meteorological data available on the LAN.
- The "View Area RMS Data" button provides a display and/or printout of the most recent RMS area monitor data available on the LAN.
- The "Advanced Features" button allows the user to enter RCS Post Accident Sample results and to edit the default RCS spike factors. It also allows printout of these parameters.

When the pathway/calculation type is selected, the user is then taken to the input screen for that calculation. An example is shown below:

Data Entry Panel for Condenser Offgas Release Using RMS Data

If the PPM is down, or the data is suspect, data can be obtained by asking the Control Room Supervisor for a printout of PFC Data from Area 38, Group 35

If you believe fuel damage has occurred from previous thermal or mechanical damage enter the damage class here 7-10

Enter the following information about the RCS to ensure that the damage class is not worse than you think:

	PPM	User Defined	
RCS Pressure (A0505)	2146		psig
Average of 5 Highest Incores (C4006)	621		Deg F
Is the Reactor Shutdown? (Y or N)	N		(Y or N)
Date Shut Down		08/15/2000	
Time Shut Down (Use XX:XX Format)		11:13	

Enter Condenser Offgas Rad Monitor(s) readings you wish to use for the calculation below:

RM-A-5Lo (C4028)	45		cpm
RM-A-15 (A1020)	26		cpm
RM-A-5Hi (A1008)	45		cpm
RM-G-25 (C4035)	3		mR/hr

Enter the Condenser Offgas Flow Rate (A0436) cfm

Enter the release duration hours

Enter the wind speed mph

Enter the wind direction (from) degrees

Enter the Delta T degrees F

PPM Data Updated 08/15/2000 11:08
 Met Data Updated 08-15-2000 11:00:23

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RAC Spreadsheet (Cont'd)

The input columns on the left (green cells on the screen listed under "PPM") contain the plant data and meteorological data that were imported from the LAN if such data is available for that parameter. The user should review this data to see if it makes sense given current plant conditions. The input column on the right (blue cells on the screen listed under "User Defined") permits the user to override the plant computer data and to make entries for parameters not monitored by the plant computer. For parameters that have both a green and blue cell, the spreadsheet will use the data in the green cell as long as the blue cell is left blank. If the user makes an entry in the blue cell, the spreadsheet will ignore the data in the green cell and use the user-specified data in the blue cell. If the plant data is not available from the LAN drives (as indicated by the previously described warning message), all data will need to be manually entered in the blue cells by the user.

At the bottom of each screen, the time/date stamp for the plant and meteorological data allow the user to ensure the data being used is current.

The buttons at the bottom of each screen perform the following functions:

- The "Add Comments" button takes the user to a screen that permits him/her to annotate any additional information that should be associated with the dose projection.
- The "Display Projection" button allows the user to view a summary of the dose projection.
- The "Print Projection" screen allows the user to print the complete dose projection.
- The "Main Menu" button returns the user to the main menu screen.
- The "Print at EACC" button sends a copy of the dose projection at the EOF for the EACC and Group Leader R&EC.
- The "Send to LAN" button takes a snapshot of the dose projection and sends it to a LAN file where it can be viewed from other emergency facilities
- The "Send to Midas" button can be used to create a source term file that can be imported into the MIDAS code. Use of this button should be limited to validated dose projections. "What IF" dose projections should not be fed to MIDAS.

Selection of the "Display Projection" option for individual pathways provides the following dose projection summary:

DOSE PROJECTION FOR CONDENSER OFFGAS RELEASE PATHWAY
RECOMMENDED ACTIONS TO BE TAKEN BASED ON THIS DOSE PROJECTION

Do Not Declare an Emergency Action Level

Do Not Issue a Protective Action Recommendation

Maximum Dose Rate (mrem/hr)

Location	TEDE	Location	CDE	Location	DDE
Site Boundary	0.0	Site Boundary	0.0	Site Boundary	0.0

Maximum Dose (mrem)

Location	TEDE	Location	CDE	Location	DDE
Site Boundary	0.0	Site Boundary	0.0	Site Boundary	0.0

Return to Input

Print Projection

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RAC Spreadsheet (Cont'd)

Selection of the "Display Projection" option for "Total Dose Using RMS" provides the following dose projection summary:

06/29/00 13:53

DOSE PROJECTION FOR ALL PATHWAYS WITH RMS DATA AVAILABLE

RECOMMENDED ACTIONS TO BE TAKEN BASED ON THIS DOSE PROJECTION

Do Not Declare an Emergency Action Level

Do Not Issue a Protective Action Recommendation

Maximum Dose Rate (mrem/hr)

Location	TEDE	Location	CDE	Location	DDE
Exclusion Area	0.0	Exclusion Area	0.0	Exclusion Area	0.0

Maximum Dose (mrem)

Location	TEDE	Location	CDE	Location	DDE
Exclusion Area	0.0	Exclusion Area	0.0	Exclusion Area	0.0

Pathways Contributing to Maximum Dose Location

	TEDE	CDE	
Condenser Offgas Releases	0%	0%	Return to Input
Direct-to-Atmosphere Steam Releases	0%	0%	
Reactor Building Design Basis Leakage	0%	4%	Path Projection
Reactor Building Purge Releases	0%	0%	
Station Ventilation Releases	100%	96%	

In addition to showing the maximum dose rates and doses, this screen also shows the contribution of each pathway. Having identified the major pathway, the user should then go to the individual pathway and validate the dose projection by reviewing the data inputs.

If at any time the user gets "lost in the spreadsheet" (i.e., can't get back to the input screen), pressing ALT and H simultaneously will return the user to the pathway input screen. Using the mouse and buttons to navigate through the spreadsheet will prevent getting lost in the spreadsheet. Avoid using the Page Up and Page Down keys on the keyboard.

To reset the spreadsheet to its normal default data, the user can simply exit the spreadsheet then re-enter it. To exit the spreadsheet, use the mouse to go to the File command on the upper toolbar. Then choose the Exit subcommand. A message box will ask if you wish to save the spreadsheet. Since the spreadsheet is only accessed as a "Read Only" file, it is impossible to save it. Just click on No and the exit will be complete.

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If the LAN GOES OUT OF SERVICE the RAC computer will automatically boot up to the following menu:

<p>EMERGENCY INFORMATION NETWORK LAN BACKUP CALCULATIONS IF THIS MENU APPEARS THE LAN CONNECTION WAS NOT MADE CONTACT I.S. AT X8393 WHEN TIME PERMITS USE ONE OF THE FOLLOWING MANUAL CODES TO PERFORM DOSE PROJECTIONS UNTIL THE LAN PROBLEM IS CORRECTED</p> <ol style="list-style-type: none"> 1. QUICK CALC CODE (RECOMMENDED FOR ON-SHIFT GRCS/RAC) 2. MANUAL RAC 3. AIR SAMPLE CALC 4. EXIT TO DOS <p>ENTER THE APPLICATION NUMBER:</p>

As previously described, if the LAN is out of service, RAC Spreadsheet can be accessed for use from the Desktop of the RAC Computer. This spreadsheet can be used as an alternative to the Quick Code and the Manual RAC Code.

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Instructions for Rebooting the COLA

There are times when transients in the LAN system occur that cause the host computer performing the dose projections to lock up. As a result, the host computer quits performing dose projections and the last dose projection on the EIN will be more than 10 – 15 minutes old. When the COLA is locked up, it needs to be rebooted. A remote COLA reboot device has been installed to do this. The following steps can be used to reboot the COLA from any site phone. Reboot can also be accomplished from an off-site phone simply by dialing "948" before the extension.

If the automated dose projection system host computer (COLA host) is "locked up", reboot it as follows:

Dial the COLA computer's reboot device at extension 8297.

The call will connect and an electronic voice will state "please enter your access code,". Wait until the message is complete then enter "1979".

The reboot electronic voice will then state "power is on" or "power is off" (normally "power is on")

To reboot the COLA:

Press "2" (the electronic voice will state "power is off").

Press "1" (the electronic voice will state "power is on").

Hang up the phone. The host computer will begin rebooting immediately.

Go to the Y:\EPRAC directory and type reset, then press enter.

The process may take up to 15 minutes before new dose projections appear.

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Basic RAC Checkoff

1. Determine Release Pathways with Emergency Director.
2. Print Decision Support Screen (1A), RAC Screen (1B), and Input Screen on Predominate Pathway. (4 then 11-10)
3. Print Source Term Screen of Predominate Pathway (4 then S1-10) and review noble gas to iodine ratio. (*Normally a 50:1 or greater ratio.*)
4. Validate inputs into the RAC Code *Check that RMS is functional and operational.*
5. Review Field Team Data. (*Reuter Stokes monitors are like field teams.) Remember, Reuter Stokes uses 15 minute averages and compares against MIDAS. Field team data should be checked against MIDAS. MIDAS does not take into consideration environmental iodine plateout or precipitation. MIDAS can estimate precipitation depletion of the plume upon request. The RAC Code is considered validated if field team data is within a tenth but not greater than MIDAS.*
6. Use the TSC to verify inputs. (*i.e., condition of charcoal filtration, damage class determination, leak rates in plant systems, etc.*)

If the COLA is not providing accurate dose projections, for whatever reason, ensure that the Group Leader RE&C, the EAC, and the state BRP representative understand that the COLA screens are not displaying accurate dose projections.

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Indications of Mechanical Fuel Damage

For Thermal Hydraulic damage use RAC Code. For Mechanical Damage and as a gross backup to the RAC code here are 2 tables for consideration:

LOCA with Leakrate and Isotopic Concentrations in Equilibrium

Fuel Damage Class	RCS Activity (uCi/ml)	RMG 22/23 (R/hr)
2-4	4500 - 45,000	6000 - 45,000
5-7	5.6E5 - 5.2E6	>45,000

LOCA Has NOT Occurred

Fuel Damage Class	RCS Activity (uCi/ml)	RMG 22/23 (R/hr)
2-4	4500 - 45,000	1.5 - 20
5-7	5.6E5 - 5.2E6	>20

Reference RAF 6612-89-002

RM-G-6/7 Indications of Mechanical Fuel Damage During Non-LOCA Situations

If 5% of the core has experienced cladding damage and released its gap activity, RM-G-6 would be expected to read between 30,000 to 40,000 mR/hr. Due to its normal location, RM-G-7 would be expected to read about 10% of what RM-G-6 reads. Reference RAF 3640-98-034.

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EDCM Calculation Guides

Condenser Offgas Releases

Calculation Type	When to Use	Page
COLA Using RMS	COG RMS and flowrate instrumentation available on PPM	113
COLA Using Samples	Representative RM-A-5 pre-filter/marinelli results available with flow rate available on PPM	116
Manual Code Using RMS	COLA RMS calculation not available due to PPM or LAN problems	118
Manual Code Using Samples	Representative COG pre-filter/marinelli results available with flow rate unavailable on PPM. Use this calc for MAP-5 samples.	121
Manual Code Contingency Calculation	Use when RMS is not available. Should be used for performing "What If" calculations	123
Quick Code	Used by on-shift RAC in first hour if COLA is not available	126

Reactor Building Design Basis Leakage

Calculation Type	When to Use	Page
COLA Using RMS	RMG-22/23 and RB pressure available on PPM	128
COLA Using Samples	Representative CATPASS results available with RB pressure available on PPM	131
Manual Code Using RMS	COLA RMS calculation not available due to PPM or LAN problems or if using RMA-2 monitor results	133
Manual Code Using Samples	Representative CATPASS results available with RB pressure unavailable on PPM	136
Manual Code Contingency Calculation	Use when RMS is not available. Should be used for performing "What If" calculations	138
Quick Code	Not available for this pathway	141

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Emergency Feed Pump Exhaust (Also used for Main Steam Line Breaks)

Calculation Type	When to Use	Page
COLA Using RMS	RMG-26/27 and emergency feedwater flow rate available on PPM	142
COLA Using Samples	Not available for this pathway	145
Manual Code Using RMS	RMG-26/27 or emergency feedwater flow not available due to PPM or LAN problems	146
Manual Code Using Samples	Not available for this pathway	149
Manual Code Contingency Calculation	Use when RMS or feedwater flow is not available. Use to perform "What If" calculations. This calculation should be used for a main steam line break.	150
Quick Code	Not available for this pathway	153

Atmospheric Dump Valve Release (MS-V-4A or MS-V-4B)

Calculation Type	When to Use	Page
COLA Using RMS	RMG-26/27 and main steam pressure available on PPM	154
COLA Using Samples	Not available for this pathway	157
Manual Code Using RMS	RMG-26/27 or main steam pressure not available due to PPM or LAN problems	158
Manual Code Using Samples	Not available for this pathway	161
Manual Code Contingency Calculation	Use when RMS or main steam pressure is not available. Use to perform "What If" calcs	162
Quick Code	Used by on-shift RAC in first hour if COLA is not available	165

Main Steam Relief Valves ('A' or 'B' side)

Calculation Type	When to Use	Page
COLA Using RMS	RMG-26/27 and main steam pressure available on PPM and MS-V-2 is open	167
COLA Using Samples	Not available for this pathway	170
Manual Code Using RMS	RMG-26/27 or main steam pressure not available due to PPM or LAN problems and MS-V-2 is open	171
Manual Code Using Samples	Not available for this pathway	174
Manual Code Contingency Calculation	Use when RMS or main steam pressure is not available, or if MS-V-2 is closed. Should be used for performing "What If" calculations	175
Quick Code	Used by on-shift RAC in first hour if COLA is not available	178

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Station Ventilation

Calculation Type	When to Use	Page
COLA Using RMS	Station Vent RMS and ventilation flow rate are available on PPM	180
COLA Using Samples	Representative RM-A-8 pre-filter/marinelli results available with flow rate available on PPM	183
Manual Code Using RMS	Station Vent RMS or ventilation flow rate not available due to PPM or LAN problems	185
Manual Code Using Samples	Representative RM-A-8 pre-filter/marinelli results available with flow rate not available on PPM. Use this for MAP-5 samples	188
Manual Code Contingency Calculation	Use when RMS or Station Vent flow rate is not available. Should be used for performing "What If" calculations	190
Quick Code	Used by on-shift RAC in first hour if COLA is not available	191

Reactor Building Purge Exhaust

Calculation Type	When to Use	Page
COLA Using RMS	RB Purge RMS and ventilation flow rate are available on PPM	193
COLA Using Samples	Representative RM-A-9 pre-filter/marinelli results available with flow rate available on PPM	196
Manual Code Using RMS	RB Purge RMS or ventilation flow rate not available due to PPM or LAN problems	198
Manual Code Using Samples	Representative RM-A-9 pre-filter/marinelli results available with flow rate not available on PPM. Use this for MAP-5 samples	201
Manual Code Contingency Calculation	Use when RMS or RB Purge flow rate is not available. Should be used for performing "What If" calculations	203
Quick Code	Used by on-shift RAC in first hour if COLA is not available	206

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ESF Fuel Handling Building

Calculation Type	When to Use	Page
COLA Using RMS	RM-A-14 and FHB vent flow rate are available on PPM	208
COLA Using Samples	Representative RM-A-14 pre-filter/marinelli results available with FHB flow rate on PPM	210
Manual Code Using RMS	RM-A-14 or FHB flow rate not available due to PPM or LAN problems	212
Manual Code Using Samples	Representative RM-A-14 pre-filter/marinelli results available with FHB flow rate not available on PPM. Use this for iodine cartridge samples	214
Manual Code Contingency Calculation	Use when RM-A-14 is not available.	216
Quick Code	Not available for this pathway	218

Other Manual Calculations Available

Calculation Type	When to Use	Page
Manual Code RB Fuel Handling Accident Using RMS	Fuel handling accident in the Reactor Building with RMS available	219
Manual Code RB Fuel Handling Accident Using Samples	Fuel handling accident in the Reactor Building with sample results available	222
Manual Code RB Fuel Handling Accident Using Contingency Calculation	Fuel handling accident in the Reactor Building with RMS or sample results not available	223
Manual Code Waste Gas Decay Tank Rupture Using RMS	Waste Gas Decay Tank rupture with RMS available	225
Manual Code Waste Gas Decay Tank Rupture Using Samples	Waste Gas Decay Tank rupture with sample results available	227
Manual Code Waste Gas Decay Tank Rupture Using Contingency Calculation	Waste Gas Decay Tank rupture with RMS or sample results not available	228

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Condenser Offgas COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.0075 (1/133) based on partitioning of iodine in the condenser
- The RMS monitor (RM-A-5, RM-A-15, RM-A-5 Hi, or RM-G-25) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The logic the COLA uses in picking which monitor to perform the calculation is as follows:
 1. If RM-G-25 and RM-A-5 Hi both read ≤ 100 , the COLA is using the highest reading on RM-A-5 or RM-A-15.
 2. If RM-A-5 Hi reads > 100 cpm, but RM-G-25 is < 100 mR/hr, the COLA is using RM-A-5 Hi.
 3. If RM-G-25 reads > 100 mR/hr, the COLA is using RM-G-25
- Once the COLA determines the isotopic concentrations leaving via COG, it uses the COG flow rate from the plant computer to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours.
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen if the damage class is believed to be other than that indicated by the COLA using current RCS temperature and pressure.

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Condenser Offgas COLA Calculation Using RMS

Problems to Watch For

- Condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel damage class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the “LLD” for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If COLA dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

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- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing condenser vacuum or increases in damage class.
- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter marinelli) when conditions appear to have stabilized.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Condenser Offgas COLA Calculation Using Samples

How it works:

- Effluents leaving via COG are sampled using a pre-filter marinelli sample
- The user enters the positive noble gas and iodine isotope concentrations from the analysis into the Condenser Offgas Sample Edit Screen.
- If a MAP-5 sample is used, the manual code must be used to perform the calculation, since the COLA will not produce a noble gas source term.
- Once the COLA determines the isotopic concentrations leaving via COG, it uses the COG flow rate from the plant computer to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

- Sample results need to be entered on the Condenser Offgas Sample Edit Screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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Condenser Offgas COLA Calculation Using Samples

Problems to Watch For

- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should make the Condenser Offgas Sample Edit Screen inactive and resume COLA RMS calculations.
- MAP-5 samples cannot be used solely with the COLA code since noble gases are not measured. The COLA code will not produce a noble gas source term from a MAP-5 sample. MAP-5 samples must be calculated using the manual codes to get the correct TEDE dose. The MAP-5 sample should still be input into the COLA code since the thyroid doses produced by the COLA will still be accurate.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If COLA dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing condenser vacuum or increase in damage class using a manual code contingency calculation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Condenser Offgas Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.0075 (1/133) based on partitioning of iodine in the condenser. It is accounted for in the manual code.
- The RMS monitor (RM-A-5, RM-A-15, RM-A-5 Hi, or RM-G-25) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate. The user selects which monitor will be used for the calculation. Generally, the highest range monitor reading > 100 should be used.
- Once the code determines the isotopic concentrations leaving via COG, it uses the COG flow rate input by the user to determine the uCi/sec leaving the plant (source term).

Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

- This pathway is always considered a ground level release

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- The monitor to be used and the monitor reading
- The time in minutes since reactor shutdown
- Condenser offgas flowrate
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Condenser Offgas Manual Code Calculation Using RMS

Problems to Watch For

- Condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing condenser vacuum or increase in damage class using a manual code contingency calculation.

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- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter marinelli) when conditions appear to have stabilized.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Condenser Offgas Manual Code Calculation Using Samples

How it works:

- Effluents leaving via COG are sampled using a MAP-5 sample or a pre-filter marinelli sample
- If a pre-filter marinelli sample is used, the user enters the positive noble gas and iodine isotope concentrations from the analysis when prompted by the code.
- If a MAP-5 sample is used, the user enters the positive iodine isotope concentrations from the analysis when prompted by the code. Since MAP-5 samples do not provide noble gas results, manual code will scale in the noble gases. It assumes that the noble gas to iodine ratio leaving COG is the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway.
- The iodine reduction factor for this pathway used to scale in noble gases from MAP-5 samples is 0.0075 (1/133) based on partitioning of iodine in the condenser
- Once the code determines the isotopic concentrations leaving via COG, it uses the COG flow rate input by the user to determine the $\mu\text{Ci/sec}$ leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group 2 of the PPC (See STA)

- The code will prompt the user to input values for RCS temperature and pressure or Fuel Damage Class values. These must be input but will have no bearing on the calculation since effluent concentrations leaving the plant are being determined by isotopic sample analysis.
- Sample results and sample time from condenser offgas
- Time since reactor shutdown
- Condenser offgas flowrate
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Condenser Offgas Manual Code Calculation Using Samples

Problems to Watch For

- The MAP-5 sample panel may present a dose rate hazard to personnel if the release rate is high or if it has been running for a long time with the same cartridges.
- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should begin using COLA or manual code RMS calculations.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.

If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projection for losing condenser vacuum or increases in damage class.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Condenser Offgas Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the primary-to-secondary leak rate and the activity concentration in the RCS, after adjusting for iodine losses (reduction factors) applicable to this pathway. It is independent of condenser offgas flow rate.
- The iodine reduction factor for this pathway is 0.0075 (1/133) based on partitioning of iodine in the condenser. It is accounted for in the manual code.
- Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.

Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The primary-to-secondary leak rate, in gpm, provided by the STA or TSC.
- The time in minutes since reactor shutdown
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Condenser Offgas Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.
- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity (uCi/cc) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter/marinelli) to increase the accuracy of the dose projection.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.

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- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way. The key will be the accuracy of the RCS total activity and primary-to-secondary leak rate estimates.

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Condenser Offgas Quick Code Calculation

How it works:

- This code provides a quick, but crude, estimate of offsite dose. As such it should only be used by the on-shift RAC, during the first hour of an emergency, if the COLA Code is not available.
- This code requires an RMS reading for its calculation. If an RMS reading is not available, a manual code contingency calculation must be performed.
- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The RCS mixture is assumed to have the same isotopic distribution as a Fuel Damage Class 2.
- The iodine reduction factor for this pathway is 0.0075 (1/133) based on partitioning of iodine in the condenser. It is accounted for in the code.
- The RMS monitor (RM-A-5, RM-A-15, RM-A-5 Hi, or RM-G-25) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate. The user selects which monitor will be used for the calculation. Generally, the highest range monitor reading > 100 should be used.
- The code assumes a COG flow of 40 cfm. Dose results may be ratioed by the actual cfm (i.e. if the actual flow is only 20 cfm, the dose projection is reduced by ½).
- The code assumes an 8 hour release duration.
- Once the code determines the isotopic concentrations leaving via COG, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- Met Data (wind speed, wind direction, and delta t)
- Since the COLA is not available, all readings must come from control room instrumentation.

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Condenser Offgas Quick Code Calculation

Problems to Watch For

- The IREO RAC should not use this code. The full manual code should be used when the IREO organization is activated.
- This calculation assumes an RCS isotopic distribution that is the same as a Fuel Damage Class 2. This may be somewhat non-conservative where fuel damage is not present, but significant iodine spiking has occurred. As soon as time is available, a manual code RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.

If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

- Periodically verify the release duration and pathway with the ED.
- Label all Quickcode calculations as "Quickcode"

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Reactor Building Design Basis Leakage COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant via reactor building leakage is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.4 with RB spray off, or 0.03 with RB spray on, based on minimal hold-up time in the building.
- The RMS monitor (RM-G-22 or RM-G-23) determines the airborne activity in the reactor building. The COLA uses the higher of the readings on RM-G-22 or RM-G-23. If RM-G-22 or 23 read less than 1 R/hr, the COLA assumes they are seeing only background and assumes they read 0 for dose calculations. It does not use RMA-2 in the calculation.
- Once the COLA determines the isotopic concentrations in the reactor building, it uses the leakage flow rate from the building, based on building pressure, to determine the uCi/sec leaving the plant (source term). Reduction of RB pressure to atmospheric pressure stops releases from this pathway.
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.

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Reactor Building Design Basis Leakage COLA Calculation Using RMS

Problems to Watch For

- This calculation should only be used when the purge valves are closed. If they are open, some form of reactor building purge calculation should be performed.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the “LLD” for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual “What If” dose projections for losing containment integrity or increase in damage class.
- Consider getting an effluent sample from this pathway (pre-filter marinelli or CATPASS as applicable) when conditions appear to have stabilized.

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- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Design Basis Leakage COLA Calculation Using Samples

How it works:

- A sample of the reactor building atmosphere can be obtained using the CATPASS system.
- The user enters the positive noble gas and iodine isotope concentrations from the analysis into the Reactor Building Design Basis Leakage Sample Edit Screen.
- Once the isotopic concentrations in the reactor building are input, the COLA uses the leakage flow rate from the building, based on building pressure, to determine the uCi/sec leaving the plant (source term). Reduction of RB pressure to atmospheric pressure stops releases from this pathway.
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

- CATPASS sample results need to be entered on the Reactor Building Design Basis Leakage Sample Edit Screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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Reactor Building Design Basis Leakage COLA Calculation Using Samples

Problems to Watch For

- At very high levels of airborne activity in the reactor building, a CATPASS sample can involve personnel exposure to high dose rates when obtaining the sample.
- The CATPASS system takes 45 minutes to warm up so direct the OSC to start the warm up as soon as you think you may want this type of sample.
- The sample will typically be collected from the cooler discharge rather than the isokinetic nozzle to reduce moisture in the sample.
- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should make the Reactor Building Design Basis Leakage Sample Edit Screen inactive and resume COLA RMS calculations.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing containment integrity using a manual code sample calculation, or increases in damage class using a manual code contingency calculation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Design Basis Leakage Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant via reactor building leakage is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.4 with RB spray off, or 0.03 with RB spray on, based on minimal hold-up time in the building.
- The RMS monitor (RM-A-2) determines the airborne activity in the reactor building. The manual code does not use RM-G-22 or RM-G-23. If RM-A-2 is isolated (>4 psi in RB), this calculation cannot be used. Use COLA RMS calculation or manual contingency calculation.
- Once the code determines the isotopic concentrations in the reactor building, it uses the leakage flow rate from the building, based on a user input building pressure, to determine the uCi/sec leaving the plant (source term). Reduction of RB pressure to atmospheric pressure stops releases from this pathway.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- Status of the purge valves (closed if this calculation is being used)
- The RM-A-2 readings:
 1. Current RM-A-2 noble gas reading
 2. Current RM-A-2 iodine reading
 3. Previous RM-A-2 iodine reading
 4. Time since previous RM-A-2 iodine reading
- The time in minutes since reactor shutdown
- Reactor building pressure

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Reactor Building Design Basis Leakage Manual Code Calculation Using RMS

- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- This calculation should only be used when the purge valves are closed. If they are open, some form of reactor building purge exhaust calculation should be performed.
- This calculation option is only good when reactor building pressure is below 4 psi. If RM-A-2 is isolated (>4 psi in RB), this calculation cannot be used. Use COLA RMS calculation or manual contingency calculation if building pressure is above 4 psi.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing containment integrity or increases in damage class using a manual code contingency calculation.

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- Consider getting an effluent sample from this pathway (pre-filter marinelli or CATPASS as applicable) when conditions appear to have stabilized.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Design Basis Leakage Manual Code Calculation Using Samples

How it works:

- A sample of the reactor building atmosphere can be obtained using the CATPASS system.
- The user enters the positive noble gas and iodine isotope concentrations from the analysis when prompted by the code.
- Once the isotopic concentrations in the reactor building are input, the code uses the leakage flow rate from the building, based on a user input building pressure, to determine the uCi/sec leaking from the reactor building (source term). Reduction of RB pressure to atmospheric pressure stops releases from this pathway.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)

Met Data is available on Area 19, Group2 of the PPC (See STA)

- The code will prompt the user to input values for RCS temperature and pressure or Fuel Damage Class values. These must be input but will have no bearing on the calculation since effluent concentrations leaving the plant are being determined by isotopic sample analysis.
- CATPASS sample results and time of sample results.
- Purge valve position (normally closed but open if doing a "what if containment is lost" calculation)
- Reactor building pressure
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Manual Code Calculation
Using Samples**

Problems to Watch For

- This is a good calculation to perform a "What If" calculations for loss of containment integrity when a CATPASS sample has been obtained.
- The CATPASS system takes 45 minutes to warm up so direct the OSC to start the warm up as soon as you think you may want this type of sample.
- The sample will typically be collected from the cooler discharge rather than the isokinetic nozzle to reduce moisture in the sample.
- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should begin using COLA or manual code RMS calculations.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing containment integrity or increase in damage class using a manual code contingency calculation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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**Reactor Building Design Basis Leakage
Manual Code Calculation
Contingency Calculation**

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the total RCS leakage into the reactor building and the activity concentration in the RCS, after adjusting for iodine losses (reduction factors) applicable to this pathway.
- The iodine reduction factor for this pathway is 0.4 with RB spray off, or 0.03 with RB spray on, based on minimal hold-up time in the building..
- Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.
- Once the code determines the isotopic concentrations in the reactor building, it uses building leak rate, based on a user input building pressure, to determine the uCi/sec leaking from the building (source term). Reduction of RB pressure to atmospheric pressure stops releases from this pathway.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- **THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE**

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The total RCS leakage into the RB, if known. The STA or TSC should provide RCS leak rates.
- The time in minutes since reactor shutdown
- The status of reactor building spray (on or off)

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- The status of the purge valves (closed if performing this calculation)
- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.
- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity (uCi/cc) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- The code will prompt the user for the total RCS leakage into the reactor building. If the leakage is less than 63,000 gallons (one RCS volume), the actual leakage should be input. If the leakage is more than 63,000 gallons, a maximum of 63,000 gallons should be used. Inputting more than 63,000 gallons will overestimate the source term because it will put more activity in the building than is available for release from the RCS.
- If the total RCS leakage is not known, the code will assume the entire RCS volume (63,000 gallons) has been released to the building using a damage class 4. If total RCS leakage is not known and the damage class is other than 4, the user should respond that the leakage is known and specify the leakage as 63,000 gallons.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.

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- Consider getting a CATPASS sample to increase the accuracy of the dose projection. The CATPASS system takes 45 minutes to warm up so direct the OSC to start the warm up as soon as you think you may want this type of sample.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way.

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**Reactor Building Design Basis Leakage
Quick Code Calculation**

How it works:

This calculation is not performed by the Quick Code.

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Emergency Feed Pump Exhaust COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The COLA uses the higher reading of RM-G-26 or RM-G-27
- Once the COLA determines the isotopic concentrations in the main steam line, it uses the mass flow rate through the EFP turbine (based on emergency feedwater being supplied) to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.

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Emergency Feed Pump Exhaust COLA Calculation Using RMS

Problems to Watch For

- Main steam line and condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers via AS-V-4 to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.

Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose.
- If the steam driven EFP is on and being fed by steam from the OTSG's, the steam must travel past RM-G-26 or RM-G-27. There is no concern about the monitors being isolated by a closed MS-V-2.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Effluent samples are not available for this pathway. If fuel damage is suspected, consider asking for an RCS post accident sample to refine the dose projection.

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- If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.

If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for an increase in damage class.
- Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.
- If a Site Protection Officer is stationed at the reactor building equipment hatch, consider moving the individual from that area.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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**Emergency Feed Pump Exhaust
COLA Calculation
Using Samples**

How it works:

This option cannot be used on the COLA at this time

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Emergency Feed Pump Exhaust Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The choice of which monitor should be based on which generator is supplying the pump. RM-G-26 for the 'A' side or RM-G-27 for the 'B' side.
- Once the code determines the isotopic concentrations in the main steam line, it uses the mass flow rate through the EFP turbine. The user must specify this mass flow rate (obtain from TSC). Use default of 30,000 lb/hr until the TSC can provide a better value.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
 - The monitor to be used and the monitor reading.
 - The time in minutes since reactor shutdown
 - The mass flow rate of steam exiting the EFP turbine must be specified by the user in the "Sum of other Direct to Atmosphere Releases" space on the screen used to specify which MSR's or ADV's are open. The mass flow rate can be obtained from the TSC. Use default of 30,000 lb/hr until the TSC can provide a better value.
 - Met Data (wind speed, wind direction, and delta t)
- Release duration

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Problems to Watch For

- Main steam line and Condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers via AS-V-4 to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.

Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose.
- If the steam driven EFP is on and being fed by steam from the OTSG's, the steam must travel past RM-G-26 or RM-G-27. There is no concern about the monitors being isolated by a closed MS-V-2.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- If the mass flow rate through the pump cannot immediately be determined, use the manual code contingency calculation for this pathway.
- This pathway is always considered a ground level release. However, if this calculation is run with an ADV or MSR also open, the code may inappropriately classify it as an elevated release. If the EFP is running with an ADV or MSR open, both cases must be run separately and the doses added together.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.

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- Effluent samples are not available for this pathway. If fuel damage is suspected, consider asking for an RCS post accident sample to refine the dose projection.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for losing condenser vacuum or increases in damage class using a manual code contingency calculation.
- Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.
- If a Site Protection Officer is stationed at the reactor building equipment hatch, consider moving the individual from that area.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a very bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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**Emergency Feed Pump Exhaust
Manual Code Calculation
Using Samples**

How it works:

This option cannot be used on the manual code at this time

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Emergency Feed Pump Exhaust/Main Steam Line Break Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted. It is also good to use if the mass flow through the EFP cannot immediately be obtained and the 30,000 lb/hr default is not believed to be representative, or if RM-G-26 and RM-G-27 are at background levels.
- This is the calculation that should also be used in the case of a main steam line break.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the primary-to-secondary leak rate and the activity concentration in the RCS. The source term rate is independent of mass flow through the steam driven EFP or the main steam line break.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.

Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.

- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

THIS PATHWAY IS ALWAYS CONSIDERED A GROUND LEVEL RELEASE

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The primary-to-secondary leak rate, in gpm, provided by the STA or TSC.
- The time in minutes since reactor shutdown
- Met Data (wind speed, wind direction, and delta t)

Release duration

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Emergency Feed Pump Exhaust/Main Steam Line Break Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose.
- If the mass flow rate of steam through the pump turbine cannot immediately be determined, this is a good calculation to use. If all ADV's and MSR's are kept closed, all primary activity entering the secondary side will be assumed to be released via this pathway.
- If RM-G-26 and RM-G-27 are at background levels, this is a good calculation to perform to verify dose projections made using RMS data.
- This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.
- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity (uCi/cc) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.

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**Emergency Feed Pump Exhaust/Main Steam Line Break
Manual Code Calculation
Contingency Calculation**

- Effluent samples are not available for this pathway. Consider requesting an RCS sample (normal or post accident) to increase the accuracy of the dose projection.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- This pathway is always considered a ground level release. However, if this calculation is run with an ADV or MSR also open, the code may inappropriately classify it as an elevated release. If the EFP is running with an ADV or MSR open, both cases must be run separately and the doses added together.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- If a Site Protection Officer is stationed at the reactor building equipment hatch, consider moving the individual from that area.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way.

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**Emergency Feed Pump Exhaust
Quick Code Calculation**

How it works:

This calculation is not performed by the Quick Code.

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Atmospheric Dump Valve Release (A or B Side) COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The COLA uses the reading on RM-G-26 if MS-V-4A is open and the reading on RM-G-27 if MS-V-4B is open.
- Once the COLA determines the isotopic concentrations in the main steam line, it uses the mass flow rate out the ADV. The mass flow rate is a function of the main steam pressure and the percent demand on the MS-V-4 valve. Both of these parameters are picked up off the plant computer.
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

AS A RESULT OF BUOYANT PLUME RISE, THIS PATHWAY IS ALMOST ALWAYS AN ELEVATED RELEASE.

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.

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Atmospheric Dump Valve Release (A or B Side) COLA Calculation Using RMS

Problems to Watch For

- Main steam line and condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- Be aware that the COLA measures the degree of the ADV opening by the percent demand (how much it should be open for plant conditions). If an ADV were to stick open, but did not need to be open, the percent demand will be 0 and the COLA will not recognize the ADV is open. As a result, it will compute a source term of 0. If this occurs, a manual code RMS calculation should be performed specifying the valve as 100% open. An alternative would be to edit the COLA Parameter Edit Screen to say an MSR is stuck open. The latter will provide a more conservative dose estimate (factor of 2), but will keep the EIN and MIDAS plume plots reasonably accurate.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers via AS-V-4 to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose
- If the release is through an ADV, the steam must travel past RM-G-26 or RM-G-27. There is no concern about the monitors being isolated by a closed MS-V-2.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.

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2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Effluent samples are not available for this pathway. If fuel damage is suspected, consider asking for a RCS post accident sample to refine the dose projection.
 - If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.
 - Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
 - Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
 - Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
 - If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
 - Periodically verify the release duration and pathway with the ED.
 - Consider performing manual "What If" dose projections for an increase in damage class using the manual code contingency calculation
 - Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.
 - Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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**Atmospheric Dump Valve Release (A or B Side)
COLA Calculation
Using Samples**

How it works:

This option cannot be used on the COLA at this time

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Atmospheric Dump Valve Release (A or B Side) Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches. These reduction factors are accounted for in the manual code.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The choice of which monitor should be based on which ADV is open. RM-G-26 for MS-V-4A or RM-G-27 for MS-V-4B. If both valves are open, use the higher of the two monitors.
- Once the code determines the isotopic concentrations in the main steam line, it uses the mass flow rate out the ADV. The mass flow rate is a function of the main steam pressure and the percent open of the MS-V-4 valve. The user specifies both of these parameters.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- As a result of buoyant plume rise, this pathway is almost always an elevated release.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
 - The monitor to be used and the monitor reading.
 - The time in minutes since reactor shutdown
 - The main steam pressure
 - The percent the ADV is open.
 - Whether generator level is above 600 inches or not
 - Met Data (wind speed, wind direction, and delta t)
- Release duration

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Atmospheric Dump Valve Release (A or B Side) Manual Code Calculation Using RMS

Problems to Watch For

- Main steam line and condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.

Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose
- If the release is through an ADV, the steam must travel past RM-G-26 or RM-G-27. There is no concern about the monitors being isolated by a closed MS-V-2.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Effluent samples are not available for this pathway. If fuel damage is suspected, consider asking for an RCS post accident sample to refine the dose projection.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.

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Manual Code Calculation
Using RMS**

- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for an increase in damage class using the manual code contingency calculation.
- Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.
- This pathway is always considered an elevated release. However, if this calculation is run with the EFP running, the code will erroneously classify the EFP release as an elevated release. With the EFP running both cases must be run separately and the doses added together.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a very bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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**Atmospheric Dump Valve Release (A or B Side)
Manual Code Calculation
Using Samples**

How it works:

This option cannot be used on the manual code at this time

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Atmospheric Dump Valve Release (A or B Side) Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted, or if RM-G-26 and RM-G-27 are at background levels.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the primary-to-secondary leak rate and the activity concentration in the RCS. The source term rate is independent of mass flow through the ADV.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.
- Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.

Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

- As a result of buoyant plume rise, this pathway is almost always an elevated release.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The primary-to-secondary leak rate, in gpm, provided by the STA or TSC.
- The main steam pressure
- The percent the ADV is open
- Whether generator level is above 600 inches or not
- The time in minutes since reactor shutdown
- Met Data (wind speed, wind direction, and delta t)

Release duration

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Atmospheric Dump Valve Release (A or B Side) Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- If RM-G-26 and RM-G-27 are at background levels, this is a good calculation to perform to verify dose projections made using RMS data.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose.

This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.

- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity (uCi/cc) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.

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Manual Code Calculation
Contingency Calculation**

- Effluent samples are not available for this pathway. Consider requesting an RCS Sample (normal or post accident) to increase the accuracy of the dose projection.
- This pathway is always considered an elevated release. However, if this calculation is run with the EFP running, the code will erroneously classify the EFP release as an elevated release. With the EFP running both cases must be run separately and the doses added together.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way.

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Atmospheric Dump Valve Release (A or B Side) Quick Code Calculation

How it works:

- This code provides a quick, but crude, estimate of offsite dose. As such it should only be used by the on-shift RAC, during the first hour of an emergency, if the COLA Code is not available.
- This code requires an RMS reading for its calculation. If an RMS reading is not available, a manual code contingency calculation must be performed.
- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The RCS mixture is assumed to have the same isotopic distribution as a Fuel Damage Class 2.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. It is accounted for in the code.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate. The user selects which monitor will be used for the calculation.
- The code assumes the mass flow rate to approximate an ADV 100% open at a main steam pressure of 1040 psi.
- The code assumes an 8 hour release duration.
- Once the code determines the isotopic concentrations in the main steam line, it uses the flow rate out of the ADV to determine the $\mu\text{Ci/sec}$ leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always considered a ground level release

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- Met Data (wind speed, wind direction, and delta t)
- Since the COLA is not available, all readings must come from control room instrumentation.

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Quick Code Calculation**

Problems to Watch For

- The IREO RAC should not use this code. The full manual code should be used when the IREO organization is activated.
- This calculation assumes an RCS isotopic distribution that is the same as a Fuel Damage Class 2. This provides a reasonable estimate of offsite dose for both fuel damage and iodine spiking situations. As soon as time is available, however, a manual code RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.

If the MS-V-2 valves are closed, RM-G-26 and RM-G-27 are isolated from steam flow and may not be representative of current main steam conditions. Determine MS-V-2 position from the ED. With the MS-V-2 valves closed, manual code contingency calculations should be used to calculate offsite doses unless the last known reading on these monitors is known to be representative of current main steam conditions.

- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Label all Quickcode calculations as "Quickcode"

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Main Steam Safety Release (A or B Side) COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The COLA uses the highest reading on RM-G-26 or RM-G-27.
- There is no plant computer point that provides indication that an MSR is open. The user must tell the COLA that an MSR is open by editing the Parameter Edit Screen. Opening an MSR on the COLA does not specify whether it is on the A or B side.
- Once the COLA determines the isotopic concentrations in the main steam line, it uses the mass flow rate out the highest rated MSR. The mass flow rate is a function of the main steam pressure. This parameter is picked up off the plant computer.
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- As a result of buoyant plume rise, this pathway is almost always an elevated release.

User Inputs Needed to Perform the Calculation

- MSR open using the Parameter Edit screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.

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Main Steam Safety Release (A or B Side) COLA Calculation Using RMS

Problems to Watch For

- Main steam line and condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
 - If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose
- If the MS-V-2 valves are closed, RM-G-26 and RM-G-27 are isolated from steam flow and may not be representative of current main steam conditions. Determine MS-V-2 position from the ED. With the MS-V-2 valves closed, manual code contingency calculations should be used to calculate offsite doses unless the last known reading on these monitors is known to be representative of current main steam conditions.
 - Since the COLA does not know whether the open MSR is on the A or B side, and because it uses the highest of the main steam monitor readings, it can be a conservative calculation. For example, if the open MSR is on the B side (RM-G-27) but it is the OTSG-A that is leaking (RM-G-26), the COLA is assuming that an A side MSR is open, resulting in what could be a very conservative calculation. Should this type of situation occur, the manual code RMS calculation should be used to see how conservative the COLA is.
 - The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
 - Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.

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COLA Calculation
Using RMS**

3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Effluent samples are not available to this pathway. If fuel damage is suspected, consider asking for an RCS post accident sample to refine the dose projection.
 - If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.
 - Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
 - Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
 - Depending on the physical form of iodine in the field, the “LLD” for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
 - If dose projections show PAG’s are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
 - Periodically verify the release duration and pathway with the ED.
 - Consider performing manual “What If” dose projections for an increase in damage class using the manual code contingency calculation.
 - Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.
 - Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can’t be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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COLA Calculation
Using Samples**

How it works:

This option cannot be used on the COLA at this time

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How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches. These reduction factors are accounted for in the manual code.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate.
- The user inputs the reading on RM-G-26 if an 'A' side MSR is open or the reading on RM-G-27 if a 'B' side MSR open. If MSR's are open on both the A and B side, the highest of the two readings should be used.
- Once the code determines the isotopic concentrations in the main steam line, it uses the mass flow rate out the MSR. The mass flow rate is a function of the main steam pressure. The main steam pressure is input by the user.
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- As a result of buoyant plume rise, this pathway is almost always an elevated release.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
 - The monitor to be used and the monitor reading.
 - The time in minutes since reactor shutdown
 - The main steam pressure
 - The specific MSR that is open.
 - Whether generator level is above 600 inches or not
 - Met Data (wind speed, wind direction, and delta t)
- Release duration

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Problems to Watch For

- Main steam line and condenser offgas monitor increases can result from increased RCS activity or increased primary-to-secondary leakage, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased primary-to-secondary leakage. Check with STA or TSC to determine if leak rate changes have been observed.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose
- If the MS-V-2 valves are closed, RM-G-26 and RM-G-27 are isolated from steam flow and may not be representative of current main steam conditions. Determine MS-V-2 position from the ED. With the MS-V-2 valves closed, manual code contingency calculations should be used to calculate offsite doses unless the last known reading on these monitors is known to be representative of current main steam conditions.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.

Effluent samples are not available for this pathway. If fuel damage is suspected, consider asking for an RCS post accident sample to refine the dose projection.

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- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for an increase in damage class using the manual code contingency calculation.

Consider performing a manual contingency calculation based on primary-to-secondary leak rate as verification of this type of dose projection if RM-G-26 and RM-G-27 are reading close to background.

- This pathway is always considered an elevated release. However, if this calculation is run with the EFP running, the code will erroneously classify the EFP release as an elevated release. With the EFP running both cases must be run separately and the doses added together.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? If RM-G-26 and RM-G-27 readings are less than 100 cpm, this will probably be a very bounding type calculation. If they are above 100 cpm, this type of calculation should be a pretty good approximation of what the doses could be.

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How it works:

This option cannot be used on the manual code at this time

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Main Steam Safety Release (A or B Side) Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- If RM-G-26 and RM-G-27 are at background levels, this is a good calculation to perform to verify dose projections made using RMS data.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the primary-to-secondary leak rate and the activity concentration in the RCS. The source term rate is independent of mass flow through the MSR.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. Additional iodine reduction can occur if the OTSG level is raised above 600 inches.
- Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- As a result of buoyant plume rise, this pathway is almost always an elevated release.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)
Met Data is available on Area 19, Group 2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The primary-to-secondary leak rate, in gpm, provided by the STA or TSC.
- The main steam pressure
- The specific MSR that is open
- Whether generator level is above 600 inches or not

The time in minutes since reactor shutdown

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Main Steam Safety Release (A or B Side) Manual Code Calculation Contingency Calculation

- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- If the steam driven EFP (EFP-1) is on, request that the ED switch over to the electrically driven pumps to terminate this release pathway. If this is not possible, request that the ED use the auxiliary boilers to drive the pump. Ask to switch to the unaffected OTSG until the boilers can be used.
- Raising the OTSG level to 600 inches will provide additional iodine reduction. Request that the ED consider increasing OTSG level for this purpose.
- This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.
- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity ($\mu\text{Ci/cc}$) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- Effluent samples are not available for this pathway. Consider requesting an RCS sample (normal or post accident) to increase the accuracy of the dose projection.

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**Main Steam Safety Release (A or B Side)
Manual Code Calculation
Contingency Calculation**

- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
 - This pathway is always considered an elevated release. However, if this calculation is run with the EFP running, the code will erroneously classify the EFP release as an elevated release. With the EFP running both cases must be run separately and the doses added together.
 - Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
 - Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
 - When performing "What If" dose projections, clearly label them as "What If" calculations.
 - Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way.

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Main Steam Safety Release (A or B Side) Quick Code Calculation

How it works:

- This code provides a quick, but crude, estimate of offsite dose. As such it should only be used by the on-shift RAC, during the first hour of an emergency, if the COLA Code is not available.
- This code requires an RMS reading for its calculation. If an RMS reading is not available, a manual code contingency calculation must be performed.
- The isotopic distribution of activity leaving the plant is assumed to have the same isotopic distribution as a Fuel Damage Class 2.
- The iodine reduction factor for this pathway is 0.5 based on partitioning of iodine in the steam generators. It is accounted for in the code.
- The RMS monitor (RM-G-26 or RM-G27) determines the activity in the main steam. These monitors will respond to both increases in RCS activity and primary-to-secondary leakrate. The user selects which monitor will be used for the calculation.

The code assumes the mass flow rate out of the MSR to be approximately equivalent to an ADV 100% open at a main steam pressure of 1040 psi.

- The code assumes an 8 hour release duration.
- Once the code determines the isotopic concentrations in the main steam line, it uses the assumed flow rate out of the MSR to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always considered an elevated release.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 35 & 36 of the PPC (See STA)

Met Data is available on Area 19, Group2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- Met Data (wind speed, wind direction, and delta t)
- Since the COLA is not available, all readings must come from control room instrumentation.

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Main Steam Safety Release (A or B Side) Quick Code Calculation

Problems to Watch For

- The IREO RAC should not use this code. The full manual code should be used when the IREO organization is activated.
- This calculation assumes an RCS isotopic distribution that is the same as a Fuel Damage Class 2. This provides a reasonable estimate of offsite dose for both fuel damage and iodine spiking situations. As soon as time is available, however, a manual code RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- The methodology this code uses to quantify releases using RM-G-26 and 27 is overly conservative. To get a more realistic estimate of the release, utilize the correction factor described in Section 5.9.4.2 of the EDCM to correct the offsite doses and release rates produced by this calculation.
- If the MS-V-2 valves are closed, RM-G-26 and RM-G-27 are isolated from steam flow and may not be representative of current main steam conditions. Determine MS-V-2 position from the ED. With the MS-V-2 valves closed, manual code contingency calculations should be used to calculate offsite doses unless the last known reading on these monitors is known to be representative of current main steam conditions.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Label all Quickcode calculations as "Quickcode".

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Station Vent COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is a combination of primary system iodine retention (0.4) and charcoal filtration (0.01). The total iodine reduction factor is then $(0.4)(0.01) = 0.004$.
- The RMS monitor (RM-A-8 Gas, RM-A-8 Iodine, or RM-A-8 high) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakage into the auxiliary/fuel handling building.
- The logic the COLA uses in picking which monitor to perform the calculation is as follows:
 1. If RM-A-8 High reads less than 100, the COLA is using the reading on RM-A-8 Gas to compute the noble gas source term.
 2. If RM-A-8 High reads less than 100, the COLA is using the difference between the current reading on RM-A-8 Iodine and the previous reading on RM-A-8 iodine compute the iodine source term.
 3. If RM-A-8 High reads > 100 cpm, the COLA is using RM-A-8 High to compute the noble gas and iodine source terms.
- Once the COLA determines the isotopic concentrations leaving via station vent, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad
- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.

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Station Vent COLA Calculation Using RMS

Problems to Watch For

- Station vent monitor increases can result from increased RCS activity or RCS leakage in the Auxiliary/Fuel Handling Building, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased leakage to the Auxiliary/Fuel Handling Building. Check with STA or TSC to determine if leak rate changes have been observed.
- If RM-A-8 High is ≤ 100 cpm, RM-A-8 Iodine is used to calculate the iodine source term. The iodine source term is not ratioed in from the RCS noble gas to iodine ratio. The isotopic distribution of the iodines is the same as in the RCS.

The RM-A-8 iodine calculation assumes that 4 minutes have elapsed since the current and previous iodine channel readings. Due to differences in the timing of PPM files and COLA calculations, there can be variability in thyroid dose estimate (factor of 2) during each 15 minute period. Use the highest of the three estimates performed each 15 minutes.
- If RM-A-8 High is ≤ 100 cpm, and RM-A-8 Iodine is offscale high, the iodine source term will not be calculated correctly. In this situation, the manual RMS calculation for station vent should be performed.
- If RM-A-8 High is > 100 cpm, the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.

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**Station Vent
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Using RMS**

- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the “LLD” for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.

Consider getting an effluent sample from this pathway (MAP-5 or pre-filter marinelli) when conditions appear to have stabilized.

- Consider performing manual “What If” dose projections for increases in damage class.
- If the charcoal filters become degraded and are believed to be operating at less than normal efficiency, the manual code RMS calculation should be used for this pathway. The TSC can provide information on charcoal filter efficiency and degradation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Station Vent COLA Calculation Using Samples

How it works:

- Effluents leaving via Station Vent are sampled using a pre-filter marinelli sample
- The user enters the positive noble gas and iodine isotope concentrations from the analysis into the Station Vent Sample Edit Screen.
- If a MAP-5 sample is used, the manual code must be used to perform the calculation, since the COLA will not produce a noble gas source term.
- Once the COLA determines the isotopic concentrations leaving via Station Vent, it uses the flow rate from the plant computer to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

- Sample results need to be entered on the Station Vent Sample Edit Screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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Station Vent COLA Calculation Using Samples

Problems to Watch For

- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should make the Station Vent Sample Edit Screen inactive and resume COLA RMS calculations.
- MAP-5 samples cannot be used solely with the COLA code since noble gases are not measured. The COLA code will not produce a noble gas source term from a MAP-5 sample. MAP-5 samples must be calculated using the manual codes to get the correct TEDE dose. The MAP-5 sample should still be input into the COLA code since the thyroid doses produced by the COLA will still be accurate.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for increases in damage class using a manual code contingency calculation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Station Vent Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is a combination of primary system iodine retention (0.4) and charcoal filtration efficiency specified by the user (E). The total iodine reduction factor is then $(0.4)(1-E)$, normally = 0.004.
- The RMS monitor (RM-A-4, 6, or 8 Gas, RM-A-4, 6, or 8 Iodine, or RM-A-8 high) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakage into the auxiliary/fuel handling building.
- The user selects whether RM-A-4, RM-A-6, RM-A-8 or RM-A-8 High is used for the calculation:
 1. If RM-A-8 or RM-A-8 High is selected, the code will ask the user if RM-A-8 Iodine is on scale. If the answer is yes, the code will calculate the iodine source term base on the current and previous iodine channel readings specified by the user. If RM-A-8 iodine is offscale, the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway.
 2. If RM-A-4 or RM-A-6 are selected. The code assumes the iodine channels are onscale and iodine channels must be input to get an iodine source term.
 3. If RM-A-4 or RM-A-6 are selected, or if RM-A-8 Iodine is offscale, the code will ask the user if the charcoal filters are operational. If they are, the code will prompt the user to input their efficiency. The efficiency should be input as 0.99 unless information from the TSC indicates another value should be used.
- Once the code determines the isotopic concentrations leaving via station vent, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

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Station Vent Manual Code Calculation Using RMS

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 38 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- The monitor to be used and the monitor reading.
- The time in minutes since reactor shutdown
- Station Vent flowrate
- The Reactor building purge flowrate (for adjacent plume rise)
- Charcoal filter operability and efficiency

Met Data (wind speed, wind direction, and delta t)

- Release duration

Problems to Watch For

- Station Vent monitor increases can result from increased RCS activity or increased RCS leakage to the Aux/FHB, or a combination of the two. If a sudden increase occurs:
 1. Check for signs of increased RCS activity. Coincident increases on RM-L-1, RM-G-22, RM-G-23, RM-G-6, or RM-G-7 may indicate increased RCS activity from fuel damage. Also check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased leakage to the Auxiliary/Fuel Handling Building. Check with STA or TSC to determine if leak rate changes have been observed.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.

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- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for increases in damage class using a manual code contingency calculation.
- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter marinelli) when conditions appear to have stabilized.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Station Vent Manual Code Calculation Using Samples

How it works:

- Effluents leaving via station vent are sampled using a MAP-5 sample or a pre-filter marinelli sample
- If a pre-filter marinelli sample is used, the user enters the positive noble gas and iodine isotope concentrations from the analysis when prompted by the code.
- If a MAP-5 sample is used, the user enters the positive iodine isotope concentrations from the analysis when prompted by the code. Since MAP-5 samples do not provide noble gas results, manual code will scale in the noble gases. It assumes that the noble gas to iodine ratio leaving Station Vent is the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway.
- The iodine reduction factor for this pathway is a combination of primary system iodine retention (0.4) and charcoal filtration efficiency specified by the user (E). The total iodine reduction factor is then $(0.4)(1-E)$, normally = 0.004.

Once the code determines the isotopic concentrations leaving via Station Vent, it uses the Station Vent flow rate input by the user to determine the uCi/sec leaving the plant (source term).

- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 38 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- The code will prompt the user to input values for RCS temperature and pressure or Fuel Damage Class values. These must be input but will have no bearing on the calculation since effluent concentrations leaving the plant are being determined by isotopic sample analysis.
- Sample results from Station Vent and the time of the sample
- Station vent flow rate
- The reactor building purge flow rate (for adjacent plume rise)
- Charcoal filter operability and efficiency
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Station Vent Manual Code Calculation Using Samples

Problems to Watch For

- The MAP-5 sample panel may present a dose rate hazard to personnel if the release rate is high or if it has been running for a long time with the same cartridges.
- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should begin using COLA or manual code RMS calculations.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projection for increases in damage class.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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**Station Vent
Manual Code Calculation
Contingency Calculation**

How it works:

The manual code does not support this calculation at this time.

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Station Vent Quick Code Calculation

How it works:

- This code provides a quick, but crude, estimate of offsite dose. As such it should only be used by the on-shift RAC, during the first hour of an emergency, if the COLA Code is not available.
- This code requires an RMS reading for its calculation. If an RMS reading is not available, a manual code contingency calculation must be performed.
- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The RCS mixture is assumed to have the same isotopic distribution as a Fuel Damage Class 2.
- The iodine reduction factor for this pathway is a combination of primary system iodine retention (0.4) and charcoal filtration (0.1). The total iodine reduction factor should be $(0.4)(0.1) = 0.04$. This is conservative since the charcoal filtration of iodines should be closer to 99% efficient.
- The RMS monitor (RM-A-8 or RM-A-8 High) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakrate into the Aux /Fuel Handling Building. The user selects which monitor will be used for the calculation. Generally, the highest range monitor reading > 100 should be used.
- The code assumes a Station Vent flow of 80,000 cfm. Dose results may be ratioed by the actual cfm (i.e. if the actual flow is only 40,000 cfm, the dose projection is reduced by ½).
- The code assumes an 8 hour release duration.
- Once the code determines the isotopic concentrations leaving via Station Vent, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the meteorological conditions present.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 38 of the PPC (See STA)
Met Data is available on Area 19, Group 2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- Met Data (wind speed, wind direction, and delta t)

Since the COLA is not available, all readings must come from control room instrumentation.

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Station Vent Quick Code Calculation

Problems to Watch For

- The IREO RAC should not use this code. The full manual code should be used when the IREO organization is activated.
- This calculation assumes an RCS isotopic distribution that is the same as a Fuel Damage Class 2. This provides a reasonable estimate of offsite dose for both fuel damage and iodine spiking situations. As soon as time is available, however, a manual code RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- The user should check the sum of the actual flow at FR-149 and FR-150 to determine if the dose needs to be adjusted based on the 80,000 cfm flow assumed in the calculation.
- As soon as time is available, a manual RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Label all Quickcode calculations as "Quickcode"

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Reactor Building Purge Exhaust COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is a combination of reduction by natural processes (0.4) or reduction by reactor building spray (0.03) and charcoal filtration (0.01). The total iodine reduction factor with no reactor building spray is then $(0.4)(0.01) = 0.004$. The total iodine reduction factor with reactor building spray is then $(0.03)(0.01) = 0.0003$.
- The RMS monitor (RM-A-9 Gas, RM-A-9 Iodine, RM-A-9 High, or RM-G-24) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakage into the reactor building.
- The logic the COLA uses in picking which monitor to perform the calculation is as follows:
 1. If RM-A-9 High and RM-G-24 read ≤ 100 , the COLA is using the reading on RM-A-9 Gas to compute the noble gas source term.
 2. If RM-A-9 High and RM-G-24 read ≤ 100 , the COLA is using the difference between the current reading on RM-A-9 Iodine and the previous reading on RM-A-9 iodine compute the iodine source term
 3. If RM-A-9 High reads > 100 cpm and RM-G-24 reads ≤ 100 mR/hr, the COLA is using RM-A-9 High to compute the noble gas and iodine source terms.
 4. If RM-G-24 reads > 100 mR/hr, the COLA is using RM-G-24 to compute the noble gas and iodine source terms
- Once the COLA determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours

Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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Reactor Building Purge Exhaust COLA Calculation Using RMS

Problems to Watch For

- Fuel Damage Class using the Parameter Edit screen the damage class is believed to be other than that indicated by current RCS temperature and pressure.
- Reactor Building Purge Exhaust monitor increases can result from increased RCS activity or RCS leakage in the reactor building, or a combination of the two. If a sudden increase occurs:
 1. Check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased leakage to the Reactor Building. Check with STA or TSC to determine if leak rate changes have been observed.
- If RM-A-9 High is ≤ 100 cpm, RM-A-9 Iodine is used to calculate the iodine source term. The iodine source term is not ratioed in from the RCS noble gas to iodine ratio. The isotopic distribution of the iodines is the same as in the RCS.

The RM-A-9 iodine calculation assumes that 4 minutes have elapsed since the current and previous iodine channel readings. Due to differences in the timing of PPM files and COLA calculations, there can be variability in thyroid dose estimate (factor of 2) during each 15 minute period. Use the highest of the three estimates performed each 15 minutes.

- If RM-A-9 High is ≤ 100 cpm and RM-A-9 Iodine is offscale high, the iodine source term will not be calculated correctly. In this situation, the manual RMS calculation for the reactor building purge exhaust should be performed.
- If RM-A-9 High or RM-G-24 is > 100 , the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred, but RCS temperature and pressure improve, the COLA will reduce the Fuel Damage Class.
 2. If this occurs, the user must edit the damage class using the Parameter Edit Screen to lock in the higher damage class.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into the Reactor Coolant Baseline Activity Edit Screen, ensure the Fuel Damage Class is set to 1 on the Parameter Edit Screen and the spiking factors in the Sample Edit Screen are set to 1. If the COLA is using a damage class greater than 1, the COLA will use the default isotopic activities for that damage class instead of the post accident samples that were input. If the spiking factors are not set to 1, the COLA will erroneously apply the spiking factors to the input sample results.

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Reactor Building Purge Exhaust COLA Calculation Using RMS

- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.

Consider performing manual "What If" dose projections for increases in damage class.

- Consider getting an effluent sample from this pathway (MAP-5, pre-filter marinelli, or CATPASS as applicable) when conditions appear to have stabilized.
- If the charcoal filters become degraded and are believed to be operating at less than normal efficiency, the manual code RMS calculation should be used for this pathway. The TSC can provide information on charcoal filter efficiency and degradation.
- If no significant releases are occurring through station vent, consider maximizing station vent flow to increase dispersion from adjacent plume momentum.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Purge Exhaust COLA Calculation Using Samples

How it works:

- Effluents leaving via the reactor building purge exhaust are sampled using a pre-filter marinelli sample
- The user enters the positive noble gas and iodine isotope concentrations from the analysis into the Reactor Building Purge Exhaust Sample Edit Screen.
- If a MAP-5 sample is used, the manual code must be used to perform the calculation, since the COLA will not produce a noble gas source term.
- Once the COLA determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the flow rate from the plant computer to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

- Sample results need to be entered on the Station Vent Sample Edit Screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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Reactor Building Purge Exhaust COLA Calculation Using Samples

Problems to Watch For

- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should make the Reactor Building Purge Exhaust Sample Edit Screen inactive and resume COLA RMS calculations.
- MAP-5 samples cannot be used solely with the COLA code since noble gases are not measured. The COLA code will not produce a noble gas source term from a MAP-5 sample. MAP-5 samples must be calculated using the manual codes to get the correct TEDE dose. The MAP-5 sample should still be input into the COLA code since the thyroid doses produced by the COLA will still be accurate.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projections for increases in damage class using a manual code contingency calculation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.
- If no significant releases are occurring through station vent, consider maximizing station vent flow to increase dispersion from adjacent plume momentum.

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Reactor Building Purge Exhaust Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the RCS is not important to this calculation, just the RCS isotopic distribution.
- The iodine reduction factor for this pathway is a combination of reduction by natural processes (0.4) or reduction by reactor building spray (0.03) and charcoal filtration (E) specified by the user. The total iodine reduction factor with no reactor building spray is then $(0.4)(1-E)$, normally 0.004. The total iodine reduction factor with reactor building spray is then $(0.03)(1-E)$, normally = 0.0003.
- The RMS monitor (RM-A-9 Gas, RM-A-9 Iodine, RM-A-9 High, or RM-G-24) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakage into the reactor building.
- The user selects whether RM-A-9, RM-A-9 High, or RM-G-24 is used for the calculation. The logic the code uses in picking which monitor to perform the calculation is as follows:
 1. If RM-A-9, RM-A-9 High, or RM-G-24 is selected, the code will ask the user if RM-A-9 Iodine is on scale. If the answer is yes, the code will calculate the iodine source term based on the current and previous iodine channel readings specified by the user. If RM-A-9 iodine is offscale, the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway.
 2. If RM-A-9, RM-A-9 High, or RM-G-24 are selected, and RM-A-9 Iodine is offscale, the code will ask the user if the charcoal filters are operational. If they are, the code will prompt the user to input their efficiency. The efficiency (E) should be input as 0.99 unless information from the TSC indicates another value should be used.
- Once the code determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the flow rate input by the user to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

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Reactor Building Purge Exhaust Manual Code Calculation Using RMS

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- Purge valve position (open if performing this calculation)
- The monitor to be used and the monitor reading.
- The time in minutes since reactor shutdown
- Station vent flowrate (for adjacent plume rise)
- The reactor building purge flowrate
- RB spray on or off
- Charcoal filter operability and efficiency
- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- Reactor Building Purge Exhaust monitor increases can result from increased RCS activity or RCS leakage in the reactor building, or a combination of the two. If a sudden increase occurs:
 1. Check the ED/ESD Screen for changes in Fuel Damage Class based on thermal hydraulic conditions in the core.
 2. Check for signs of increased leakage to the Reactor Building. Check with STA or TSC to determine if leak rate changes have been observed.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.

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Reactor Building Purge Exhaust Manual Code Calculation Using RMS

3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.
- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
 - Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
 - Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
 - Consider performing manual "What If" dose projections for increases in damage class using a manual code contingency calculation
 - Consider getting an effluent sample from this pathway (MAP-5, pre-filter marinelli, or CATPASS as applicable) when conditions appear to have stabilized.
 - Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Purge Exhaust Manual Code Calculation Using Samples

How it works:

- The MAP-5 sample panel may present a dose rate hazard to personnel if the release rate is high or if it has been running for a long time with the same cartridges.
- Effluents leaving via the reactor building purge exhaust are sampled using a MAP-5 sample or a pre-filter marinelli sample.
- If a pre-filter marinelli sample is used, the user enters the positive noble gas and iodine isotope concentrations from the analysis when prompted by the code.
- If a MAP-5 sample is used, the user enters the positive iodine isotope concentrations from the analysis when prompted by the code. Since MAP-5 samples do not provide noble gas results, manual code will scale in the noble gases. It assumes that the noble gas to iodine ratio leaving the reactor building purge exhaust is the same as the isotopic distribution of activity in the RCS after adjusting for iodine losses (reduction factors) applicable to this pathway.

The iodine reduction factor for this pathway is a combination of reduction by natural processes (0.4) or reduction by reactor building spray (0.03) and charcoal filtration (E) specified by the user. The total iodine reduction factor with no reactor building spray is then $(0.4)(1-E)$, normally 0.004. The total iodine reduction factor with reactor building spray is then $(0.03)(1-E)$, normally = 0.0003

- Once the code determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the reactor building purge exhaust flow rate input by the user to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

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Reactor Building Purge Exhaust Manual Code Calculation Using Samples

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)

Met Data is available on Area 19, Group 2 of the PPC (See STA)

- The code will prompt the user to input values for RCS temperature and pressure or Fuel Damage Class values. These must be input but will have no bearing on the calculation since effluent concentrations leaving the plant are being determined by isotopic sample analysis.
- Sample results from the reactor building purge exhaust and the time of the sample
- Station Vent flowrate (for adjacent plume rise)
- The Reactor Building purge flowrate
- Charcoal filter operability and efficiency (normally 0.99)
- Reactor building spray status

Met Data (wind speed, wind direction, and delta t)

- Release duration

Problems to Watch For

- The user must ensure that the sample results are representative of current plant conditions. If plant conditions change significantly after the sample was obtained, the user should begin using COLA or manual code RMS calculations.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles
- Periodically verify the release duration and pathway with the ED.
- Consider performing manual "What If" dose projection for increases in damage class.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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Reactor Building Purge Exhaust Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is equal to the product of the total leakage into the reactor building and the activity concentration in the RCS, after adjusting for iodine losses (reduction factors) applicable to this pathway.
- The iodine reduction factor for this pathway is a combination of reduction by natural processes (0.4) or reduction by reactor building spray (0.03) and charcoal filtration (E) specified by the user. The total iodine reduction factor with no reactor building spray is then $(0.4)(1-E)$, normally 0.004. The total iodine reduction factor with reactor building spray is then $(0.03)(1-E)$, normally = 0.0003.
- Unlike RMS calculations, this calculation is very dependent on RCS total activity. As a result, the code has the ability to use RM-L-1 high or low readings to estimate total RCS activity. The user may also specify a total RCS activity.
- Once the code determines the isotopic concentrations in the reactor building, it uses the reactor building purge exhaust flow rate to determine the uCi/sec leaking from the building (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- RCS temperature and pressure or the user specified Fuel Damage Class
- RM-L-1 high or low readings if letdown is not isolated.
- An estimate of total RCS activity, if known.
- The total RCS leakage into the reactor building, if known. The STA or TSC should provide.
- The time in minutes since reactor shutdown
- Charcoal filter efficiency (normally 0.99)
- The status of reactor building spray (on or off)

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Reactor Building Purge Exhaust Manual Code Calculation Contingency Calculation

- The status of the purge valves (open if doing this calculation)
- Met Data (wind speed, wind direction, and delta t) and release duration

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on total RCS activity. The code will adjust RCS total activity if an RM-L-1 reading is input. Prior to inputting an RM-L-1 reading, verify that RCS letdown is not secured. If it has been secured (and it typically is during this type of accident), RM-L-1 readings should not be used unless the user is sure that the last reading is representative of current RCS conditions. Note that due to travel time in the sample lines, RM-L-1 may take up to 30 minutes before responding to a change in RCS activity.
- If RM-L-1 readings are not available, the code will permit the user to enter a total RCS activity (uCi/cc) if this is known. It generally is not. An example of when this could be used is if an RCS sample has just been pulled but has not been analyzed. If the dose rate on the sample is a factor of 10 higher than a normal RCS sample, it can be inferred that the RCS activity is 10 times higher than it was prior to the incident. Be aware, entering a total RCS activity will replace damage class default RCS activities and spiking factors.
- The code will prompt the user for the total RCS leakage into the reactor building. If the leakage is less than 63,000 gallons (one RCS volume), the actual leakage should be input. If the leakage is more than 63,000 gallons, a maximum of 63,000 gallons should be used. Inputting more than 63,000 gallons will overestimate the source term because it will put more activity in the building than is available for release from the core.
- If the total RCS leakage is not known, the code will assume the entire RCS volume (63,000 gallons) has been released to the building using a damage class 4. If total RCS leakage is not known and the damage class is other than 4, the user should respond that the total leakage is known and specify the leakage as 63,000 gallons.
- Remember that if fuel damage has occurred, it cannot get better.
 1. If damage has occurred but RCS temperature and pressure improve, and the new values are input into the code, the code will reduce the Fuel Damage Class.
 2. If this occurs, the user must specify the damage class instead of entering pressure and temperature.
 3. After doing this, the user must watch RCS temperature and pressure to ensure that damage class does not increase beyond the damage class assumed.

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**Reactor Building Purge Exhaust
Manual Code Calculation
Contingency Calculation**

- If post accident RCS results are to be input into code, specify that the Fuel Damage Class as 1 and there has been no power transient when the code asks. If the code is using a damage class greater than 1, the code will use the default isotopic activities for that damage class instead of the post accident samples that were input.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

Periodically verify the release duration and pathway with the ED.

- When performing "What If" dose projections, clearly label them as "What If" calculations
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on the inputs, this type of calculation could go either way
- Consider getting a MAP-5, pre-filter/marinelli, or CATPASS sample from this pathway to increase the accuracy of the dose projection. The CATPASS system takes 45 minutes to warm up so direct the OSC to start the warm up as soon as you think you may want this type of sample.

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Reactor Building Purge Exhaust Quick Code Calculation

How it works:

- This code provides a quick, but crude, estimate of offsite dose. As such it should only be used by the on-shift RAC, during the first hour of an emergency, if the COLA Code is not available.
- This code requires an RMS reading for its calculation. If an RMS reading is not available, a manual code contingency calculation must be performed.
- The isotopic distribution of activity leaving the plant is assumed to have the same isotopic distribution as a Fuel Damage Class 2.
- The iodine reduction factor for this pathway is a combination of reduction by natural processes (0.4) and charcoal filtration (0.1). The total iodine reduction factor is then $(0.4)(0.1) = 0.04$. Reactor building spray is assumed to be off. This is conservative since the charcoal filtration of iodines should be closer to 99% efficient.
- The RMS monitor (RM-A-9, RM-A-9 High, or RM-G-24) determines the activity leaving via this pathway. These monitors will respond to both increases in RCS activity and increased leakrate into the reactor building. The user selects which monitor will be used for the calculation. Generally, the highest range monitor reading > 100 should be used.
- The code assumes a reactor building purge exhaust flow of 10,000 cfm. Dose results may be ratioed by the actual cfm (i.e. if the actual flow is only 5,000 cfm, the dose projection is reduced by $\frac{1}{2}$).
- The code assumes an 8 hour release duration.
- Once the code determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the meteorological conditions present.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)

Met Data is available on Area 19, Group 2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- Met Data (wind speed, wind direction, and delta t)

Since the COLA is not available, all readings must come from control room instrumentation.

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**Reactor Building Purge Exhaust
Quick Code Calculation**

Problems to Watch For

- The IREO RAC should not use this code. The full manual code should be used when the IREO organization is activated.
- This calculation assumes an RCS isotopic distribution that is the same as a Fuel Damage Class 2. This provides a reasonable estimate of offsite dose for both fuel damage and iodine spiking situations. As soon as time is available, however, a manual code RMS calculation should be performed so a dose estimate using more representative plant parameters can be obtained.
- The user should check the actual flow at FR-909 or FR-148A to determine if the dose needs to be adjusted based on the 10,000 cfm flow assumed in the calculation.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Label all Quickcode calculations as "Quickcode"

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ESF Fuel Handling Building COLA Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same isotopic distribution of activity as a fuel assembly 72 hours after shutdown from full power, after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the fuel assembly is not important to this calculation, just the isotopic distribution.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the spent fuel pool (0.01) and charcoal filtration (0.01). The total iodine reduction factor is then $(0.01)(0.01) = 0.0001$.
- The RMS monitor (RM-A-14) determines the activity leaving via this pathway.
- If the COLA sees that the normal fuel handling building ventilation system is < 3000 cfm, it assumes that the shutdown of the ventilation system was caused by a fuel handling accident (interlock with RM-G-9 or RM-A-14). It then assumes the ESF Ventilation is operating at a constant flow rate of 7000 cfm.
- Once the COLA determines the isotopic concentrations leaving via the ESF Ventilation, it uses the 7000 cfm flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always a ground level release.

User Inputs Needed to Perform the Calculation

- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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ESF Fuel Handling Building COLA Calculation Using RMS

Problems to Watch For

- The assumed isotopic mix is the same as a spent fuel assembly 72 hours after shutdown from full power. It is likely to be conservative for CDE if the actual fuel assembly is significantly older than that. Air samples from this pathway should be obtained as soon as possible to run a COLA or manual calculation using samples.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.

If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.

- Periodically verify the release duration and pathway with the ED.
- Consider getting an effluent sample from this pathway (radioiodine or pre-filter marinelli) as soon as possible.
- If the charcoal filters become degraded and are believed to be operating at less than normal efficiency, the manual code RMS calculation should be used for this pathway. The TSC can provide information on charcoal filter efficiency and degradation.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation will produce conservative thyroid doses if the fuel assembly is significantly greater than 72 hours old.

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ESF Fuel Handling Building COLA Calculation Using Samples

How it works:

- Effluents leaving via the ESF ventilation system are sampled using a pre-filter marinelli sample
- The user enters the positive noble gas and iodine isotope concentrations from the analysis into the ESF Ventilation Sample Edit Screen.
- If just the RM-A-14 iodine sample is used, the manual code must be used to perform the calculation, since the COLA will not produce a noble gas source term.
- If the COLA sees that the normal fuel handling building ventilation system is < 3000 cfm, it assumes that the shutdown of the ventilation system was caused by a fuel handling accident (interlock with RM-G-9 or RM-A-14). It then assumes the ESF Ventilation is operating at a constant flow rate of 7000 cfm.
- Once the COLA determines the isotopic concentrations leaving via the ESF Ventilation, it uses the 7000 cfm flow rate to determine the uCi/sec leaving the plant (source term).

Having developed the source term, the COLA uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.

- This pathway is always a ground level release.

User Inputs Needed to Perform the Calculation

- Sample results need to be entered on the ESF Vent Sample Edit Screen
- Release duration using the Parameter Edit screen if other than 8 hours
- Met Data using the Parameter Edit screen if the data being picked up from the Met Tower is bad

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ESF Fuel Handling Building COLA Calculation Using Samples

Problems to Watch For

- RM-A-14 iodine samples cannot be used solely with the COLA code since noble gases are not measured. The COLA code will not produce a noble gas source term from a RM-A-14 iodine sample. RM-A-14 iodine samples must be calculated using the manual codes to get the correct TEDE dose. The RM-A-14 iodine sample should still be input into the COLA code since the thyroid doses produced by the COLA will still be accurate.
- Monitor met data. If met data shows absolutely no changes for a 30 – 45 minute period, there may be a problem with the data. Verify met data with EACC and/or Control Room indications.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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ESF Fuel Handling Building Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same isotopic distribution of activity as a fuel assembly 72 hours after shutdown from full power, after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the fuel assembly is not important to this calculation, just the isotopic distribution.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the spent fuel pool (0.01) and charcoal filtration (E). The total iodine reduction factor is then $(0.01)(1-E)$, normally = 0.0001.
- The RMS monitor (RM-A-14) determines the activity leaving via this pathway.
- The code defaults to a ventilation flow rate of 7000 cfm.
- Once the code determines the isotopic concentrations leaving via the ESF Ventilation, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always a ground level release.

User Inputs Needed to Perform the Calculation

- The monitor to be used and the monitor reading.
- The time in minutes since the accident
- Charcoal filter operability and efficiency (normally 0.99)
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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ESF Fuel Handling Building Manual Code Calculation Using RMS

Problems to Watch For

- The assumed isotopic mix is the same as a spent fuel assembly 72 hours after shutdown from full power. It is likely to be conservative for CDE if the actual fuel assembly is significantly older than that. Air samples from this pathway should be obtained as soon as possible to run a COLA or manual calculation using samples.
- The code prompts the user for the time since reactor shutdown to perform decay corrections. The time since the fuel handling accident occurred should be entered in this field.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider getting an effluent sample from this pathway radioiodine or pre-filter marinelli as soon as possible.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be. This type of calculation will produce conservative thyroid doses if the fuel assembly is significantly greater than 72 hours old.

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ESF Fuel Handling Building Manual Code Calculation Using Samples

How it works:

- Effluents leaving via the reactor building purge exhaust are sampled using an RM-A-14 iodine sample or a pre-filter marinelli sample.
- If a pre-filter marinelli sample is used, the user enters the positive noble gas and iodine isotope concentrations from the analysis when prompted by the code.
- If a radioiodine sample is used, the user enters the positive iodine isotope concentrations from the analysis when prompted by the code. Since radioiodine samples do not provide noble gas results, manual code will scale in the noble gases. It assumes that the noble gas to iodine ratio leaving the ESF ventilation is the same as the isotopic distribution of activity in the damaged fuel assembly after adjusting for iodine losses (reduction factors) applicable to this pathway.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the spent fuel pool (0.01) and charcoal filtration (E). The total iodine reduction factor is then $(0.01)(1-E)$, normally = 0.0001
- The code assumes a ventilation flow rate of 7000 cfm.
- Once the isotopic concentrations leaving via the ESF Vent are entered, the code uses the ESF Vent flow rate to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always a ground level release.

User Inputs Needed to Perform the Calculation

- Sample results from ESF Ventilation System and the time of the sample
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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**ESF Fuel Handling Building
Manual Code Calculation
Using Samples**

Problems to Watch For

- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- Periodically verify the release duration and pathway with the ED.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation should be a pretty good approximation of what the doses could be.

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ESF Fuel Handling Building Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted. It should be used when RMS data is not available.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is assumed to be equal to the gap activity in 56 fuel pins, 72 hours after reactor shutdown.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the spent fuel pool (0.01) and charcoal filtration (E). The total iodine reduction factor is then $(0.01)(1-E)$, normally = 0.0001.
- Once the code determines the isotopic concentrations in the fuel handling building, it uses ESF Vent flow rate input by the user to determine the uCi/sec leaking from the building (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway is always a ground level release.

User Inputs Needed to Perform the Calculation

- Charcoal filter operability and efficiency (normally 0.99)
- Flow rate out the ESF Ventilation System (normally assumed to be 7000 cfm)
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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ESF Fuel Handling Building Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on the activity in the damaged fuel assembly and the extent of damage to the fuel assembly. The calculation assumes 56 of 208 pins are broken during the accident. It assumes the assembly involved was shutdown from full power 72 hours ago. Conditions that vary from these assumptions will decrease the accuracy of the dose projection.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.

Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.

- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on how closely actual conditions match the stated assumptions, this type of calculation could go either way. However, it will typically be a bounding type calculation.
- Consider getting an effluent sample from this pathway (radioiodine or pre-filter/marinelli) as soon as possible.

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**ESF Fuel Handling Building
Quick Code Calculation**

How it works:

This calculation is not performed by the Quick Code.

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Reactor Building Fuel Handling Accident Manual Code Calculation Using RMS

How it works:

- The isotopic distribution of activity leaving the plant is assumed to be the same as the isotopic distribution of activity fuel assembly 72 hours after shutdown from full power, after adjusting for iodine losses (reduction factors) applicable to this pathway. The total activity in the fuel assembly is not important to this calculation, just the isotopic distribution.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the fuel transfer canal (0.01) and charcoal filtration (E). The total iodine reduction factor is then $(0.01)(1-E)$, normally = 0.0001.
- **If the purge valves are open**, the RMS monitor (RM-A-9 Gas, RM-A-9 Iodine, RM-A-9 High, or RM-G-24) determines the activity leaving via this pathway.
 - ♦ The user selects whether RM-A-9, RM-A-9 High, or RM-G-24 is used for the calculation. The logic the code uses in picking which monitor to perform the calculation is as follows:
 1. If RM-A-9, RM-A-9 High, or RM-G-24 is selected, the code will ask the user if RM-A-9 Iodine is on scale. If the answer is yes, the code will calculate the iodine source term based on the current and previous iodine channel readings specified by the user. If RM-A-9 Iodine is offscale, the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway.
 2. If RM-A-9, RM-A-9 High, or RM-G-24 are selected, and RM-A-9 Iodine is offscale, the code will ask the user if the charcoal filters are operational. If they are, the code will prompt the user to input their efficiency. The efficiency (E) should be input as 0.99 unless information from the TSC indicates another value should be used.
 - ♦ Once the code determines the isotopic concentrations leaving via the reactor building purge exhaust, it uses the flow rate to determine the uCi/sec leaving the plant (source term).
- **If the purge valves are closed**, the RMS monitor (RM-A-2) determines the airborne activity in the reactor building. The manual code does not use RM-G-22 or RM-G-23. If RM-A-2 is isolated (>4 psi in RB), this calculation cannot be used. Use manual contingency calculation.
 - ♦ Once the code determines the isotopic concentrations in the reactor building, it uses the leakage flow rate from the building, based on building pressure input by the user, to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- If the purge valves are closed, this pathway is always a ground level release. If the purge valves are open, this pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

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User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- The time in minutes since the accident
- Purge valves open or closed
- Charcoal filter operability and efficiency (normally 0.99)
- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- The assumed isotopic mix is the same as a spent fuel assembly that was shutdown from full power 72 hours ago. It is likely to be conservative for CDE if the actual fuel assembly is significantly older than that. For this type of accident in the reactor building, an age of 72 hours is probably a pretty good assumption. Air samples from this pathway should be obtained as soon as possible to run a COLA or manual calculation using samples.
- The code prompts the user for the time since reactor shutdown to perform decay corrections. The time since the fuel handling accident occurred should be entered in this field.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider getting an effluent sample from this pathway (MAP-5, pre-filter marinelli, or CATPASS as applicable) as soon as possible.

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Manual Code Calculation
Using RMS**

- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation will produce conservative thyroid doses if the fuel assembly is significantly greater than 72 hours old.

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**Reactor Building Fuel Handling Accident
Manual Code Calculation
Using Samples**

How it works:

- If the purge valves are open, this calculation is identical to a reactor building purge exhaust manual code calculation using samples.
- If the purge valves are closed, this calculation is identical to a reactor building design basis leakage exhaust manual code calculation using samples.

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Reactor Building Fuel Handling Accident Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted. It should be used when RMS data is not available.
- This calculation uses no RMS data. The isotopic distribution and total activity being released via this pathway is assumed to be equal to the gap activity in an entire fuel assembly (208 fuel pins), 72 hours after reactor shutdown. The user may modify the number of pins that were believed to be damaged.
- The iodine reduction factor for this pathway is a combination of reduction by decontamination in the fuel transfer canal (0.01) and charcoal filtration (E). The total iodine reduction factor is then $(0.01)(1-E)$, normally = 0.0001.
- **If the purge valves are open**, the code uses reactor building purge exhaust flow rate input by the user to determine the uCi/sec leaking from the building (source term).

If the purge valves are closed, the code uses reactor building leak rate based on the building pressure input by the user to determine the uCi/sec leaking from the building (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- If the purge valves are closed, this pathway is always a ground level release. If the purge valves are open, this pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 37 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- Charcoal filter operability and efficiency (normally 0.99)
- Estimated number of fuel pins damaged
- Flow rate out the reactor building purge exhaust and the station vent if the purge valves are open
- Reactor building pressure if the purge valves are closed.
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Reactor Building Fuel Handling Accident Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on the activity in the damaged fuel assembly and the extent of damage to the fuel assembly. The calculation assumes as a default that 208 pins are broken during the accident. It assumes the assembly involved was shutdown from full power 72 hours ago. Conditions that vary from these assumptions will decrease the accuracy of the dose projection.
- Consider getting an effluent sample from this pathway (MAP-5 pre-filter/marinelli, or CATPASS as applicable) as soon as possible.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on how closely actual conditions match the stated assumptions, this type of calculation could go either way. However, it will typically be a bounding type calculation.

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**Waste Gas Decay Tank Rupture Accident
Manual Code Calculation
Using RMS**

How it works:

- The isotopic distribution of activity in the tank is assumed to be the same as the isotopic distribution of activity in TMI-1 FSAR Table 14.2-21 for the design basis waste gas decay tank rupture. The total activity in the tank is not important to this calculation, just the isotopic distribution.
- The iodine reduction factor for this pathway is solely charcoal filtration (E). The total iodine reduction factor is normally $(1-E) = 0.01$.
- The RMS monitor (RM-A-4, 6, or 8 Gas, RM-A-4, 6, or 8 Iodine, or RM-A-8 high) determines the activity leaving via this pathway. These monitors will respond to a waste gas decay tank rupture as well as increases in RCS activity and increased leakage into the auxiliary/fuel handling building.
- The user selects whether RM-A-4, RM-A-6, RM-A-8 or RM-A-8 High is used for the calculation: logic the COLA uses in picking which monitor to perform the calculation is as follows:
 1. If RM-A-8 or RM-A-8 High is selected, the code will ask the user if RM-A-8 Iodine is on scale. If the answer is yes, the code will calculate the iodine source term base on the current and previous iodine channel readings specified by the user. If RM-A-8 Iodine is offscale, the iodine source term is scaled in from the noble gas to iodine ratio after adjusting for iodine losses (reduction factors) applicable to this pathway.
 2. If RM-A-4 or RM-A-6 are selected. The code assumes the iodine channels are onscale and iodine channels must be input to get an iodine source term.
 3. If RM-A-4 or RM-A-6 are selected, or if RM-A-8 Iodine is offscale, the code will ask the user if the charcoal filters are operational. If they are, the code will prompt the user to input their efficiency. The efficiency (E) should be input as 0.99 unless information from the TSC indicates another value should be used.
- Once the code determines the isotopic concentrations leaving via station vent, it uses the flow rate input by the user to determine the uCi/sec leaving the plant (source term).
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

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Waste Gas Decay Tank Rupture Accident Manual Code Calculation Using RMS

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 38 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- The monitor to be used and the monitor reading.
- The station vent and reactor building purge exhaust flow rates
- The time in minutes since the accident
- Charcoal filter operability and efficiency
- Met Data (wind speed, wind direction, and delta t)
- Release duration

Problems to Watch For

- The assumed isotopic mix is the same as the design basis accident in the FSAR. It is likely to be very conservative for CDE since historically, there is much less iodine in the tank than was assumed in the FSAR accident. Air samples from this pathway should be obtained as soon as possible to run a COLA or manual calculation using samples.
- The code prompts the user for the time since reactor shutdown to perform decay corrections. The time since the waste gas decay tank rupture occurred should be entered in this field.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter marinelli) as soon as possible.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? This type of calculation will produce conservative thyroid doses.

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**Waste Gas Decay Tank Rupture Accident
Manual Code Calculation
Using Samples**

How it works:

- This calculation is identical to a station vent manual code calculation using samples.

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Waste Gas Decay Tank Rupture Accident Manual Code Calculation Contingency Calculation

How it works:

- This calculation is very useful for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted. It should be used when RMS data is not available.
- This calculation uses no RMS data. The user inputs the isotopic distribution and total activity being released via this pathway. Two selections are available; a "typical" tank inventory or a "worst case" inventory. Both of these inventories are very conservative based on operational history.
- The iodine reduction factor for this pathway is solely charcoal filtration (E). The total iodine reduction factor is normally $(1-E) = 0.01$.
- The code uses duration of the accident input by the user to determine the uCi/sec leaking from the building (source term).
- The code uses station vent flow rate input by the user to determine the effective release height.
- Having developed the source term, the code uses the meteorological dispersion model to calculate the concentrations and doses at distances from the plant.
- This pathway can be a ground level release, an elevated release, or a mixture of the two depending on the flow rate from station vent and the reactor building purge exhaust and the meteorological conditions present.

User Inputs Needed to Perform the Calculation

Plant data inputs are available on Area 38, Group 38 of the PPC (See STA)
Met Data is available on Area 19, Group2 of the PPC (See STA)

- Charcoal filter operability and efficiency (normally 0.99)
- "Typical" or "worst case" tank
- Flow rate out the reactor building purge exhaust and the station vent
- Met Data (wind speed, wind direction, and delta t)
- Release duration

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Waste Gas Decay Tank Rupture Accident Manual Code Calculation Contingency Calculation

Problems to Watch For

- Of all calculations available, contingency calculations are the least accurate. They should only be used when RMS data or effluent samples are not available. Contingency calculations are ideal for performing "What If" calculations, where the precise response of an RMS monitor to a change in plant conditions cannot be predicted.
- This type of calculation is very dependent on the activity in the damaged waste gas decay tank. The assumptions for the activity in the tank are very conservative.
- Remember that the CDE contributes to the TEDE. Do not expect field team dose rate readings to match up with TEDE projections. Roughly 3% of the CDE dose is included in the TEDE dose. Ensure field teams get iodine samples even if E-520 dose rates are low.
- Depending on the physical form of iodine in the field, the "LLD" for thyroid dose rates measured by field teams could be as high as 5 mrem/hr based on a 10 minute air sample. Consider longer sampling times if additional sensitivity is desired.
- If dose projections show PAG's are exceeded at 10 miles, validation of the dose projection from field reading should be performed prior to issuing a PAR beyond 10 miles.
- Periodically verify the release duration and pathway with the ED.
- When performing "What If" dose projections, clearly label them as "What If" calculations.
- Always communicate the uncertainty of the dose projection. Is it a bounding calculation such that I know doses can't be any higher than this? Or, is this the best approximation of what I believe offsite doses actually could be? Depending on how closely actual conditions match the stated assumptions, this type of calculation could go either way. However, it will typically be a bounding type calculation.
- Consider getting an effluent sample from this pathway (MAP-5 or pre-filter/marinelli) as soon as possible.

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PSLR vs COG RMS Reading Graphs

Graphs are presented in this section which can be used to provide a rough estimate of PSLR based on condenser off gas monitor readings and estimated RCS activities. The graphs are referenced in RAF 6612-97-011. The following assumptions were used in the graphs:

- The condenser off gas flow rate was fixed at 50 cfm to simplify the correction of the PSLR for the actual COG flow during use. The correction is made by taking the Factor value from the graph and multiplying it by the actual flow divided by 50 cfm.
- Total RCS activity for the purposes of these graphs are the total iodine and noble gas activity. Tritium is not to be included in the total RCS activity.
- For RCS activities 10 uCi/cc and below, the isotopic mix is assumed to be the same as TMI Cycle 9, which represents a core with fuel pin defects that are present prior to the PSLR.
- Do not adjust total RCS activity for iodine spiking. The RCS total activities listed on the graphs are not intended to be used with iodine spiking factors since most of the iodine transferred to the secondary side does not leave via the condenser off gas. For example, if the RCS activity prior to shutdown was 10 uCi/cc and an iodine spike of 50 would be expected upon shutdown (Damage Class 1A), the iodine spiking would not be used to adjust the RCS activity for the graph. The 10 uCi/cc line would still be used to determine the leak rate.
- For RCS activities above 10 uCi/cc up to Damage Class 2 the isotopic mix is assumed to be the same as a Damage Class 2. The total RCS activity specified for each diagonal line was multiplied by the normalized Damage Class 2 isotopic distribution to develop an isotopic distribution for that activity. This is meant to represent the RCS isotopic mix that could occur as gap activity enters the RCS during the accident.
- The lines for Damage Classes 2 - 5 are the default RCS activities found in the TMI EDCM.
- Graphs were generated for each range monitor for times of 0, 4, and 8 hours post shutdown to account for isotopic distribution changes resulting from radiological decay.

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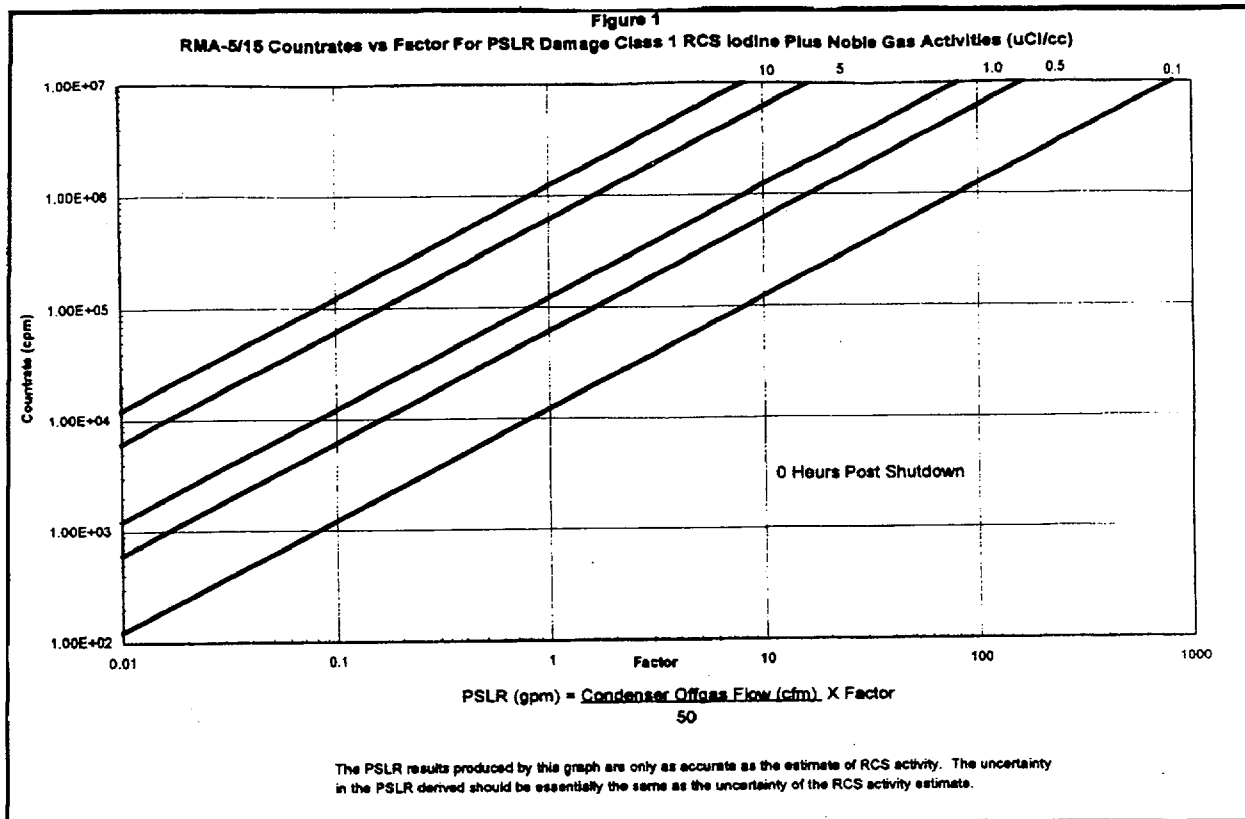
- The graphs assume there are no direct to atmosphere releases (main steam relief valve, atmospheric dump valve, or EF-P-1) occurring. If such a release is occurring, the estimation of PSLR using condenser off gas monitor is more complex since all of the activity released into the secondary side does not reach the condenser. To correct for this loss of activity, the following equation can be used:

$$PSLR_t = (PSLR_{cog}) / (1 - F_m - F_e - F_a)$$

Where:

- PSLR_t = Total primary-to-secondary leakage (gpm)
- PSLR_{cog} = Primary-to-secondary leakage estimated from the graph (gpm)
- F_m = Estimated fraction of main steam flow estimated to be leaving through a main steam safety (dimensionless)
- F_e = Estimated fraction of main steam flow estimated to be leaving through EF-P-1A (dimensionless)
- F_a = Estimated fraction of main steam flow estimated to be leaving through the atmospheric dump valves (dimensionless)

The user of these graphs must be aware that the PSLR results they produce are only as accurate as the estimate of RCS activities. The uncertainty in the PSLR derived should be essentially the same as the uncertainty of the RCS activity estimate. The graphs for 0, 4, and 8 hours post shutdown are attached in the following pages.

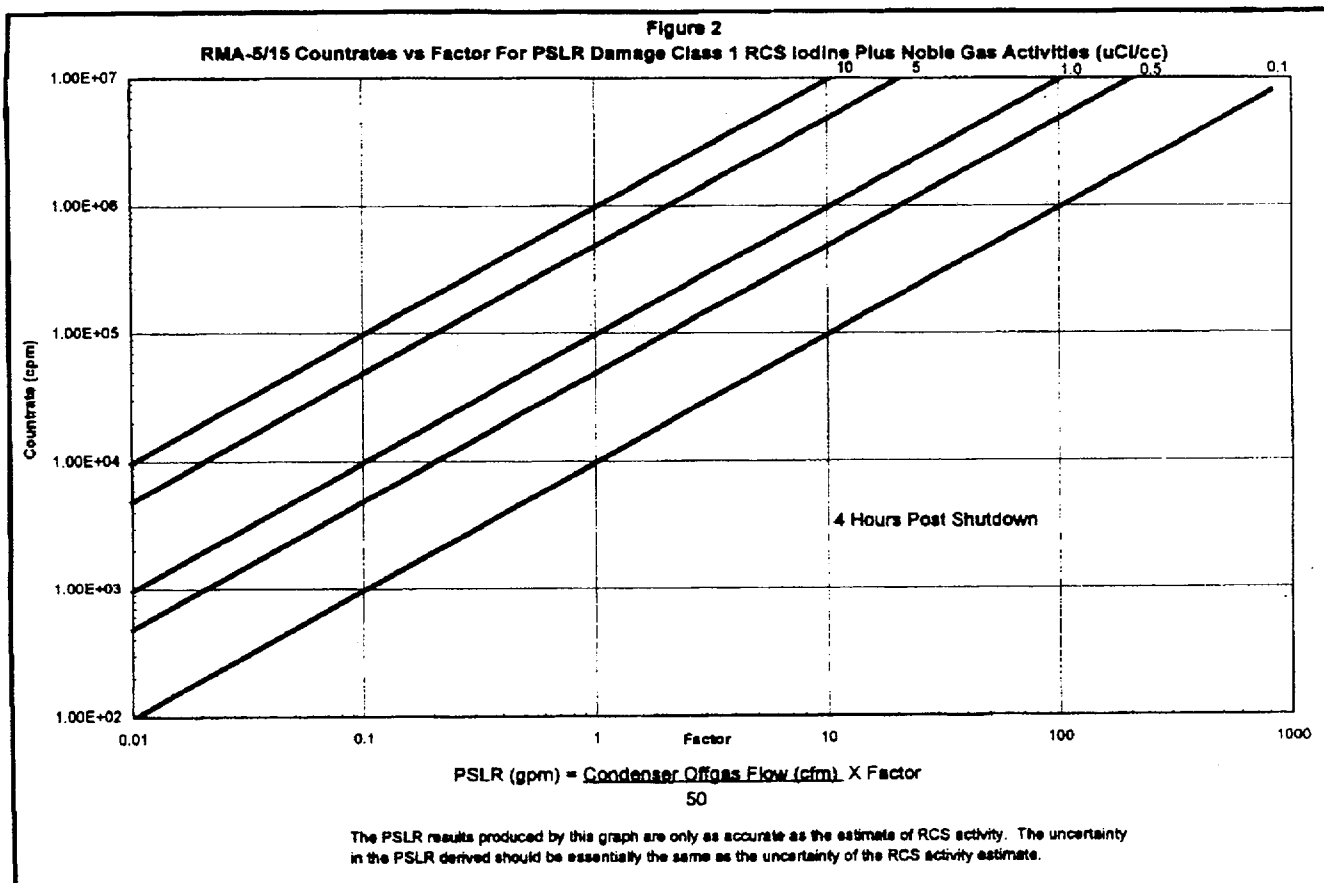


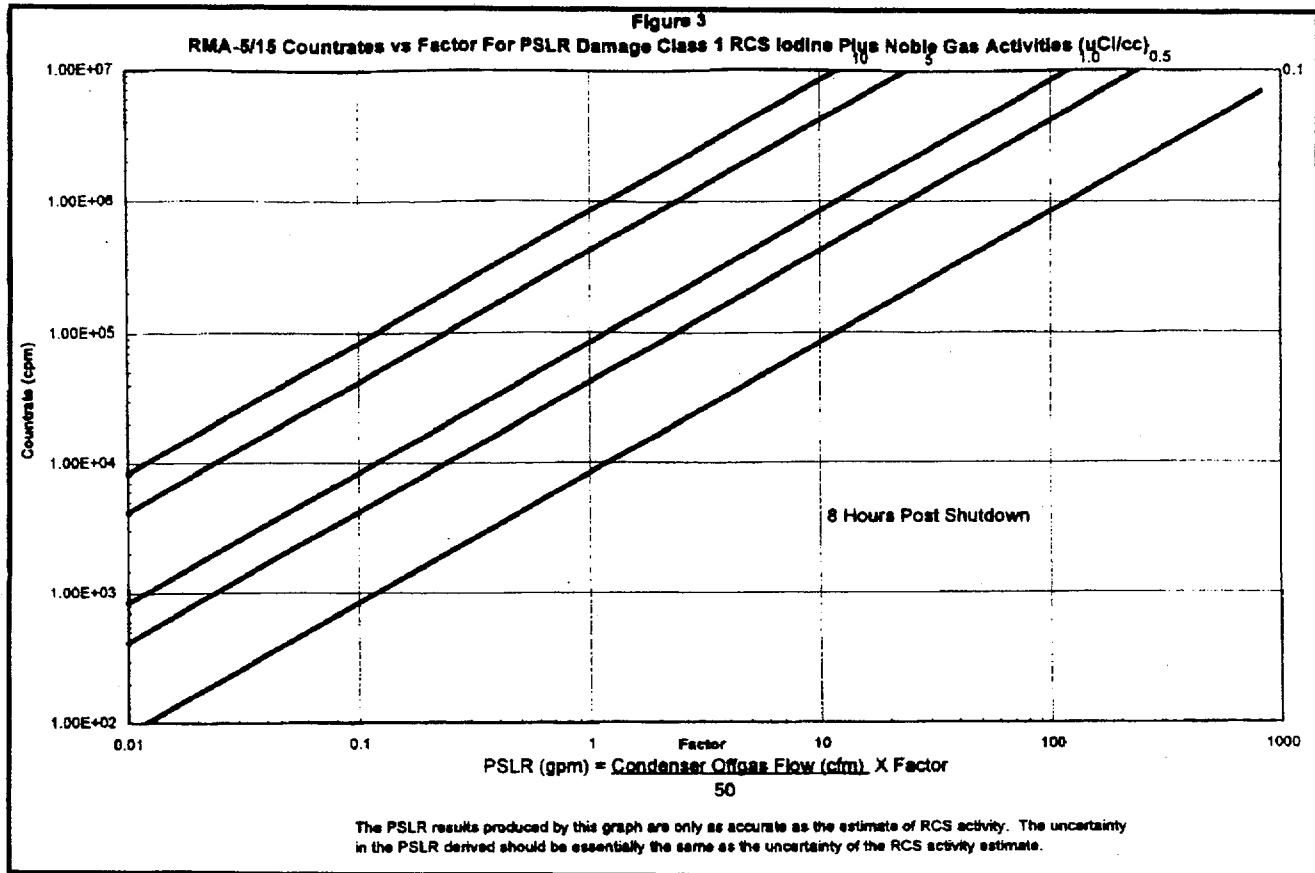
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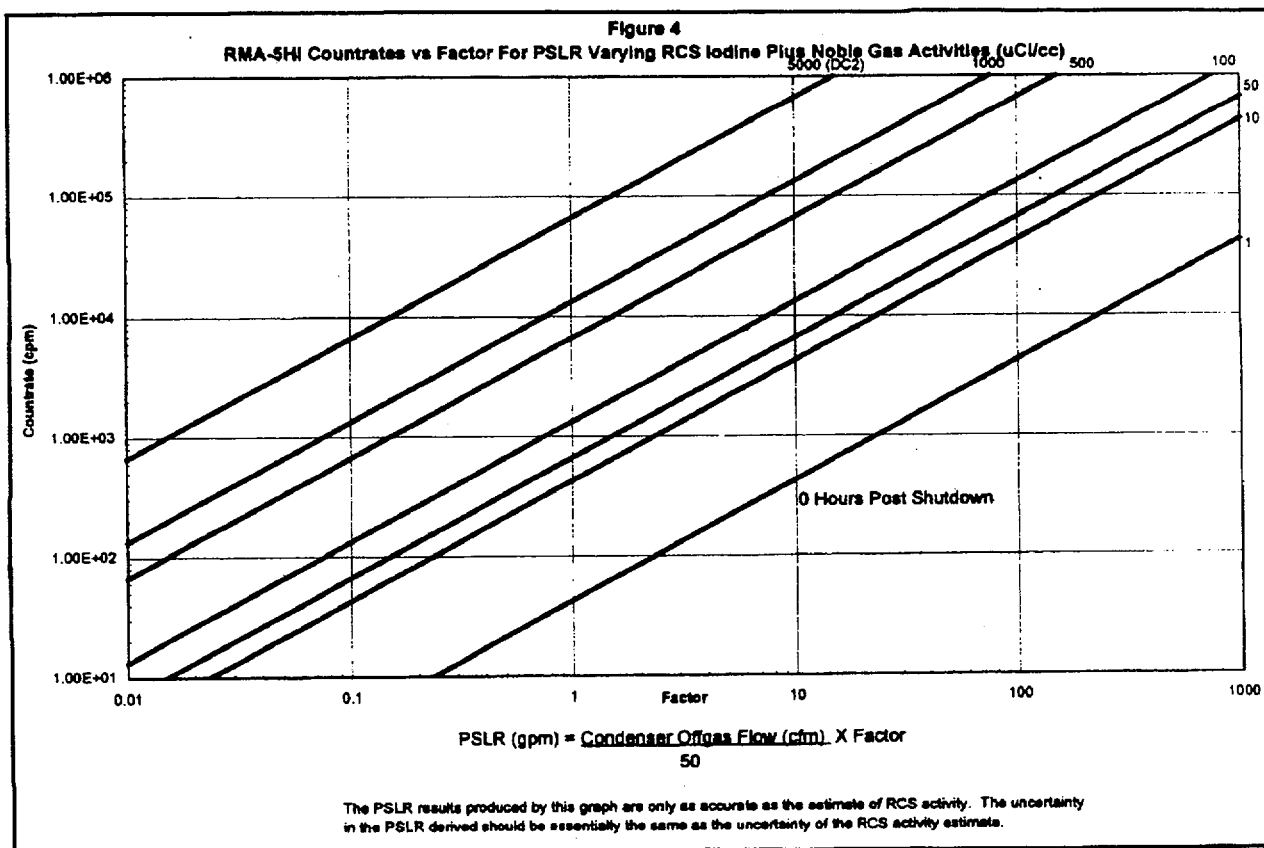
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