



Radioactive Air Emissions Guide: Demonstrating Compliance Using Computer Models

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The Radioactive Air Emissions (RAE) section in the Office of Radiation Protection encourages licensees to use computer models annually to determine compliance with state and federal (Environmental Protection Agency or EPA) radioactive air emission standards. These standards are given in [WAC 173-480-040](#) and 40CFR Part 61 [Subpart H](#) or [Subpart I](#).

For many licensees, RAE has approved the [CAP88 program](#), which can be downloaded from the Environmental Protection Agency's website. Most licensees are also approved to use [COMPLY, which is also available on EPA's website](#).

Which model am I approved to use?

CAP88 and COMPLY is approved for facilities that are operated or licensed by the U.S. Department of Energy (DOE), Nuclear Regulatory Commission (NRC), and most non-federal facilities. Federal facilities not operated or licensed by the DOE or NRC, such as Department of Defense, must use the COMPLY program unless granted alternative approval from EPA. Uranium mine owners and operators must use [COMPLY-R](#), a similar program that is not covered in this guide. Contact us at AIRRichland@doh.wa.gov if you need help with COMPLY-R.

If your facility has the option to choose between CAP88 or COMPLY, we recommend closely evaluating the strengths and weaknesses of each model to be sure you can provide accurate and representative input data for the model of your choice. You will also need approval from us once you decide.

Why are there different models used to demonstrate compliance?

There are different levels of model sophistication. COMPLY is known as a screening model. Screening models are used as an initial tool to conservatively estimate the impact due to emissions from a given source, and eliminate or confirm whether further detailed dispersion modeling is needed. They consolidate many steps in environmental transport and dosimetry, and apply assumptions and model parameters that attempt to deliberately overestimate the dose to people. Screening assessments usually employ worst-case inputs to ensure that the model outputs are conservative and can provide a sound basis for deciding whether or not further complex calculations and modelling are appropriate.

CAP88 is an example of a refined model. These models consist of analytical techniques with more detailed treatment of atmospheric processes and require more detailed, site-specific input data. Properly validated inputs offer more realistic model outputs, which is often necessary for facilities with large source terms.

Typically, the use of screening techniques followed, as appropriate, by a more refined analysis is desirable. Screening techniques used can be followed by a more refined analysis, if desired. If a screening assessment indicates a predicted dose is significantly below the emission standard, then further detailed dispersion modeling shouldn't be needed. Using a refined model is more time-consuming and requires a higher level of modeling competency from the licensee, which has little benefit if you can meet the requirements using a more conservative method.

What information do I need to run COMPLY?

COMPLY has a series of four, tiered screening levels. At all levels, the program will determine if you comply with the 10 mrem/year standard. If you fail compliance at any level, you can progress to the next level and provide more information, which should lower the dose. You may start at any level; however, we recommend you begin at the lowest level. This is because the lower the level at which you meet your license/permit limit, the fewer parameters you have to supply and justify as part of your initial application or annual reports.

Required inputs for corresponding levels:

Required Inputs	Levels
Nuclide names (Am-241, Tc-99m, etc.)	1-4
Stack concentration (curies/m ³) or annual possession amounts (curies/year)	1
Release rate (curies/year or curies/second)	2-4
Release height (meters)	2-4
Building height, width, and length (meters)	2-4
Stack or vent diameter (meters)	2-4
Stack or vent volumetric flow rate (m ³ / second)	2-4
Distance to maximally exposed individual (meters)	2-4
Average wind speed (m/s)	2-4
Distance to sources of vegetables, milk, and meat (meters)	3-4
Average air temperature and stack temperature (°F)	4
Wind rose (call a local meteorological station)	4

What information do I need to run CAP88?

To run CAP88, you will need to know:

- Run Type – Individual or population
- Population Age – RAE has only approved adult age group
- Average annual precipitation – cm/year
- Average air temperature – °C
- Average lid height – meters
- Average absolute humidity – grams/m³
- Stack height and diameter – meters
- Plume Type (pick one)
 - Heat release rate – calories/second
 - Exit velocity – meters/second
 - Plume rise for each Pasquill stability class – meters
 - None – used for modeling downwash
- Fraction of vegetables, milk, and meat produced in the home, assessment area, and imported
- Nuclide
 - Names (such as Am-241, Tc-99m)
 - Chemical form – particulate, vapor

- Particle size – microns
- Release rate – curies/year

How do I calculate a radionuclide's release rate?

There are many methods for determining a release rate. If you do not have a sampling system, the simplest method is to take your annual possession quantity for the year and multiply it by the appropriate release fraction given in [WAC 246-247-030\(21\)\(a\)](#) and/or [40 CFR Part 61 Appendix D](#). The resulting potential-to-emit will be your unabated release rate in Ci/yr. If you have abatement technology, you can then use Table 1 in 40 CFR Part 61 Appendix D to calculate your abated release rate. Alternate methods to those given in WAC 246-247-030(21) require prior approval from your regulator and should be specified in your license.

How will I know if I am compliant?

COMPLY will tell you if you are compliant after every screening level. You can get more detailed information on your report if you type "EPA USER" when asked for your company's name. You must always verify the reported dose is in compliance with your license/permit, which may be less than the 10 mrem/year standard that COMPLY uses.

For CAP88, you will need to look at the first page of the Synopsis Report. If the effective dose equivalent for the year is less than 10 mrem, you are in compliance with the federal regulations for that year. Once again, you must always verify the reported dose is in compliance with your license/permit.

How do I report my compliance determination?

All licensees must submit an annual report to RAE, regardless if computer models or other methods are used to determine compliance. Your report must include sufficient information to assure the validity of your compliance determination. When using computer programs, you can demonstrate this by including all of the assessment reports and any relevant supporting documentation – such as annual possession quantity, sources for meteorological data, and abatement system diagrams – to justify the use of your input parameters.

Some of the input parameters have default values. However, if you can obtain site-specific values for these parameters, we recommend that you use them as long as you provide documentation justifying the use of the alternative factor(s) in your annual report. It is wise to seek prior approval from RAE and submit the written approval with your justification documentation.

How should a facility demonstrate compliance for radionuclides not included in CAP88 or COMPLY?

For radionuclides not included in CAP88 or COMPLY, facilities should contact the [EPA Region 10 office](#) for guidance.

What should I do if I am close to exceeding/ have exceeded my license limit?

You should immediately call your DOH regulator for further guidance. To avoid this from happening, it is recommended you track your emissions periodically throughout the year.

What are the distance limitations for using CAP88?

You cannot use CAP88 if the maximally exposed individual (MEI) is over 80 km from your facility. While there is no minimum distance, if the MEI is closer than two stack heights (measured from the ground) the data could be inaccurate. Alternative methods, such as ambient air monitoring at the receptor locations, will need to be considered in this case.

What are the distance limitations for using COMPLY?

You cannot use COMPLY if the MEI is over 3 km from your facility. At less than 100 m from a stack, the model will grossly over-predict the MEI's dose, so alternative methods are recommended in this case.

How do I determine the MEI for my models?

At levels 2-3 in COMPLY, you must determine the MEI's distance from the point of release. If you choose to use wind rose data at level 4, you must do this for receptors in all 16 cardinal directions. Due to the limitations of this screening tool, the MEI should be located at the site boundary. We may require additional evaluation to ensure the MEI location is at the point of maximum annual air concentration in an unrestricted area, which may be farther offsite.

For CAP88, it is easier to meet the MEI location requirements given in [WAC 173-480-070\(2\)](#). This is because the model uses meteorological data and potential MEI distances to determine where the highest dose is located and will assume that is where the MEI is located. If the auto-determined location is in a restricted area of your facility, you may select an alternate location at the point of maximum annual air concentration in an unrestricted area.

Where can I find meteorological data for my area?

You can find the average annual precipitation and temperature on the National Climatic Data Center [website](#). If you use CAP88, you will have to use a wind file from the closest location, since you cannot make new wind files. You will also have to ask a meteorologist for the typical lid height (tropospheric mixing layer) and absolute humidity for your area, though often these default values are acceptable. It may be advantageous to compare your CAP88 wind file data to recent, local meteorological data to ensure they are comparable. Read Appendix D in the COMPLY User's Guide and NRC Regulatory Guide 1.23 Revision 1 for general guidance on choosing suitable meteorological data for either program.

How do I determine the proper agricultural inputs?

In COMPLY, you are expected to have a reasonable knowledge of what businesses are in your area. You can use satellite data (such as Google Earth) to determine the distance to the closest sources of vegetables, milk, and meat production.

In CAP88, you should use the default production values for Washington. The food source should be the most conservative option for modeling radionuclide ingestion by assuming it is all sourced from the MEI's home. You may use alternate food source fractions if you can provide justification for site-specific values.

Can I use models other than CAP88 or COMPLY to determine compliance? Can I ask for an exemption for determining compliance?

RAE and EPA may grant a licensee some exemptions and may accept alternate procedures on a case-specific basis. These exemptions need to be written documentation and should be specified in your license.

Are these models appropriate for estimating actual exposures from normal operations? Can it be used to model short-term or "accidental" releases?

No, the purpose of both models is to produce values strictly for comparison to regulatory standards and are not intended to represent actual doses to real people from normal operations or radiological accidents.

Neither program is appropriate for modeling short term or accidental releases for several reasons:

- The dose or risk conversion factors are all predicted on chronic, low-level exposure.
- The Gaussian model is, by definition, a long-term model.
- CAP88 is written to accept only weather data that has a joint frequency distribution typical of annual averages. Wind rose data used in COMPLY typically has the same limitation.

These models cannot be used for determining the actual annual dose to an individual or population because both programs are written to satisfy regulatory requirements. Both programs use simplified mathematical models and equations for environmental transport, external dosimetry, and internal dosimetry so that actual doses may not be underestimated. Performing a complete dose reconstruction should not be necessary for demonstrating compliance to radioactive air emission standards and license limits for normal operations.

Why doesn't the program run on my computer?

COMPLY Version 1.6 was made by EPA in 1989. Most computers today cannot run these older programs. EPA recently released an updated version of the program, which should run on modern operating systems. If you wish to use Version 1.6, you will have to use an older operating system (Windows ME or older or 32-bit versions of Windows XP, Windows Vista, or Windows 7) or download an emulator that can run 8-bit MS-DOS programs.

The latest version of CAP88 (version 4) will run on Windows XP and newer operating systems. RAE no longer approves older versions of this program. You cannot run CAP88 or COMPLY on Apple computers.

Where can I get more detailed information?

The user's guide for CAP88 is provided in the program's help files. For COMPLY, a guide can be downloaded from EPA's [website](#). The guidance document [EPA 520/1-89-002](#) is also a good resource for determining compliance with radioactive air emissions. [NCRP Report No. 123](#) (an update to NCRP Commentary No. 3) and chapter 4 of [EPA 520/1-89-001](#) are very good sources for understanding the basis for these models. Finally, the [Regulatory Guidance](#) page on the Office of Radiation Protection website has additional guidance documents.

Who can I contact for further guidance?

Current contact information can be found on the [Office of Radiation Protection website](#). You can also ask the EPA any CAP88 or COMPLY technical questions through [their website](#).

References

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- Electronic Code of Federal Regulations, "[Appendix W to Part 51-Guideline on Air Quality Models.](#)"
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- Office of Radiation and Indoor Air, "User's Guide for the COMPLY Code (Revision 2)," U.S. Environmental Protection Agency, Washington, DC, October 1989, EPA 520/1-89-003.
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