

NRC Dose3

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2020 Fall RUG Virtual Meeting
October 29, 2020

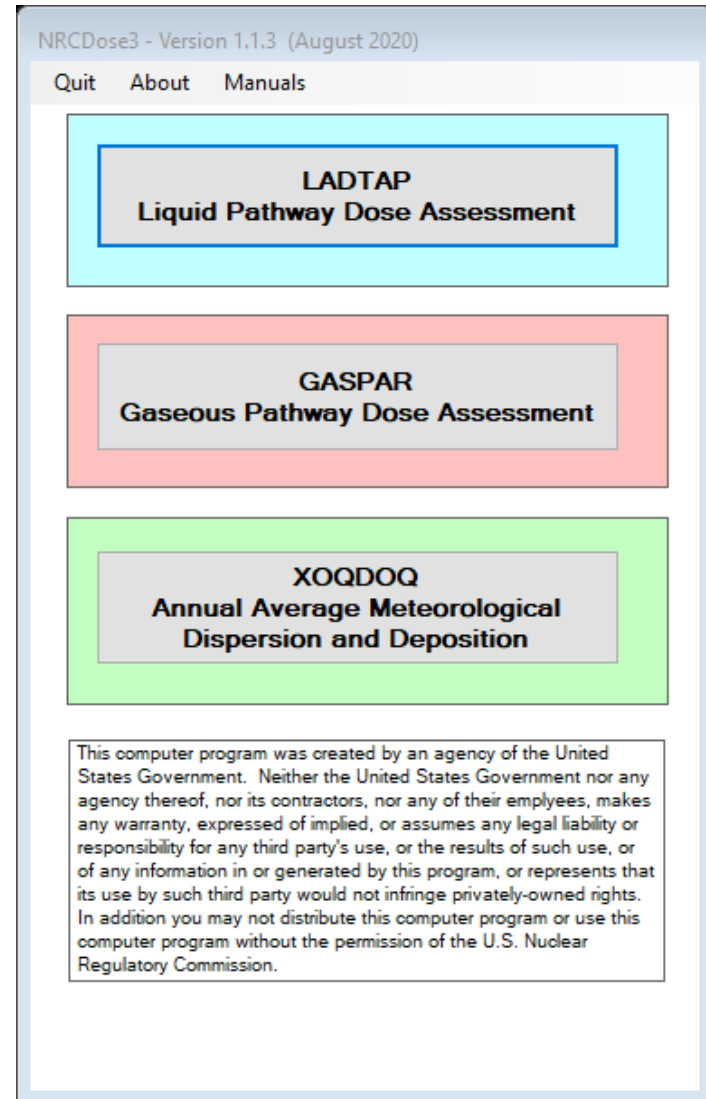


Topics

- NRC Dose3 Overview
- Overview of Features
- XOQDOQ Modeling and Use/Screens
- GASPAR Modeling and Use/Screens
- LADTAP Modeling and Use/Screens
- NRC Dose3 Code Discussions



NRCDOSE3 OVERVIEW



Purpose of Code

- Exposure pathway dose modeling, primarily developed for reactor effluents to demonstrate compliance with:
 - 10 CFR Part 20
 - Appendix I to 10 CFR Part 50
 - 40 CFR Part 190
 - 10 CFR Part 51
- Results used for reactor licensing (applicants, licensees, NRC staff) and inspection activities
- With expanded source term applicable to other fuel cycle facilities

NRC Guidance

- NRC guidance on reactor effluent dose calculations is contained in:
 - RG 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*
 - RG 1.111, *Methods of Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light Water Cooled Reactors*
 - RG 1.113, *Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purposes of Implementing Appendix I*

FORTRAN Codes

LADTAP II

- Liquid effluent doses
- NUREG/CR-4013, RSICC CCC-363

GASPAR II

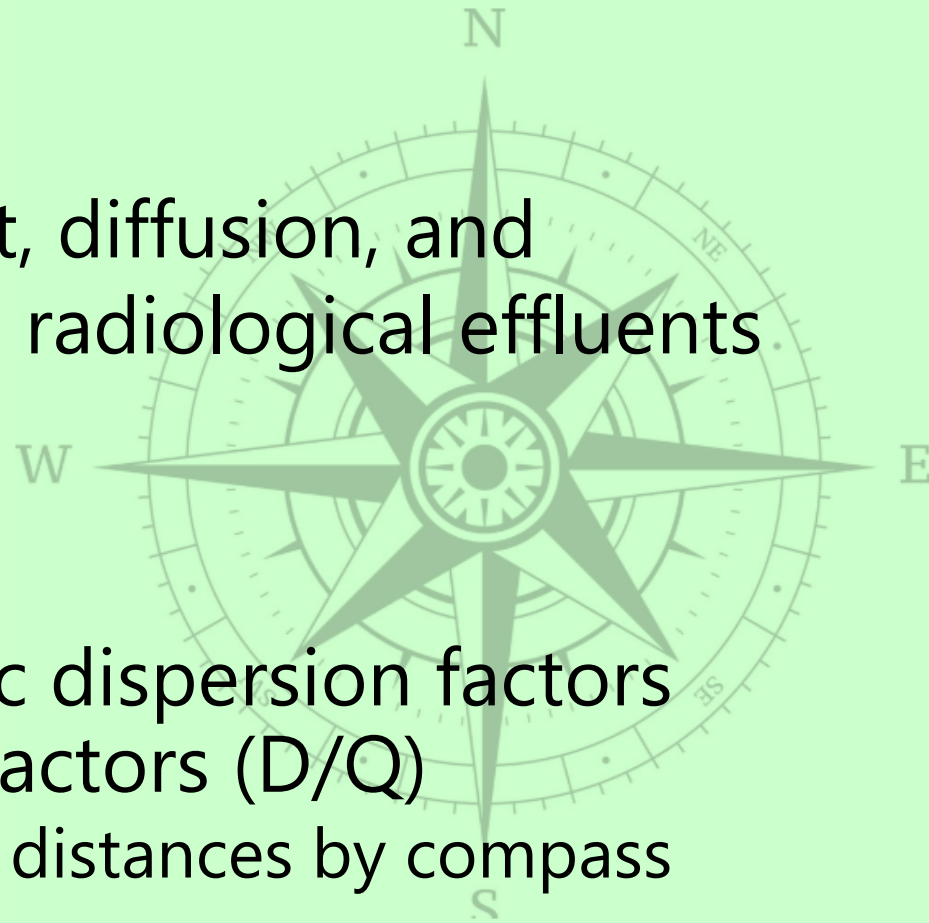
- Gaseous effluent doses
- NUREG/CR-4653, RSICC CCC-463

XOQDOQ

- Atmospheric transport and diffusion
- NUREG/CR-2919, RSICC CCC-316

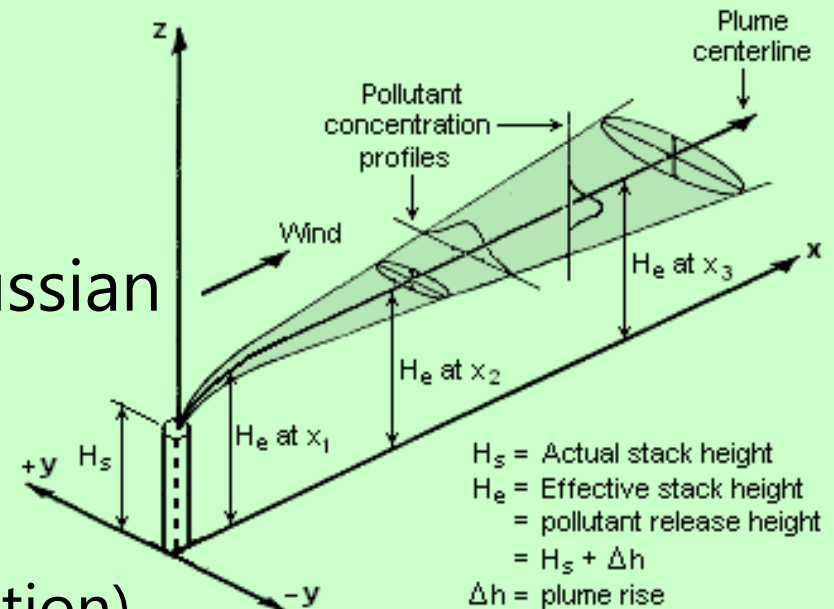
XOQDOQ

- Evaluation of transport, diffusion, and deposition of airborne radiological effluents
 - Routine releases
 - Intermittent releases
 - Non-emergency
- Calculates atmospheric dispersion factors (χ/Q) and deposition factors (D/Q)
 - Predefined segmented distances by compass sectors out to 50 miles
 - User defined points of interest



XOQDOQ

- Straight-line trajectory Gaussian plume model. Considers:
 - Dry deposition
 - Radioactive decay
 - Plume recirculation (stagnation)
- Calculates effective plume height
 - Physical release height
 - aerodynamic downwash
 - plume rise
 - terrain features



GASPAR II

- Estimates airborne effluent doses
 - Routine
 - Non-emergency
 - Individuals or populations
- Requires:
 - Source term released (Ci/yr)
 - Atmospheric dispersion (XOQDOQ)
 - Demographics



GASPAR II

- Internal Exposure Pathways
 - Inhalation (of plume)
 - Ingestion of contaminated food
 - leafy vegetables
 - vegetables and grains
 - meat
 - milk
- External Exposure Pathways
 - Plume
 - Ground Plane



LADTAP II

- Estimates liquid effluent doses
 - Routine
 - Non-emergency
 - Individuals, populations or biota
- Hydrologic model represents mixing in the effluent impoundment system and surface waters



LADTAP II

- Internal Exposure Pathways:
 - Drinking water (freshwater site)
 - Fish
 - Invertebrates
 - Aquatic plants
 - Irrigated crops
- External Exposure Pathways
 - Shoreline
 - Boating
 - Swimming



GASPAR II and LADTAP II

- ICRP-2 DCFs (1950s)
- Four (4) Age Groups
 - Infant
 - Child
 - Teen
 - Adult
- 7 Organs
 - Total Body
 - Bone
 - Liver
 - Thyroid
 - Kidneys
 - Lungs
 - GI-LLI



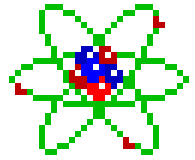
NRC and Industry End Uses

- NRC licensing reviews
 - Design Certification, Combined License, and Early Site Permit Applications
 - License Amendment Requests
- NRC health physics reactor inspections
 - Independent assessment of potential doses from effluent releases
 - Independent assessment of ODCM Dose Conversion Factors and effluent dose calculations

NRC and Industry End Uses (Cont.)

- Calculate doses at locations of interest
- Evaluate Land Use Census
 - Public interest
- Annual dose assessments
 - Actual receiving water body flows and dilutions
 - Meteorology with effluents for evaluated year
- ODCM Dose Conversion Factors

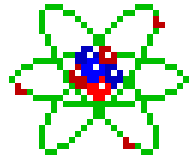
Why Update to NRC Dose3



- Updates the NRC Dose 2.3.20 (CCC-684) code
- Significant increase in flexibility and functionality



Why Update to NRC Dose3



- Need for a licensing tool to support reactor application submittals
- Provides an acceptable method for evaluating exposure pathway doses from reactor effluents
- Improves efficiency in reactor licensing process, and NRC safety and environmental reviews

Overview of Updates

- Improved functionality
 - Updated Windows interface
- Option to select ICRP-2, ICRP-30, or ICRP-72 Dose Conversion Factors (DCFs)
 - Age range
 - Organs
- Expanded license application ready reports

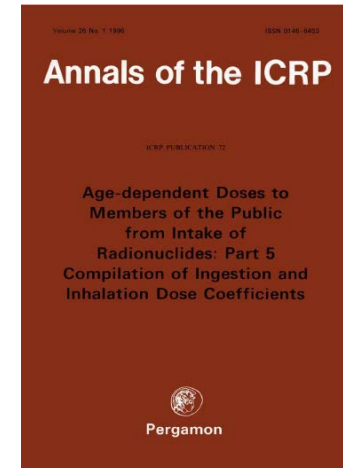
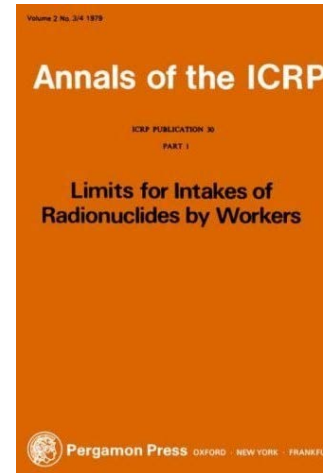
Overview of Updates

- User-modifiable parameter values
 - Bioaccumulation factors
 - Consumption rates
 - Usage factors
 - Other parameters

Previous versions of NRCDose
(and FORTRAN codes) did not
allow for edits to parameters

Updates (Cont.) – DCFs

- Expanded ICRP-2 DCFs
- ICRP-30 DCFs
- ICRP-72 DCFs
- Ingestion DCFs:
Gastrointestinal Absorption Fractions (f₁)
- Inhalation DCFs: Lung Clearance Classes for Chemical Compounds
 - ICRP-30: D/W/Y
 - ICRP-72: F/M/S



DCFs obtained from Radiological Toolbox, NRC RAMP at
<https://ramp.nrc-gateway.gov/>

Updates (Cont.) – Biota Dose

- Biota dose added to GASPAR and expanded in LADTAP
- Biota dose calculated at all user defined special location (GASPAR)
- Biota dose based on species mass, effective radius, primary food eaten (produce or meat) and consumption rate

Updates (Cont.) – Biota Dose

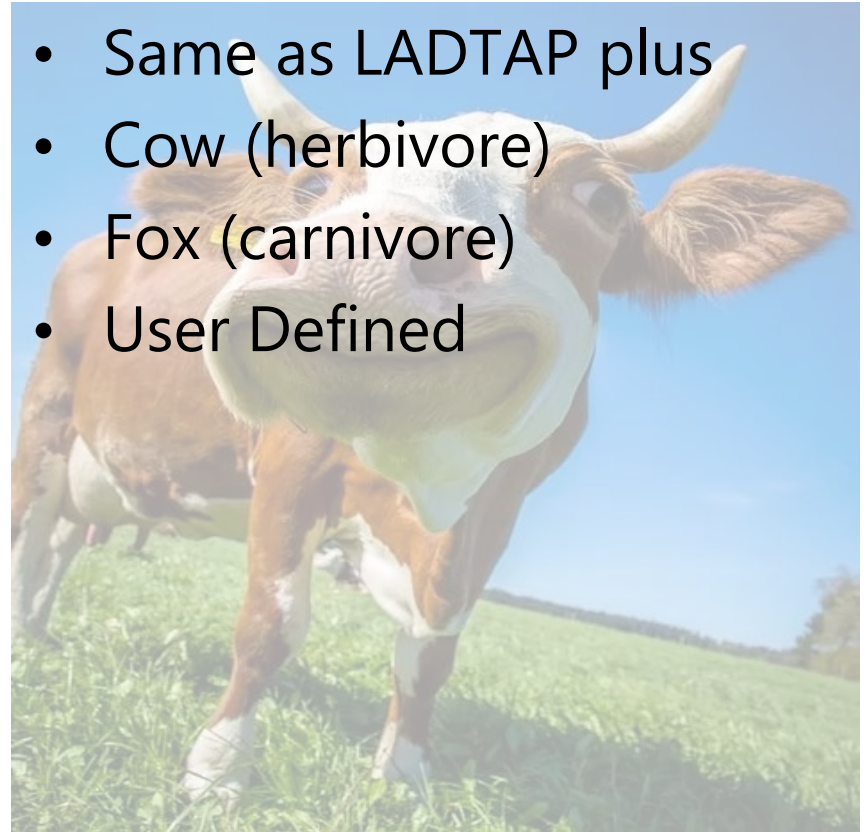
LADTAP

- Algae
- Muskrat
- Racoon
- Duck
- Heron
- User defined



GASPAR

- Same as LADTAP plus
- Cow (herbivore)
- Fox (carnivore)
- User Defined



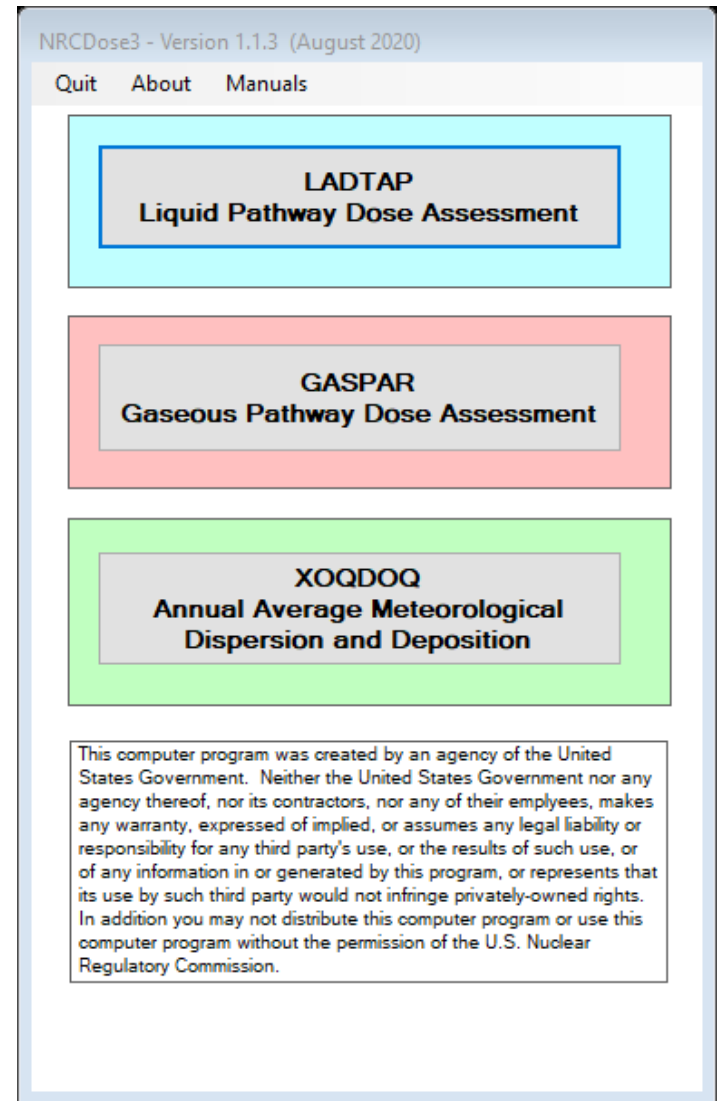
Documentation and Release

- NRC Dose3 Quick Start Guide
 - How to install, run, and view output
- DRAFT NUREG on NRC Dose3 Code: User Guide and Technical Manual
 - Technical basis
- Distribution by NRC RAMP

<https://ramp.nrc-gateway.gov/>

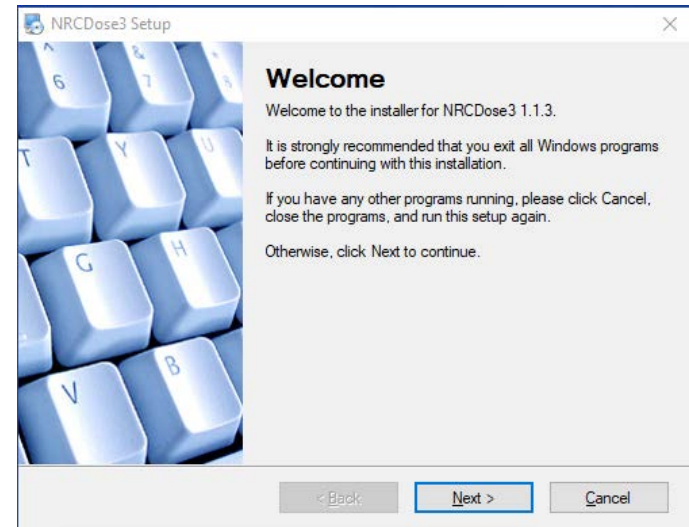


OVERVIEW OF FEATURES AND ENHANCEMENTS



Installation and Operation

- Double-click
NRCDose3_v113_Setup.exe
- Follow prompts
- NRCDose3 will install in
C:\directory (unless
changed by the user)



File Types

.XN3

- XOQDOQ
- Case file saved by XOQDOQ

.GN3

- GASPAR
- Case file saved by GASPAR

.LN3

- LADTAP
- Case file saved by LADTAP

.DAT

- LADTAP and GASPAR
- Data file used in place of manually entered data
- Used to initially test the program (Older DAT files incompatible with NRCDose3)



File Structure

- When a code is opened, it will be loaded with the last case file from the database
 - When first opened, an example case file will be pre-loaded
- If a different case is desired, select *File->Open LN3 File* from the menu to load a saved case
 - Or "*Open GN3 File*" or "*Open XN3 File*" as applicable
- When saving a case, it will be saved to the database as well as a case file (.xn3, .gn3, .ln3 file type, as applicable)

Hard-Coded Parameters

- Previous versions of codes had many hard-coded parameters that are now user-editable
- Editing may be appropriate for site-specific conditions

CAUTION

Changing parameters from accepted methods (i.e., RGs) or licensing documentation may require evaluation or justification

XOQDOQ Expanded Editable Parameters

- Building wake constant
 - Though not recommended without a sound technical bases
- Essentially all other key modeling parameters (input values to the meteorological model) were already user defined or user controlled

LADTAP Expanded Editable Parameters

- Population age group fractions
- Food and water consumption rates
- Bioaccumulation and transfer factors
- Various environmental exposure times and produce production and storage times

GASPAR Editable Parameters

- Population age group fractions
- Human consumption and inhalation rates
- Bioaccumulation factors
- Various environmental exposure times and produce production and storage times
- Meat and milk animal consumption rates

Dose Conversion Factors

- Expanded ICRP-2 DCFs from:
 - RG 1.109, Revision 1, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I* (October 1977)
 - NUREG-0172, *Age Specific Radiation Dose Commitment Factors for One-Year Chronic Intake* (November 1977)
 - NUREG-0172, *Errata* (August 1983)
 - NUREG/CR-2384, *Age Specific Inhalation Radiation Dose Commitment Factors for Selected Radionuclides* (August 1982)
 - EMP-155, *Review and Expansion of USNRC Regulatory Guide 1.109 Models for Computing Dose Conversion Factors* (February 1983)



DCFs

- Some radionuclides in those sources were not included in LADTAP II/GASPAR II
- NRC Dose3 includes ICRP-2 DCFs for ALL radionuclides contained in those sources
- NRC Dose3 includes ICRP-30 and ICRP-60/72 DCFs for ALL radionuclides in those sources
- 203 radionuclides included in NRC Dose3



Additional Radionuclides

S-35	Kr-88	Xe-138
Cl-36	Kr-89	Ba-133
Ar-39	Sr-85	Tm-170
Ar-41	Cd-109	Yb-169
Ca-45	Sn-113	Ta-182
Ga-67	I-125	Ir-192
Se-75	Xe-131m	Au-198
Kr-83m	Xe-133m	Tl-201
Kr-85m	Xe-133	Tl-204
Kr-85	Xe-135m	Rn-22
Kr-87	Xe-137	Pu-236



DCFs

- NRC Dose3 allows only one chemical form, inhalation class or ingestion class for each radionuclide
- Multiple ingestion DCFs based on f1 value
- Multiple inhalation DCFs based on inhalation class
 - D/W/Y for ICRP-30
 - F/M/S for ICRP-72
- Nuclear power plant effluents are assumed to be oxides; other fuel cycle facilities may have different states

Age Ranges

ICRP-30

- Adult only
 - Occupational DCFs

ICRP-72

- Adult
- 15 year old
- 10 year old
- 5 year old
- 1 year old
- Newborn

Organs

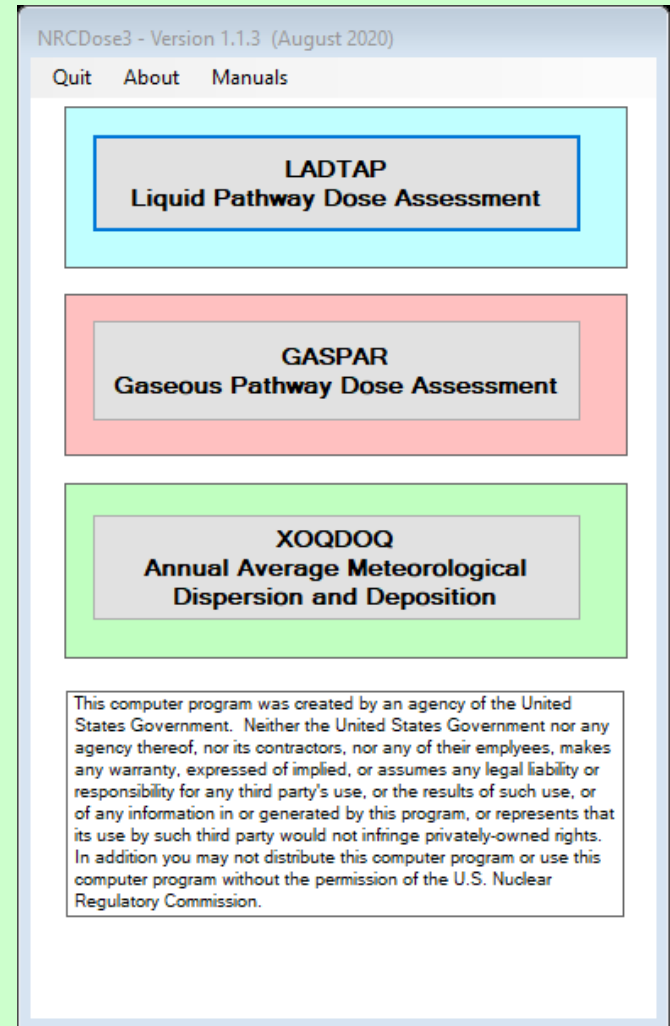
ICRP-30

- 24 organs, including remainder

ICRP-72

- 27 organs, including remainder
 - Colon, ETA, remainder

XOQDOQ MODELING AND USE



XOQDOQ – Atmospheric Transport and Dispersion

- Implements the straight-line Gaussian modeling of RG 1.111
- Calculates ground-level concentrations
- Accounts release points characteristics (height, plume rise)
- Additional plume dispersion due to building wakes
- Plume depletion via dry deposition and radioactive decay

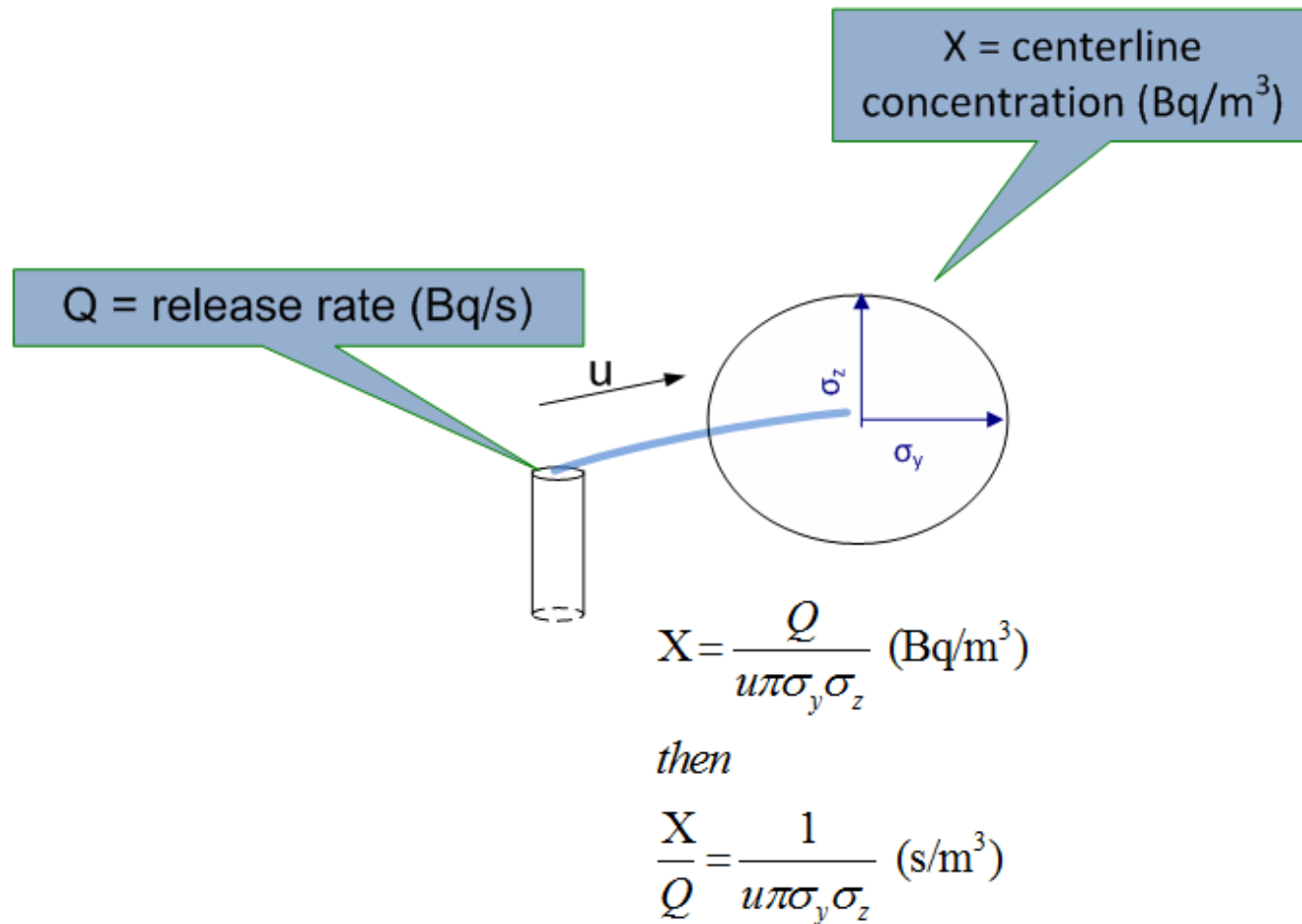
XOQDOQ – Atmospheric Transport and Dispersion

- Annual average relative dispersion (χ/Q) and deposition (D/Q) values at user specified locations (MEI doses) and standard radial distances and segments (population doses) for routine releases
- Intermittent releases (e.g., containment purge, waste gas tank)
- Elevated, ground level, or mixed mode releases
- Meteorological modeling considerations: building wake effects, plume depletion (dry deposition), and radioactive decay

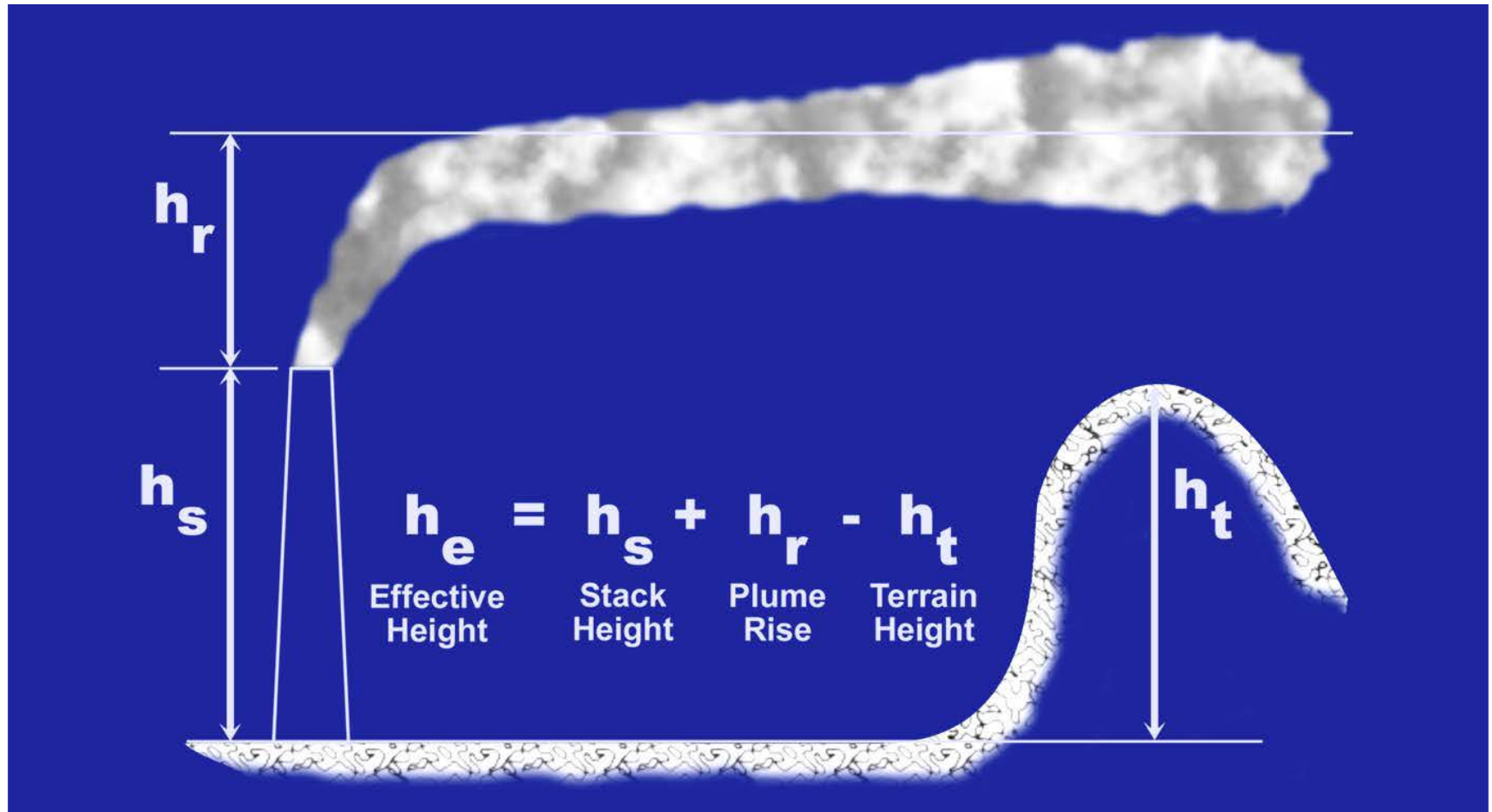
XOQDOQ – Atmospheric Transport and Dispersion

- Wind direction in 16 compass directions (22.5° sectors), 14 wind speed classes, and 7 atmospheric stability classes (A-G)
- Three different dispersion χ/Q values; one deposition D/Q value
 - Undecayed, Undepleted χ/Q
 - Decayed, Undepleted χ/Q (2.26-day half-life)
 - Decayed, Depleted χ/Q (8-day half-life)
 - Deposition D/Q (2.26-day and 8-day half-lives)
- Output used as meteorological data input to GASPAR

Basic Meteorology Dispersion – χ/Q



Dispersion – Release and Terrain Characteristics



Gaussian Model – Sector Average

- Dividing the area surrounding a point source into 16 segments gives $360^\circ/16 = 22.5^\circ$ per segment
- For averaging condition (over time), the plume is assumed to meander, spreading uniformly over the 22.5° sector

$$\frac{\chi}{Q} = \frac{2.032}{\sigma_z u x}$$

where

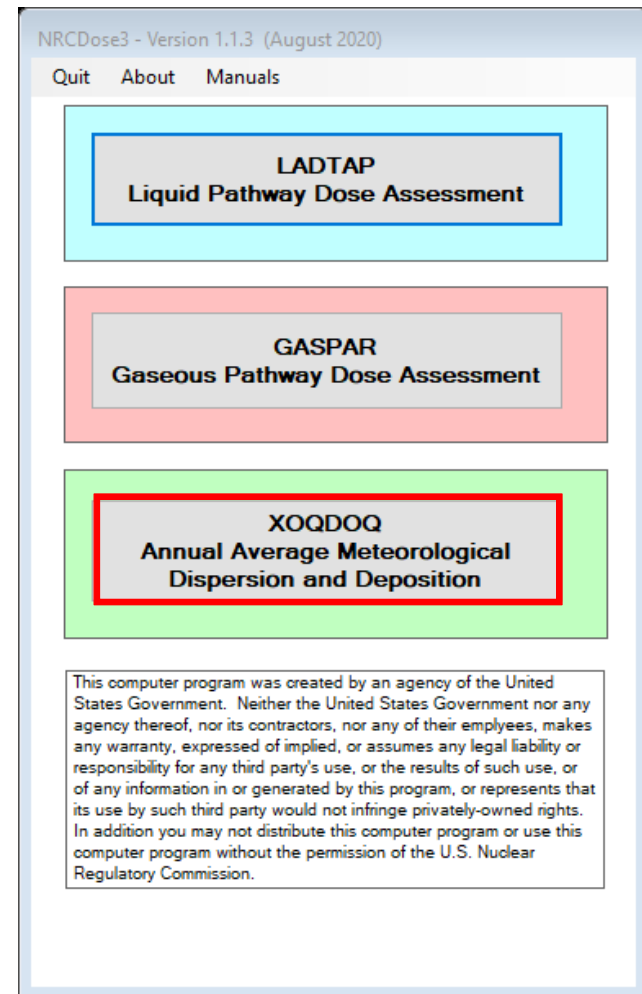
x = the distance from the point of release

u = the wind velocity

$2.032 = \sqrt{2/\pi}$ divided by the width of a 22.5° segment in radians

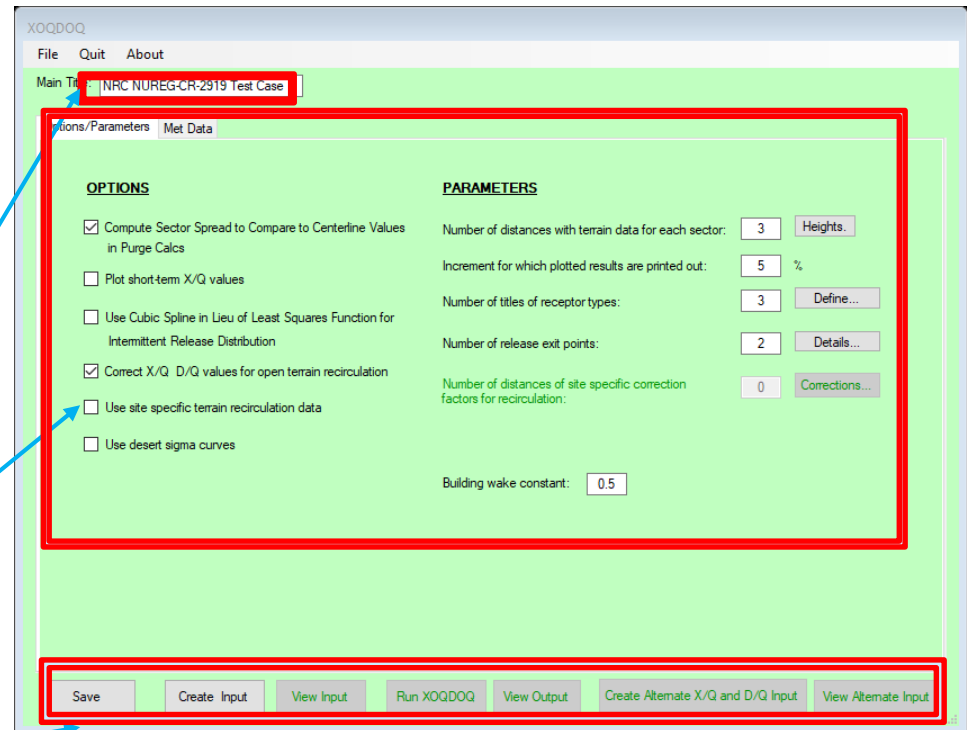
Starting and Running XOQDOQ

- Double click "XOQDOQ"



XOQDOQ Main Screen

- XOQDOQ Module Main Screen opens with case data that is saved in the database
- Contains three main functional areas:
 - toolbar and initial setup area,
 - data input tabs
 - code execution and reports



XOQDOQ – File Management

- New — New XOQDOQ case. Clears the databases.
- Open XN3 File — open an existing “*.XN3” file previously created with NRC Dose3
- Open Legacy Input File — Opens Windows Explorer; navigate to “*.dat” file
 - Uses a file created with the original XOQDOQ
 - “Create input” not needed; select run XOQDOQ. Input screens and options cannot be used

XOQDOQ – File Management

- Save to Database — Choose this option to save current case to the database. When XOQDOQ is opened with “Current Project” selected, the information in the database, as last saved before exiting, initially populates all XOQDOQ screens and windows.
- Save to XN3 File — Choose this option to save the completed case to a “*.XN3” file
- Delete — Choose this option to open an explorer window that will allow the user to delete any previously saved “*.XN3” files

XOQDOQ Main Screen – Options

- Various options
 - Purge calc (short term releases) printout compares sector spread to centerline values
 - Printout plot of short-term X/Q values (not very useful)
 - Open terrain recirculation: correction is applied uniformly to all directional sectors out to 10 km (NUREG/CR-2919, Figure 3.2)
 - Use site-specific terrain recirc values (user input under Parameters)
 - Desert sigma curves (specialized dispersion values developed for desert environment)

OPTIONS

- ☒ Compute Sector Spread to Compare to Centerline Values in Purge Calcs
- ☐ Plot short-term X/Q values
- ☐ Use Cubic Spline in Lieu of Least Squares Function for Intermittent Release Distribution
- ☒ Correct X/Q D/Q values for open terrain recirculation
- ☐ Use site specific terrain recirculation data
- ☐ Use desert sigma curves

XOQDOQ Options/Parameters

PARAMETERS

Number of distances with terrain data for each sector:

Increment for which plotted results are printed out: %

Number of titles of receptor types:

Number of release exit points:

Number of distances of site specific correction factors for recirculation:

Building wake constant:

Terrain Height Values

DISTANCE:

Distance: meters

Height: meters

	Distance	Height		Distance	Height
S:	<input type="text" value="100"/>	<input type="text" value="0"/>	N:	<input type="text" value="100"/>	<input type="text" value="0"/>
SSW:	<input type="text" value="100"/>	<input type="text" value="0"/>	NNE:	<input type="text" value="100"/>	<input type="text" value="0"/>
SW:	<input type="text" value="100"/>	<input type="text" value="0"/>	NE:	<input type="text" value="100"/>	<input type="text" value="0"/>
WSW:	<input type="text" value="100"/>	<input type="text" value="0"/>	ENE:	<input type="text" value="100"/>	<input type="text" value="0"/>
W:	<input type="text" value="100"/>	<input type="text" value="0"/>	E:	<input type="text" value="100"/>	<input type="text" value="0"/>
WNW:	<input type="text" value="100"/>	<input type="text" value="0"/>	ESE:	<input type="text" value="100"/>	<input type="text" value="0"/>
NW:	<input type="text" value="100"/>	<input type="text" value="0"/>	SE:	<input type="text" value="100"/>	<input type="text" value="0"/>
NNW:	<input type="text" value="100"/>	<input type="text" value="0"/>	SSE:	<input type="text" value="100"/>	<input type="text" value="0"/>



XOQDOQ Main Screen – Parameters

PARAMETERS

Number of distances with terrain data for each sector: Heights.

Increment for which plotted results are printed out: %

Number of titles of receptor types: Define...

Number of release exit points: Details...

Number of distances of site specific correction factors for recirculation: Corrections...

Building wake constant:

Receptor Types

Type	Title	Locations	
1.	<input type="text" value="Site Boundary"/>	<input type="text" value="3"/>	<input type="button" value="Define.."/>
2.	<input type="text" value="Cows"/>	<input type="text" value="3"/>	<input type="button" value="Define..."/>
3.	<input type="text" value="Residences"/>	<input type="text" value="2"/>	<input type="button" value="Define..."/>

Save Exit

Receptor Locations

LOCATION

Direction:

Distance: meters

Save Exit



XOQDOQ Main Screen – Parameters

PARAMETERS

Number of distances with terrain data for each sector: Heights.

Increment for which plotted results are printed out: %

Number of titles of receptor types: Define...

Number of release exit points: Details...

Number of distances of site specific correction factors for recirculation: Corrections...

Building wake constant:

Location Selection

RELEASE POINTS

Mixed-mode Release - with P.
Ground Level

Edit
Delete
Save
Exit

Release Point Data

Release Point Title:

Vent/Stack Average Velocity: m/sec

Vent/Stack Inside Diameter: meters

Release Point Height: meters

Height of Vent's/Stack's Bldg: meters

Minimal cross-sectional area for Vent's/Stack's Bldg: m sq

Wind Height used for the vent/stack elevated release: meters

Vent/Stack heat emission rate: cal/sec

Purges:

Number of intermittent releases:

Average number of hours per intermittent release:

Save

Exit



Met Data Input

- Calms
- Met data: hours or % frequency
- Height of measurement
- Plant grade
- Half-lives (do not change)
- Inputting joint frequency distribution (JFDs)
 - Line-by-line entering for each Stability Class

File Quit About

Main Title:

Options/Parameters Met Data

☒ Distribute calms as first wind-speed class ☐ Input joint frequency distribution data as percent frequency

Number of velocity categories: Max Wind Speeds... Number of stability categories: Wind speed class units: ☐ mph ☒ m/sec

Number of hours, or percent, of calm for each stability category:

Class A. hr D. hr G. hr

Class B. hr E. hr

Class C. hr F. hr

Height (above ground level) of the measured wind presented in the joint frequency data: m

Plant grade elevation (above sea level): m

Half-lives used in X/Q calculations (days)

1. 2. 3.

Import JFD Data (METQA) Import JFD Data (EXCEL) (Hours) Total:

STABILITY

Class A

Class B

Class C

Class D

Class E

Class F

Class G

Clear

Wind Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Class 2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 3	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 4	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 5	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1

Save Create Input View Input Run XOQDOQ View Output Create Alternate X/Q and D/Q Input View Alternate Input



Windspeed Input

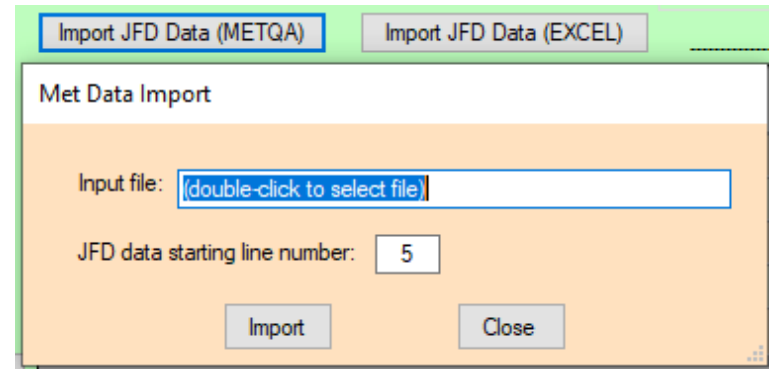
- Enter the “Number of velocity categories” (maximum 13), and then select “Max Wind Speeds...” to enter the maximum wind speed of each category

The screenshot shows a software interface with a green header bar. On the left, it says 'Number of velocity categories: 5'. On the right, there is a button labeled 'Max Wind Speeds...'. Below this is a dialog box titled 'Maximum Wind Speeds' with an orange background. Inside the dialog, it says 'Wind Speed Units: m/sec'. Below that is a section titled 'Wind Speed' with a list of categories. The first category, 'Class 1', has a text input field containing '1.00'. The other categories are numbered 2 through 7, with input fields containing '2.00', '4.00', '8.00', '16.00', and empty fields for 6 and 7. At the bottom of the dialog are two buttons: 'Save' and 'Exit'.

Class	Wind Speed (m/sec)
Class 1	1.00
2	2.00
3	4.00
4	8.00
5	16.00
6	
7	

Import Met Data

- Met data (JFD) can be imported using 2 standard file formats
 - **MetQA**: file format generated by an internal (NRC) application MetQA (Version 2.0), which represents the NRC staff's implementation of NUREG-0917
 - **EXCEL**: specific data array by wind direction, wind speed range, and atmospheric stability classes ranging, in sequence, from extremely unstable (Class A) thru extremely stable (Class G)



NOTE: Input file examples included in install

Import Met Data – Example File Format

AutoSave OFF Met Data Import Format for XOQDOQ 5 wind speeds

Home Insert Draw Page Layout Formulas Data Review View

U25 fx

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	JFD Data Import																	
2																		
3	This sample file (for use as a template) is configured for 7 Stability Classes and 5 velocity (speed) categories. Edit as appropriate for your case.																	
4																		
5	Stability	Wind Speed																
6	Class	Category	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
7	Class 1	Speed 1	0	0	0	0	0	0	0	1	1	3	1	0	0	0	0	0
8		Speed 2	0	0	0	0	0	0	0	0	3	3	0	0	1	0	0	0
9		Speed 3	0	1	0	0	0	1	3	5	12	8	5	4	1	5	1	0
10		Speed 4	1	0	0	1	1	2	7	17	73	39	20	22	16	11	2	0
11		Speed 5	0	0	2	0	0	0	13	41	55	43	31	33	35	35	1	1
12	Class 2	Speed 1	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0
13		Speed 2	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0
14		Speed 3	0	0	0	0	0	0	0	0	2	1	0	0	1	1	1	1
15		Speed 4	1	0	0	1	0	0	2	10	10	7	6	6	8	1	1	0
16		Speed 5	0	1	1	0	0	1	2	12	11	8	7	8	8	11	1	0
17	Class 3	Speed 1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
18		Speed 2	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0
19		Speed 3	1	0	1	0	0	1	2	3	2	10	4	3	5	0	0	0
20		Speed 4	0	4	0	0	0	0	2	10	21	15	6	12	17	4	3	1
21		Speed 5	0	1	0	1	0	2	5	23	10	16	9	7	14	11	2	0
22	Class 4	Speed 1	6	5	3	2	5	4	9	11	10	6	2	3	2	6	6	4
23		Speed 2	3	4	4	4	7	7	15	12	18	20	5	13	5	4	3	1
24		Speed 3	19	25	20	15	29	38	55	74	92	44	45	31	34	33	24	9
25		Speed 4	81	63	58	52	59	82	132	160	171	110	83	75	110	120	100	65
26		Speed 5	104	97	95	56	38	92	174	203	87	44	55	53	104	201	172	145
27	Class 5	Speed 1	3	5	8	4	10	11	12	2	3	4	4	0	1	0	2	1
28		Speed 2	4	5	14	16	18	23	23	18	17	9	9	8	3	8	4	7
29		Speed 3	26	28	35	39	78	96	95	55	43	23	26	28	22	24	21	16
30		Speed 4	46	72	83	92	133	181	191	119	66	38	35	34	40	67	105	52
31		Speed 5	96	132	95	70	57	139	220	132	36	27	24	21	26	95	133	84
32	Class 6	Speed 1	1	1	0	0	1	3	2	5	2	1	0	2	0	3	1	0
33		Speed 2	1	1	1	1	3	8	8	8	5	3	3	1	4	2	1	2
34		Speed 3	4	6	9	9	21	33	36	33	16	21	12	13	11	10	12	3
35		Speed 4	17	12	22	18	27	63	101	47	20	15	13	6	17	43	48	23
36		Speed 5	14	9	14	7	15	44	86	29	13	5	5	9	10	40	69	23
37	Class 7	Speed 1	0	0	0	0	1	0	3	2	1	0	1	1	0	2	0	0
38		Speed 2	1	2	1	1	4	3	3	5	2	2	1	3	6	1	2	4
39		Speed 3	5	4	4	4	6	17	25	22	25	13	10	7	15	13	12	4
40		Speed 4	2	3	9	6	9	29	52	39	16	10	9	11	15	31	45	16
41		Speed 5	2	3	9	1	6	24	65	25	9	8	6	1	9	26	70	13
42																		
43																		



XOQDOQ – Save, Create Input and Run

XOQDOQ

File Quit About

Main Title: NRC NUREG-CR-2919 Test Case 1

Options/Parameters Met Data

☒ Distribute calms as first wind-speed class ☐ Input joint frequency distribution data as percent frequency

Number of velocity categories: 5 Max Wind Speeds... Number of stability categories: 7 Wind speed class units: ☐ mph ☒ m/sec

Number of hours, or percent, of calm for each stability category:

Class A: 0 hr D: 4 hr G: 4 hr

Class B: 0 hr E: 4 hr

Class C: 4 hr F: 4 hr

Height (above ground level) of the measured wind presented in the joint frequency data: 10.00 m

Plant grade elevation (above sea level): 0.00 m

Half-lives used in X/Q calculations (days)

1: 101.00 2: 2.26 3: -8.00

Import JFD Data (METQA) Import JFD Data (EXCEL) (Hours) Total: 16

STABILITY

Class A
Class B
Class C
Class D
Class E
Class F
Class G

Clear

Wind Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Class 2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 3	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 4	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Class 5	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1

Save Create Input View Input Run XOQDOQ View Output Create Alternate X/Q and D/Q Input View Alternate Input

After inputting JDFs,

- Save
 - This will save to the dataset as well as to any file name as being used.
- Create Input
 - This creates the dataset in the format required by the FORTRAN code
- View Input
 - Allows user to view the created input file
- Run XOQDOQ

Save Create Input View Input Run XOQDOQ View Output Create Alternate X/Q and D/Q Input View Alternate Input

XOQDOQ – Save, Create, Input and Run

- **Save** to save the dataset to any file name as being used.
- **Create Input** to create the dataset in the format required by the FORTRAN code
- **View Input** to view created input file
- **Run XOQDOQ**

The screenshot shows the XOQDOQ software interface. At the top, there is a menu bar with 'File', 'Quit', and 'About'. Below the menu bar, the 'Main Title' is set to 'NRC NUREG-CR-2919 Test Case 1'. The 'Options/Parameters' dialog box is open, showing two tabs: 'Options' and 'Parameters'. The 'Options' tab is selected, displaying several checkboxes: 'Compute Sector Spread to Compare to Centerline Values in Purge Calcs' (checked), 'Plot short-term X/Q values' (unchecked), 'Use Cubic Spline in Lieu of Least Squares Function for Intermittent Release Distribution' (unchecked), 'Correct X/Q D/Q values for open terrain recirculation' (checked), 'Use site specific terrain recirculation data' (unchecked), and 'Use desert sigma curves' (unchecked). The 'Parameters' tab is also visible, showing input fields for 'Number of distances with terrain data for each sector' (3), 'Increment for which plotted results are printed out' (5 %), 'Number of titles of receptor types' (3), 'Number of release exit points' (2), 'Number of distances of site specific correction factors for recirculation' (0), and 'Building wake constant' (0.5). At the bottom of the dialog box, there are buttons for 'Save', 'Create Input', 'View Input', 'Run XOQDOQ', 'View Output', 'Create Alternate X/Q and D/Q Input', and 'View Alternate Input'.

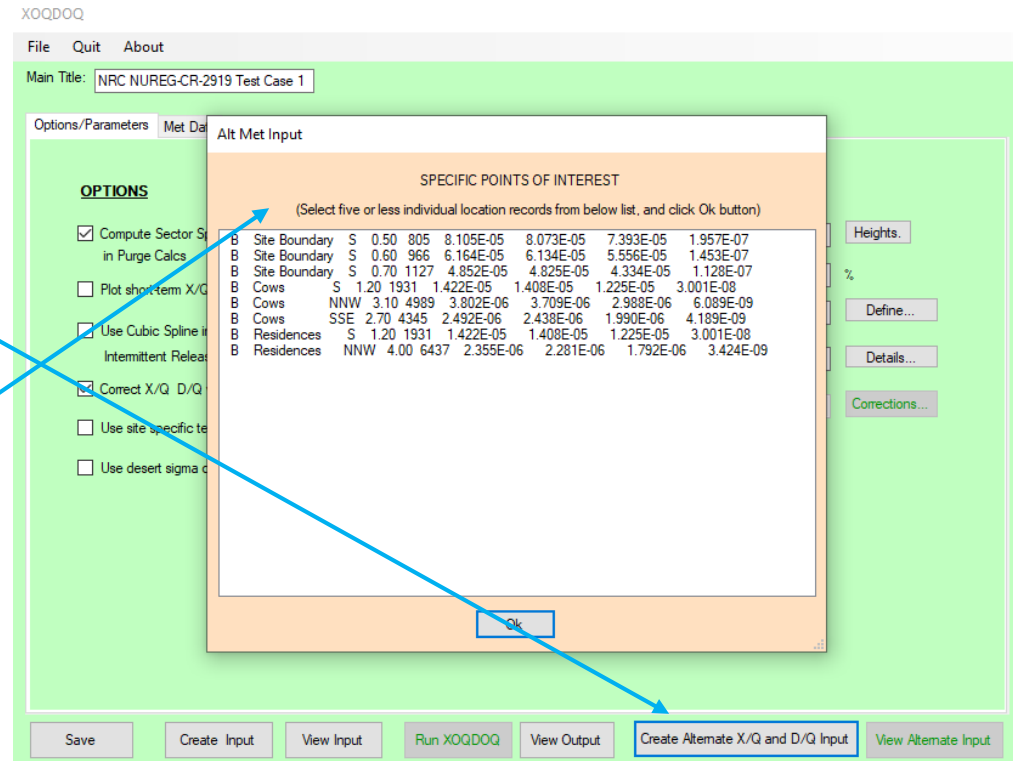
A row of buttons from the XOQDOQ software interface, including 'Save', 'Create Input', 'View Input', 'Run XOQDOQ', 'View Output', 'Create Alternate X/Q and D/Q Input', and 'View Alternate Input'. The 'Create Input' button is highlighted with a blue border. Two blue arrows point from the 'Create Input' button in the screenshot above to the 'Create Input' button in this row.

- Shows the input deck as used by the FORTRAN code
- Follows the card format as described in NUREG/CR-2919

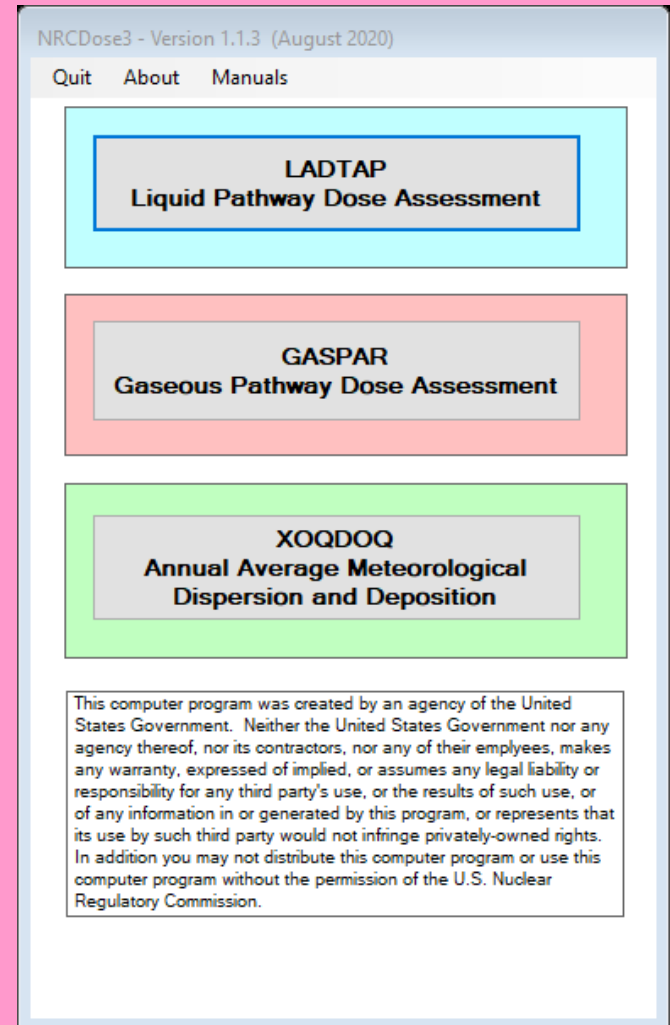


Create Alt. Input – For GASPAR

- A meteorological dataset suitable for import by GASPAR can be created
 - Select **Create Alternate X/Q and D/Q Input**
- Pop-up screen to select up to 5 locations
- An input file will be created internal which may be referenced during the GASPAR run
- Only applicable to XOQDOQ for single release point runs



GASPAR MODELING AND USE



GASPAR

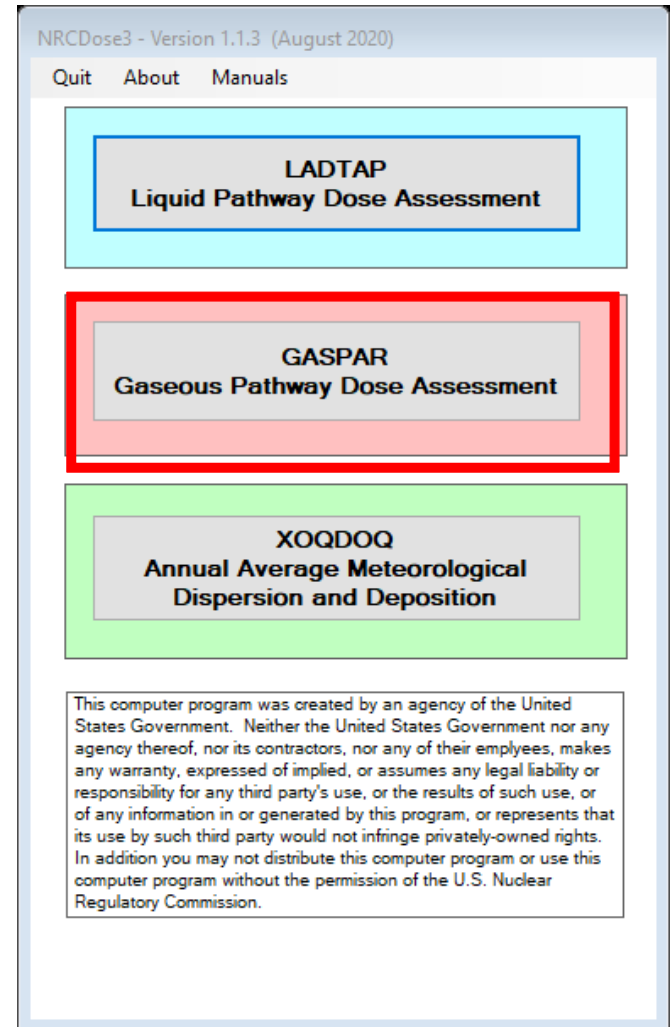
- Performs dose assessments for gaseous radioactive effluents released into the atmosphere
- Implements dose assessment methods described in RG 1.109
- Calculates the radiation dose to individuals, population groups, and biota from:
 - inhalation of contaminated air,
 - direct exposure from contaminated ground and
 - consumption of contaminated foods
- Basic calculation methods are described in NUREG/CR-4653

GASPAR

- Calculated doses support
 - NEPA evaluations
 - Compliance with the NRC public dose limits in 10 CFR Part 20
 - EPA public dose limits in 40 CFR Part 190
 - NRC ALARA design objectives and numerical guides in 10 CFR Part 50, Appendix I

Starting and Running GASPAR

- Double click "GASPAR"



GASPAR Main Screen

- Contains three main functional areas:
 - the toolbar and initial setup area,
 - data input tabs area and
 - code execution and reports area

NOTE: GASPAR opens with the last saved database

GASPAR

File Quit About

Case Title: GASPAR Test Case 1 - ICRP-2 Dose Factors: ICRP-2 (Default)

Options Source Term Pop/Prod Data Special Location Data Dose Factors Pathway Factors Consumption Values

☒ Calculate individual doses only
☒ Print cumulative dose reports only
☐ Print dose-factor library data
☐ Perform PARTS calculation Info...
☐ Read X/Q and D/Q data from XOQDOQ-generated file

Add Biota

Fraction of the year that leafy vegetables are grown: 0.75
Fraction of the year that milk cows are on pasture: 0.80
Fraction of max individual's vegetable intake from own garden: 0.50
Fraction of milk-cow feed intake from pasture while on pasture: 1.00
Relative Humidity (%): 8.00
Average temperature over growing season (F): 70.00
Fraction of the year that goats are on pasture: 1.00
Fraction of goat feed intake from pasture while on pasture: 1.00
Fraction of the year that beef cattle are on pasture: 0.80
Fraction of beef-cattle feed intake from pasture while on pasture: 1.00

Save Create Input View Input Run GASPAR View Output FSAR Report Supplemental Report

GASPAR Start-up

- New — Select this option to begin a new GASPAR case. This will clear the database from any previously input information.
- Open GN3 File — Select this option to access and open a "*.GN3" file that was previously created with NRC Dose3.
- Save to Database — Choose this option to save the current case to the database. When GASPAR starts, it loads the data that was last saved (typically from the last, previous run), populating all GASPAR screens and windows.
- Save to GN3 File — Choose this option to save the completed case to a "*.GN3" file. This allows the file to be saved for later use, or for sharing with others.
- Delete — Choose this option to open an explorer window that will allow the user to delete any previously saved "*.GN3" files.

GASPAR – Options

- Enter a Case Title
- Select dose factors to be used:
 - ICRP-2 (Default)
 - ICRP-30
 - ICRP-72
- Option for individual doses only
- Printing cumulative or detailed dose reports
- Printing dose factor library (don't select unless want many pages of DCFs for all 203 radionuclides)
- PARTS calculations (calculates dose conversion factors incorporating site-specific dose modeling; used in ODCM)

GASPAR

File Quit About

Case Title: **GASPAR Test Case 1 - ICRP-2** Dose Factor: **ICRP-2 (Default)**

Options Source Term Pop/Prod Data Special Location Data Dose Factors Pathway Factors Consumption Values

☒ Calculate individual doses only
☒ Print cumulative dose reports only
☐ Print dose-factor library data
☐ Perform PARTS calculation
☐ Read X/Q and D/Q data from XOQDOQ-generated file

Info...

Add Biota

Fraction of the year that leafy vegetables are grown: 0.75
Fraction of the year that milk cows are on pasture: 0.80
Fraction of max individual's vegetable intake from own garden: 0.50
Fraction of milk-cow feed intake from pasture while on pasture: 1.00
Relative Humidity (%): 8.00
Average temperature over growing season (F): 70.00
Fraction of the year that goats are on pasture: 1.00
Fraction of goat feed intake from pasture while on pasture: 1.00
Fraction of the year that beef cattle are on pasture: 0.80
Fraction of beef-cattle feed intake from pasture while on pasture: 1.00

Save Create Input View Input Run GASPAR View Output FSAR Report Supplemental Report

NOTE: Changing DCFs will re-initialize the source term

GASPAR Main Screen

- The seven GASPAR Data Input Tabs:
 - Options
 - Source Term
 - Pop/Prod Data
 - Special Locations
 - Dose Factors
 - Pathway Factors
 - Consumption Values

The screenshot displays the GASPAR software interface. At the top, the title bar reads 'GASPAR' with menu options 'File', 'Quit', and 'About'. Below this, the 'Case Title' field contains 'GASPAR Test Case 1 - ICRP-2' and the 'Dose Factors' dropdown is set to 'ICRP-2 (Default)'. A red rectangular box highlights the 'Options' tab bar, which includes the following tabs: 'Options', 'Source Term', 'Pop/Prod Data', 'Special Location Data', 'Dose Factors', 'Pathway Factors', and 'Consumption Values'. The 'Consumption Values' tab is active, showing a list of parameters with input fields. The parameters and their values are: 'Fraction of the year that leafy vegetables are grown:' (0.75), 'Fraction of the year that milk cows are on pasture:' (0.80), 'Fraction of max individual's vegetable intake from own garden:' (0.50), 'Fraction of milk-cow feed intake from pasture while on pasture:' (1.00), 'Relative Humidity (%):' (8.00), 'Average temperature over growing season (F):' (70.00), 'Fraction of the year that goats are on pasture:' (1.00), 'Fraction of goat feed intake from pasture while on pasture:' (1.00), 'Fraction of the year that beef cattle are on pasture:' (0.80), and 'Fraction of beef-cattle feed intake from pasture while on pasture:' (1.00). On the left side of the 'Consumption Values' tab, there are several checkboxes: 'Calculate individual doses only' (checked), 'Print cumulative dose reports only' (checked), 'Print dose-factor library data' (unchecked), 'Perform PARTS calculation' (unchecked), and 'Read X/Q and D/Q data from XOQDOQ-generated file' (unchecked). An 'Info...' button is located next to the 'Perform PARTS calculation' checkbox. An 'Add Biota' button is positioned below the checkboxes. At the bottom of the window, there is a row of buttons: 'Save', 'Create Input', 'View Input', 'Run GASPAR', 'View Output', 'FSAR Report', and 'Supplemental Report'.



GASPAR – Options

- Input site-specific for pathway modeling assumptions
 - Fraction of foods taken from local garden
 - Fraction of year animals on pasture

Dose Factors	Pathway Factors	Consumption Values
		Fraction of the year that leafy vegetables are grown: 0.75
		Fraction of the year that milk cows are on pasture: 0.80
		Fraction of max individual's vegetable intake from own garden: 0.50
		Fraction of milk-cow feed intake from pasture while on pasture: 1.00
		Relative Humidity (%): 8.00
		Average temperature over growing season (F): 70.00
		Fraction of the year that goats are on pasture: 1.00
		Fraction of goat feed intake from pasture while on pasture: 1.00
		Fraction of the year that beef cattle are on pasture: 0.80
		Fraction of beef-cattle feed intake from pasture while on pasture: 1.00

GASPAR – Biota

- Modeling based on BNWL-1754 (same as LADTAP)
- Six (6) biota types automatically included
 - muskrat, racoon, duck, heron, cow, and fox
- Option for User defined biota
 - Food type (limited to either herbivore or carnivore)

Additional Biota Types

Name	Food Type	Mass (g)	Effective Radius (cm)	Consumption Rate (g/day)
Bear	Herbivore	200000	30.0	10000

Add Biota Type

Delete Biota Type

Clear

Name: Consumption Rate: g/day

Primary Food:

Mass: g

Effective Radius: cm

Save Close



GASPAR – Source Term

- Title
- Source term multiplication
- Add, delete or clear options

NOTE: Only a single source term may be used for each case

Options Source Term Pop/Prod Data Special Location Data Dose Factors Pathway Factors Consumption Values

Source Term:

Title:

Source Multiplication Factor:

Release time for purges: hr

Nuclide	Quantity (Ci)
CS-137	1.00E+00
H-3	1.00E+02
I-131	1.00E-01
KR-85	3.00E+02
XE-135	2.00E+02

Add Nuclide

Delete Nuclide

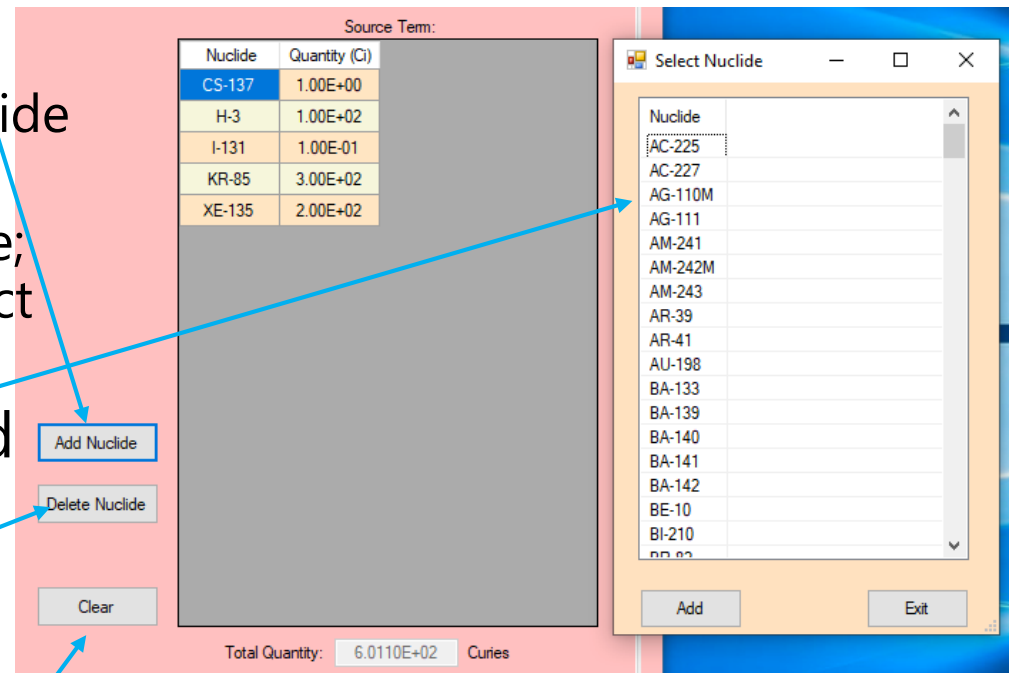
Clear

Total Quantity: Curies



GASPAR – Source Term

- Select: Add Nuclide
 - Pop-up menus with nuclide list
 - Highlight desired nuclide; use "control" key to select multiple nuclides
- Selecting "Add" will add them to list
- "Delete Nuclide" will delete selected nuclide
- "Clear" will clear all nuclides in the source term



GASPAR – Source Term – ICRP-30 and ICRP-72 DCFs

- ICRP-30 and ICRP-72 DCFs, select the applicable solubility (f1) or lung clearance type (F, M, S) for each radionuclide

NOTE: Only one solubility or inhalation class allowed per radionuclide

The screenshot displays the 'Source Term' window in the GASPAR software. It features a table with columns: Nuclide, Default, Class, f1, and Quantity (Ci). The table lists several radionuclides: CS-137, H-3, I-131, KR-85, and XE-135. The 'Add Nuclide' button is highlighted with a red box. A blue arrow points from the text 'select the applicable solubility (f1) or lung clearance type (F, M, S)' to the 'f1' column of the table. A 'Select Nuclide' dialog box is open on the right, showing a list of radionuclides with their Default, Class, and f1 values. The 'Add' button in the dialog is also visible.

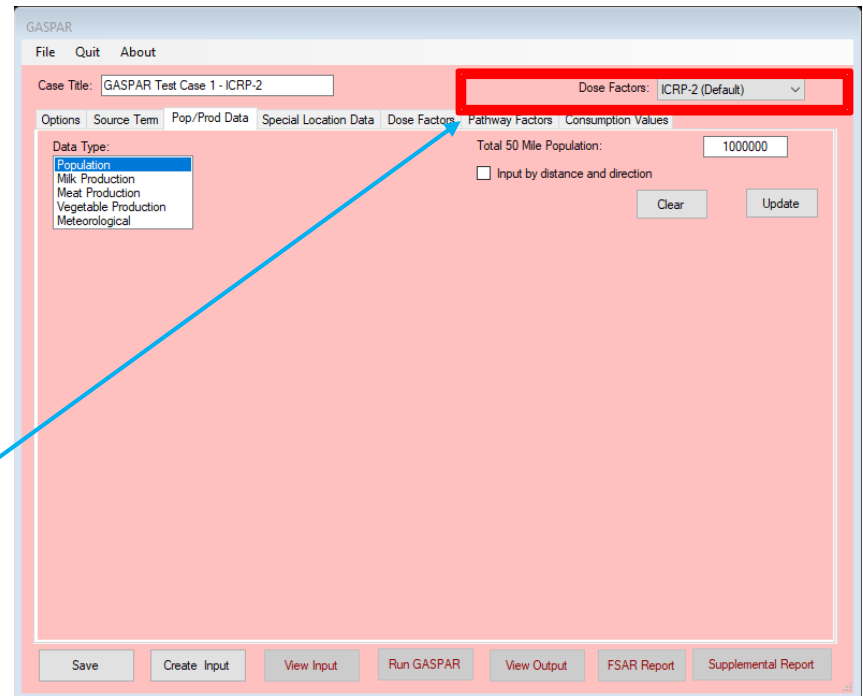
Nuclide	Default	Class	f1	Quantity (Ci)
CS-137	Yes	F		1.00E+00
H-3	Yes	V		1.00E+02
I-131	Yes	F		1.00E-01
KR-85	Yes			3.00E+02
XE-135	Yes			2.00E+02

Total Quantity: 6.0110E+02 Curies



GASPAR – Population/Production Data

- Used for population dose calculations only
- Dropdown menu for data type
 - Population
 - Milk
 - Meat
 - Vegetable
 - Meteorology
- Except for meteorology, 50 mile data may be entered rather than sector segmented data



The screenshot shows the GASPAR software interface. The 'Dose Factors' tab is selected, and the 'Data Type' dropdown menu is open, showing options: Population, Milk Production, Meat Production, Vegetable Production, and Meteorological. The 'Total 50 Mile Population' field is set to 1000000. A red box highlights the 'Dose Factors: ICRP-2 (Default)' dropdown menu. A blue arrow points from the text 'Except for meteorology, 50 mile data may be entered rather than sector segmented data' to the 'Data Type' dropdown menu.

GASPAR – Input Population/Production Data

- Applies for population, milk, meat, and vegetable production
- Input population or production data by meteorological sector and distance (data typically found in applicant's FSAR or ER)

NOTE: Select “UPDATE” before exiting input

The screenshot shows the GASPAR software interface. The 'Case Title' is 'GASPAR Test Case 1 - ICRP-2'. The 'Dose Factors' are set to 'ICRP-2 (Default)'. The 'Pop/Prod Data' tab is selected. The 'Data Type' dropdown is set to 'Population'. The 'Input by distance and direction' checkbox is checked. The 'Update' button is highlighted with a red box.

	1 mi	2 mi	3 mi	4 mi	5 mi	10 mi	20 mi	30 mi	40 mi
N	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0

GASPAR – Special Location Data

- Select Add to add new location (will clear fields)
 - Identified the location where individual doses will be calculated
- Location data
 - Name
 - Distance/Direction (information use only)
- Atmospheric dispersion factors
- Detailed Reports
- Save

The screenshot displays the GASPAR software interface, specifically the 'Special Location Data' tab. The interface is divided into several sections:

- Special Locations:** A list box containing 'Test Loc #1' and 'Test Loc #2'. An 'Add' button is highlighted with a red box, and a 'Remove' button is also visible.
- Location for Individual Doses:** A section containing fields for 'Name of Location' (Test Loc #1), 'Direction from site' (N), and 'Distance from site' (1000.00 m).
- Atmospheric Dispersion Factors:** A section containing input fields for 'Undecayed, Undepleted' (1.000E-06), 'Decayed, Undepleted' (1.000E-06), 'Decayed, Depleted' (1.000E-06), and 'Ground Deposition Factor' (1.000E-07).
- Report Control:** A section with a checkbox 'Don't print any detailed reports' and a list of report types to omit: Plume exposure, Ground exposure, Vegetable ingestion, Cow Meat ingestion, Cow-milk ingestion, Goat-milk ingestion, and Inhalation.
- Save:** A button located at the bottom right of the form.

The bottom of the window features a menu bar (File, Quit, About) and a toolbar with buttons for Save, Create Input, View Input, Run GASPAR, View Output, FSAR Report, and Supplemental Report.

GASPAR – Dose Factors

- Dropdown menu for displaying dose factors
 - Inhalation
 - Ingestion
 - By age group
- Values for the Dose Factors being used

NOTE: Dose factor data is not editable

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
AC-225	4.23E-04	5.82E-04	2.84E-05	0.00E+00	6.63E-05	2.21E-02	2.52E-04
AC-227	2.30E+00	3.05E-01	1.36E-01	0.00E+00	9.82E-02	2.41E-01	5.08E-05
AG-110M	1.35E-06	1.25E-06	7.43E-07	0.00E+00	2.46E-06	5.79E-04	3.78E-05
AG-111	4.25E-08	1.78E-08	8.87E-09	0.00E+00	5.74E-08	2.33E-05	2.79E-05
AM-241	1.68E+00	1.13E+00	6.71E-02	0.00E+00	5.04E-01	6.06E-02	4.60E-05
AM-242M	1.70E+00	1.06E+00	6.73E-02	0.00E+00	5.01E-01	2.44E-02	5.79E-05
AM-243	1.68E+00	1.10E+00	6.57E-02	0.00E+00	4.95E-01	5.75E-02	5.40E-05
AR-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AR-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AU-198	0.00E+00	5.70E-09	4.50E-08	0.00E+00	2.30E-08	1.00E-05	2.70E-05
BA-133	9.50E-06	4.20E-07	2.50E-06	0.00E+00	2.10E-09	1.90E-04	1.00E-05
BA-139	1.17E-10	8.32E-14	3.42E-12	0.00E+00	7.78E-14	4.70E-07	1.12E-07
BA-140	4.88E-06	6.13E-09	3.21E-07	0.00E+00	2.09E-09	1.59E-04	2.73E-05
BA-141	1.25E-11	9.41E-15	4.20E-13	0.00E+00	8.75E-15	2.42E-07	1.45E-17
BA-142	3.29E-12	3.38E-15	2.07E-13	0.00E+00	2.86E-15	1.49E-07	1.96E-26
BE-10	1.98E-04	3.06E-05	4.96E-06	0.00E+00	0.00E+00	2.22E-04	1.67E-05
BI-210	2.31E-07	1.59E-06	1.32E-07	0.00E+00	1.92E-05	1.11E-03	2.95E-05
BR-82	0.00E+00	0.00E+00	1.69E-06	0.00E+00	0.00E+00	0.00E+00	1.30E-06
BR-83	0.00E+00	0.00E+00	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.90E-08



GASPAR – Dose Factors – Nuclide Data

- Nuclide decay data
- External dose factors
- Absorbed Energies
 - For biota calculations
 - Effective radii

NOTE: Dose factor data is not editable

Nuclide Data

Nuclide	Atomic Number	Atomic Weight	Isomeric State	Decay Constant	EXG TB Factor (mrem/hr per pCi/m2)
H-3	1	3		1.78E-09	0.00E+00
BE-10	4	10		1.37E-14	0.00E+00
C-14	6	14		3.84E-12	0.00E+00
N-13	7	13		1.16E-03	7.60E-09
F-18	9	18		1.05E-04	6.80E-09
NA-22	11	22		8.44E-09	1.60E-08

Effective Energies

Nuclide	1 cm	1.5 cm	2.5 cm	3.5 cm	5 cm
Ac-225	5.92E+00	5.92E+00	5.92E+00	5.92E+00	5.92E+00
Ac-227	8.50E-02	8.50E-02	8.51E-02	8.52E-02	8.52E-02
Ag-110	1.18E+00	1.18E+00	1.18E+00	1.18E+00	1.18E+00
Ag-110m	1.49E-01	1.82E-01	2.42E-01	3.03E-01	3.96E-01
Ag-111	3.55E-01	3.55E-01	3.55E-01	3.56E-01	3.57E-01
Am-241	5.61E+00	5.61E+00	5.62E+00	5.62E+00	5.62E+00
Am-242m	7.03E-02	7.08E-02	7.14E-02	7.18E-02	7.22E-02

Exit



GASPAR – Dose Factors

Submersion

- Submersion (semi-infinite plume) dose factors for noble gases

Noble Gas Submersion DFs - Default

Type	AR-41	KR-83M	KR-85M	KR-85	KR-87	KR-88	KR-89	XE-131M	XE-133M
Gamma Air	9.30E-03	1.93E-05	1.23E-03	1.72E-05	6.17E-03	1.52E-02	1.73E-02	1.56E-04	3.27E-04
Beta Air	3.28E-03	2.88E-04	1.97E-03	1.95E-03	1.03E-02	2.93E-03	1.06E-02	1.11E-03	1.48E-03
Gamma T-Body	8.84E-03	7.56E-08	1.17E-03	1.61E-05	5.92E-03	1.47E-02	1.66E-02	9.15E-05	2.51E-04
Beta Skin	2.69E-03	0.00E+00	1.46E-03	1.34E-03	9.73E-03	2.37E-03	1.01E-02	4.76E-04	9.94E-04
Beta Lung	0.00E+00	2.91E-06	1.95E-05	1.87E-05	1.02E-04	3.38E-05	1.09E-04	1.10E-05	1.46E-05
Tau	1.05E-04	1.04E-04	4.38E-05	2.05E-09	1.51E-04	6.78E-05	3.61E-03	6.80E-07	3.55E-06

Close

NOTE: GASPAR calculates airborne submersion dose only from noble gas

GASPAR – Pathway Factors

- Default values included for various environmental pathway modeling parameters
- Goat milk transfer factors
- Hold-up and Transport Times
- Physical parameters
- Option to reset to default values

GASPAR

File Quit About

Case Title: Dose Factors:

Options Source Term Pop/Prod Data Special Location Data Dose Factors **Pathway Factors** Consumption Values

Growing period for vegetables consumed by human: days

Cow feed ingestion rate: kg/day

Goat feed ingestion rate: kg/day

Vegetables retention for particulates other than iodine:

Weather removal constant: 1/sec

Soil surface density: kg/m²

Iodine retention:

Pasture grass yield: kg/m²

Feed crop yield: kg/m²

Garden vegetable crop yield: kg/m²

Goat Feed to Milk Transfer Factors (D/L)

Hydrogen:	<input type="text" value="0.17"/>	Calcium:	<input type="text" value="0.47"/>
Boron:	<input type="text" value="0.012"/>	Iron:	<input type="text" value="0.0013"/>
Carbon:	<input type="text" value="0.10"/>	Copper:	<input type="text" value="0.013"/>
Magnesium:	<input type="text" value="0.042"/>	Strontium:	<input type="text" value="0.014"/>
Phosphorus:	<input type="text" value="0.25"/>	Iodine:	<input type="text" value="0.06"/>
Chlorine:	<input type="text" value="0.50"/>	Cesium:	<input type="text" value="0.30"/>
Potassium:	<input type="text" value="0.057"/>	Polonium:	<input type="text" value="0.0018"/>

Holdup and Transport Times (sec)

Meat to consumption:	<input type="text" value="1.73E6"/>
Milk to population:	<input type="text" value="3.46E5"/>
Vegetables to population:	<input type="text" value="1.21E6"/>
Vegetables to individual:	<input type="text" value="5.18E6"/>
Milk to individual:	<input type="text" value="1.73E5"/>
Leafy vegetables to individual:	<input type="text" value="8.64E4"/>
Pasture grazing period:	<input type="text" value="2.59E6"/>
Feed storage time:	<input type="text" value="7.78E6"/>

Physical Parameters

Midpoint of plant life:	<input type="text" value="6.31E8"/> sec
Shielding factor for individuals:	<input type="text" value="0.7"/>
Shielding factor for populations:	<input type="text" value="0.5"/>
Hydrosphere water volume:	<input type="text" value="2.7E19"/> L
Volume of the atmosphere:	<input type="text" value="3.8E18"/> m ³
Iodine deposit fraction:	<input type="text" value="0.5"/>

Transfer Factors

Page Defaults

Save Create Input View Input Run GASPAR View Output FSAR Report Supplemental Report



GASPAR – Transfer Factors

- By element
 - Feed-to-meat (cow)
 - Soil-to-vegetation
 - Grass-to-milk (cow)
- Can be edited to address site-characteristic data
- Tab to reset to Default values
- Save – any changed

Transfer Factors

Element	Item	Value
H	Meat	1.2E-02
H	Soil	4.8E+00
H	Milk	1.0E-02
HE	Meat	2.0E-02
HE	Soil	5.0E-02
HE	Milk	2.0E-02
LI	Meat	1.0E-02
LI	Soil	8.3E-04
LI	Milk	5.0E-02
BE	Meat	1.0E-03
BE	Soil	4.2E-04
BE	Milk	1.0E-04
B	Meat	8.0E-04
B	Soil	1.2E-01
B	Milk	2.7E-03
C	Meat	3.1E-02
C	Soil	5.5E+00
C	Milk	1.2E-02

Get Defaults Save Close



GASPAR – Consumption Values

- U.S. (country) population
 - used for total population H-3 and C-14 dose calcs
- Population fractions
- Maximum and average individual consumption values; by age group
- Get Defaults to reset
- Save changes

The screenshot displays the GASPAR software interface. At the top, there is a menu bar with 'File', 'Quit', and 'About'. Below the menu bar, the 'Case Title' is set to 'GASPAR Test Case 1 - ICRP-2'. To the right, 'Dose Factors' are set to 'ICRP-2 (Default)'. A tabbed interface shows 'Options', 'Source Term', 'Pop/Prod Data', 'Special Location Data', 'Dose Factors', 'Pathway Factors', and 'Consumption Values' (which is currently selected). Under the 'Consumption Values' tab, there is a section for 'Usage Parameters' with a '2000 US population' of '2.80E+08' and 'Fraction of population' for 'Adults' (0.71), 'Teenagers' (0.11), and 'Children' (0.18). Below this is a 'Usage Defaults' button. The main section is 'Intake Consumption Data', which contains a table with consumption values for different intake types and age groups. To the right of the table is a 'Get Defaults' button. At the bottom of the window, there are buttons for 'Save', 'Create Input', 'View Input', 'Run GASPAR', 'View Output', 'FSAR Report', and 'Supplemental Report'.

Intake Type ->	Inhalation (m3/yr)	Vegetables (kg/yr)	Leafy Vegetables (kg/yr)	Milk (kg/yr)	Meat (kg/yr)
Max Adult Consumption	8000.00	520.00	64.00	310.00	110.00
Max Teen Consumption	8000.00	630.00	42.00	400.00	65.00
Max Child Consumption	3700.00	520.00	26.00	330.00	41.00
Max Infant Consumption	1400.00	0.00	0.00	330.00	0.00
Avg Adult Consumption	8000.00	190.00	30.00	110.00	95.00
Avg Teen Consumption	8000.00	240.00	20.00	200.00	59.00
Avg Child Consumption	3700.00	200.00	10.00	170.00	37.00



Running GASPAR – Viewing Outputs/Reports

- Can be Saved and Run from any screen
 - Save
 - Create Input
 - View Input
 - Run GASPAR
 - View Output
 - FSAR Report
 - Supplemental Report

GASPAR

File Quit About

Case Title: GASPAR Test Case 1 - ICRP-2 Dose Factors: ICRP-2 (Default)

Options Source Term Pop/Prod Data Special Location Data Dose Factors Pathway Factors Consumption Values

Usage Parameters

2000 US population: 2.80E+08 Fraction of population: Adults 0.71 Teenagers 0.11 Children 0.18

Usage Defaults

Intake Consumption Data

Intake Type ->	Inhalation (m ³ /yr)	Vegetables (kg/yr)	Leafy Vegetables (kg/yr)	Milk (kg/yr)	Meat (kg/yr)
Max Adult Consumption	8000.00	520.00	64.00	310.00	110.00
Max Teen Consumption	8000.00	630.00	42.00	400.00	65.00
Max Child Consumption	3700.00	520.00	26.00	330.00	41.00
Max Infant Consumption	1400.00	0.00	0.00	330.00	0.00
Avg Adult Consumption	8000.00	190.00	30.00	110.00	95.00
Avg Teen Consumption	8000.00	240.00	20.00	200.00	59.00
Avg Child Consumption	3700.00	200.00	10.00	170.00	37.00

Get Defaults

Save

Save Create Input View Input Run GASPAR View Output FSAR Report Supplemental Report

Save Create Input View Input Run GASPAR View Output FSAR Report Supplemental Report

View Input

- Input follows the format of the “card deck” as described in NUREG/CR-4653
- The datasets reflect modeling under the “Pathway factors” tab, such as transfer factors, exposure and transfer assumptions.
- The bottom section is the standard format for GASPAR input (individual doses only), containing the Selections inputs, source term, Special Location assumptions
- If population doses performed, would also include the population, production and meteorological data

```
[1.20E-2 2.00E-2 1.00E-2 1.00E-3 8.00E-4 3.10E-2 7.70E-2 1.60E-2 1.50E-1 2.00E-2 3.00E-2 5.00E-3
1.50E-3 4.00E-5 4.60E-2 1.00E-1 8.00E-2 2.00E-2 1.20E-2 4.00E-3 1.60E-2 3.10E-2 2.30E-2 2.40E-3
8.00E-4 4.00E-2 1.30E-2 5.30E-3 8.00E-3 3.00E-2 1.30E+0 2.00E+1 2.00E-3 1.50E-2 2.60E-2 2.00E-2
3.10E-2 6.00E-4 4.60E-3 3.40E-2 2.80E-1 8.00E-3 4.00E-1 4.00E-1 1.50E-3 4.00E-3 1.70E-2 5.30E-4
8.00E-3 8.00E-2 4.00E-3 7.70E-2 2.90E-3 2.00E-2 4.00E-3 3.20E-3 2.00E-4 1.20E-3 4.70E-3 3.30E-3
4.80E-3 5.00E-3 4.80E-3 3.60E-3 4.40E-3 5.30E-3 4.40E-3 4.00E-3 4.40E-3 4.00E-3 4.40E-3 4.00E-1
1.60E+0 1.30E-3 8.00E-3 4.00E-1 1.50E-3 4.00E-3 8.00E-3 2.60E-1 4.00E-2 2.90E-4 1.30E-2 1.20E-2
8.00E+0 2.00E-2 2.00E-2 3.40E-2 6.00E-2 2.00E-4 8.00E+2 3.40E-4 2.00E-4 1.40E-5 2.00E-4 2.00E-4
2.00E-4 2.00E-4 2.00E-4 2.00E-4 2.00E-4
4.80E+0 5.00E-2 8.30E-4 4.20E-4 1.20E-1 5.50E+0 7.50E+0 1.60E+0 6.50E-4 1.40E-1 5.20E-2 1.30E-1
1.80E-4 1.50E-4 1.10E+0 5.90E-1 5.00E+0 6.00E-1 3.70E-1 3.60E-2 1.10E-3 5.40E-5 1.30E-3 2.50E-4
2.90E-2 6.60E-4 9.40E-3 1.90E-2 1.20E-1 4.00E-1 2.50E-4 1.00E-1 1.00E-2 1.30E+0 7.60E-1 3.00E+0
1.30E-1 1.70E-2 2.60E-3 1.70E-4 9.40E-3 1.20E-1 2.50E-1 5.00E-2 1.30E+1 5.00E+0 1.50E-1 3.00E-1
2.50E-1 2.50E-3 1.10E-2 1.30E+0 2.00E-2 1.00E+1 1.00E-2 5.00E-3 2.50E-3 2.50E-3 2.50E-3 2.40E-3
2.50E-3 2.50E-3 2.50E-3 2.60E-3 2.60E-3 2.50E-3 2.60E-3 2.50E-3 2.60E-3 2.50E-3 2.60E-3 1.70E-4
6.30E-3 1.80E-2 2.50E-1 5.00E-2 1.30E+1 5.00E-1 2.50E-3 3.80E-1 2.50E-1 6.80E-2 1.50E-1 1.50E-1
2.50E-1 3.50E+0 1.00E-2 3.10E-4 2.50E-3 4.20E-3 2.50E-3 2.50E-3 2.50E-3 2.50E-4 2.50E-4 2.50E-4
2.50E-3 2.50E-3 2.50E-3 2.50E-3
1.00E-2 2.00E-2 5.00E-2 1.00E-4 2.70E-3 1.20E-2 2.20E-2 2.00E-2 1.40E-2 2.00E-2 4.00E-2 1.00E-2
5.00E-4 1.00E-4 2.50E-2 1.80E-2 5.00E-2 2.00E-2 1.00E-2 8.00E-3 5.00E-6 5.00E-6 1.00E-3 2.20E-3
2.50E-4 1.20E-3 1.00E-3 6.70E-3 1.40E-2 3.90E-2 5.00E-5 5.00E-4 6.00E-3 4.50E-2 5.00E-2 2.00E-2
3.00E-2 8.00E-4 1.00E-5 5.00E-6 2.50E-3 7.50E-3 2.50E-2 1.00E-6 1.00E-2 1.00E-2 1.20E-4
1.00E-4 2.50E-3 1.50E-3 1.00E-3 6.00E-3 2.00E-2 1.20E-2 4.00E-4 5.00E-6 1.00E-4 5.00E-6 5.00E-6
5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6
2.50E-2 5.00E-4 2.50E-2 5.00E-3 5.00E-3 5.00E-3 5.00E-3 3.80E-2 2.20E-2 6.20E-4 5.00E-4 3.00E-4
5.00E-2 2.00E-2 5.00E-2 8.00E-3 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6 5.00E-6
5.00E-6 5.00E-6 5.00E-6 5.00E-6
2.80E+08
3
9.30E-03 1.93E-05 1.23E-03 1.72E-05 6.17E-03 1.52E-02 1.73E-02 1.56E-04 3.27E-04 3.53E-04 3.36E-03
1.92E-03 1.51E-03 9.21E-03
3.28E-03 2.88E-04 1.97E-03 1.95E-03 1.03E-02 2.93E-03 1.06E-02 1.11E-03 1.48E-03 1.05E-03 7.39E-04
2.46E-03 1.27E-02 4.75E-03
7.18E-03 1.40E-07 8.03E-04 2.81E-05 4.64E-03 1.13E-02 1.12E-02 4.08E-05 1.50E-04 1.55E-04 2.22E-03
1.29E-03 1.21E-03 6.41E-03
1.18E-02 4.16E-06 2.62E-03 1.54E-03 1.60E-02 1.58E-02 2.43E-02 5.63E-04 1.22E-03 5.81E-04 3.47E-03
3.65E-03 1.58E-02 1.25E-02
0.00E+00 2.91E-06 1.95E-05 1.87E-05 1.02E-04 3.38E-05 1.09E-04 1.10E-05 1.46E-05 1.05E-05 8.79E-06
2.46E-05 1.23E-04 4.93E-05
1.05E-04 1.04E-04 4.38E-05 2.05E-09 1.51E-04 6.78E-05 3.61E-03 6.80E-07 3.55E-06 1.53E-06 7.41E-04
2.12E-05 2.96E-03 8.15E-04
60.0 50.0 6.0 0.2 5.73E-7
240.0 1.0 0.7 2.0
1.73E+06 3.46E+05 1.21E+06 5.18E+06 1.73E+05 8.64E+04 2.59E+06 7.78E+06
1.70E-01 1.20E-02 1.00E-01 4.20E-02 2.50E-01 5.00E-01 5.70E-02 4.70E-01 1.30E-03 1.30E-02
1.40E-02 6.00E-02 3.00E-01 1.80E-03
0.18 0.11 0.71
3760.0 5548.0 5950.0
111.0 120.0 175.0
4.8 8.1 17.0
141.0 83.0 70.0
22.0 35.0 47.0
3360.0 5000.0 5040.0 6060.0 8000.0 8980.0
182.0 249.0 269.0 323.0 296.0 429.0
4.8 10.1 11.5 14.6 19.9 42.2
150.0 477.0 347.0 369.0 340.0 301.0
27.0 51.0 58.0 74.0 97.0 120.0
0.7 0.5 0.5 5.0
6.31E8 2.7E19 3.8E18
0
GASPAR Test Case 1 - ICRP-72
1 1 1 0 1 0 0
1000 0.75 0.8 0.5 1 8 70 1 1 0.8 1
Source Term 1
1 0 0
CS-137 1.000E+00
H -3 1.000E+02
I -131 1.000E-01
KR-85 3.000E+02
XE-135 2.000E+02
1Test Loc #1 N 1000 1.000E-06 1.000E-06 1.000E-06 1.000E-0700000000
1Test Loc #2 NE 1200 2.200E-07 2.100E-07 2.000E-07 3.400E-0900000000
```

Run GASPAR – View Output

- Basic assumptions used for calculations
- Lists the Source Term
- Followed by Doses
 - Population (if performed)
 - Individual by Special Locations
- If selected “Print Dose Factor Library,” output will include all nuclides

```
*****
*
*
*                               NRC Dose3
*
*                               GASPAR Test Case 1 - ICRP-2
*
*                               U.S. NUCLEAR REGULATORY COMMISSION
*                               WASHINGTON, D.C. 20555
*
*                               DATE OF RUN:10-23-2019
*
*                               CALCULATIONS PERFORMED USING THE ICRP-2
*                               BASED DOSE CONVERSION FACTORS
*
*****

GASPAR Test Case 1 - ICRP-2

JOB CONTROL PARAMETERS

JC(1) = 1 :POPULATION/INDIVIDUAL DOSE SELECTION
JC(2) = 1 :NUMBER OF SOURCE RELEASE POINTS
JC(3) = 1 :PRINT CONTROL FOR DOSE ACCUMULATION
JC(4) = 0 :READ CONTROL FOR BLOCK DATA CHANGE RECORDS
JC(5) = 0 :PRINT CONTROL FOR DOSE FACTOR TABLE
JC(6) = 0 :CALCULATION CONTROL FOR UNIT DOSE FACTORS
JC(7) = 0 :READ CONTROL FOR DISPERSION DATA INPUT FILE
JC(8) = 0
JC(9) = 0
JC(10)= 0

EXPOSURE PATHWAY FRACTIONS

PARAMETER DESCRIPTION(FRACTION)  VALUE
-----
FV  LEAFY VEGETABLE FROM GARDEN    0.75
FG  OTHER EDIBLES FROM GARDEN      0.50
FP  TIME MILK COWS ON PASTURE       0.80
FB  TIME BEEF ON PASTURE            0.80
FGT TIME MILK GOATS ON PASTURE      1.00
FPF MILK COW INTAKE FROM PASTURE    1.00
FBF BEEF INTAKE FROM PASTURE        1.00
FPG MILK GOAT INTAKE FROM PASTURE   1.00

HUMIDITY(G/M**3)  1.42

SOURCE TERM RELEASE NUMBER  1

RELEASE POINT  Source Term 1
UML = 1.00E+00 SOURCE TERM MULTIPLICATION FACTOR
JC1 = 0        NEW OR PREVIOUS MET DATA PARAMETER
JC2 = 0        NEW OR PREVIOUS SOURCE TERM RELEASE DATA 'PARAMETER

NUCLIDE      CI/YR
-----
55CS137      1.00E+00
1H 3         1.00E+02
53I 131      1.00E-01
36KR 85      3.00E+02
54XE135      2.00E+02

6.011E+02 TOTAL CURIES FOR  5 RADIONUCLIDES
```

GASPAR FSAR Report

- Provides a summary report of assumptions and doses
- Suitable for use in creating input for safety analyses and licensing support

FSAR Input Report - GASPAR Test Case 1 - ICRP-2 - 22-Oct-2019 18:07

Input Parameters for the GASPAR Code

X/Q (sec/m3)
For maximum individual dose calculation
Undecayed, Undepleted: 1.00E-06
Decayed, Undepleted: 1.00E-06
Decayed, Depleted: 1.00E-06

D/Q (1/m2)
For maximum individual dose calculation 1.00E-07

Distance to residence (mi) 0.62
Midpoint of plant life (yr) 20.0
Fraction of the year that leafy vegetables are grown: 0.75
Fraction of the year that milk cows are on pasture: 0.80
Fraction of milk-cow feed intake that is from pasture while on pasture: 1.00
Fraction of the year that goats are on pasture: 1.00
Fraction of goat feed intake that is from pasture while on pasture: 1.00
Fraction of the maximum individual's vegetable intake that is from garden: 0.50
Average absolute humidity over the growing season (g/m3): 1.00
Fraction of the year that beef cattle cows are on pasture: 0.80
Fraction of beef-cattle feed intake that is from pasture while on pasture: 1.00
Animal considered for milk pathway Cow and Goat
Annual milk production for all distances and directions within 50 miles (L) 1000
Annual meat production for all distances and directions within 50 miles (kg) 1000
Annual vegetable production for all distances and directions within 50 miles (kg) 1000

Gaseous Source Term for the GASPAR Code

Isotope	Release Rate (Ci/yr)
CS-137	1.00E+00
H-3	1.00E+02
I-131	1.00E-01
KR-85	3.00E+02
XE-135	2.00E+02

Calculated Doses from Gaseous Effluents (Plume Exposure due to Noble Gases)

Type of Dose	Dose
Gamma dose in air (mrad/yr)	1.23E-02
Beta dose in air (mrad/yr)	3.41E-02
Dose to total body (mrem/yr)	8.14E-03
Dose to skin (mrem/yr)	3.41E-02

Note:
1. Doses due to noble gases, including AR-41

Calculated Doses from Gaseous Effluents (mrem/yr)

Age Group	Effective	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung
Ground	4.13E+01	4.13E+01	4.13E+01	4.13E+01	4.13E+01	4.13E+01	4.13E+01
Vegetable							
Adult	1.30E+01	4.09E-01	1.45E+01	1.99E+01	6.81E+00	1.20E+01	2.25E+00
Teen	1.07E+01	4.62E-01	2.30E+01	3.06E+01	1.05E+01	1.49E+01	4.05E+00
Child	7.70E+00	3.58E-01	5.41E+01	5.18E+01	1.70E+01	2.76E+01	6.09E+00
Meat							
Adult	1.81E+00	5.71E-02	2.01E+00	2.76E+00	9.40E-01	6.30E-01	3.14E-01
Teen	7.76E-01	3.39E-02	1.67E+00	2.22E+00	7.60E-01	4.56E-01	2.96E-01
Child	4.38E-01	2.10E-02	3.08E+00	2.95E+00	9.65E-01	6.88E-01	3.47E-01
Cow Milk							
Adult	1.53E+01	4.72E-01	1.71E+01	2.33E+01	8.00E+00	1.73E+01	2.63E+00
Teen	1.44E+01	6.13E-01	3.09E+01	4.12E+01	1.41E+01	2.74E+01	5.44E+00
Child	1.06E+01	4.76E-01	7.45E+01	7.13E+01	2.35E+01	5.40E+01	8.36E+00
Trifluoromethane	1.00E+01	4.75E-01	1.10E+01	1.30E+01	3.70E+01	1.35E+01	5.15E+01

GASPAR Supplemental Report

- Provides additional information that may not be included in the GASPAR output or the FSAR

Supplemental FSAR Input - GASPAR Test Case 1 - ICRP-2 - 22-Oct-2019 18:10

Program Constants for GASPAR

Intake Product Parameters

Growing period for vegetables consumed by human:	60.0	days
Cow feed ingestion rate:	50.0	kg/day
Goat feed ingestion rate:	6.0	kg/day
Vegetables retention for particulates other than iodine:	0.2	
Weather removal constant:	5.73E-7	1/sec
Soil surface density:	240.0	1/sec
Iodine retention:	1.0	
Pasture grass yield:	0.7	kg/m2
Feed crop yield:	2.0	kg/m2
Garden vegetable crop yield:	2.0	kg/m2

Holdup & Transport Times (sec)

Meat to consumption:	1.73E6
Milk to population:	3.46E5
Vegetables to population:	1.21E6
Vegetables to individual:	5.18E6
Milk to individual:	1.73E5
Leafy vegetables to individual:	8.64E4
Pasture grazing period:	2.59E6
Feed storage time:	7.78E6

Physical Parameters

Midpoint of plant life:	6.31E8	sec
Shielding factor for individuals:	0.7	
Shielding factor for populations:	0.5	
Hydrosphere water volume:	2.7E19	m3
Volume of the atmosphere:	3.8E18	m3
Iodine deposit fraction:	0.5	
Bone correction factor:	5.0	

Goat Feed to Milk Transfer Factors (D/L)

Hydrogen:	0.17	Calcium:	0.47
Boron:	0.012	Iron:	0.0013
Carbon:	0.10	Copper:	0.013
Magnesium:	0.042	Strontium:	0.014
Phosphorus:	0.25	Iodine:	0.06
Chlorine:	0.50	Cesium:	0.30
Potassium:	0.057	Polonium:	0.0018

Usage Parameters

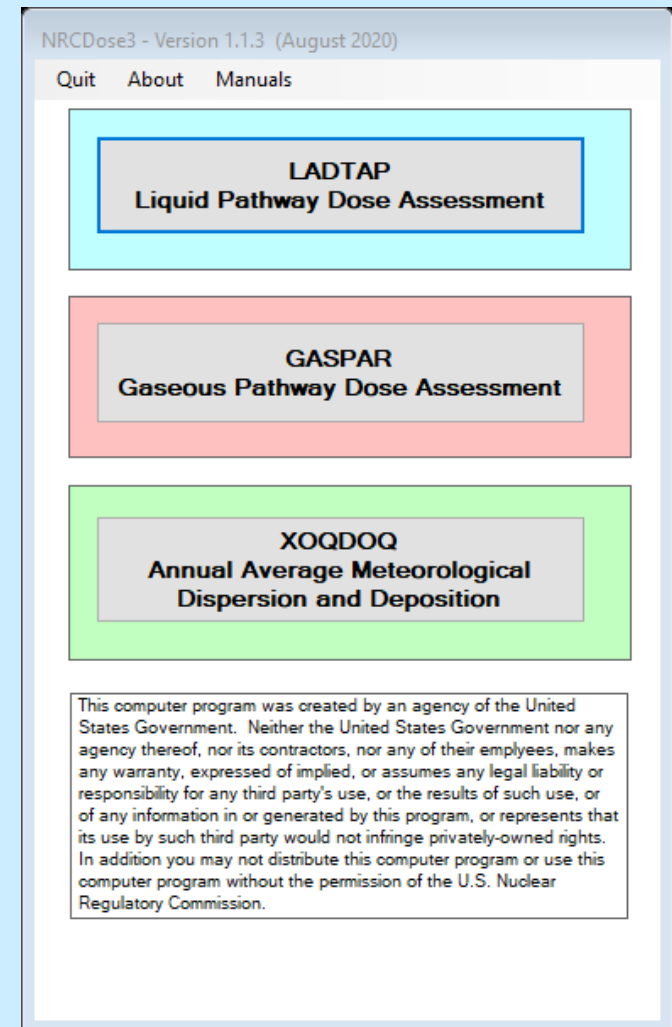
2000 US Population:	2.80E+08		
	Children	Teenagers	Adults
Fraction of population:	0.18	0.11	0.71
Average inhalation rate:	8000.0	8000.0	3700.0
Average vegetable intake:	190.0	240.0	200.0
Average leafy vegetable intake:	30.0	20.0	10.0
Average milk intake:	110.0	200.0	170.0
Average meat intake:	95.0	59.0	37.0

Transfer Coefficients for the LADTAP and GASPAR Codes

Units: Veg (veg/soil); Milk (d/l); Meat (d/kg)

Element	Item	Value
H	Meat	1.20E-02
H	Veg/Soil	4.80E+00
H	Milk	1.00E-02
KR	Meat	2.00E-02
KR	Veg/Soil	3.00E+00
KR	Milk	2.00E-02
I	Meat	2.90E-03
I	Veg/Soil	2.00E-02
I	Milk	6.00E-03

LADTAP MODELING AND USE



LADTAP Dose Modeling

- Routine liquid effluent releases – not for short-term accident
- Modeling assumes annual average conditions
 - Average dispersion in receiving water body
 - Average radioactive effluents over time
- RG 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Rev. 1, October 1977

LADTAP Dose Modeling

- Exposure pathways to man: potable water, aquatic foods, shoreline deposits, swimming, boating, and irrigated foods; and to non-human biota (7 surrogate species)
- Pathway (age groups, organs) doses to maximum exposed individual (MEI) and population

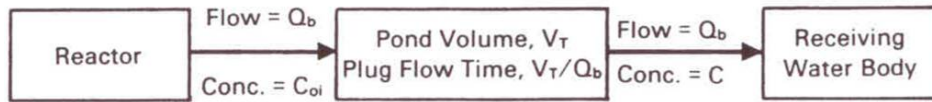
LADTAP

- Exposure pathways – MEI and Populations:
 - Surface water transport (dilution and transport times) to downstream water supplies
 - Aquatic foods: fresh and saltwater water fish, invertebrate (crustacea and shellfish), and aquatic plants (seaweed)
 - Shoreline deposition: direct exposure from shoreline deposits; build-up to mid-point of plant life (assumed 40 year life)
 - Swimming and boating: direct exposure
 - Irrigated foods; and to non-human biota (7 surrogate species)

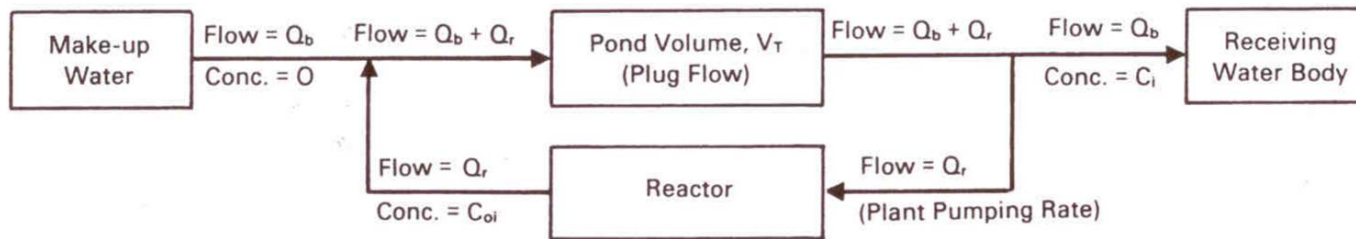
LADTAP – Reconcentration models

- Models from RG 1.113:
 - **Plug-Flow Model** - uniform, constant flow through pond; negligible evaporation
 - **Partially Mixed Model** - applicable where blowdown and plant pumping significant
 - **Completely Mixed Model** - estimates effluent concentration at midpoint of plant life
- Refer to NUREG/CR-4013, Section 3.1.1 for more detail

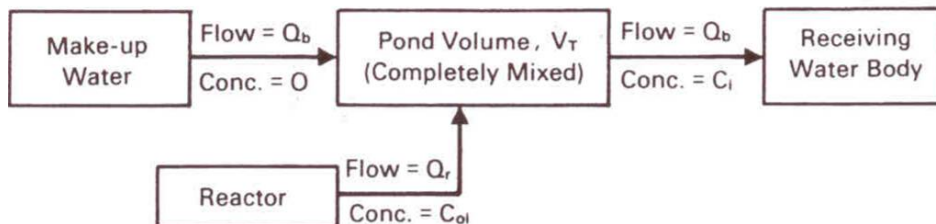
LADTAP – Reconcentration models



(a) Plug-Flow Model



(b) Partially Mixed Model

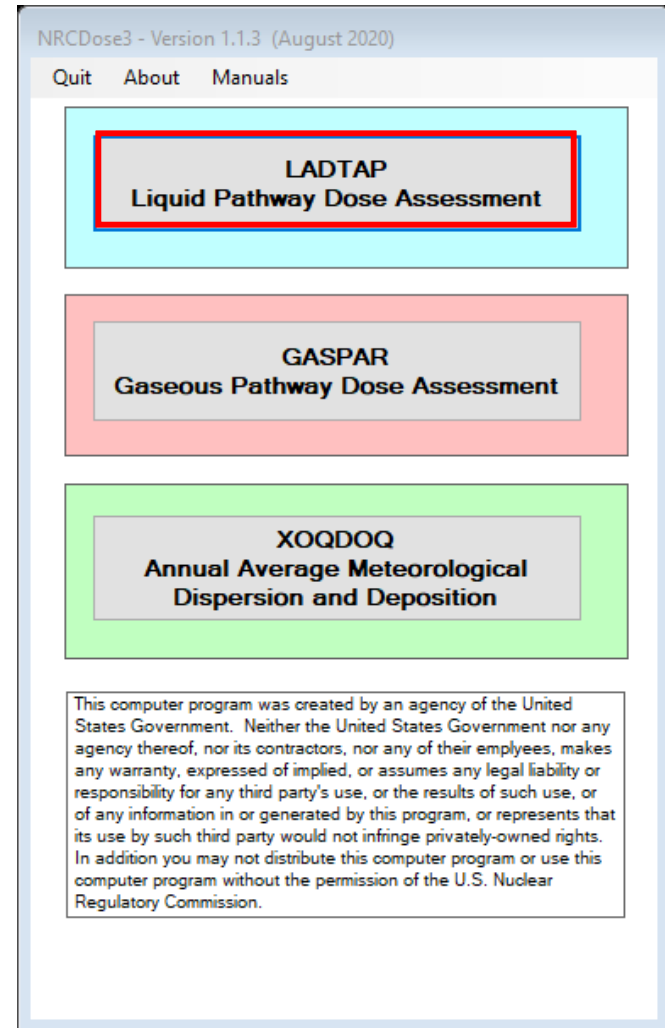


(c) Completely Mixed Model

FIGURE 3.2. Schematic Representations of Impoundment Models

Starting and Running LADTAP

- Double click "LADTAP"



LADTAP Main Screen

- LADTAP Module Main Screen opens with case data that is saved in the database
- Contains three main functional areas:
 - the toolbar and initial setup area,
 - data input tabs area and
 - code execution and reports area

LADTAP

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-2 (Default)

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Discharge Flow Rate: 3150.00 CFS Site Type
Source Term Multiplier: 1 ☒ Fresh water
50 mi Population: 2200000 ☐ Salt water

☐ Print dose factors

Population Fractions
Modify defaults?
☒ No ☐ Yes Edit

Dose Contributions
Print by radionuclide %
☒ No ☐ Yes

Reconcentration
Model: Partially-Mixed
Effluent discharge rate from impoundment system to the receiving water body: 200 CFS
Impoundment Total Volume: 50000 ft³

Add Nuclide
Delete Nuclide
Clear

Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3.90E-04	
CS-138	2.80E-02	
CS-137	5.50E-03	
H-3	1.80E+01	
I-131	5.20E-04	

Total Quantity: 1.8037E+01 Curies

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP Start-up

- New — Select this option to begin a new LADTAP case. This will clear the database from any previously input information.
- Open LN3 File — Select this option to access and open a “*.LN3” file that was previously created with NRC Dose3.
- Save to Database — Choose this option to save the current case to the database. When LADTAP starts, it loads the data that was last saved (typically from the last, previous run), populating all LADTAP screens and windows.
- Save to LN3 File — Choose this option to save the completed case to a “*.LN3” file. This allows the file to be saved for later use, or for sharing with others.
- Delete — Choose this option to open an explorer window that will allow the user to delete any previously saved “*.LN3” files.

LADTAP – Basic Information

- Scenario Name
- Source Term Identifier
- Dose Factor Library
 - ICRP-2 (Default)
 - ICRP-30
 - ICRP-72

NOTE: Changing DCF Library will cause other entries to reset

LADTAP

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-2 (Default)

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Discharge Flow Rate: 3150.00 CFS

Source Term Multiplier: 1

50 mi Population: 2200000

Site Type

☒ Fresh water

☐ Salt water

☐ Print dose factors

Population Fractions

Modify defaults?

☒ No ☐ Yes Edit

Dose Contributions

Print by radionuclide %

☒ No ☐ Yes

Reconciliation

Model: Partially-Mixed

Effluent discharge rate from impoundment system to the receiving water body: 200 CFS

Impoundment Total Volume: 50000 ft³

Add Nuclide

Delete Nuclide

Clear

Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3.90E-04	
CS-138	2.80E-02	
CS-137	5.50E-03	
H-3	1.80E+01	
I-131	5.20E-04	

Total Quantity: 1.8037E+01 Curies

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP – Selections

- Release/site information
- Fresh or Saltwater
- Print Dose Factors
- Dose contribution by nuclide
- Modify Population Fractions
 - (ICRP-2/ICRP-72)
 - Adult (71%)
 - Teen (11%)
 - Child (18%)
 - ICRP-30
 - Adult (100%)

LADTAP

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-2 (Default)

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Discharge Flow Rate: 3150.00 CFS

Source Term Multiplier: 1

50 mi Population: 2200000

Site Type:
☒ Fresh water
☐ Salt water

☐ Print dose factors

Population Fractions
Modify defaults?
☒ No ☐ Yes Edit

Dose Contributions
Print by radionuclide %
☒ No ☐ Yes

Reconciliation
Model: Partially-Mixed
Effluent discharge rate from impoundment system to the receiving water body: 200 CFS
Impoundment Total Volume: 50000 ft³

Add Nuclide
Delete Nuclide
Clear

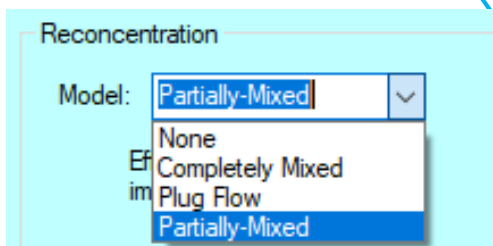
Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3.90E-04	
CS-138	2.80E-02	
CS-137	5.50E-03	
H-3	1.80E+01	
I-131	5.20E-04	

Total Quantity: 1.8037E+01 Curies

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report

LADTAP – Reconcentration

- Drop down menus for the three (3) models



The screenshot shows the LADTAP software interface. At the top, there are tabs for 'File', 'Quit', and 'About'. Below these are input fields for 'Scenario: NUREG/CR-4013 Sample Problem 1', 'Source Term: Test #1', and 'Dose Factors: ICRP-2 (Default)'. A 'Selections' tab is active, showing various input fields and checkboxes. A red box highlights the 'Reconcentration' section, which includes a dropdown menu for 'Model:' (set to 'Partially-Mixed'), an 'Effluent discharge rate from impoundment system to the receiving water body' field (set to 200 CFS), and an 'Impoundment Total Volume' field (set to 50000 ft³). To the right, a 'Source Term' table lists nuclides and their quantities. A blue arrow points from the 'Reconcentration' section to the 'R-Factor' column in the table.

Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3.90E-04	
CS-138	2.80E-02	
CS-137	5.50E-03	
H-3	1.80E+01	
I-131	5.20E-04	

Total Quantity: 1.8037E+01 Curies

Alternatively, user can put in a nuclide specific reconcentration factor manually.

LADTAP – Reconcentration models

- Plug-Flow Model

$$C_i = C_{0i} * \exp[-2.788 \times 10^{-4} \lambda_i \frac{V_T}{Q_B}]$$

- Partially Mixed Model

$$C_i = C_0 * \frac{R}{(R+1) * \exp[\frac{V_T * \lambda_i}{3600 * Q_r (R+1)} - 1]}$$

where :

$$R = \frac{\text{reactor effluent discharge rate}}{\text{pond flow-through rate}}$$

- Completely Mixed Model

$$C_i = C_0 * \frac{Q_b}{(Q_b + V_T * \lambda_i / 3600) \left\{ 1 - \exp \left[-3.15 \times 10^7 (Q_b + \frac{\lambda_i V_T}{3600}) (\frac{T_{PL}}{V_T}) \right] \right\}}$$

LADTAP – Source Term

- Select: Add Nuclide
- Pop-up menus with nuclide list
- Highlight desired nuclide; use "control" key to select multiple nuclides
 - Select "Add" to add to list
- "Delete Nuclide" will delete selected nuclide
- "Clear" will clear all nuclides in the Source Term

The screenshot shows the LADTAP Source Term interface. A 'Select Nuclide' pop-up menu is open, displaying a list of nuclides. The 'Add Nuclide' button is highlighted in the main interface. The 'Delete Nuclide' and 'Clear' buttons are also visible. The 'Source Term' table is partially visible in the background.

Site Type

☒ Fresh water
☐ Salt water

Contributions
by radionuclide %
No
Yes

Add Nuclide

Delete Nuclide

Clear

Run LADTAP

View Output

Source Term:

Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3	
CS-138	2	
CS-137	5	
H-3	1	
I-131	5	

Select Nuclide

Nuclide
AC-225
AC-227
AG-110M
AG-111
AM-241
AM-242M
AM-243
AR-39
AR-41
AU-198
BA-133
BA-139
BA-140
BA-141
BA-142
BE-10
BI-210
BR-82

Add

Exit

Total Quantity



LADTAP – Source Term

- ICRP-30 and ICRP-72 DCFs
 - For radionuclides with more than one solubility class, select the applicable one
 - The same nuclide with more than one solubility class is not allowed

Source Term:

Nuclide	Default	f1	Quantity (Ci)	R-Factor
CS-134	Yes	1	3.90E-04	
CS-137	Yes	1	5.50E-03	
CS-138	Yes			
H-3	Yes			
I-131	Yes			
I-133	Yes			
I-135	Yes			

Select Nuclide

Nuclide	Default	f1
AC-225	Yes	0.001
AC-227	Yes	0.001
AG-110M	Yes	0.05
AG-111	Yes	0.05
AM-241	Yes	0.001
AM-242M	Yes	0.001
AM-243	Yes	0.001
AR-39	Yes	
AR-41	Yes	
AU-198	Yes	0.1
BA-133	Yes	0.1
BA-139	Yes	0.1
BA-140	Yes	0.1
BA-141	Yes	0.1
BA-142	Yes	0.1
BE-10	Yes	0.005
BI-210	Yes	0.05
BR-82	Yes	1

Add Nuclide

Delete Nuclide

Clear

Total Quantity

Run LADTAP

View Output

Add

Exit

LADTAP – ALARA Locations (Individual Doses)

- Defines the exposure assumptions for individual dose calculations
- Enter data
 - Shore width factor defines the geometry for the shoreline exposure
 - Dilution factors by pathway
 - Transit time by pathways

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-2.In3

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-2 (Default)

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

ALARA - Max. Individual

Shore-width factor: River Shoreline (0.2)

Dilution Factor

Aquatic food and boating:	1	Calc
Shoreline and swimming:	1	Calc
Drinking water:	4	Calc

Transit Time (hrs)

Drinking water:	3
Other pathways:	0.1

Change default usage and consumption data

☐ No ☒ Yes Edit

Additional Usage Locations

At outfall	Add
Downstream	

Remove

Number of Records: 2

ALARA - Additional Location

Location: At outfall

Dilution Factor

All pathways: 1 Calc

Transit Time (hrs)

All pathways: 1

Shore-width factor: River Shoreline (0.2)

Change default usage and consumption data

☐ No ☒ Yes Edit

Cancel Save

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP – Dilution Factor Calculation

- Using the “Calc” options, a dilution factor will be calculated based on receiving water body parameters
 - Based on RG 1.113
 - For nontidal uniform flow and steady-state conditions, diffusive transport in the flow direction negligible compared with advective transport

Dilution Factor Calculation

Surface water model

☒ River
☐ Lake

Surface Water Velocity (ft/sec):

Surface Water Depth (ft):

Downstream Distance (ft):

Offshore Distance (ft):

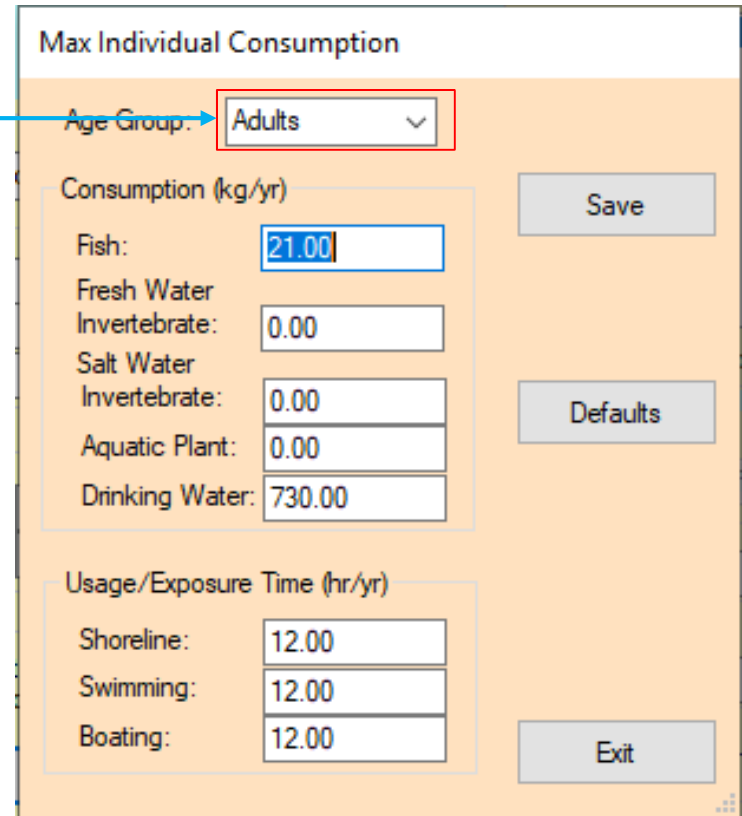
River Width/Lake Discharge Depth (ft):

LADTAP Dilution Calculation

- Surface Water Model — Select the appropriate hydrological model by clicking on either River or Lake model option
- Surface Water Velocity — surface water velocity in units of feet per second (ft/s)
- Surface Water Depth — surface water depth in units of ft
- Downstream Distance — downstream distance in units of ft
- Offshore Distance — offshore distance in units of ft
- River Width/Lake Discharge Depth — either the river width or lake discharge depth depending on the model selected in units of ft

LADTAP – Individual Age Group Exposure Assumptions

- Drop down menu to select age group
 - ICRP-2 DCFs: four age groups: Adult, Teen, Child, Infant
 - ICRP-30 DCFs: Adult age group only
 - ICRP-72 DCFs: Adult, 15-year, 10-year, 5-year, 1-year and newborn
- Remember to Save before Exit



Max Individual Consumption

Age Group: Adults

Consumption (kg/yr)

Fish:	<input type="text" value="21.00"/>
Fresh Water Invertebrate:	<input type="text" value="0.00"/>
Salt Water Invertebrate:	<input type="text" value="0.00"/>
Aquatic Plant:	<input type="text" value="0.00"/>
Drinking Water:	<input type="text" value="730.00"/>

Usage/Exposure Time (hr/yr)

Shoreline:	<input type="text" value="12.00"/>
Swimming:	<input type="text" value="12.00"/>
Boating:	<input type="text" value="12.00"/>

Save

Defaults

Exit

LADTAP – Additional Locations (Individual Doses)

- Add/remove additional locations of interest – by name
- Define exposure assumptions
 - Dilution
 - Transit time
 - Shore width factor
- Ability to change exposure times and consumption rates

The screenshot displays two windows from the LADTAP software. The top window, titled 'Additional Usage Locations', has a red border and contains a list box with 'At outfall' and 'Downstream'. To the right of the list are 'Add' and 'Remove' buttons. Below the list box, it says 'Number of Records: 2'. A blue arrow points from the text 'Add/remove additional locations of interest – by name' to the 'Add' button. The bottom window, titled 'ALARA - Additional Location', has a yellow background. It contains several input fields: 'Location:' with 'At outfall' selected, 'Dilution Factor' with 'All pathways: 1' and a 'Calc' button, 'Transit Time (hrs)' with 'All pathways: 1', and 'Shore-width factor:' with a dropdown menu showing 'River Shoreline (0.2)'. At the bottom, there is a section 'Change default usage and consumption data' with radio buttons for 'No' and 'Yes' (selected), and 'Edit' and 'Save' buttons. A blue arrow points from the text 'Ability to change exposure times and consumption rates' to this section. Another blue arrow points from the text 'Define exposure assumptions' to the 'ALARA - Additional Location' dialog box.

LADTAP Population Doses: Fish and Shellfish

- Select pathway from dropdown menu
- Add location
- Define harvest, dilution and transit time

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-72

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Fish Usage: Sport Fishing
Commercial Fishing
Sport Invertebrate Harvest
Commercial Invertebrate Harvest

Sport Fishing

Fish Downstream Add Remove

Number of Records: 1

Sport Fishing Location

Location: Fish Downstream

Annual harvest: 70000 kg/yr
Dilution factor: 4 Calc
Transit Time: 1 hrs
Cancel Save

Population Usage: Drinking Water
Shoreline
Swimming
Boating

Drinking Water Usage

Water at 16 mi downstream Add Remove

Number of Records: 1

Drinking Water Usage Location

Location: Water at 16 mi downstream

Total Population: 2200000
Dilution factor: 4 Calc
Transit Time: 1 hrs
Supply rate: 0 gpd
Avg Ind Usage: 0 gpd
Cancel Save

Biota Locations

Fish at outfall
Fish Downstream Add Remove

Number of Records: 2

Biota Exposure

Location: Fish at outfall

Dilution factor: 1 Calc
Transit Time: 0.1 hrs
Cancel Save

Add Biota

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP Population Usages

- From drop down, select population usage: drinking water, shoreline, swimming or boating
- Add location
- For drinking water, define the population served or the supply rate
- For others, define person-hours annual usage
- Define dilution and transit time
- Add additional locations as needed

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1 Dose Factors: ICRP-72

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Fish Usage: Sport Fishing
Commercial Fishing
Sport Invertebrate Harvest
Commercial Invertebrate Harvest

Sport Fishing

Fish Downstream Add Remove

Number of Records: 1

Sport Fishing Location

Location: Fish Downstream

Annual harvest: 70000 kg/yr
Dilution factor: 4 Calc
Transit Time: 1 hrs

Cancel Save

Population Usage: Drinking Water
Shoreline
Swimming
Boating

Drinking Water Usage

Water at 16 mi downstream Add Remove

Number of Records: 1

Drinking Water Usage Location

Location: Water at 16 mi downstream

Total Population: 2200000
Dilution factor: 4 Calc
Transit Time: 1 hrs
Supply rate: 0 gpd
Avg Ind Usage: 0 gpd

Cancel Save

Biota Locations

Fish at outfall
Fish Downstream Add Remove

Number of Records: 2

Biota Exposure

Location: Fish at outfall

Dilution factor: 1 Calc
Transit Time: 0.1 hrs

Cancel Save

Add Biota

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report

LADTAP – Biota Doses

- Add locations for calculating doses to biota
- Define dilution and transit time
- Add additional locations as needed
- A “new” biota can be defined and added

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: NUREG/CR-4013 Sample Problem 1 Source Term: Test #1

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors Pathway Factors

Fish Usage: Sport Fishing
Commercial Fishing
Sport Invertebrate Harvest
Commercial Invertebrate Harvest

Population Usage: Drinking Water
Shoreline
Swimming
Boating

Sport Fishing

Fish Downstream

Add

Remove

Number of Records: 1

Sport Fishing Location

Location: Fish Downstream

Annual harvest: 70000 kg/yr

Dilution factor: 4 Calc

Transit Time: 1 hrs

Cancel Save

Drinking Water Usage

Water at 16 mi downstream

Add

Remove

Number of Records: 1

Drinking Water Usage Location

Location: Water at 16 mi downstream

Total Population: 2200000

Dilution factor: 4 Calc

Transit Time: 1 hrs

Supply rate: 0 gpd

Avg Ind Usage: 0 gpd

Cancel Save

Biota Locations

Fish at outfall

Add

Remove

Number of Records: 2

Biota Exposure

Location: Fish at outfall

Dilution factor: 1 Calc

Transit Time: 0.1 hrs

Cancel Save

Add Biota

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP – Biota Doses

- Select the “Add Biota” button
- Enter the name and exposure assumptions for the new biota type.
- Select the “Save” button
- Up to five (5) new biota may be added

Additional Biota Types

Add Biota Type

Delete Biota Type

Clear

Name	Food Type	Mass (g)	Effective Radius (cm)	Consumption Rate (g/day)	Shoreline Exposure (hrs/yr)	Swimming Exposure (hrs/yr)
Bear	Fish	300	15	1E+04	4000	2000

Name:

Bear

Food Type:

Fish

Mass:

300

g

Effective Radius:

15

cm

Consumption Rate:

1E+04

g/day

Shoreline Exposure:

4000

hrs/yr

Swimming Exposure:

2000

hrs/yr

Save

Close



LADTAP – Irrigated Foods

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: Source Term: Dose Factors: ICRP-2 (Default) ▼

Selections ALARA Locations Fish/Population/Biota **Irrigation Food Data** Dose Factors Pathway Factors

Irrigated Food Pathways

Add

Remove

Number of Records:

Irrigated Food Data

Food type:

Irrigation rate: L/m²/mon

Total production rate within 50-mi radius: kg/yr or L/yr

Change default usage and consumption data

☒ No ☐ Yes



LADTAP – Irrigated Foods

- From dropdown menu select food type
- Total production within 50 miles
- Add irrigation rate
- Option to change default consumption rates
- For milk and meat, add non-contaminated water fractions
- Save: adds Food type to list.

Irrigated Food Data

Food type: I ▼

Irrigation rate: 0.00 L/m²/mon

Vegetables
Leafy Vegetables
Milk
Meat

Irrigated Food Data

Food type: Vegetables ▼

Irrigation rate: 0.00 L/m²/mon

Total production rate within 50-mi radius: 0.00 kg/yr or L/yr

Change default usage and consumption data

☒ No ☐ Yes Edit

Cancel Save

Usage Locations

Irrigated Food Data

Food type: Milk ▼

Irrigation rate: 0.00 L/m²/mon

Total production rate within 50-mi radius: 0.00 kg/yr or L/yr

Non-contaminated Irrigation Water:

Fraction of animal feed production: 0.00

Fraction of animal drinking water: 0.00

Change default usage and consumption data

☐ No ☒ Yes Edit

Cancel Save

Usage Locations



LADTAP – Irrigated Foods

ICRP-2

Irrigated Food Type Consumption Data					
Food Type -->	Vegetables	Leafy Vegetables	Milk	Meat	
Max Adult Consumption (kg/yr)	520.00	64.00	310.00	110.00	
Max Teen Consumption (kg/yr)	630.00	42.00	400.00	65.00	
Max Child Consumption (kg/yr)	520.00	26.00	330.00	41.00	
Max Infant Consumption (kg/yr)	0.00	0.00	330.00	0.00	
Avg Adult Consumption (kg/yr)	190.00	30.00	110.00	95.00	
Avg Teen Consumption (kg/yr)	240.00	20.00	200.00	59.00	
Avg Child Consumption (kg/yr)	200.00	10.00	170.00	37.00	
Max Individual Holdup Time (hr)	336.00	24.00	48.00	480.00	
Avg Individual Holdup Time (hr)	1440.00	48.00	96.00	480.00	

ICRP-72

Irrigated Food Type Consumption Data					
Food Type -->	Vegetables	Leafy Vegetables	Milk	Meat	
Max Adult Consumption (kg/yr)	429.00	42.20	301.00	120.00	
Max 15 Yr Old Consumption (k...	296.00	19.90	340.00	97.00	
Max 10 Yr Old Consumption (k...	323.00	14.60	369.00	74.00	
Max 5 Yr Old Consumption (kg...	269.00	11.50	347.00	58.00	
Max 1 Yr Old Consumption (kg...	249.00	10.10	477.00	51.00	
Max Newborn Consumption (k...	182.00	4.80	150.00	27.00	
Avg Adult Consumption (kg/yr)	175.00	17.00	70.00	47.00	
Avg 15 Yr Old Consumption (k...	120.00	8.10	83.00	35.00	
Avg 10 Yr Old Consumption (k...	123.00	5.60	125.00	29.00	



LADTAP – Irrigated Foods, Farm Data

- For each farm location, add:
 - Dilution
 - Production
 - Transit time

The image displays two side-by-side screenshots of the LADTAP software interface, which is used for managing farm data. The left window, titled "Water Usage Locations", features a "Food type:" dropdown menu set to "Vegetables", a large empty list box, and "Add" and "Remove" buttons. Below the list box, it shows "Number of Records: 2". The right window, titled "Water Usage Data", also has a "Food type:" dropdown set to "Vegetables". It includes a "Location:" dropdown menu with "Test Location" selected. Below this are three input fields: "Dilution factor:" with the value "1.0", "Production rate:" with the value "1.0" and the unit "kg/yr or L/yr", and "Transit Time:" with the value "1.00" and the unit "hrs". A "Calc" button is positioned next to the "Dilution factor" field. At the bottom of this window are "Cancel" and "Save" buttons.

- Save: adds Food type to list
- Add locations for selected farms for production
- Option to change default consumption rates

LADTAP – Dose Factors

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: Source Term: Dose Factors: ICRP-2 (Default) ▼

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data **Dose Factors** Pathway Factors

Factors:

- Adult Ingestion ▼
- Adult Ingestion
- Teen Ingestion
- Child Ingestion
- Infant Ingestion
- Adult Inhalation
- Teen Inhalation
- Child Inhalation
- Infant Inhalation

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
AC-225	4.40E-06	6.06E-06	2.96E-07	0.00E+00	6.90E-07	0.00E+00	4.07E-04
AC-227	1.87E-03	2.48E-04	1.11E-04	0.00E+00	8.00E-05	0.00E+00	8.19E-05
AG-110M	1.60E-07	1.48E-07	8.79E-08	0.00E+00	2.91E-07	0.00E+00	6.04E-05
AG-111	5.81E-08	2.43E-08	1.21E-08	0.00E+00	7.84E-08	0.00E+00	4.46E-05
AM-241	7.55E-04	7.05E-04	5.41E-05	0.00E+00	4.07E-04	0.00E+00	7.42E-05
AM-242M	7.61E-04	6.63E-04	5.43E-05	0.00E+00	4.05E-04	0.00E+00	9.34E-05
AM-243	7.54E-04	6.90E-04	5.30E-05	0.00E+00	3.99E-04	0.00E+00	8.70E-05
AR-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AR-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AU-198	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	9.70E-08	6.91E-11	2.84E-09	0.00E+00	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	0.00E+00	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	0.00E+00	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	0.00E+00	1.85E-11	1.24E-11	3.00E-26
BE-10	3.18E-06	4.91E-07	7.94E-08	0.00E+00	3.71E-07	0.00E+00	2.68E-05
BI-210	4.61E-07	3.18E-06	2.64E-07	0.00E+00	3.83E-05	0.00E+00	4.75E-05
BR-82	0.00E+00	0.00E+00	2.26E-06	0.00E+00	0.00E+00	0.00E+00	2.59E-06
BR-83	0.00E+00	0.00E+00	4.02E-08	0.00E+00	0.00E+00	0.00E+00	5.79E-08

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report

LADTAP – Dose Factors

- Nuclide Data
 - External TB and skin DFs from
 - Ground Surface
 - Water Submersion
 - Absorbed Energies
 - For biota calculations
 - Effective radii

NOTE: Nuclide Data is non-editable

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario:

Selections ALARA Loc

Factors:
Adult Ingestion

Nuclide Data

Nuclide	Atomic Number	Atomic Weight	Isomeric State	Decay Constant	EXG TB Factor (mrem/hr per pCi/m2)
H-3	1	3		1.78E-09	0.00E+00
BE-10	4	10		1.37E-14	0.00E+00
C-14	6	14		3.84E-12	0.00E+00
N-13	7	13		1.16E-03	7.60E-09
F-18	9	18		1.05E-04	6.80E-09
NA-22	11	22		8.44E-09	1.60E-08

Effective Energies

Nuclide	1 cm	1.5 cm	2.5 cm	3.5 cm	5 cm
Ac-225	5.92E+00	5.92E+00	5.92E+00	5.92E+00	5.92E+00
Ac-227	8.50E-02	8.50E-02	8.51E-02	8.52E-02	8.52E-02
Ag-110	1.18E+00	1.18E+00	1.18E+00	1.18E+00	1.18E+00
Ag-110m	1.49E-01	1.82E-01	2.42E-01	3.03E-01	3.96E-01
Ag-111	3.55E-01	3.55E-01	3.55E-01	3.56E-01	3.57E-01
Am-241	5.61E+00	5.61E+00	5.62E+00	5.62E+00	5.62E+00
Am-242m	7.03E-02	7.08E-02	7.14E-02	7.18E-02	7.22E-02

Exit

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report

LADTAP Pathway Factors

LADTAP Input: C:\NRC\Dose3\NUREG-CR-4013 Sample Problem 1 - ICRP-72.In3

File Quit About

Scenario: Source Term: Dose Factors: ICRP-2 (Default) ▼

Selections ALARA Locations Fish/Population/Biota Irrigation Food Data Dose Factors **Pathway Factors**

Bioaccumulation Factors

Usage/Consumption

Page Defaults

Processing time for aquatic foods: hrs

Processing time for water supply systems: hrs

Milk animals pasture grass consumption rate: kg/d

Milk animals water consumption rate: L/d

Beef animals pasture grass consumption rate: kg/d

Beef animals water consumption rate: L/d

Fraction of deposition captured by vegetation:

Total US Population:

Midpoint of plant life: years

Plant Weathering Half-life: days

Density Thickness of Root Zone: kg/m²

Default Age Group Fractions		Growing Period (days)	Crop Yield (kg/m ²)
Adult:	<input type="text" value="0.71"/>	Vegetables: <input type="text" value="60"/>	<input type="text" value="2.0"/>
Teen:	<input type="text" value="0.11"/>	Leafy Vegetables: <input type="text" value="60"/>	<input type="text" value="2.0"/>
Child:	<input type="text" value="0.18"/>	Milk: <input type="text" value="30"/>	<input type="text" value="0.7"/>
		Meat: <input type="text" value="45"/>	<input type="text" value="0.7"/>

(U.S. Commercial Harvests)

Sport and Commercial Aquatic Food Harvest Parameters

Sport Harvest Processing Time: hrs

Commercial Harvest Processing Time: hrs

Freshwater Fish Harvest: kg/yr

Freshwater Invertebrates Harvest: kg/yr

Saltwater Fish Harvest: kg/yr

Saltwater Invertebrates Harvest: kg/yr

Save Create Input View Input Run LADTAP View Output FSAR Report Supplemental Report



LADTAP Pathway Factors – Bioaccumulation Factors

- Bioaccumulation factors (fresh and saltwater):
 - Fish
 - Invertebrate
 - Plants
- Transfer factors:
 - Soil-to-vegetables
 - Grass-to-meat
 - Grass-to-milk

NOTE: All bioaccumulation factors are editable for site-specific data

Bioaccumulation Factors & Transfer Coefficients

Bioaccumulation Factors (L/kg)

Element	Item	Value
H	Freshwater Plants	9.0E-01
H	Freshwater Fish	9.0E-01
H	Freshwater Invertebrates	9.0E-01
H	Saltwater Plants	9.3E-01
H	Saltwater Fish	9.0E-01
H	Saltwater Invertebrates	9.3E-01
HE	Freshwater Plants	1.0E+00
HE	Freshwater Fish	1.0E+00
HE	Freshwater Invertebrates	1.0E+00
HE	Saltwater Plants	1.0E+00
HE	Saltwater Fish	1.0E+00
HE	Saltwater Invertebrates	1.0E+00
LI	Freshwater Plants	3.0E+00
LI	Freshwater Fish	5.0E-01
LI	Freshwater Invertebrates	4.0E+01
LI	Saltwater Plants	3.0E+00
LI	Saltwater Fish	5.0E-01
LI	Saltwater Invertebrates	5.0E-01

Get Defaults
Save

Transfer Coefficients

Element	Item	Value
H	Meat	1.2E-02
H	Soil	4.8E+00
H	Milk	1.0E-02
HE	Meat	2.0E-02
HE	Soil	5.0E-02
HE	Milk	2.0E-02
LI	Meat	1.0E-02
LI	Soil	8.3E-04
LI	Milk	5.0E-02
BE	Meat	1.0E-03
BE	Soil	4.2E-04
BE	Milk	1.0E-04
B	Meat	8.0E-04
B	Soil	1.2E-01
B	Milk	2.7E-03
C	Meat	3.1E-02
C	Soil	5.5E+00
C	Milk	1.2E-02

Get Defaults
Save

Close



LADTAP Pathway Factors – Usage/Consumption

- Consumption Rates
 - Fish
 - Invertebrate
 - Plants
 - Drinking water
 - Shoreline
 - Swimming
 - Boating
- Irrigated Food Consumption:
 - Vegetables
 - Leafy vegetables
 - Milk
 - Meat
 - Transit and hold-up times

NOTE: All consumption rates are editable for site-specific data

Usage/Consumption Data

Maximum Individual Exposure Consumption Data for selected Dose Factors

Age Group	Fish (kg/yr)	Freshwater Invertebrates (kg/yr)	Aquatic Plants (kg/yr)	Drinking Water (kg/yr)
Adults	21.00	0.00	0.00	730.00
Teens	16.00	0.00	0.00	510.00
Children	6.90	0.00	0.00	510.00
Infants	0.00	0.00	0.00	330.00

Get Defaults Save

Irrigated Food Type Consumption Data

Food Type -->	Vegetables	Leafy Vegetables	Milk	Meat
Max Adult Consumption (kg/yr)	520.00	64.00	310.00	110.00
Max Teen Consumption (kg/yr)	630.00	42.00	400.00	65.00
Max Child Consumption (kg/yr)	520.00	26.00	330.00	41.00
Max Infant Consumption (kg/yr)	0.00	0.00	330.00	0.00
Avg Adult Consumption (kg/yr)	190.00	30.00	110.00	95.00
Avg Teen Consumption (kg/yr)	240.00	20.00	200.00	59.00
Avg Child Consumption (kg/yr)	200.00	10.00	170.00	37.00
Max Individual Holdup Time (hr)	336.00	24.00	48.00	480.00
Avg Individual Holdup Time (hr)	1440.00	48.00	96.00	480.00

Get Defaults Save

Average Individual Consumption Data (kg/yr)

Age Group	Fish (kg/yr)	Invertebrates (kg/yr)	Drinking Water (kg/yr)
Adults	6.90	1.00	370.00
Teens	5.20	0.75	260.00
Children	2.20	0.33	260.00

Get Defaults Save

Close



Running LADTAP – Viewing Outputs/Reports

- Save
- Create Input
- View Input
- Run LADTAP
- View Output
- FSAR Report
- Supplemental Report

The screenshot shows the LADTAP software interface. At the top, there's a menu bar with 'File', 'Quit', and 'About'. Below it, the 'Scenario' is set to 'NUREG/CR-4013 Sample Problem 1', 'Source Term' is 'Test #1', and 'Dose Factors' is 'ICRP-2 (Default)'. The 'Selections' tab is active, showing various input fields and a table of radionuclides.

Input fields include:

- Discharge Flow Rate: 3150.00 CFS
- Source Term Multiplier: 1
- 50 mi Population: 2200000
- Print dose factors: ☐
- Population Fractions: Modify defaults? ☒ No ☐ Yes (with an 'Edit' button)
- Dose Contributions: Print by radionuclide % ☒ No ☐ Yes
- Reconcentration: Model: Partially-Mixed (dropdown)
- Effluent discharge rate from impoundment system to the receiving water body: 200 CFS
- Impoundment Total Volume: 50000 ft³
- Site Type: ☒ Fresh water ☐ Salt water

Buttons include 'Add Nuclide', 'Delete Nuclide', and 'Clear'.

A table titled 'Source Term:' lists radionuclides with their quantities and R-factors:

Nuclide	Quantity (Ci)	R-Factor
I-133	1.20E-03	
I-135	1.30E-03	
CS-134	3.90E-04	
CS-138	2.80E-02	
CS-137	5.50E-03	
H-3	1.80E+01	
I-131	5.20E-04	

At the bottom, a 'Total Quantity:' field shows '1.8037E+01 Curies'. A row of buttons at the bottom includes 'Save', 'Create Input', 'View Input', 'Run LADTAP', 'View Output', 'FSAR Report', and 'Supplemental Report'. A blue arrow points from the 'Create Input' button in the list on the left to the 'Create Input' button in the software interface.

A horizontal row of buttons with a light blue background. The buttons are: 'Save', 'Create Input' (highlighted with a blue border), 'View Input', 'Run LADTAP', 'View Output', 'FSAR Report', and 'Supplemental Report'.

- Selections inputs
- Source Term
- ALARA Location assumptions
- Fish/population/biota inputs
- irrigated foods

[illegible]

Run LADTAP/View Output

```

*****
*
*                               NRCDOSE3
*
*
*
*                               EVALUATION OF RADIATION DOSES FROM RELEASES OF RADIOACTIVITY
*
*                               IN NUCLEAR POWER PLANTS LIQUID EFFLUENTS
*
*
*                               U. S. NUCLEAR REGULATORY COMMISSION
*                               WASHINGTON, D. C.
*
*
*                               NUREG/CR-4013 Sample Problem 1
*
*                               DATE OF RUN: 10-22-2019
*
*                               CALCULATIONS PERFORMED USING THE ICRP-2
*                               BASED DOSE CONVERSION FACTORS
*
*****

NUREG/CR-4013 Sample Problem 1

DISCHARGE = 3.15E+03 CFS          SOURCE TERM MULTIPLIER = 1.00E+00

50-MILE POPULATION = 2.20E+06    FRACTION --- ADULT = 0.71
                                   TEENAGER = 0.11
                                   CHLD = 0.18

FRESHWATER SITE

Test #1
PARTIALLY MIXED MODEL-- POND BLOWDOWN (CFS) - 2.00E+02  PLANT FLOW RATE (CFS) - 3.15E+03  POND VOLUME (CF) - 5.00E+04

* * * ADULT DOSE FACTORS * * *

      _____
      | INGESTION DOSE FACTORS |
      | (MREM/PCI INTAKE)      |
      |_____|
NUCLIDE  CURIE/YEAR  BONE      LIVER  TOT BODY  THYROID  KIDNEY  LUNG  GI-LLI  SHORELINE
      |_____|
      | (MREM/HR)/(PCI/M**2) |
      |_____|
NUCLIDE  CURIE/YEAR  BONE      LIVER  TOT BODY  THYROID  KIDNEY  LUNG  GI-LLI  SKIN  TOT BODY  RECON
      |_____|
53I 133  1.20E-03  1.42E-06  2.47E-06  7.53E-07  3.63E-04  4.31E-06  0.00E+00  2.22E-06  4.50E-09  3.70E-09  1.57E+01
53I 135  1.30E-03  4.43E-07  1.16E-06  4.28E-07  7.65E-05  1.86E-06  0.00E+00  1.31E-06  1.40E-08  1.20E-08  1.56E+01
55CS 134  3.90E-04  6.22E-05  1.48E-04  1.21E-04  0.00E+00  4.79E-05  1.59E-05  2.59E-06  1.40E-08  1.20E-08  1.57E+01
55CS 138  2.80E-02  5.52E-08  1.09E-07  5.40E-08  0.00E+00  8.01E-08  7.91E-09  4.65E-13  2.40E-08  2.10E-08  1.45E+01
55CS 137  5.50E-03  7.97E-05  1.09E-04  7.14E-05  0.00E+00  3.70E-05  1.23E-05  2.11E-06  4.90E-09  4.20E-09  1.57E+01
1H 3 1.80E+01  0.00E+00  5.99E-08  5.99E-08  5.99E-08  5.99E-08  5.99E-08  5.99E-08  0.00E+00  0.00E+00  1.57E+01
53I 131  5.20E-04  4.16E-06  5.95E-06  3.41E-06  1.95E-03  1.02E-05  0.00E+00  1.57E-06  3.40E-09  2.80E-09  1.57E+01

```

LADTAP FSAR Report

- Provides a summary report of assumptions and doses
- Suitable for use in creating input for safety analyses and licensing support

FSAR Input Report - NUREG/CR-4013 Sample Problem 1 - 22-Oct-2019 06:48

Parameters:

Midpoint of Plant Life (yr): 20.00
 Circulating Water System discharge rate (cfs): 3150.00
 Water type selection: Freshwater
 Reconcentration model index: 3 Partially-Mixed
 Discharge rate to receiving water (ft3/sec): 200
 Total impoundment volume (ft3): 50000
 Shore-width factor: 0.2 River Shoreline
 Dilution factor for aquatic foods and boating: 1.00
 Dilution factor for shoreline and swimming exposure: 1.00
 Dilution factor for drinking water: 4.00
 Transit time for drinking water (hr): 3.00
 Transit time for other pathways (hr): 0.10
 Source term multiplier: 1.00
 50-mile population: 2200000
 Total shoreline usage time (person-hr/yr): 83000
 Total swimming usage time (person-hr/yr): 120000
 Total boating usage time (person-hr/yr): 520000

Irrigated Foods

Food Type	Irrigation Rate (L/m2-month)	Fraction not contaminated Animal Feed	Animal Water	Total Production within 50-miles (kg/yr,L/yr)
Vegetables	5000	0.00	0.00	20000
Leafy Vegetables	6000	0.00	0.00	5000
Milk	2000	0.20	0.60	40000
Meat	200	0.20	0.60	300

Population using water-supply system: 2200000
 Annual local harvest for sports fishing (kg/yr): 70000
 Annual local harvest for commercial fishing (kg/yr): 5000
 Annual local harvest for sports invertebrates (kg/yr): 200
 Annual local harvest for commercial invertebrates (kg/yr): 300

Liquid Source Term for the LADTAP Code

Isotope	Release Rate (Ci/yr)
CS-134	3.90E-04
CS-137	5.50E-03
CS-138	2.80E-02
H-3	1.80E+01
I-131	5.20E-04
I-133	1.20E-03
I-135	1.30E-03

Individual ALARA Doses (mrem/yr)

Age Group	Skin	Bone	Liver	IBody	Thyroid	Kidney	Lung	GI-LLI
Fish								
Adult	0.00E+00	1.09E-01	1.55E-01	1.03E-01	2.11E-03	5.23E-02	1.75E-02	3.08E-03
Teen	0.00E+00	1.16E-01	1.61E-01	5.76E-02	1.97E-03	5.44E-02	2.12E-02	2.35E-03
Child	0.00E+00	1.46E-01	1.45E-01	2.21E-02	2.09E-03	4.70E-02	1.69E-02	9.69E-04
Infant	0.00E+00	3.38E-02	4.07E-02	2.99E-03	7.27E-04	1.09E-02	4.43E-03	1.42E-04
Plant								
Teen	0.00E+00	3.63E-02	5.03E-02	1.81E-02	6.40E-03	1.71E-02	6.69E-03	8.26E-04
Drinking								
Adult	0.00E+00	4.76E-04	1.70E-03	1.55E-03	2.37E-03	1.34E-03	1.18E-03	1.12E-03
Teen	0.00E+00	4.66E-04	1.42E-03	1.01E-03	1.88E-03	1.00E-03	8.59E-04	7.87E-04
Child	0.00E+00	1.36E-03	2.83E-03	1.70E-03	4.26E-03	1.94E-03	1.65E-03	1.50E-03
Infant	0.00E+00	1.41E-03	3.16E-03	1.59E-03	5.81E-03	1.93E-03	1.64E-03	1.47E-03
Shoreline								
Adult	1.52E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04
Teen	8.50E-04	7.29E-04	7.29E-04	7.29E-04	7.29E-04	7.29E-04	7.29E-04	7.29E-04
Child	1.78E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04
Infant	1.27E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05
Swimming								
Adult	9.90E-06	6.90E-06	6.90E-06	6.90E-06	6.90E-06	6.90E-06	6.90E-06	6.90E-06
Child	1.65E-06	1.15E-06	1.15E-06	1.15E-06	1.15E-06	1.15E-06	1.15E-06	1.15E-06
Boating								
Adult	4.95E-06	3.45E-06	3.45E-06	3.45E-06	3.45E-06	3.45E-06	3.45E-06	3.45E-06
Teen	4.12E-06	2.87E-06	2.87E-06	2.87E-06	2.87E-06	2.87E-06	2.87E-06	2.87E-06



LADTAP Supplemental Report

- Provides additional information on inputs and exposure assumptions that may not be included in the LADTAP output or the FSAR

Supplemental FSAR Input - NUREG/CR-4013 Sample Problem 1 - 22-Oct-2019 06:52

Program Constants for LADTAP

Processing time for aquatic foods (hrs):	24.0	Total US Population:	2.68E+0
Processing time for water supply systems (hrs):	12.0	Midpoint of plant life (yrs):	20.0
Milk animals pasture grass consumption rate (kg/d):	50.00	Plant Weathering Half-life (yrs):	14.0
Milk animals water consumption rate (L/d):	60.00	Beef animals Thickness of Root Zone (kg/m2):	240.0
Beef animals pasture grass consumption rate (kg/d):	50.00		
Beef animals water consumption rate (L/d):	50.00		
Fraction of deposition captured by vegetation:	0.25		

Default Age Group Fractions

Adult:	0.71
Teen :	0.11
Child:	0.18

(U.S. Commercial Harvests) Sport and Commercial Aquatic Food Harvest Parameters

Sport Harvest Processing Time (hrs):	168
Commercial Harvest Processing Time (hrs):	240
Freshwater Fish Harvest (kg/yr):	4.40E+0
Freshwater Invertebrates Harvest (kg/yr):	2.30E+0
Saltwater Fish Harvest (kg/yr):	6.58E+0
Saltwater Invertebrates Harvest (kg/yr):	4.10E+0

	Growing Period (days)	Crop Yield (kg/m2)
Vegetables	60	2.0
Leafy Vegetables	60	2.0
Milk	30	0.7
Meat	45	0.7

Average Individual Consumption Data

	Water Consumption (L/yr)	Fish Consumption (kg/yr)	Invertebrate Consumption (kg/yr)
Adult:	370	6.9	1
Teen :	260	5.2	0.75
Child:	260	2.2	0.33

Bioaccumulation Factors for the LADTAP Code

Element	Item	Value
H	Freshwater Plants	9.00E-01
H	Freshwater Fish	9.00E-01
H	Freshwater Invertebrates	9.00E-01
H	Saltwater Plants	9.30E-01
H	Saltwater Fish	9.00E-01
H	Saltwater Invertebrates	9.30E-01
I	Freshwater Plants	4.00E+01
I	Freshwater Fish	1.50E+01
I	Freshwater Invertebrates	5.00E+00
I	Saltwater Plants	1.00E+03
I	Saltwater Fish	1.00E+01
I	Saltwater Invertebrates	5.00E+01
CS	Freshwater Plants	5.00E+02
CS	Freshwater Fish	2.00E+03
CS	Freshwater Invertebrates	1.00E+03
CS	Saltwater Plants	5.00E+01
CS	Saltwater Fish	4.00E+01
CS	Saltwater Invertebrates	2.50E+01

Transfer Coefficients for the LADTAP and GASPAR Codes

Element	Item	Value
H	Meat	1.20E-02
H	Veg/Soil	4.80E+00
H	Milk	1.00E+00



Questions?

