



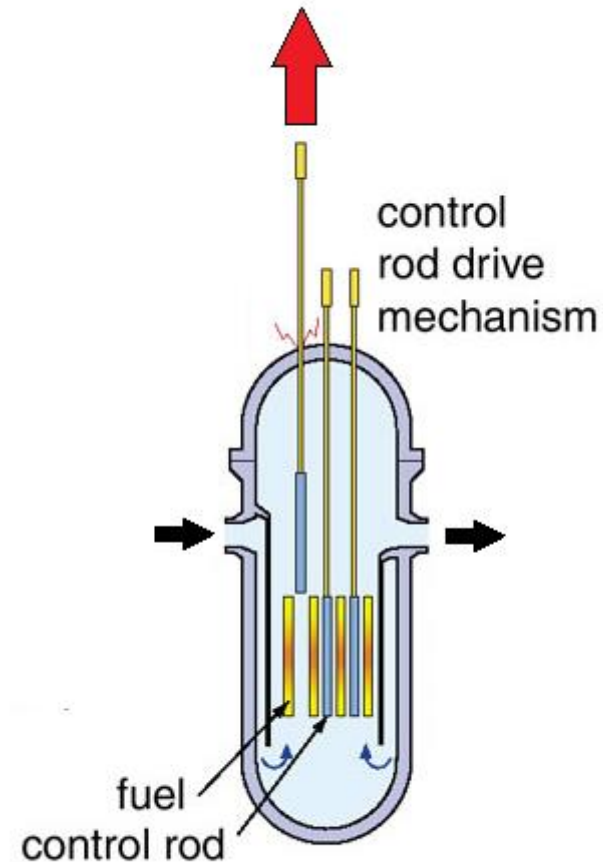
SNAP/RADTRAD

Exercise 3:

Converting our FHA Model to a Rod Ejection Accident Model

Rod Ejection Accident Overview


- It is assumed that a mechanical failure of the pressure housing of a control rod mechanism has resulted in the ejection of a rod cluster assembly
- We will use analytical assumptions outlined in RG 1.183, Appendix H
- One pathway considered for radiological release – containment to environment
- We will credit the emergency mode of operation for the control room
- Doses examined at EAB, LPZ, and CR at end of accident

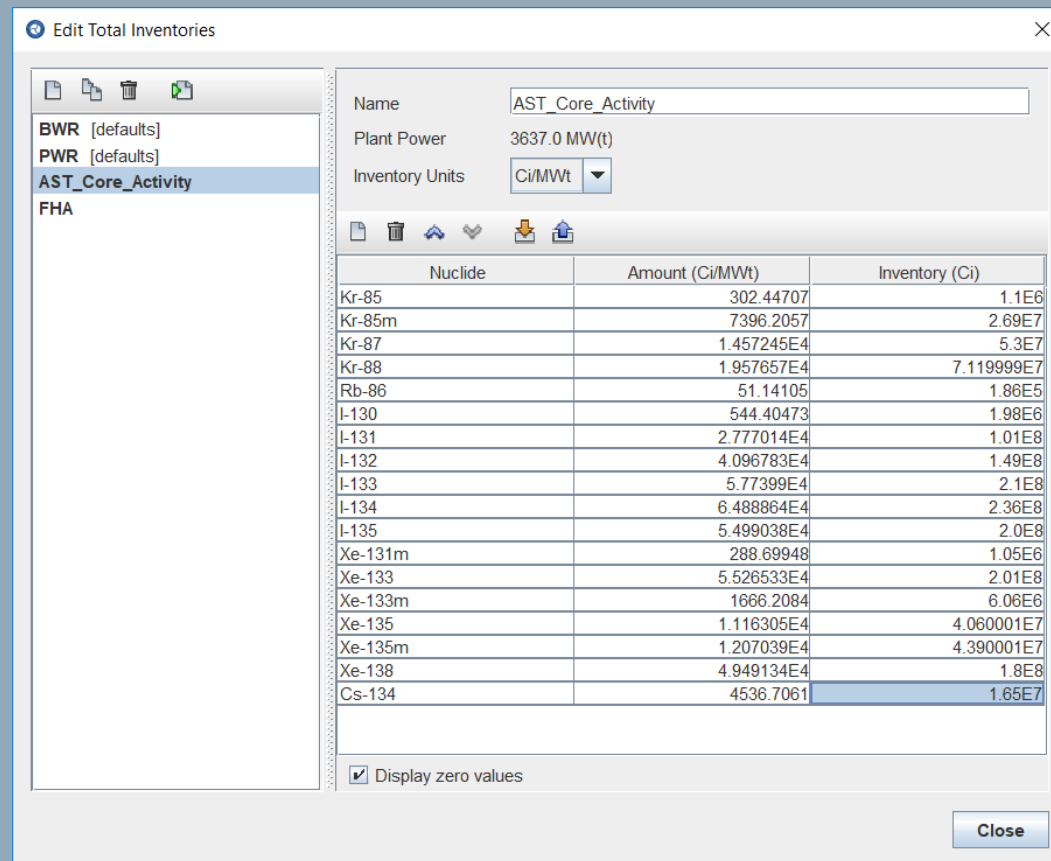


Step 1: Preliminary Setup

- You should have Exercise 2 open in your Model Editor
- In the Navigator Window, select “Model Options”
- Change the Title to “PWR_REA_simple”
- Select the job stream in the Navigator Window and change the “Name” to “PWR_REA_simple”
- Change the “Relative Location” in your job stream
 - Consider changing the location to “PWR_REA_simple” in order to prevent the files from the previous exercise from being overwritten
- Save the model as “PWR_REA_simple.med”

Step 2: Adding an Inventory

- Create a new inventory under “Nuclide Data” titled “AST_Core_Activity” and press the  icon and select REAInventory.icx if provided. If the inventory file isn’t provided, the values located will need to be entered manually.





The screenshot shows the 'Edit Total Inventories' window. On the left, a list of inventory types is shown: BWR [defaults], PWR [defaults], AST_Core_Activity (selected), and FHA. The main area displays a table with three columns: Nuclide, Amount (Ci/MWt), and Inventory (Ci). The table lists various nuclides and their corresponding values. A 'Close' button is located at the bottom right.

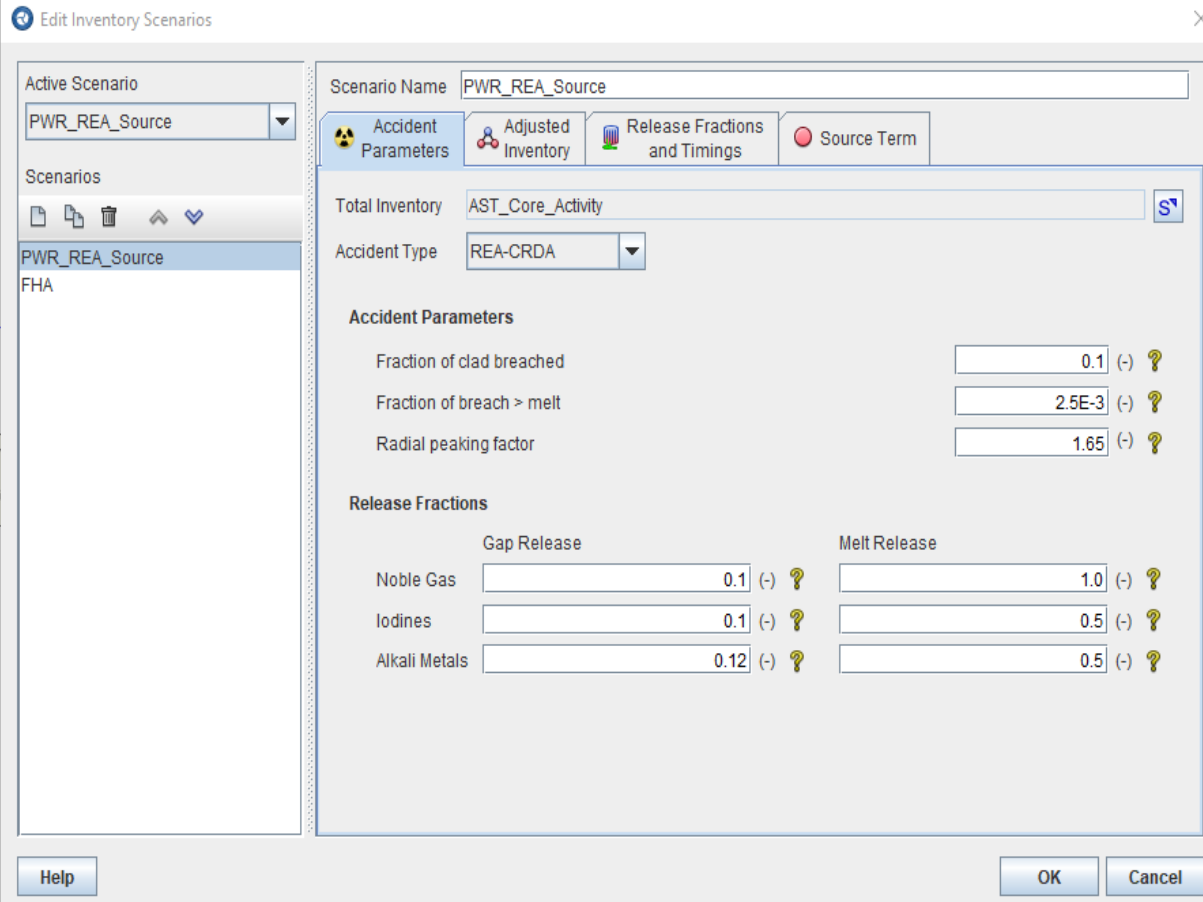
Nuclide	Amount (Ci/MWt)	Inventory (Ci)
Kr-85	302.44707	1.1E6
Kr-85m	7396.2057	2.69E7
Kr-87	1.457245E4	5.3E7
Kr-88	1.957657E4	7.119999E7
Rb-86	51.14105	1.86E5
I-130	544.40473	1.98E6
I-131	2.777014E4	1.01E8
I-132	4.096783E4	1.49E8
I-133	5.77399E4	2.1E8
I-134	6.488864E4	2.36E8
I-135	5.499038E4	2.0E8
Xe-131m	288.69948	1.05E6
Xe-133	5.526533E4	2.01E8
Xe-133m	1666.2084	6.06E6
Xe-135	1.116305E4	4.060001E7
Xe-135m	1.207039E4	4.390001E7
Xe-138	4.949134E4	1.8E8
Cs-134	4536.7061	1.65E7

☒ Display zero values

Close

Step 3: Changing the Source

- In the Navigator Window, select “Source 1 (FHA Source)” rename the source to PWR_REA_Source.
- Next expand () the Source Scenarios window and click on Create a New Scenario (the ) and select the AST_Core_Activity inventory we created.
- Next switch the Active Scenario to PWR_REA_Source and change the Accident Type located in the Accident Parameters tab to REA-CRDA. Then fill out information to match the image:



Active Scenario: PWR_REA_Source

Scenarios: PWR_REA_Source, FHA

Scenario Name: PWR_REA_Source

Accident Parameters | Adjusted Inventory | Release Fractions and Timings | Source Term

Total Inventory: AST_Core_Activity

Accident Type: REA-CRDA

Accident Parameters

Fraction of clad breached	0.1	(-)	?
Fraction of breach > melt	2.5E-3	(-)	?
Radial peaking factor	1.65	(-)	?

Release Fractions

	Gap Release			Melt Release		
Noble Gas	0.1	(-)	?	1.0	(-)	?
Iodines	0.1	(-)	?	0.5	(-)	?
Alkali Metals	0.12	(-)	?	0.5	(-)	?

Help OK Cancel

Step 3: Changing the Source (cont.)

- Press OK on the Edit Inventory Scenarios tab and Change the Source Term Fraction and the Iodine Physical Form in the Source to match the image below.

General ☐ Show Disabled

Name	PWR_REA_Source	
Component Number	1	
Description	<none>	
Source Scenarios	[2] active: PWR_REA_Source	
Source Term Fraction	1.0 (-)	
Iodine Physical Form	NUREG-1465	
Aerosol Fraction	0.95 (-)	
Elemental Fraction	0.0485 (-)	
Organic Fraction	1.5E-3 (-)	
Compartments	Compartment 2 (Containment)	

- Select the Leak to Environment Pathway and expand the Leakage Rate table. Then fill the table with the values shown in the image to the right.
- NOTE: an excel spreadsheet ExerciseData has been provided so you can copy (Ctrl + c) and paste (Ctrl + v) table values directly into the model editor.


Editing Leakage Rate

Time h	Leak Rate %/day
0.0	0.2
24.0	0.1
720.0	0.1

Sort Add Remove

OK Cancel

Step 4: CR Emergency Mode

- Create another pathway (right-click pathway > new) and rename it CR_filtered_inflow. Then drag and drop it to add it to the view and connect () the flow from the Environment compartment to the Control Room compartment just like the CR_unfiltered_inflow pathway.
- Create two new filters (right-click filters > new): CR_filtered_inflow and CR_recirc_flow.
- If the Spreadsheet ExerciseData is provided, copy and paste values into the corresponding filter tables (select a filter, expand filter table), otherwise values can be entered manually.

CR_unfiltered_inflow

Time h	Flow Rate ft³/min	Aerosol Rem...	Elemental I R...	Organic I Re...
%			%	%
0.0	2000.0	0.0	0.0	0.0
0.0333	20.0	0.0	0.0	0.0
720.0	20.0	0.0	0.0	0.0

CR_to_environ

Time h	Flow Rate ft³/min	Aerosol Rem...	Elemental I R...	Organic I Re...
%			%	%
0.0	2000.0	0.0	0.0	0.0
0.0333	570.0	0.0	0.0	0.0
720.0	570.0	0.0	0.0	0.0

CR_recirc_flow

Time h	Flow Rate ft³/min	Aerosol Rem...	Elemental I R...	Organic I Re...
%			%	%
0.0	0.0	0.0	0.0	0.0
0.0333	1250.0	95.0	95.0	95.0
720.0	1250.0	95.0	95.0	95.0

CR_filtered_inflow

Time h	Flow Rate ft³/min	Aerosol Rem...	Elemental I R...	Organic I Re...
%			%	%
0.0	0.0	0.0	0.0	0.0
0.0333	550.0	95.0	95.0	95.0
720.0	550.0	95.0	95.0	95.0

Step 4: CR Emergency Mode (cont.)

- Select the CR_filtered_inflow pathway and press the select (S) icon under filter and select CR_filtered_inflow filter.
- Do the same for the CR compartment, as shown below:

The image shows two overlapping windows from a software interface. The background window is titled 'Compartment 3 (Control Room)' and has a 'General' tab. It contains several fields: 'Name' (Control Room), 'Component Number' (3), 'Description' (<none>), 'Type' (Control Room Dose), 'Output Detail Level' (Full Edit at Time Steps), 'Volume' (1.0E5 (ft³)), 'Filter' (Filter 3 (CR_recirc_flow)), and 'Dose Locations' (1 Dose Location connection). The 'Filter' field has a blue 'S' icon next to it. Overlaid on top of this is a 'Select from Filters' dialog box. It has a title bar with a close button. Inside, there's a section 'Available Components' with a table listing four filters: 1 Filter 1 (CR_unfiltered_inflow), 2 Filter 2 (CR_to_envirion), 3 Filter 3 (CR_recirc_flow) (which is highlighted), and 4 Filter 4 (CR_filtered_inflow). Below the table are 'None' and 'Create' buttons. At the bottom of the dialog are 'OK' and 'Cancel' buttons.

Number	Component
1	Filter 1 (CR_unfiltered_inflow)
2	Filter 2 (CR_to_envirion)
3	Filter 3 (CR_recirc_flow)
4	Filter 4 (CR_filtered_inflow)

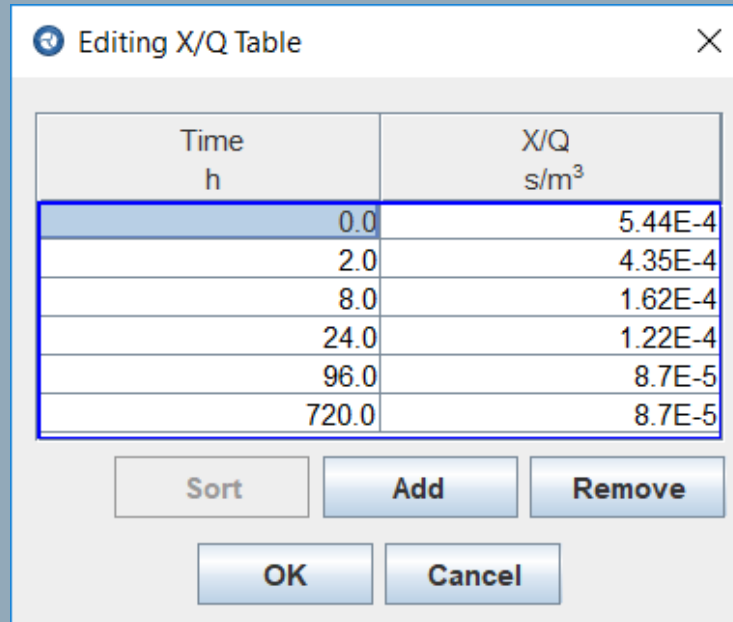
- At the environment compartment, expand the Onsite X/Q Tables and select the Control Room X/Q table as shown to the right.

The image shows a window titled 'Onsite X/Q Table Map'. It has a table with three columns. The first column is labeled '↓ Pathways →'. The second and third columns are under a green header 'Intake from Environment'. The second column is '[2] CR_unfiltered_inflow' and the third is '[4] CR_filtered_inflow'. There are three rows of data: '[1] Leak to Environment' with values 'X/Q Table 3 (Control Room..' and 'X/Q Table 3 (Control Room..'; '[3] CR_to_envirion' with empty cells; and a fourth empty row. On the left side of the table, there is a vertical green bar with the text 'Release to Environ...'. At the bottom of the window are 'Help', 'OK', and 'Cancel' buttons.

	Intake from Environment	
↓ Pathways →	[2] CR_unfiltered_inflow	[4] CR_filtered_inflow
[1] Leak to Environment	X/Q Table 3 (Control Room..	X/Q Table 3 (Control Room..
[3] CR_to_envirion		

Step 4: CR Emergency Mode (cont.)

- Expand the X/Q Tables in the Navigator Window and select the Control Room X/Q Table.
- If the ExerciseData spreadsheet is provided, copy and paste the values into the table, otherwise enter them manually as shown in the image below.

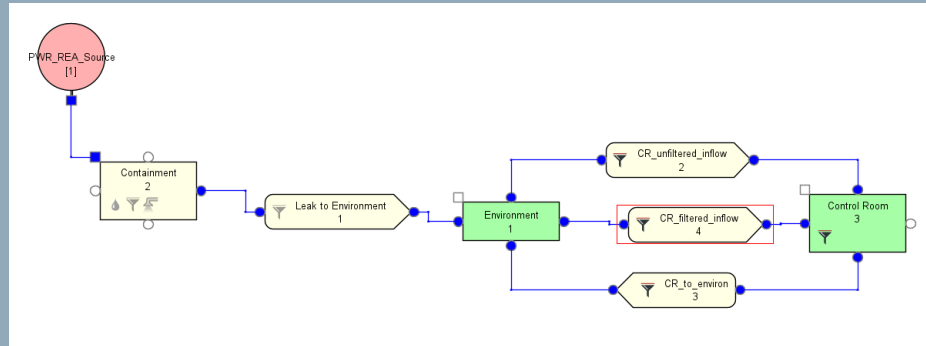


The image shows a software window titled "Editing X/Q Table" with a close button (X) in the top right corner. Inside the window is a table with two columns: "Time h" and "X/Q s/m³". The table contains six rows of data. Below the table are three buttons: "Sort", "Add", and "Remove". At the bottom of the window are two buttons: "OK" and "Cancel".

Time h	X/Q s/m³
0.0	5.44E-4
2.0	4.35E-4
8.0	1.62E-4
24.0	1.22E-4
96.0	8.7E-5
720.0	8.7E-5

Step 5: Running the Simulation

- Check the model in your View Window against the image below, paying attention to the connections and which components have filters:



- If it looks the same, try running the simulation as we did in Exercise 1 and 2
- Check the results of the simulation against the values to the right:

```
#####
Worst Two-Hour Doses
#####

Exclusion Area Boundary
  Time      Whole Body    Thyroid      TEDE
  (hr)      (rem)         (rem)        (rem)
  0.0-2.0   9.1106e-02     2.0840e+01   8.6876e-01

#####
Final Doses
#####

Low Population Zone
  Time      Whole Body    Thyroid      TEDE
  (hr)      (rem)         (rem)        (rem)
  720.0     7.3207e-02     3.4435e+01   1.4817e+00

Control Room
  Time      Whole Body    Thyroid      TEDE
  (hr)      (rem)         (rem)        (rem)
  720.0     7.1217e-03     2.0504e+01   8.7598e-01

=====
```