



Health Canada

EMRAS II Working Group 1

Scenario A Version 2

Canada Models: IMPACT, CSA Standard N288.1

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The Scenario

- Based on data from Sizewell, UK
 - Includes information about the site, as well as habits information for near by residents
- Additional parameters selected from a variety of sources
 - Parameter values chosen from IAEA technical documents, ICRP documents, CSA documents, or recommended by the participants in a previous Working Group 1 meeting
- By providing an extensive list of parameters, each participant should be modelling the identical scenario. This allows us to directly compare the models through the results.

The Scenario

- Includes an atmospheric release of Co-60, Cs-137, I-131, and Kr-85 at a rate of 1 TBq/a
- Includes a marine release of Co-60, Cs-137, and Sr-90 at a rate of 1 TBq/a
- Includes a cattle/sheep farm at a distance of 1 km from the source
- Includes a fishing location at 300 m distance from the source
- Includes a population living at 300 m distance from the source who ingest local beef, sheep, milk, fish, crustaceans, and molluscs

Canadian Models

- Canadian Standard Association (CSA) Document N288.1
 - Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities (2008)
 - Used in this exercise as guidance material
- Integrated Model for the Probabilistic Assessment of Contaminant Transport (IMPACT)
 - Based on the guidance of N288.1
 - Used by nuclear industry professionals in Canada to model the effects of routine releases
 - Used in this exercise to model the scenario

Scenario Set-Up





Release Site Set-Up

Land Polygon: Land 1

Edit Source Air plume Air Soli Underground water Plant Animal Human Monitor Alias Transmogrify Rename



Atmospheric release of Co-60, Cs-137, I-131, Kr-85

🔄 Water Polygon: Water 1

Edit Source Waterplume Air Waterbodies Sediment Plant Animal Monitor Alias Transmografy Rename

Marine release of Co-60, Cs-137, Sr-90



Land 2 Set-Up

Cattle/sheep farming location

Land Polygon: Land 2



Water 2 Set-Up

Fish, crustacean, and mollusc location



Land 3 Set-Up



Domestic farming (green vegetables, root vegetables, domestic fruits), residential location

Receptor considered to be an adult

IMPACT Database

Database allows the user to change many parameter, use all the values dictated by Scenario A Version 2

Sitmap file	name:	C: VProgram Fr	les\EcoMetrix Inc\IMPA	CT_DRL\/cons\adult.b	πp				
arameter Name			Unit Value	Reference	Contraction (Sec.)	Note			
Inhalation			m3/a 6400	DRL Guidance, 20	08	Table 4.15 - 95th percentile			
Fraction OF Time At Location Water Ingestion Soll Ingestion			0 1			1			
			L/a 839.5	DRL Guidance, 20	08	Iw; Table 4.17 - US EPA 90			
			kg/day 0.00033	DRL Guidance, 20	08	Is ; Table 4.16 - 95th percer	ercer		
edment Ingestion		kg/day 0.00033	DRL Guidance, 20	08	Is ; Table 4.16 - 95th percer 😜				
Contaminant	Unit	Value	Reference		Note				
Ac-225dd	Sv/Bq	0	Not in DRL Guidance	•	A Constant and				
Ac-228dd	Sv/Bq	0	Not in DRL Guidance	e					
Ag-110m	Sv/Bq	2.800E-09	DRL Guidance, 200	8	Table C2				
Am-241	Sv/Bq	2.000E-07	DRL Guidance, 200	8	Table C2				
Am-241d	Sv/Bq	2.000E-07	DRL Guidance, 200	6	Table C2				
An-243	Sv/Bq	2.000E-07	DRL Guidance, 200	8	Table C2				
Ar-41	Sv/Bq	0	Not in DRL Guidance	•					
As-76	Sv/Bq	1.600E-09	DRL Guidance, 200	6	Table C2				
6a-137md	Sv/Bq	0	Not in DRL Guidand	*					
68-140	Sv/Bq	2.600E-09	CRL Guidance, 200	8	Table C2				
00-7 8x.82	SV/BQ	2.000E-11	DRL Guidance, 200	0 A	Table C2				
C-14	Sullas	5.9006-10	DRI Gadance, 200	0 8	Table C2				
C-14/Methane)	Sylles	0	Not in DRI Guidau	*	10000 546				
C-14(par)	SviBo	5.800E-10	DRL Guidance, 200	8	Table C2				
Ce-141	Sv/Ba	7.100E-10	DRL Guidance, 200	8	Table C2				
Ce-143	Sv/Ba	1.100E-09	DRL Guidance, 200	6	Table C2				
Ce-144	Sv/Bq	5.200E-09	DRL Guidance, 200	8	Table C2				
CI-36	Sv/Bq	9.300E-10	DRL Guidance, 200	8	Table C2				
Cm-242	Sv/Bq	1.200E-08	DRL Guidance, 200	6	Table C2				
Cm-244	Sv/Bq	1.200E-07	DRL Guidance, 200	6	Table C2				
	Sv/Bq	7.400E-10	DRL Guidance, 200	8	Table C2				
Co-58	Sv/Bq	3.400E-09	DRL Guidance, 200	6	Table C2				
Co-58 Co-60	C. Ba	3.800E-11	DRL Guidance, 200	6	Table C2				
Co-58 Co-60 Cr-51	34/04		DRL Guidance, 200	8	Table C2				
Co-58 Co-60 Cr-51 Cs-134	Sv/Bq	1.900E-08							

Original Results

- Both atmospheric and marine results considered
- Huge variations in marine results
- Atmospheric results more consistent, but Canadian results were several orders of magnitude too high compared to other countries
- Traced problem to the concentration in air which was much higher for Canada compared to other countries
 - 1.105 Bq·m⁻³ compared to \sim 7.2 x 10⁻² Bq·m⁻³ in most other results
- Must be errors with the dispersion modelling
 - To fix this used trial and error, removed source blocks and used dictated sources (allow us to dictate air concentration) with air concentrations calculated using IAEA SRS-19, tried using a ratio (our air concentration to the expected concentration) as a correction factor

Atmospheric Results Co-60



Atmospheric Results Cs-137



Atmospheric Results I-131



Atmospheric Results Kr-85



Kr-85 results are similar due to only two pathways, cloudshine and direct radiation

Marine Results Co-60



Marine Results Cs-137



Marine Results Sr-90



Problems

- Still problems with Canadian scenario
 - Atmospheric results are too high
 - Marine results are too low, however no consistent results between the participants to compare it to

Addressed the atmospheric problems first:

 Looked at the pathways individually, those with the largest dose (contributing the most to the high Canadian results) were calculated by hand using CSA standard N288.1 to see if we could make the results appear to fit better with the international results

Pathway Results N288.1 Co-60



Pathway Results N288.1 Cs-137



Pathway Results N288.1 I-131



Scenario Rebuilt

- We decided to rebuild the scenario using IMPACT starting from scratch
 - Used dictated sources
 - Both Atmospheric and Marine scenarios
 - Worked through IMPACT database to ensure all parameters are set to the Scenario A Version 2 description provided
- Worked with the developers from EcoMetrix to uncover problems
 - Ex. We needed to set washout ratio to zero, we were modelling a sudden large deposition
- Results appear to be relatively similar to other participants



Land 2

Cattle/sheep farming site



Water 1

Fish, crustacean, and mollusc site



Land 2



Atmospheric Results Co-60



Atmospheric Results Cs-137



Atmospheric Results I-131



Marine Results Co-60



Marine Results Cs-137



Marine Results Sr-90



Continuing Issues

- Missing expected dose from milk for I-131
- Dispersion modelling still needs to be understood
 - Currently using dictator sources which dictate a concentration in a media (i.e. Air, water)
 - Dispersion modelling is still needed to complete the scenario
- Aquatic portion of scenario needs further improvements

Summary graphs for improvements within IMPACT

Total dose rate Co-60



Total dose rate Cs-137



Total dose rate I-131



Dose rate from cloud immersion Kr-85



Concentration in air Kr-85



Including Laura's screening tool. Cs-137 (A)



Laura I-131 (A)







More on Marine results

- We need to fix more parameters for the marine results.
- Justin, Dejenaria, and Christophe commented on this.. (I printed out Christophe's comments before I left).
- I will give some results and his proposed parameters.

Co-60 (M)



Co-60 (M)



Cs-137(M)



Sr-90 (M)



Christophe Suggestions?

- Distance between the release point and the beach: 0m
- •
- Coastal current velocity: 1m.s-1
- •
- Suspended sediment load: 8e-5 t/m3
- Kd for suspended sediment:
- - Co: 600 L/kg
- Cs: 2700 L/kg
- - Sr: 130 L/kg
- •
- Modeling assumption for predicting concentration in aquatic food:
- Concentration in aquatic food = Concentration in water (with suspended sediments) * bioaccumulation factor.
- •

Concentration factors:

- - Co:
- o Fish: 700 L/kg
- o Crustacean: 20000 L/kg
- o Mollusc: 20000 L/kg
- - Cs:
- o Fish: 100 L/kg
- o Crustacean: 60 L/kg
- o Mollusc: 60 L/kg
- - Sr:
- o Fish: 3 L/kg
- o Crustacean: 10 L/kg
- o Mollusc: 10 L/kg

Any other parameters I missed?

• Justin???