



NETL



CNESTEN

# ASSESSMENT OF RADIOLOGICAL ACCIDENTAL RELEASE AT NETL AND CENM FACILITIES USING RSAC-6 CODE

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- **Population:** 29.891.708 inhabitants (2004)
- **Area:** 710, 850 square kilometers.



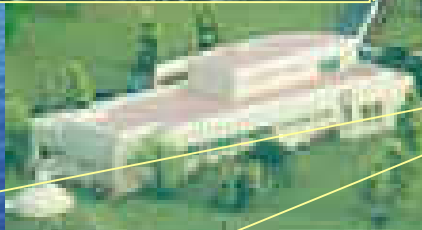
# CNESTEN missions

- Promotion of electro-nuclear project in Morocco,
- Promotion of nuclear technologies utilization in different socio-economic fields,
- Radio-isotopes production,
- Constituting a technical support of the State in term of nuclear and radiological safety.

# CENM presentation

- Training in reactor technologies and radiation protection,
- Fundamental and applied research,
- Radio-isotopes production (medicine, agronomy, industry, hydrology, mines, research,...etc),
- NAA, fluorescence X, spectrometry,
- Collect, treatment and storage of radioactive waste,
- Realization of safety studies.

# Nuclear Studies Centre at Maâmora (CENM)



# What is RSAC-6?

- Radiological Safety Analysis Computer Program,
- Developed by Idaho National Laboratory (INL),
- Calculates the consequences of a release of radionuclides to the atmosphere,
- Generates fission product inventory,
- Allows fractionation of the inventory,

# What is RSAC-6? (cont'd)

- Uses Gaussian plume diffusion for Pasquill-Gifford, Hilsmeier-Gifford, and Markee models,
- Calculates doses through inhalation, immersion, ground surface, and ingestion pathways, and cloud gamma dose.

# TRIGA MHA analysis

## 1. Source term

- MHA: a cladding rupture of one irradiated fuel element with no decay followed by release of fission products into the air.

	NETL	CENM
<b>Rate of total power generated in the highest power density fuel element</b>	<b>2.22%</b>	<b>1.7%</b>
<b>Fraction of fission product available for release</b>	<b><math>2,0 \cdot 10^{-5}</math></b>	<b><math>1,9 \cdot 10^{-5}</math></b>
<b>Fraction of available fission products release to reactor room:</b>		
<b>Noble gases</b>	<b>100%</b>	<b>100%</b>
<b>Halogens</b>	<b>100%</b>	<b>25%</b>

# TRIGA MHA analysis

## 2. Dispersion modeling: ventilation data

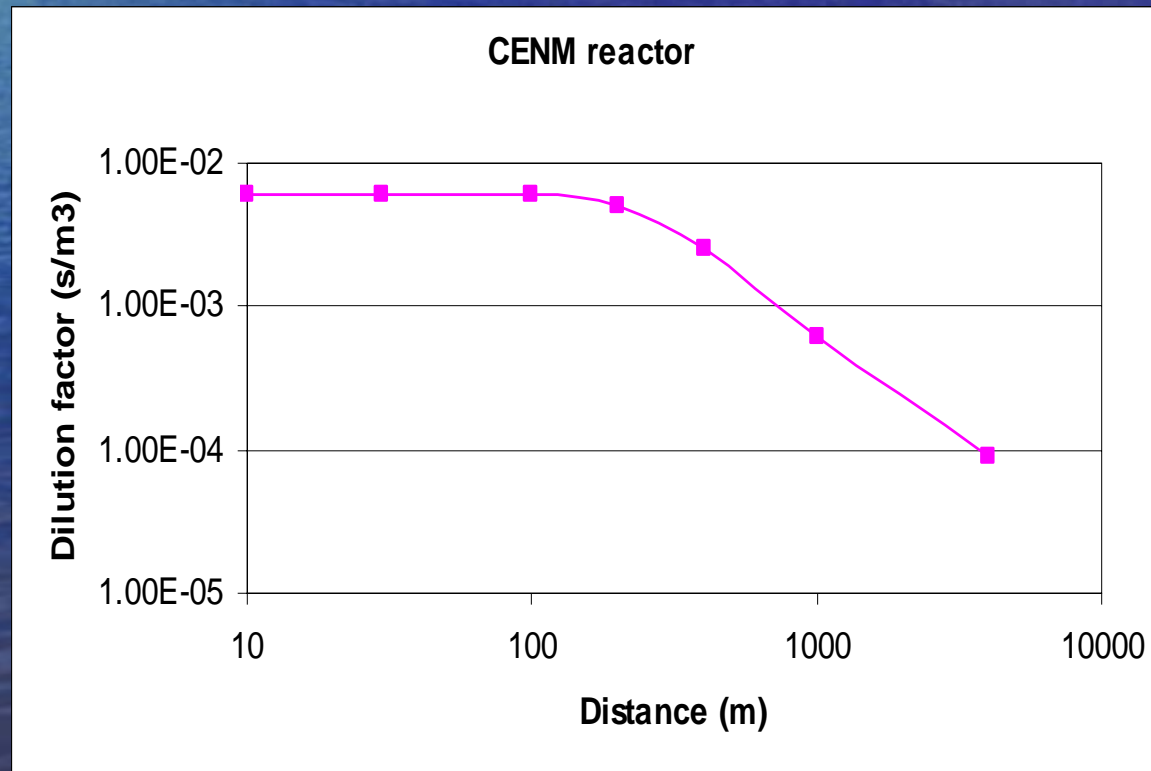
- Ventilation data

	NETL	CENM
<b>Ventilation change rate</b>	<b>10 change/h</b>	<b>0.5 change/h</b>
<b>Reactor room Volume</b>	<b>4290 m<sup>3</sup> 56.16 m*16.15 m</b>	<b>1632 (the top 4/5th is stagnant)</b>
<b>Width*height</b>		<b>39 m *21 m</b>

# TRIGA MHA analysis

## 2. Dispersion modeling: meteorological conditions

- The wind velocity: 1m/s
- Atmospheric dilution factor:
  - NETL: 0.0854s/m<sup>3</sup>,
  - CENM:



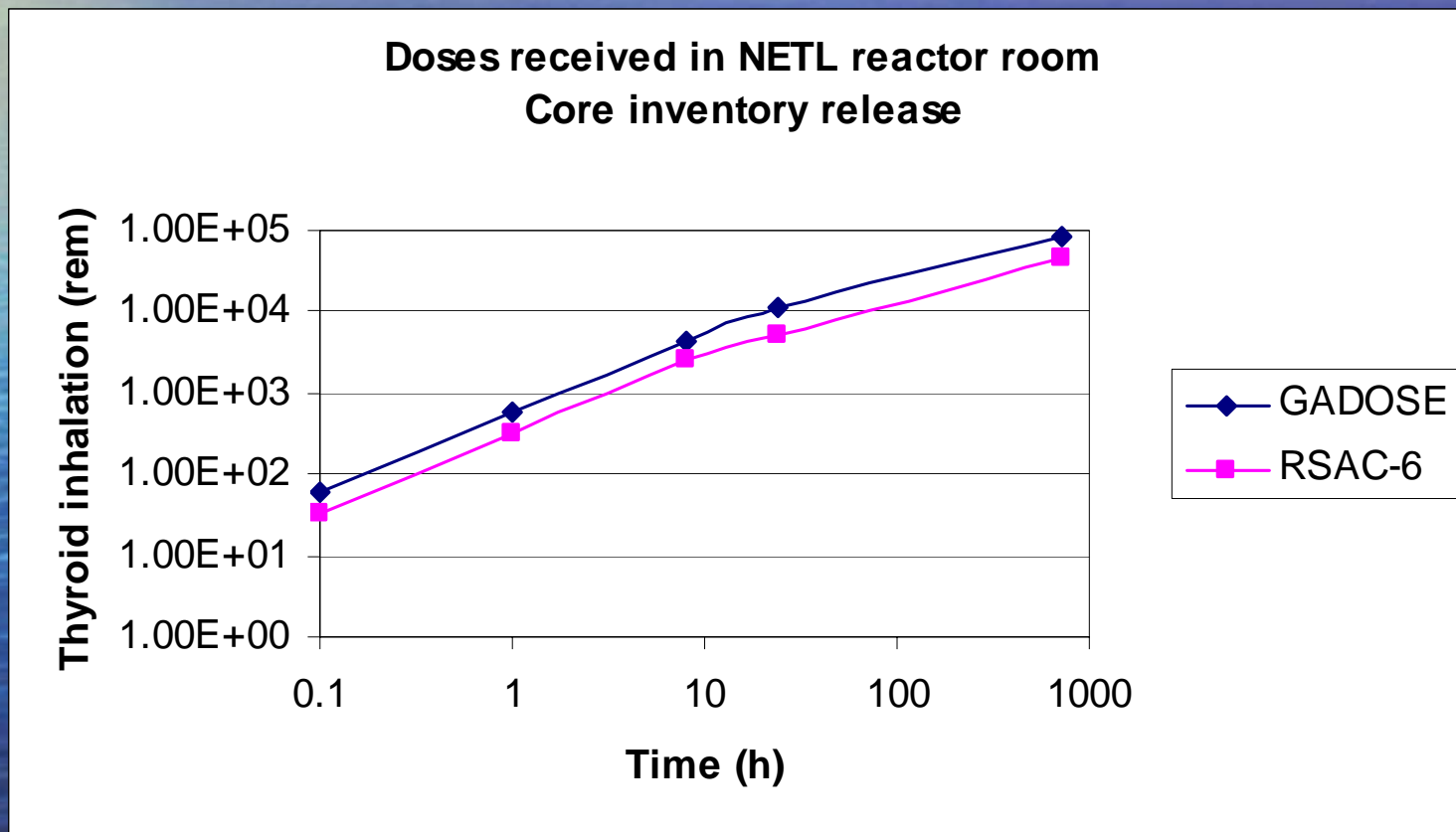
# TRIGA MHA analysis

## 2. Dispersion modeling: Breathing rates

<b>Time (h)</b>	<b>Breathing rate (m<sup>3</sup>/sec)</b>
<b>0 to 8</b>	<b>3,47 x 10<sup>-4</sup></b>
<b>8 to 24</b>	<b>1,75 x 10<sup>-4</sup></b>
<b>Over 24</b>	<b>2,32 x 10<sup>-4</sup></b>

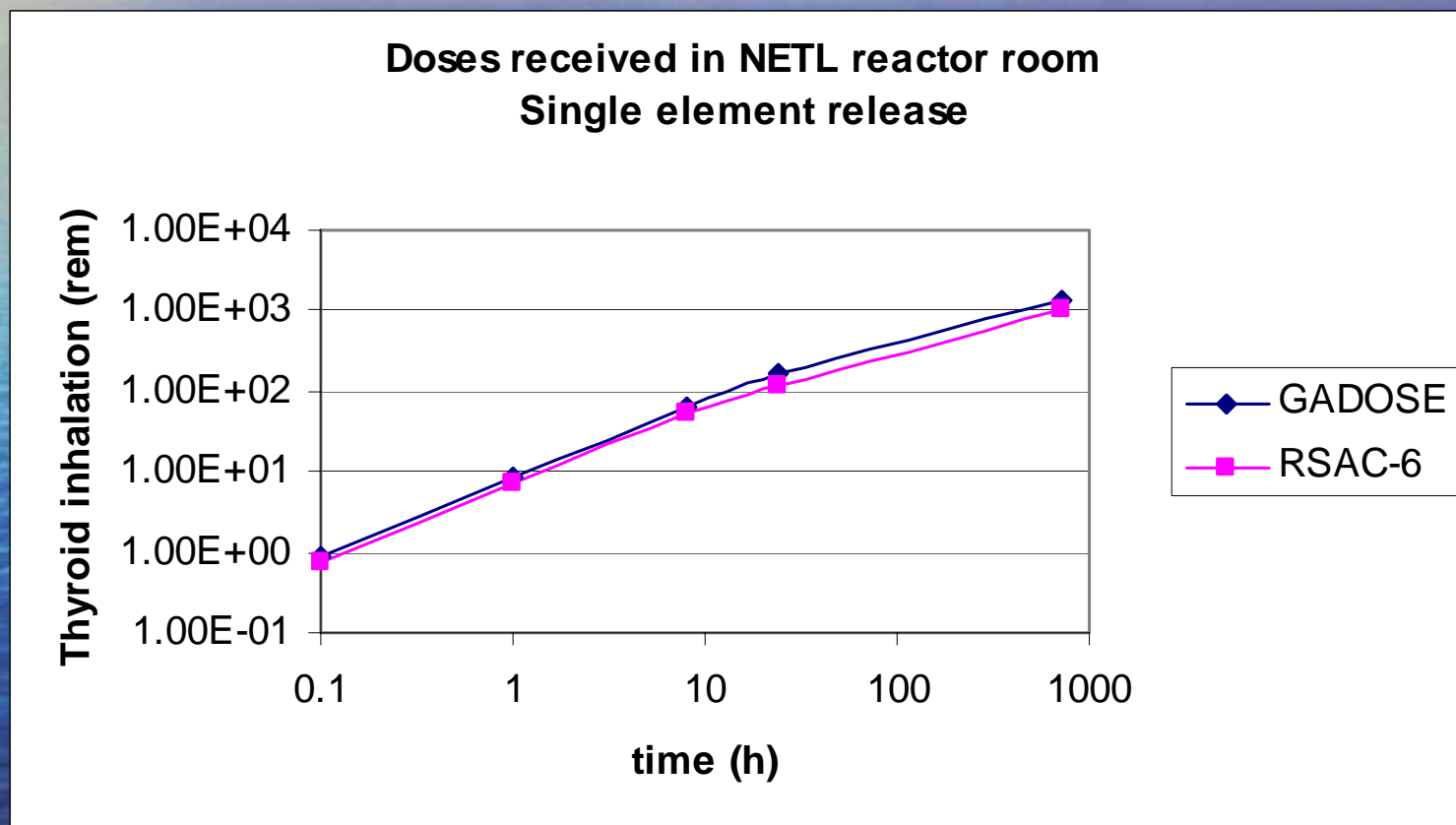
# TRIGA MHA analysis

## 3. Radiological impact assessment : NETL



# TRIGA MHA analysis

## 3. Radiological impact assessment : NETL



# TRIGA MHA analysis

## 3. Radiological impact assessment : NETL

Accident condition	Time after release (hours)	Doses received outside			
		Thyroid Inhalation		Cloud Gamma	
		GADOSE (rem)	RSAC-6 (rem)	GADOSE (rem)	RSAC-6 (rem)
Core inventory release	0.1	3.8	3.38	3.2E-2	3.71E-2
	1.0	6.0	3.38	4.5E-2	3.71E-2
	8.0	6.0	3.38	4.5E-2	3.71E-2
Single element release	0.1	5.6E-2	7.5E-2	4.7E-4	8.24E-4
	1.0	8.9E-2	7.49E-2	6.6E-4	8.24E-4
	8.0	8.9E-2	7.49E-2	6.6E-4	8.24E-4

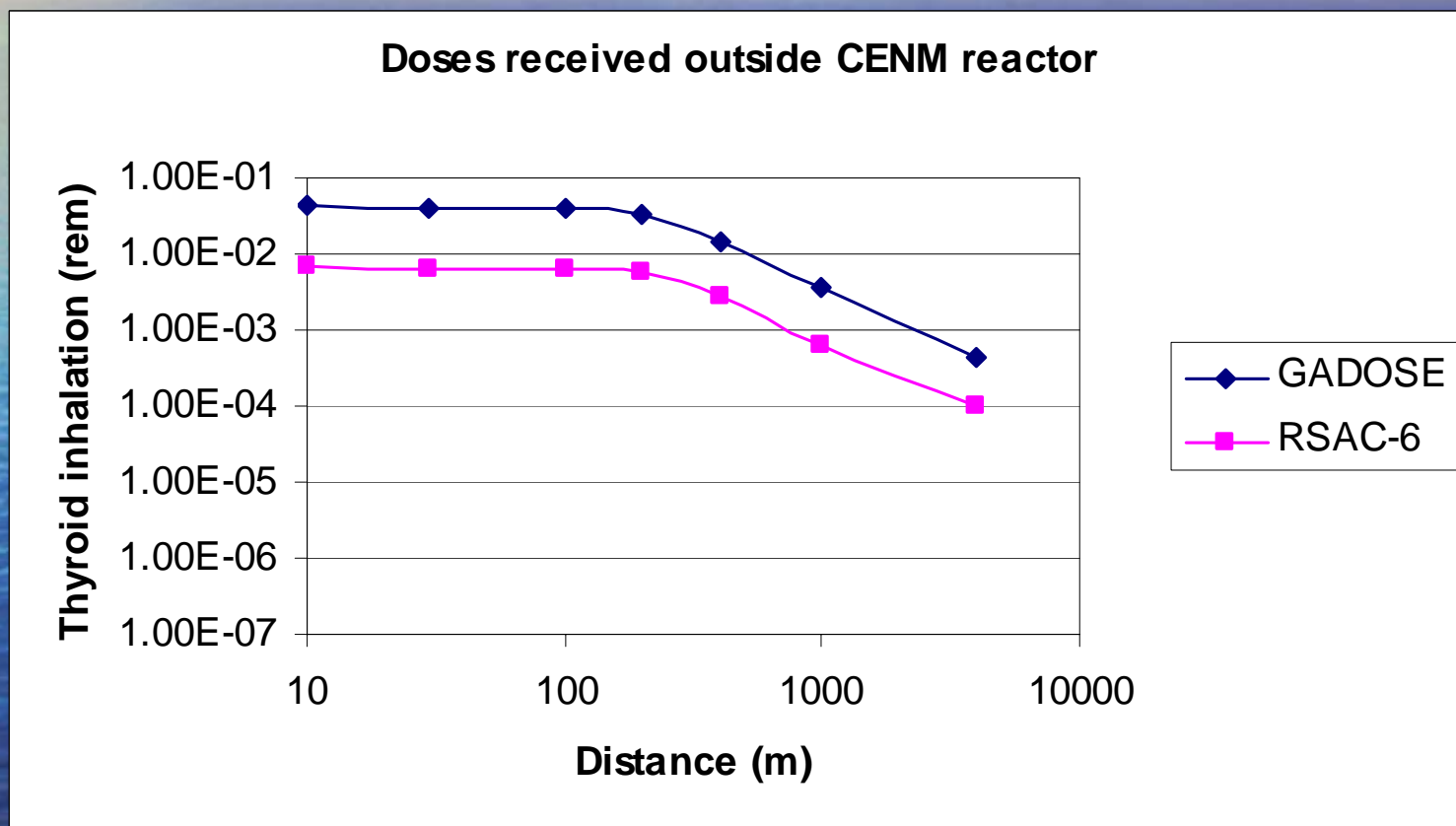
# TRIGA MHA analysis

## 3. Radiological impact assessment : CENM

Accident condition	Time after release (hours)	doses received in reactor room	
		Thyroid Inhalation	
		GADOSE (rem)	RSAC-6 (rem)
Single element release	2	44E+00	4.81E+00

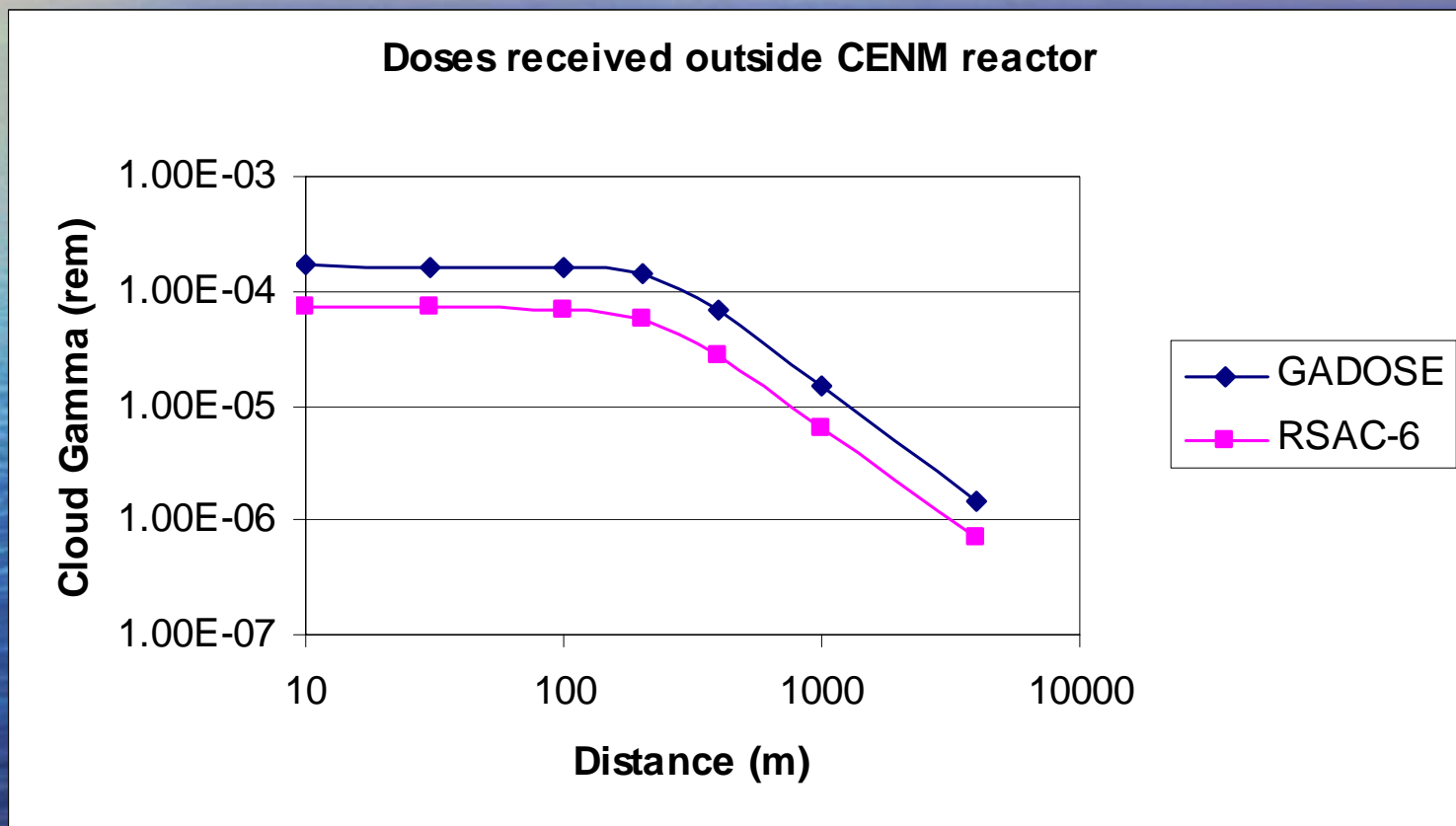
# TRIGA MHA analysis

## 3. Radiological impact assessment : CENM



# TRIGA MHA analysis

## 3. Radiological impact assessment : CENM



# BDA analysis for CENM facilities

## 1. Accident scenarios

<b>Reactor</b>	<b>Handling accident of one used fuel element with failure of ventilation and air filters</b>
<b>Laboratory</b>	<b>Generalized fire in the rear zone of iodine 131 preparation hot cells with failure of the ventilation and air filters.</b>
<b>Waste management building</b>	<b>Generalized fire in storage area of non conditioned compactable solid waste with failure of ventilation and air filters.</b>

# BDA analysis for CENM facilities

## 2. Input data

### Meteorological data

- Instantaneous release
- Average wind velocity: 27.7 m/s
- Weather class : neutral (D)
- Stack height: 0

### Breathing rate

$3,33 \times 10^{-4} \text{ m}^3/\text{s}$

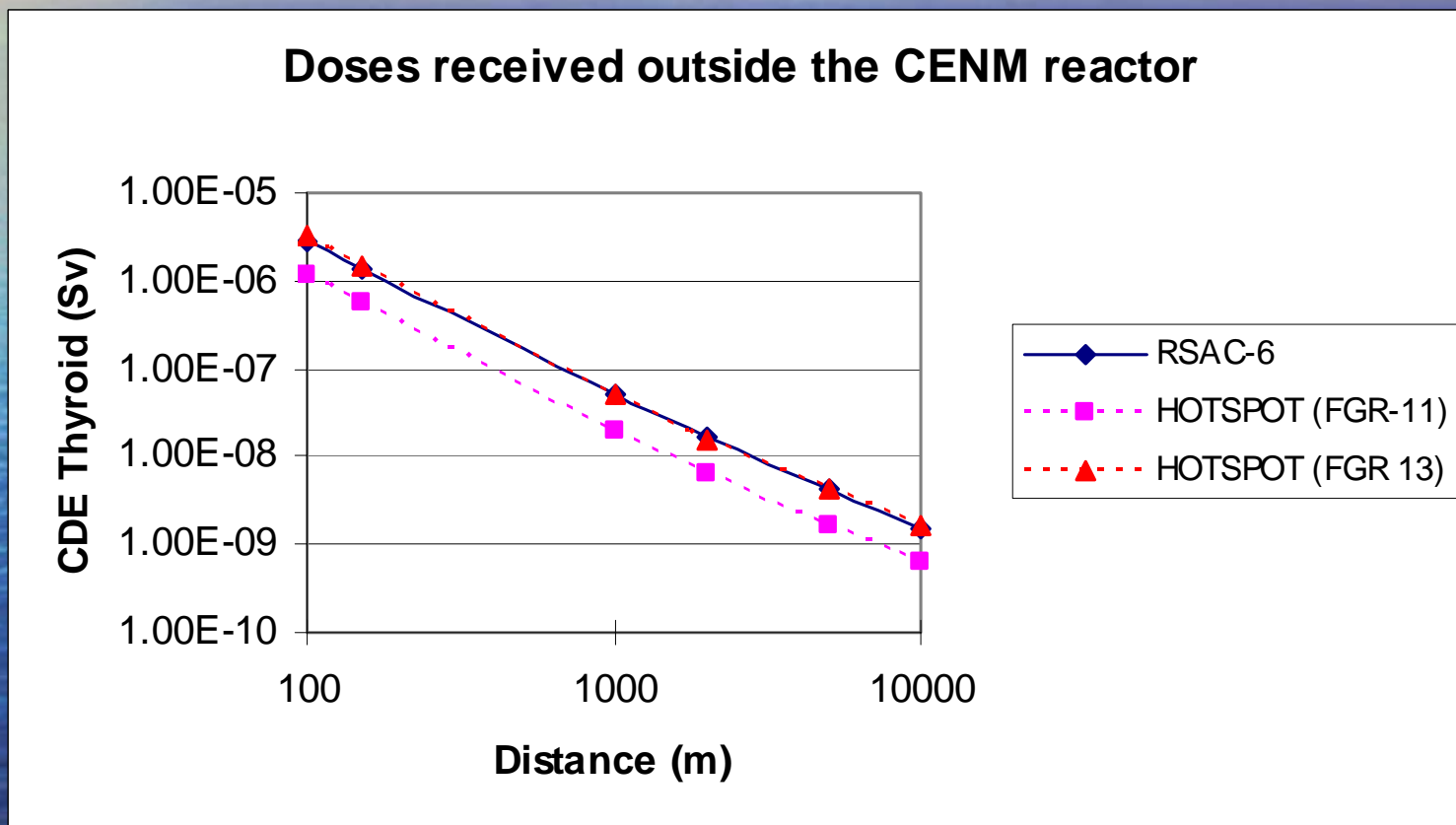
# BDA analysis for CENM facilities

## 2. Input data: Source term

<b>Building</b>	<b>Isotopes</b>
<b>Laboratory</b>	<b>I-131</b>
<b>Waste management</b>	<b>Co-60</b>
	<b>Cs-137</b>
<b>Reactor</b>	<b>Isotopes of I, Br, Kr &amp; Xe</b>

# BDA analysis for CENM facilities

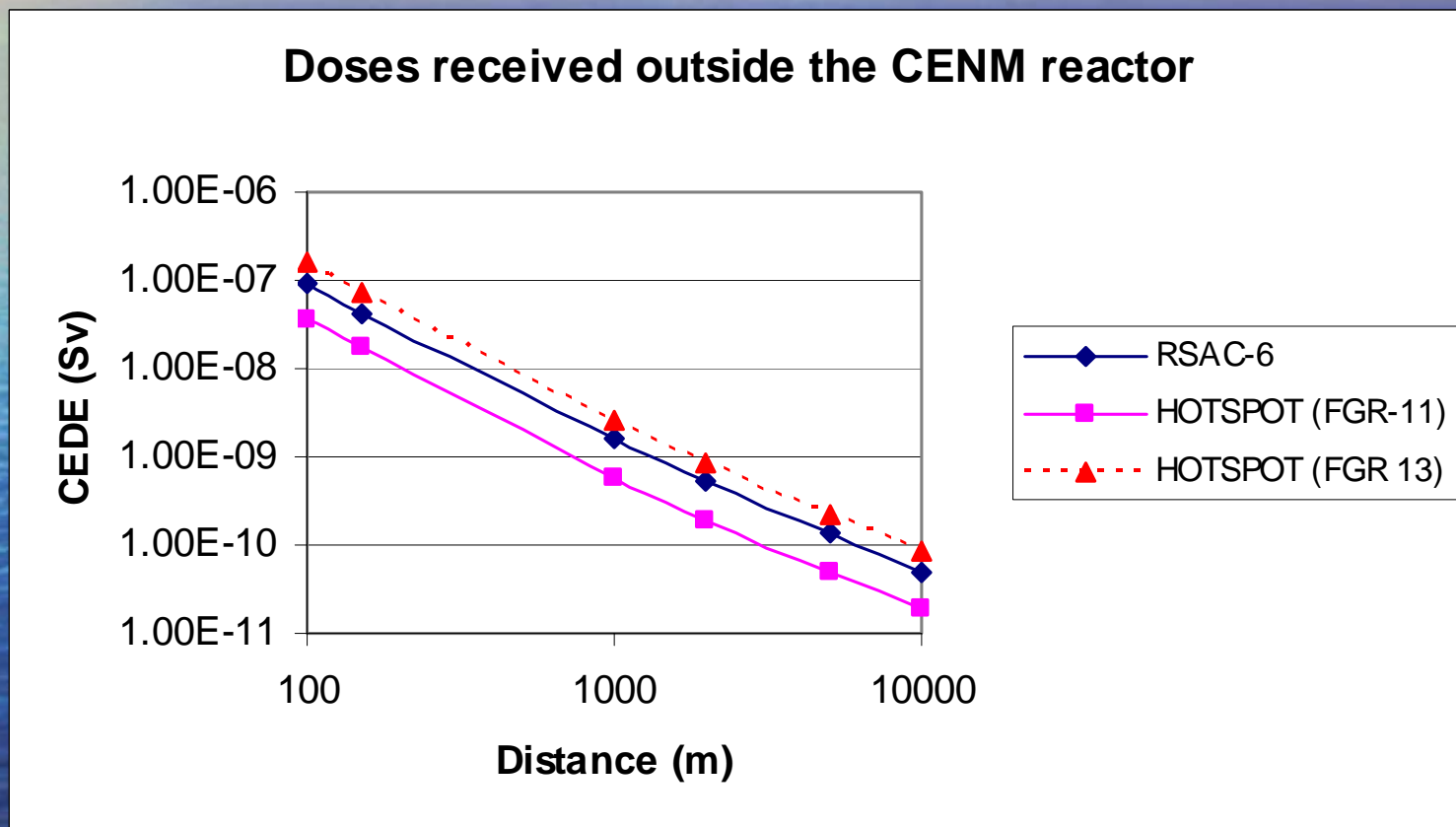
## 3. Risk assessment : Reactor



CDE Thyroid

# BDA analysis for CENM facilities

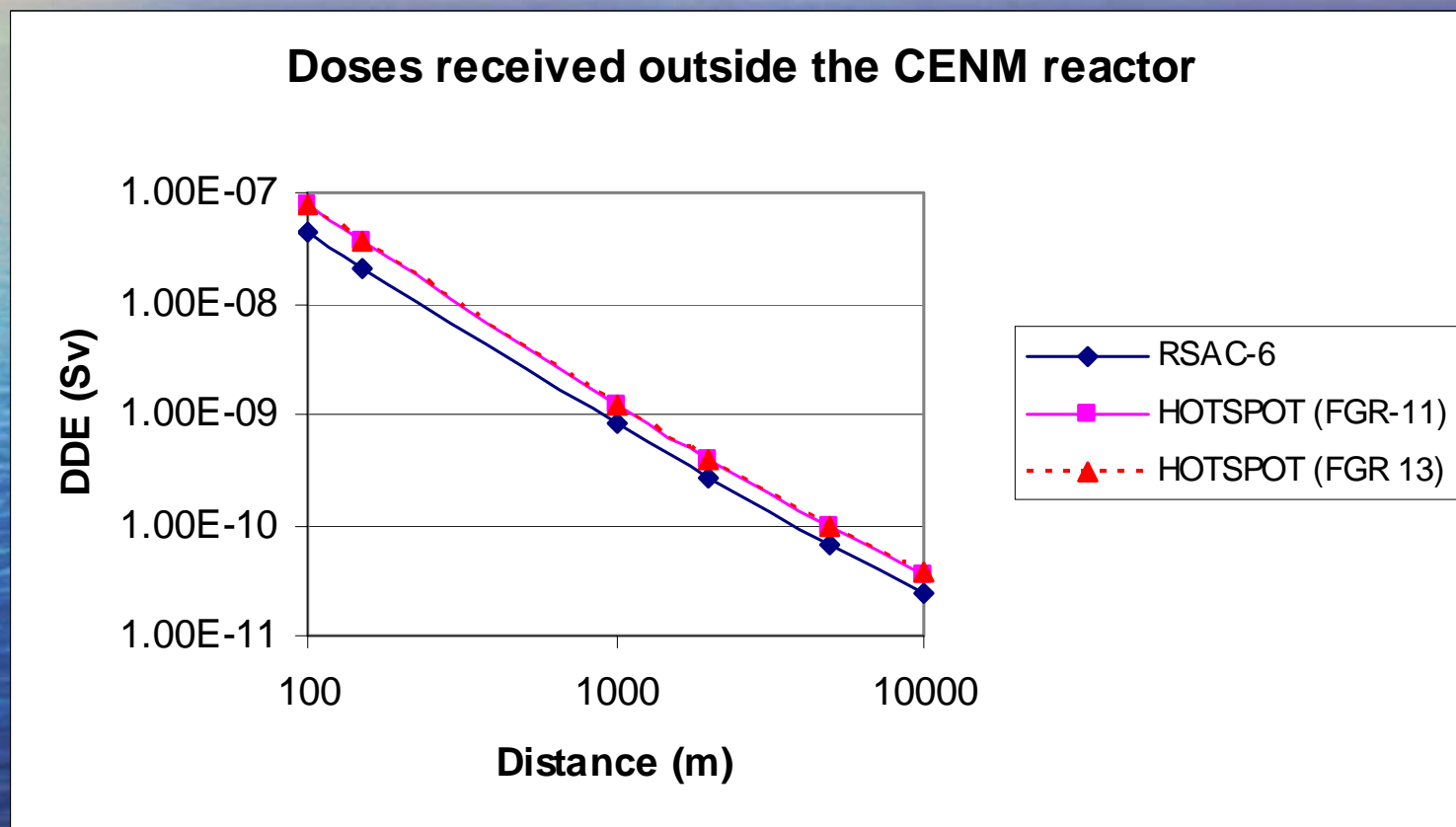
## 3. Risk assessment : Reactor



CEDE

# BDA analysis for CENM facilities

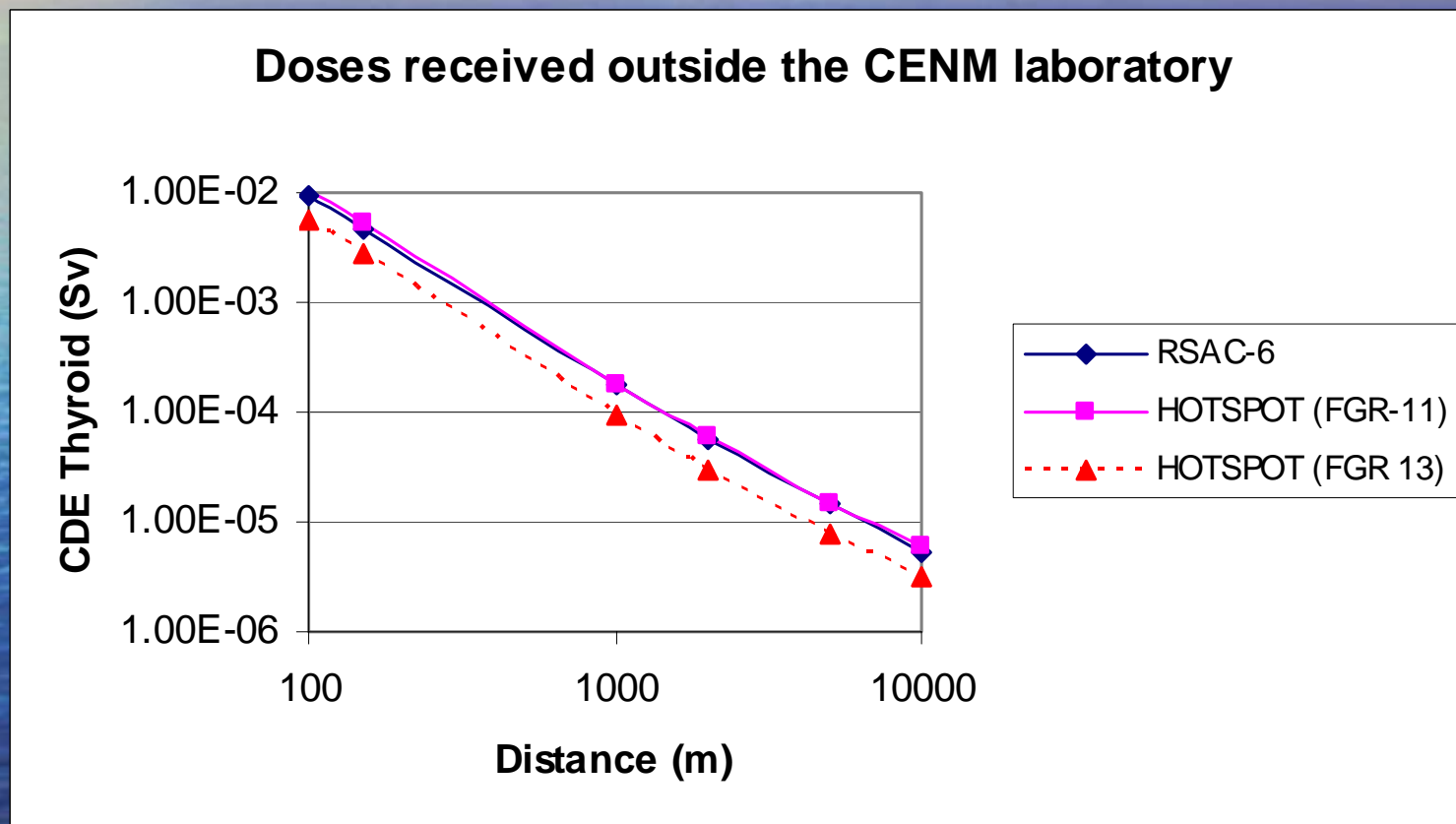
## 3. Risk assessment : Reactor



DDE

# BDA analysis for CENM facilities

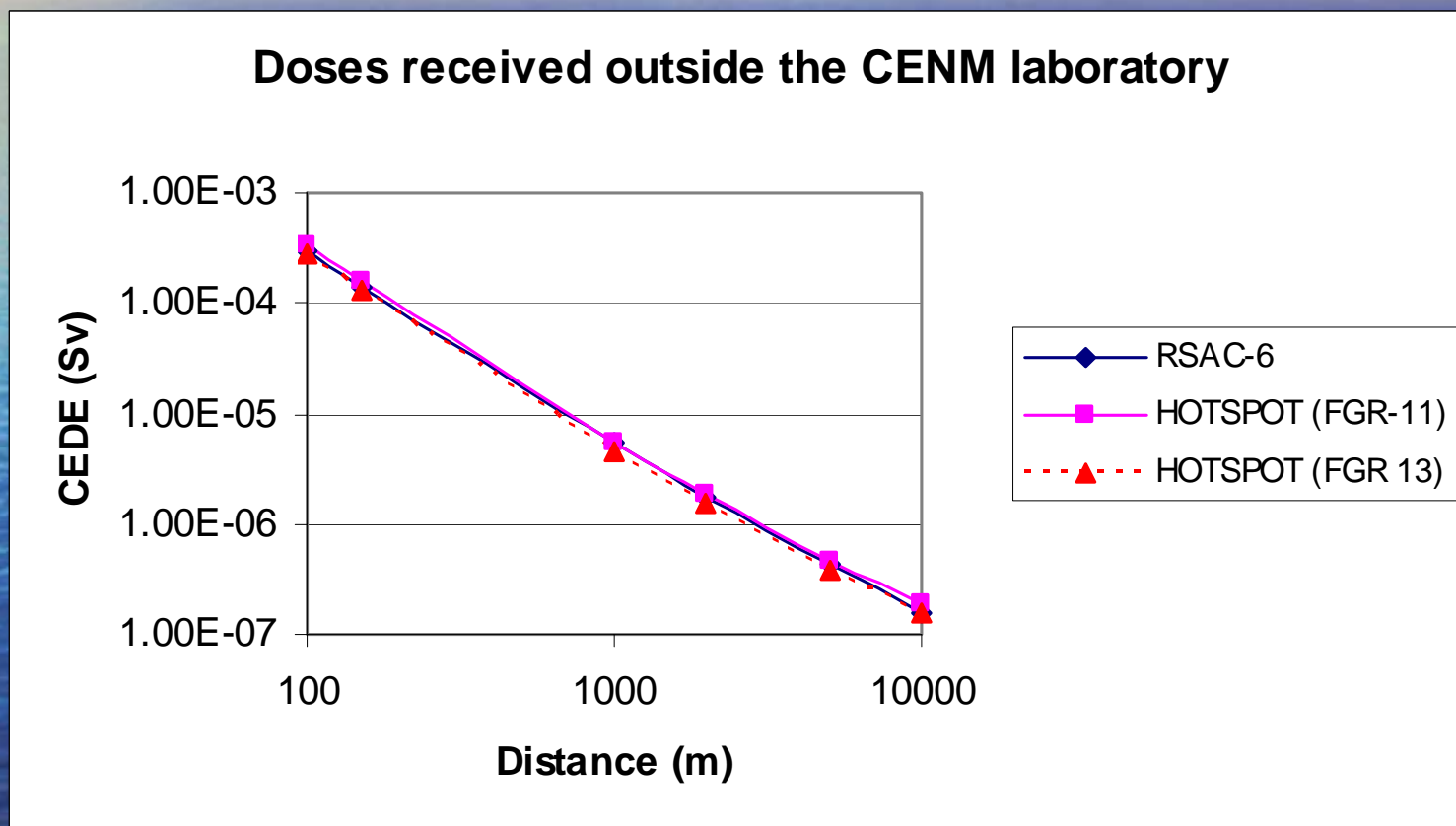
## 3. Risk assessment : Laboratory



CDE Thyroid

# BDA analysis for CENM facilities

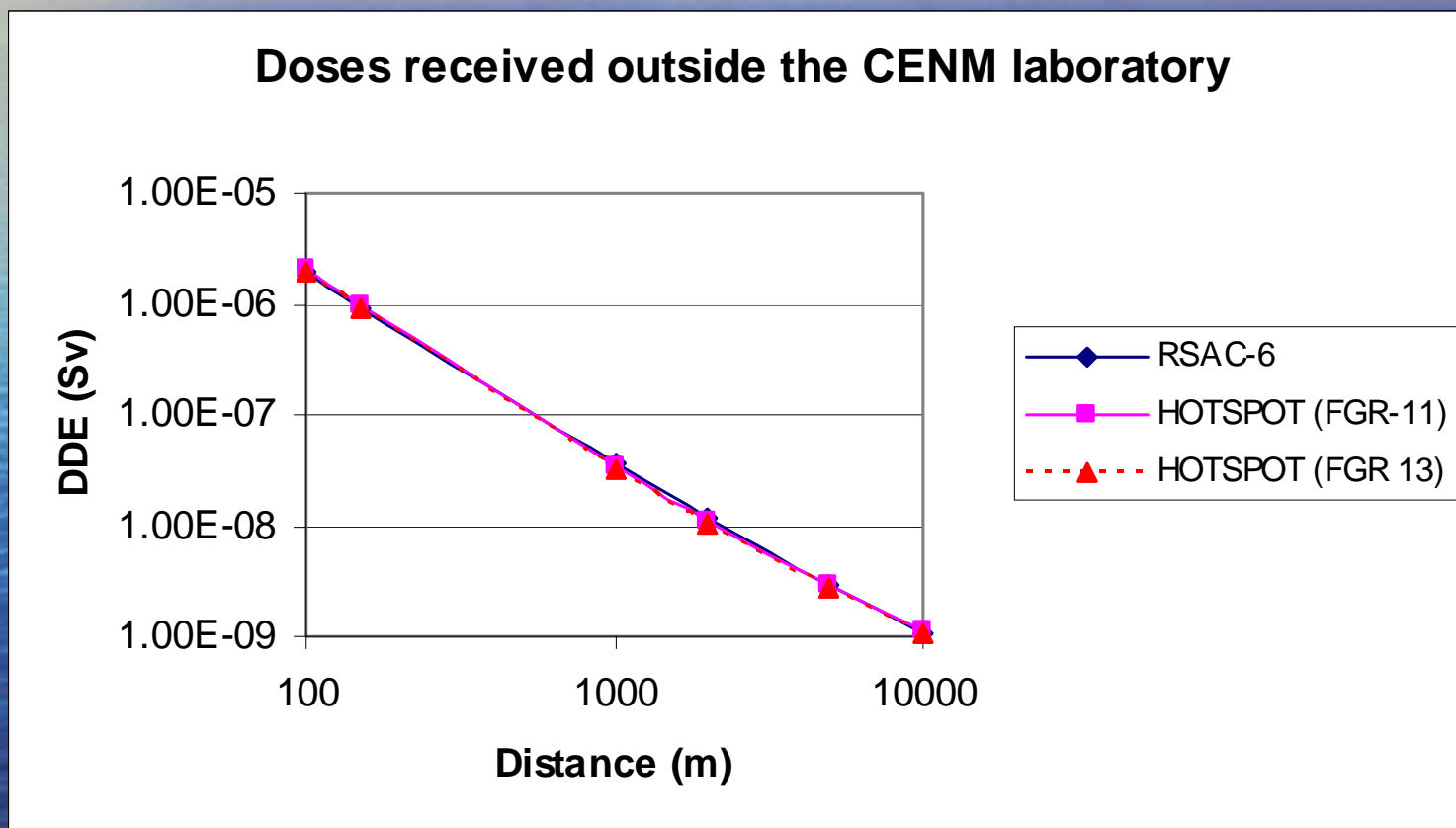
## 3. Risk assessment : Laboratory



CEDE

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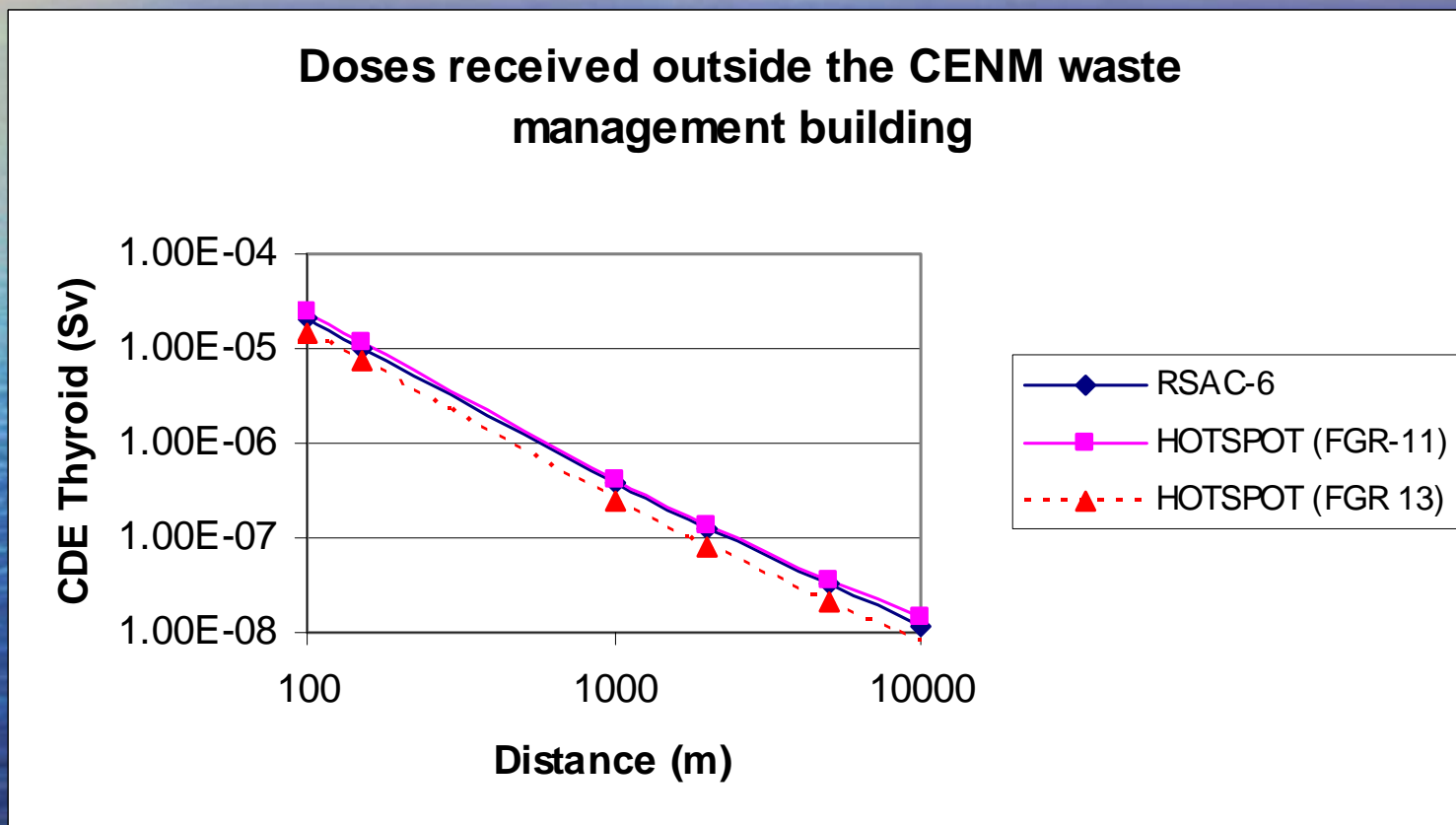
## 3. Risk assessment : Laboratory



DDE

# BDA analysis for CENM facilities

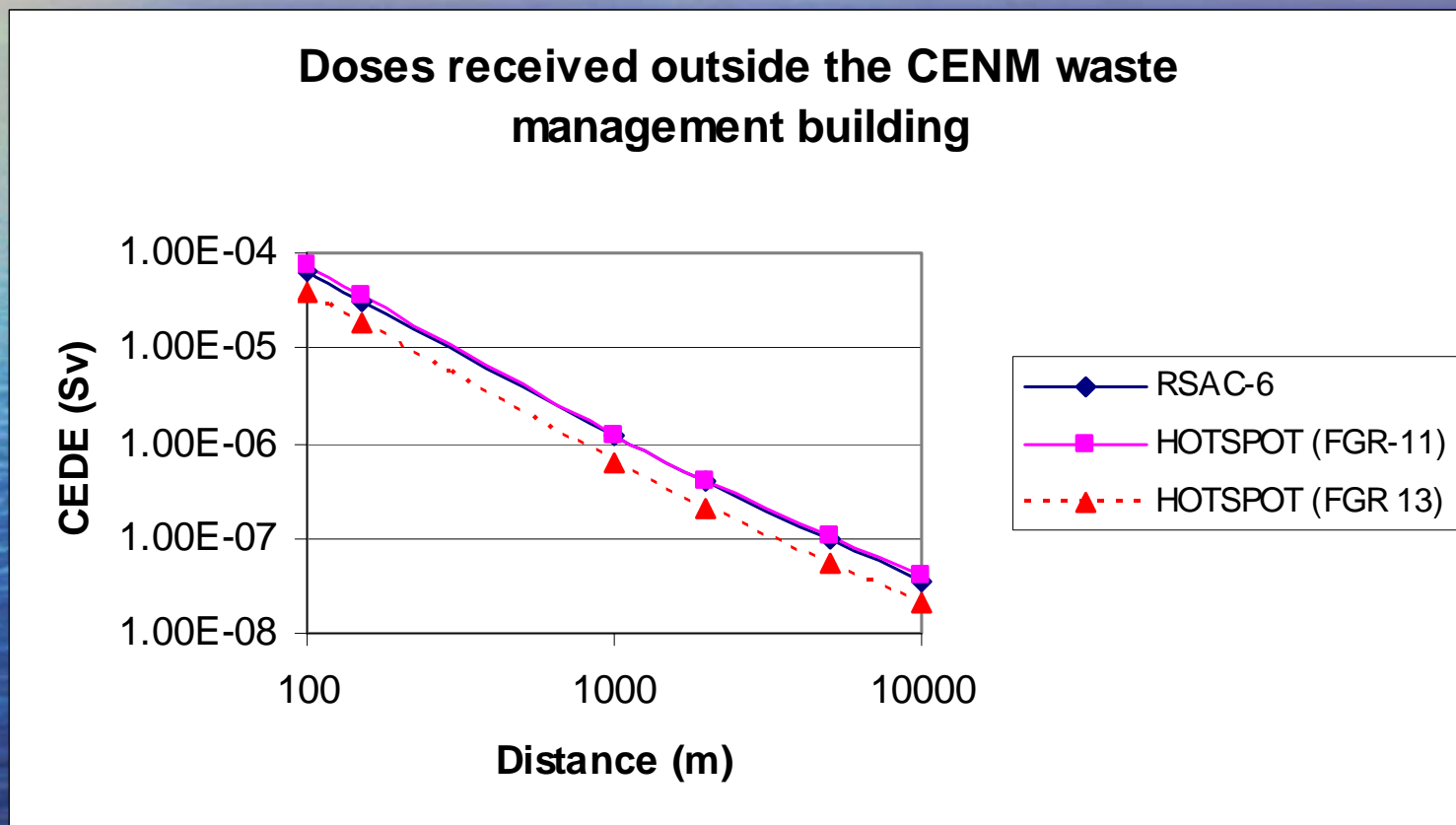
## 3. Risk assessment : Waste management building



CDE Thyroid

# BDA analysis for CENM facilities

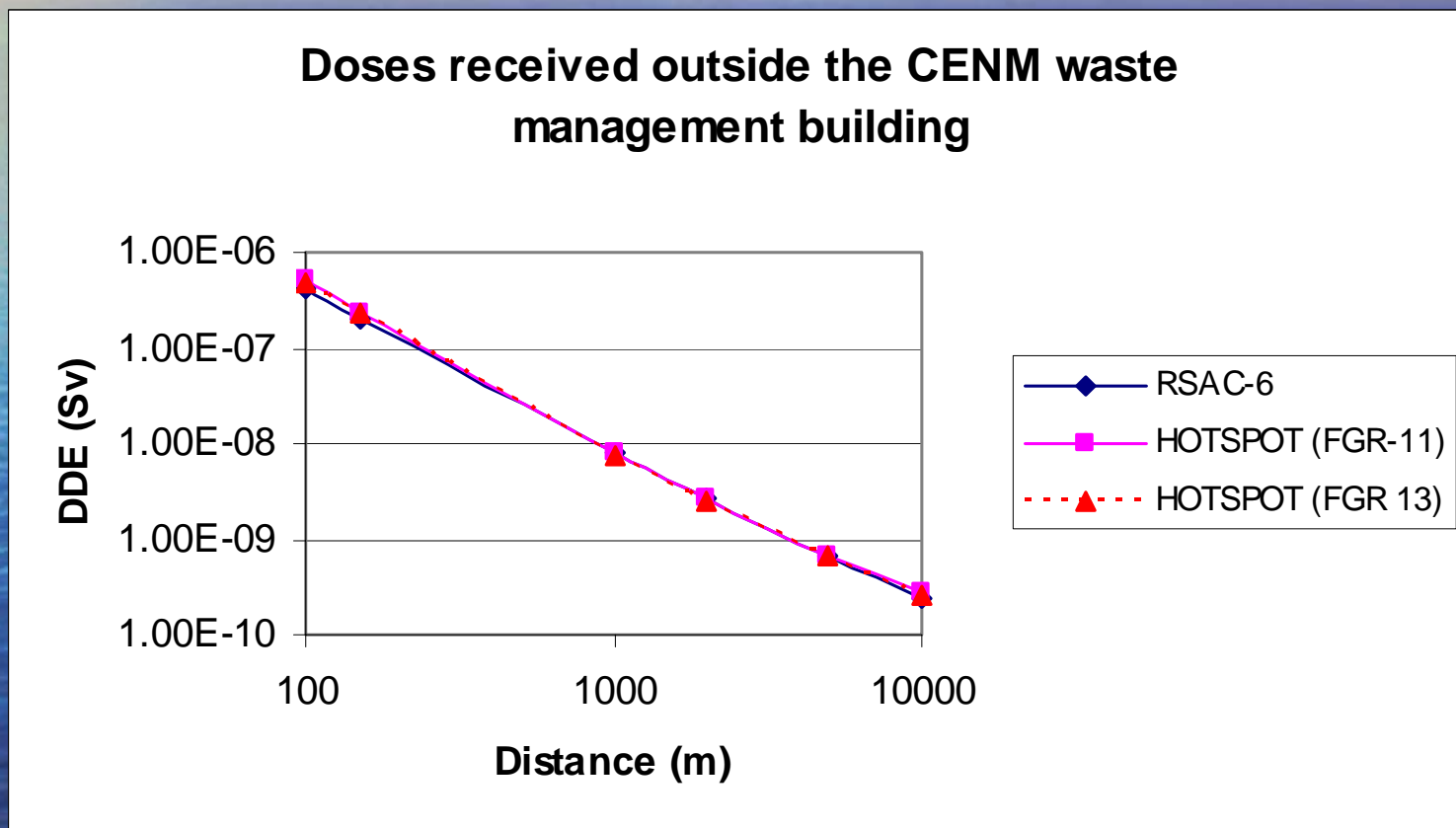
## 3. Risk assessment : Waste management building



CEDE

# BDA analysis for CENM facilities

## 3. Risk assessment : Waste management building



DDE

# Conclusion

## 1. TRIGA MHA analysis

- **NETL:** RSAC-6 results ensure dose carried out in the SAR and confirm the low radiological impact of MHA in TRIGA reactor (GADOSE results are a factor 2.1 higher than those of RSAC-6).
- **CENM:** RSAC-6 results are smaller (15%) than those presented in the SAR and confirm that MHA consequences are below Moroccan regulatory limits.
- The Difference between GADOSE and RSAC-6 results is due mainly to the difference between models and DCFs used by these codes.
- I-129 must be included in the fission inventory for both facilities.

# Conclusion (cont'd)

## 2. CENM BDA analysis

- Doses calculated by RSAC-6 are closer to those evaluated by HOTSPOT (the maximum fraction between them is about 2.5),
- Beyond design accidents considered for CENM facilities can not lead to unacceptable radiological consequences outside the CENM site.