



**International Atomic Energy Agency**

# **Harmonization of Energy Reserves/Resources Classification**

## **UNFC and IAEA/NEA Classifications Uranium**

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# IAEA/NEA Uranium Resources Classification

Decreasing economic attractiveness	\$ 130/kgU or more	REASONABLY ASSURED	ESTIMATED ADDITIONAL	ESTIMATED ADDITIONAL	SPECULATIVE RESOURCES	
		RESOURCES	RESOURCES I	RESOURCES II		
	\$ 80-130 /kgU	REASONABLY ASSURED	ESTIMATED ADDITIONAL	ESTIMATED ADDITIONAL		
		RESOURCES	RESOURCES I	RESOURCES II		
	\$ 40-80/kgU	REASONABLY ASSURED	ESTIMATED ADDITIONAL	ESTIMATED ADDITIONAL	SPECULATIVE RESOURCES	
		RESOURCES	RESOURCES I			
	\$ 40/kgU or less	REASONABLY ASSURED	ESTIMATED ADDITIONAL	RESOURCES II		
		RESOURCES	RESOURCES I			
	Decreasing confidence in estimates					



# Correlation of Terms used in Major Resources Classifications

- **NEA/IAEA**

RAR	EAR-I	EAR-II	SR
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- **Australia**

Reasonably Assured	Estimated Additional I	Undiscovered
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- **Canada**

Measured	Indicated	Inferred	Prognosticated	Speculative
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- **USA**

Reasonably Assured	Estimated Additional	Speculative
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- **Russian Federation**

A+B	C1	C2	P1	P2	P3
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# Resources Categories

- **Reasonably Assured Resources (RAR)**

**Known mineral deposits of delineated size, grade and configuration.**

**Estimates of tonnage and grade based on specific sample data and measurements.**

**Currently proven mining and processing technology.**

**High assurance of existence.**



# Resources Categories

- **Estimated Assured Resources – Category I (EAR-I)**

**Based on direct geological evidence, in extensions of well explored deposits.**

**Deposits in which geological continuity has been established, but where specific data and knowledge of the deposits' characteristics are considered in sufficient or inadequate to classify the resources as RAR.**

**Estimates of tonnage and grade based on available data and on knowledge of deposit characteristics as determined in the best known parts of the deposit.**



# Resources Categories

- **Estimated Assured Resources Category II (EAR-II)**

**Uranium that is expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralization with known deposits.**

**Estimates of tonnage, grade, cost of discovery, delineation and recovery are based primarily on knowledge of deposits characteristics in known deposits within respective trends or areas.**

# Resources Categories

- **Speculative Resources (SR)**

**Uranium that is thought to exist, mostly on the basis of indirect evidence and geological extrapolations.**

**Location of deposits specified as being somewhere within a given region or geological trend.**

**Existence and size of such resources are speculative.**



# Cost Categories

- **Cost categories are defined as:**

**US \$ 40 / kg U or less**

**US \$ 80 / kg U or less**

**US \$ 130 / kg U or less**

**Uranium Spot Price as of 14 April 2003: US \$ 10.10 / lb U<sub>3</sub>O<sub>8</sub>  
US \$ 26.26/ kg U**





# Cost Categories

- **Cost of production includes:**
  - \* **Direct cost of mining, transporting and processing the ore**
  - \* **Costs of associated environmental and waste management, during and after mining.**
  - \* **Costs of maintaining non-operating production units**
  - \* **Capital costs which remain un-amortised**
  - \* **Capital cost of providing new production units, including the cost of financing**
  - \* **Indirect costs such as overheads, taxes and royalties**
  - \* **Future exploration and development costs**

# Harmonization of Reserves/Resources Classification

UN International Framework		Detailed Exploration	General Exploration	Prospecting	Reconnaissance
	National System IAEA/NEA	Proven + Probable Measured + Indicated A+B+C1	Possible Inferred C2	Prognostic  P1	Speculative  P2+P3
Feasibility Study and/or Mining Report	RAR < 40/80 \$/kgU  RAR > 80 \$/kgU	111 Proved Mineral Reserve 211 Feasibility Mineral Resource	Usually	not	
Prefeasibility Study	EAR I < 40/80 \$/kgU  EAR I >80 \$/kgU	121 Probable Mineral Reserve  221 Prefeasibility Mineral Resource	122   222		relevant
Geological Study		RAR in situ 331  Measured Mineral Resource	EAR I in situ 332  Indicated Mineral Resource	EAR II 333  Inferred Mineral Resource	Speculative Resources 334  Reconnaissance Mineral Resource

## Correlation between UNFC, IAEA/NEA, National System Classifications

# Harmonization of Reserves/Resources Classification

- IAEA/NEA

RAR	EAR-I	EAR-II	S R
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- UNFC

< US \$ 40/kgU	111	121, 122	Usually not Relevant	
US \$ 40-80kgU	211	221, 222		
US \$ 80-130/kgU	311	321, 322		
< US\$ 130/kgU	331	332	333	334



# Harmonization of Reserves/Resources Classification

- **Terminology : CMMI Definitions**

**111 : Proved Mineral Reserve**

**121, 122 : Probable Mineral Reserve**

**211 : Feasibility Mineral Resource**

**221, 222 : Prefeasibility Mineral Resource**

**311 : Potentially Economic Feasibility Mineral Resource**

**321, 322 : Potentially Economic Prefeasibility Mineral Resource**

**331 : Measured Mineral Resource**

**332 : Indicated Mineral Resource**

**333 : Inferred Mineral Resource**

**334 : Reconnaissance Mineral Resource**



# Harmonization of Reserves/Resources Classification

## Application of UNFC to Uranium

**Advantage : Classification according to Geological knowledge and Economy**

**Already used by some countries: Hungary, Ukraine,**

**Will be included to the 2003 Red Book**

**Analysis of Reserves/Resources by Secretariat according to NEA/IAEA classifications**



# Harmonization of Reserves/Resources Classification

## Difficulties:

Country organizations don't have the personnel to apply the UNFC classification

Will have to rely on company reports

Some countries want to keep their own classification (Australia)

Some countries don't apply the IAEA/NEA classification (USA do no separate EAR-I and EAR-II)

Confidentiality of production costs.



# Uranium Resources (as of 1 January 2001)

(tonnes U)

	< US \$ 40/kg U	< US \$ 80/kgU	< US \$ 130/kgU
<b>RAR</b>	<b>&gt; 1 534 000</b>	<b>2 242 000</b>	<b>2 853 000</b>
<b>EAR-I</b>	<b>&gt; 552 000</b>	<b>865 000</b>	<b>1 080 000</b>
<b>Total</b>	<b>&gt; 2 086 000</b>	<b>3 107 000</b>	<b>3 933 000</b>

		< US \$ 80/kgU	< US \$ 130/kgU
<b>EAR-II</b>		<b>1 480 000</b>	<b>2 332 000</b>

	< US \$ 130/kgU	Unassigned Cost	Total
<b>SR</b>	<b>4 438 000</b>	<b>5 501 000</b>	<b>9 939 000</b>