IAEA
International Atomic Energy Agency
Atoms for Peace and Development

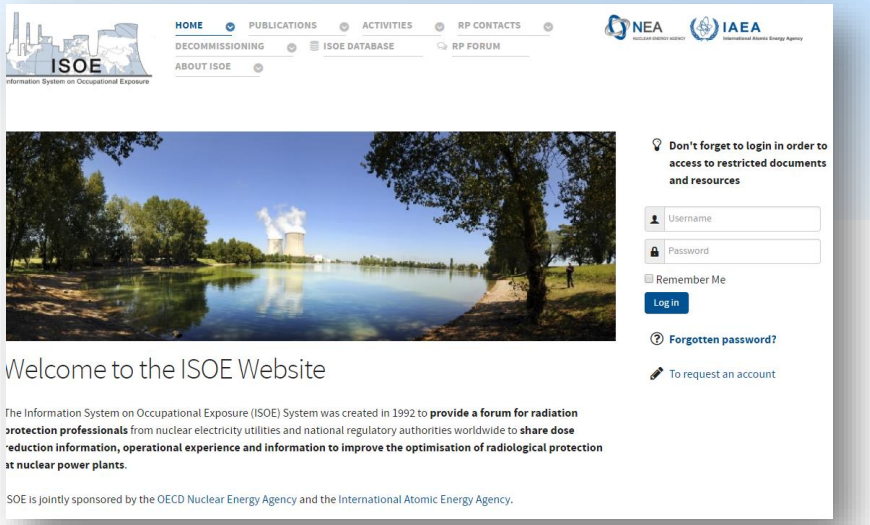
Information System on Uranium Mining Exposures (UMEX)

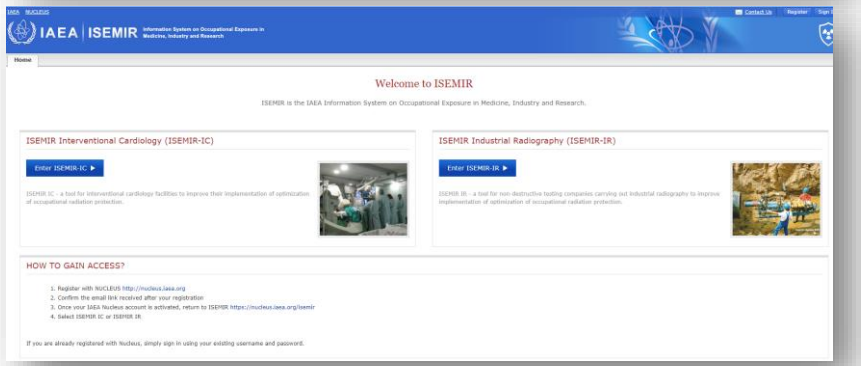
An IAEA Survey of Global Uranium Mining and Processing Occupational Doses

https://nucleus.iaea.org/sites/orpnet/worldwide/umex/SitePages/Home.aspx

UMEX – The Idea

- For nuclear industry workers there are a number of databases of occupational doses at both international and national level (Information System on Occupational Exposure, **ISOE**)
- Similar systems have been developed for medical exposures and industrial workers (**ISEMIR**)
- The Information System for Uranium Mining Exposures (**UMEX**) was designed to examine global occupational exposures in uranium mining and processing





UMEX – The Design Requirements

- Important requirements and information to collect:
  - **Capture as many of the uranium workers** as possible across a wide number of jurisdictions
  - Need to know the **type of operation** and **nature of the work** being performed
  - Need to understand the **key assumptions used to monitor and calculate exposure and dose**
  - **Collect dose information** based on individual pathways
  - Ideally wish to know the **underlying dose distribution**
  - **Record primary control mechanisms to optimise dose**

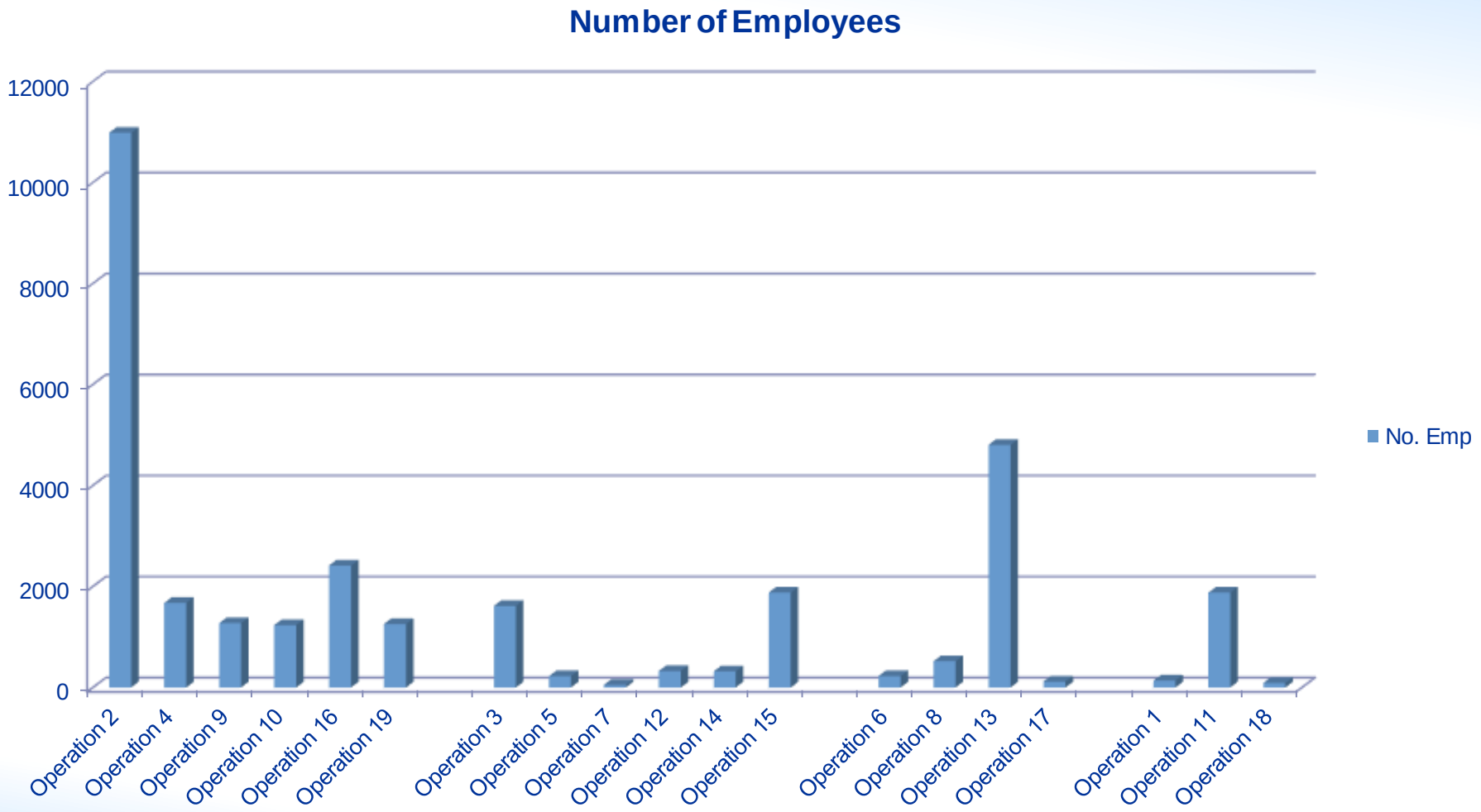
UMEX – The Design, Limitations & Solutions

- **PRIVACY** – A critical limitation so only amalgamated information received to prevent with no personal identifiers
- **EASE of USE** – To enable the widest possible response needed to make the data entry easy and quick (*otherwise it would not happen*)
- **Multiple Dose Databases** – Used national regulator to determine which is and use the official dose register
- **Variability** – Combination of drop down menus, information tabs and free form fields to structure data entry
- **Different Dose Methodologies** – Capture as much information about monitoring and dose calculation methodologies

UMEX – The Response

- The survey provided a snapshot of the doses in the **2012** calendar year
- Occupational data from **36 operating facilities** were received
- This covered production of 58,344t of uranium or approximately **85% of global uranium production**
- Amalgamated dose data was received from **in excess of 30,000 workers**

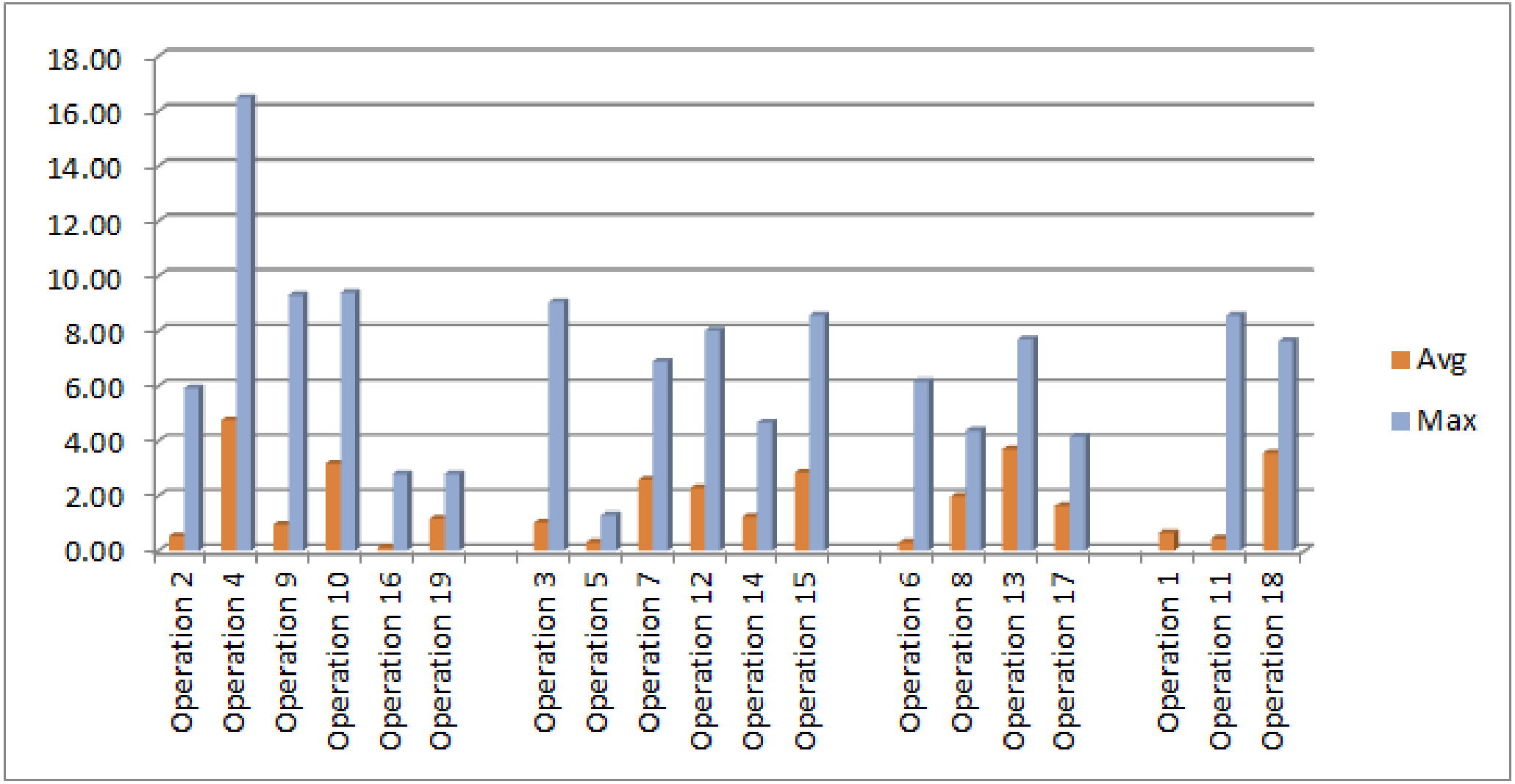
Number of Employees per Operation



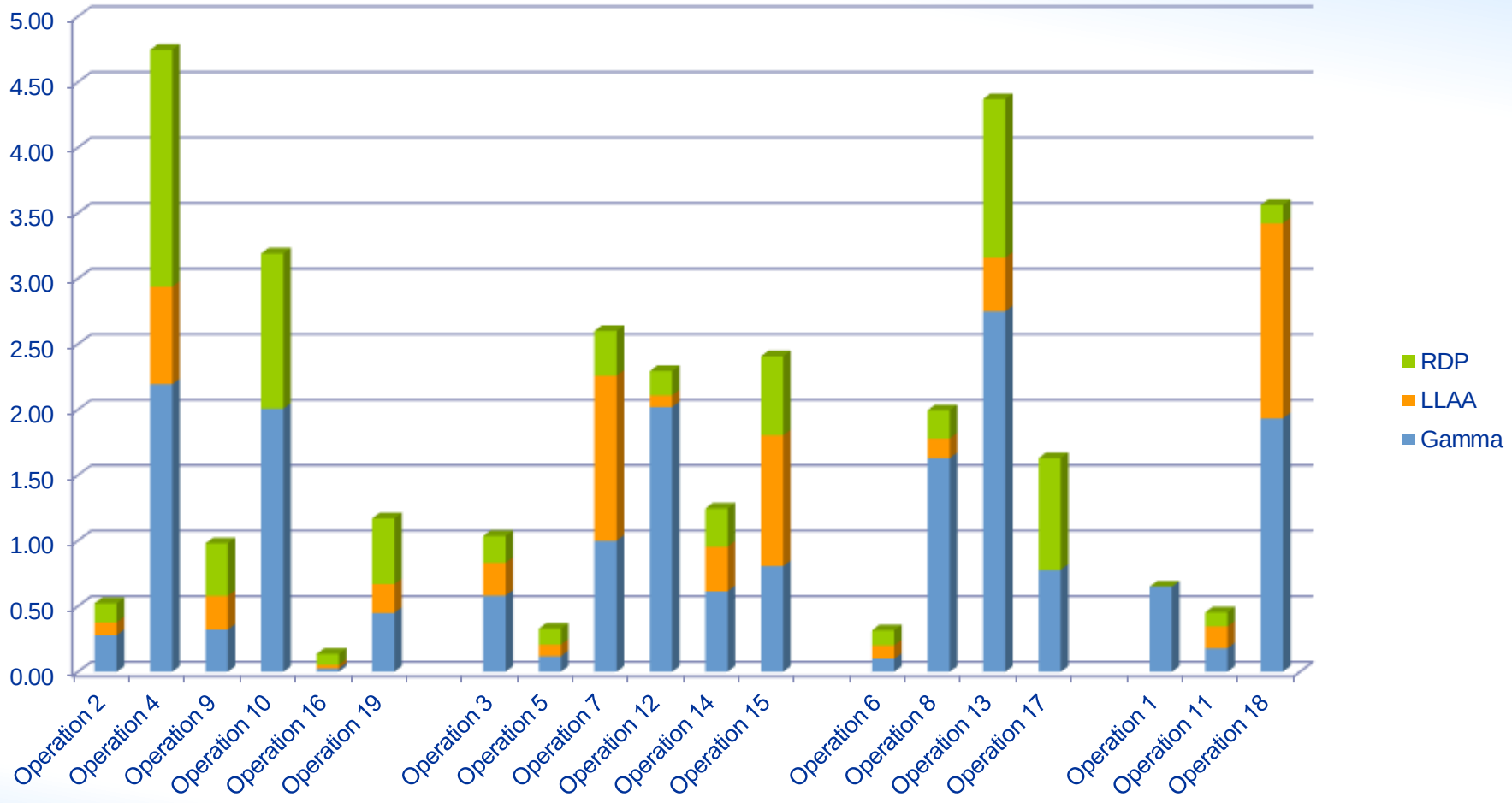
UMEX – The Results

- They characterise a industry where **occupational exposures** are well controlled and doses remain within applicable limits
- Average doses were typically **less 5mSv/y** and the maximum **individual dose was 16.5mSv/y**
- Majority of doses to personnel were below 2mSv/y

Average & Maximum Doses by Operation



Breakdown of Average Doses by Pathway & Operation



Example of UMEX Use: High Dose & Corrective Actions

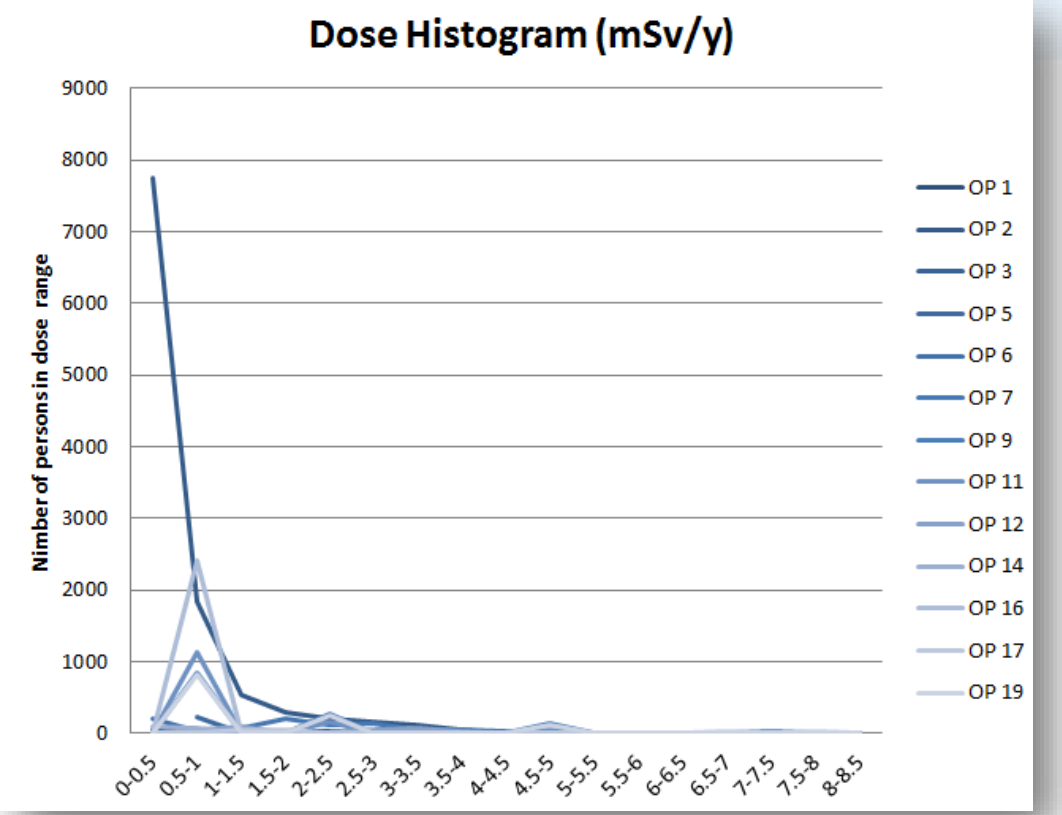
- In the initial survey results one operation recorded a maximum dose of 31mSv/y
  - Examination of the data showed 30 mSv was from gamma exposure
- The UMEX team believed the dose was incorrect and subsequent investigation by the regulator and operator confirmed that the data was both suspect and impossible for the individual to have received
  - The individuals doses was corrected to reflect the workgroup average for gamma by the regulator

Example of UMEX USE: Different Dose Distributions

- **Distributions of doses heavily influenced by the choice of workgroup and who is included**
- This distribution variability raises questions about the use of normal statistical methods for interpreting doses
- Also may call into question the use of average dose and how workgroups are defined

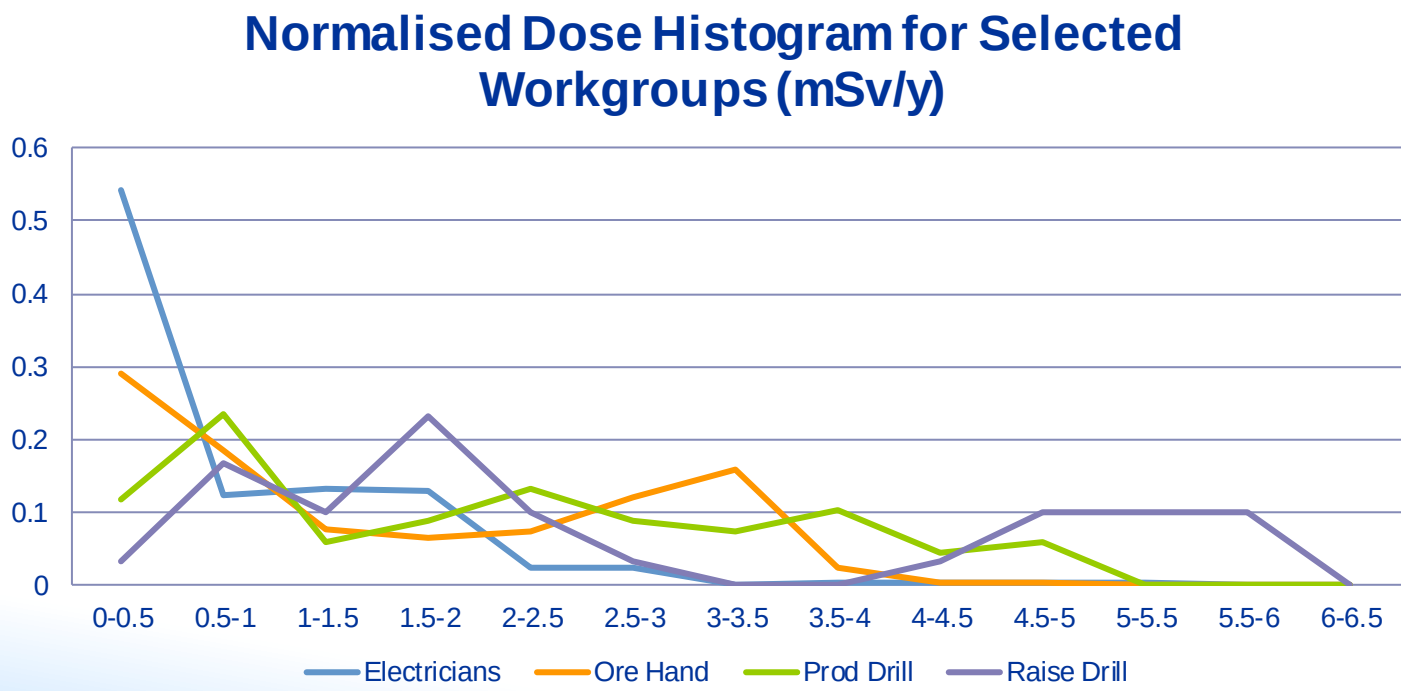
Lots of (non) Radiation Workers

- Some operations have a high majority of workers in the 0-0.5 mSv/y range
- Are these true radiation workers or are they made up of people not exposed to uranium or short term workers?
- In one operation this was very apparent



Multiple Distributions in a Workgroup

- A workgroup or similar exposure group (SEG) is expected to be homogeneous with similar exposures
- Often see multiple clumps of doses
- Likely to be people with different work practices (supervisor vs face worker)



UMEX – Next Stages

- The report on UMEX is incorporated in a Safety Report on Occupational Radiation Protection in the Uranium Mining and Processing Industry (SR-100)
- IAEA is seeking to renew the data into the future to look at time trends in doses within the uranium industry

UMEX 2.0?

- It is envisaged that uranium miner occupational dose from 2019 will be collected by the IAEA
- This will become an annual process and it is hoped to be via a electronic submission similar to ISOE
- The following is the information which would be collected

UMEX – Background & Operational Information

Corporate Information			
Country*			
State*			
Organisation Name*			
Address*			
Contact Details*			
Person completing*			
Position[1]			
Email contact*			
Phone contact*			
Operation information			
Operation Name*			
Location*			
Type of Mining**		If Combination/Other[1]	
Type of Leaching**		If Combination/Other[1]	
Type of Purification**		If Combination/Other[1]	
Type of Drying**		If Combination/Other[1]	
Average Proces Plant Feed Ore Grade/Liquor Concentration (unit)[1]		Well field/Leachate concentration into plant (i.e. feed to resin columns)	
Ore tonnage/Liquor Volume through process plant[1]			
Production*		Tonnes U Equivalent per year[1]	
End Product**			
Operational stage**			
Environment[2]			
Staff Numbers			
Occupationally exposed workers*	**Numeric**		
Occupationally exposed contractors not already included in above*	**Numeric**	Only include if contractor numbers not already included in total Occupationally exposed workers	
Non-designated workers[1]	**Numeric**	Workers not classified as occupationally exposed (i.e. admin, camp staff)	
Total[1]	**Numeric**		

UMEX – Monitoring Approach

- Details about the monitoring by exposure pathway and whether background is subtracted

Monitoring Approach			
External Exposure - Gamma			
Monitoring Approach**		If Combination/Other[1]	
Mininum Detectable Level[1]			
Monitoring Methodology**		If Combination/Other[1]	
Background subtracted**			
Inhalation of Radon Decay Products (RDP)			
Monitoring Approach**		If Combination/Other[1]	
Mininum Detectable Level[1]			
Monitoring Methodology**		If Combination/Other[1]	
Background subtracted**			
Long Lived Radioactive Dust (LLRD)			
Monitoring Approach**		If Combination/Other[1]	
Method for determining radioactivity**		If Combination/Other[1]	
Mininum Detectable Level[1]			
Radon retention in sample if appropriate[1]		%	
Monitoring Methodology**		If Combination/Other[1]	
Background subtracted**			
Biological monitoring/Internal Dosimetry**		If Combination/Other1	

UMEX – Dose Calculation

- Details about the key aspects of dose calculation including conversion factors and use of key assumptions such as particle sizing and use of respiratory protection factors

Dose Calculation				
Occupancy time**			If Combination/Other[1]	
External Exposure - Gamma				
Conversion factor if used[1]				
Inhalation of Radon Decay Products (RDP)				
Determination of RDP directly or equilibrium factor**			Specify if not listed[1]	
Particle sizing of RDP if used[1]				
Long Lived Radioactive Dust (LLRD)				
Particle size**			If Combination/Other[1]	
Solubility factor**			If Combination/Other[1]	
Uranium, actinium and thorium chain[2]				
Respiratory Protection Factor used for PPE**			If Combination/Other[1]	

Radiation Controls

Radiation Controls			
External Exposure - Gamma			
Mining controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Processing controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Inhalation of Radon Decay Products (RDP)			
Mining controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Processing controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Long Lived Radioactive Dust (LLRD)			
Mining controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Processing controls (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Special Controls in the Event of an Incident			
Mining controls/actions (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	
2		Details[1]	
Processing controls/actions (select major controls)**		Details[1]	
2		Details[1]	
2		Details[1]	

UMEX – Auxiliary Controls

- General administrative controls for radiation safety

Auxillary Controls		
Radiation induction[1]		
Radiation Training[1]		
Designated vs non-designated[1]		
supervised and controlled areas[1]		
Contamination controls[1]		
QA systems[1]		
Record keeping[1]		
Radiation Staffing[1]		
Emergency Response Plan[1]		
Restricted release Zones[1]		

UMEX – The Questionnaire – Workgroup Dose Data

- Workers divided into workgroups (freeform) under defined work categories and the number of personnel recorded
- For each workgroup average, maximum and conversion factor is given for each pathway and total
- Where possible the standard deviation, assumed distribution and basis for the conversion factor is requested
- The number of personnel in each 0.5mSv/y bracket for total dose and each pathway is also requested to enable a dose histogram to be developed

Conclusions

- The original UMEX provided a 2012 snapshot of occupational doses in the uranium industry
- The response covered approximately 85% of global uranium production
- The doses show compliance with international recommendations and represent good practice globally
- The findings of the project are incorporated in the IAEA Safety Report (SR-100)

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Thank you!