

308

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Les enjeux de la filière uranifère au Québec

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Radiation Protection in Modern Canadian Uranium Mines

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Introduction

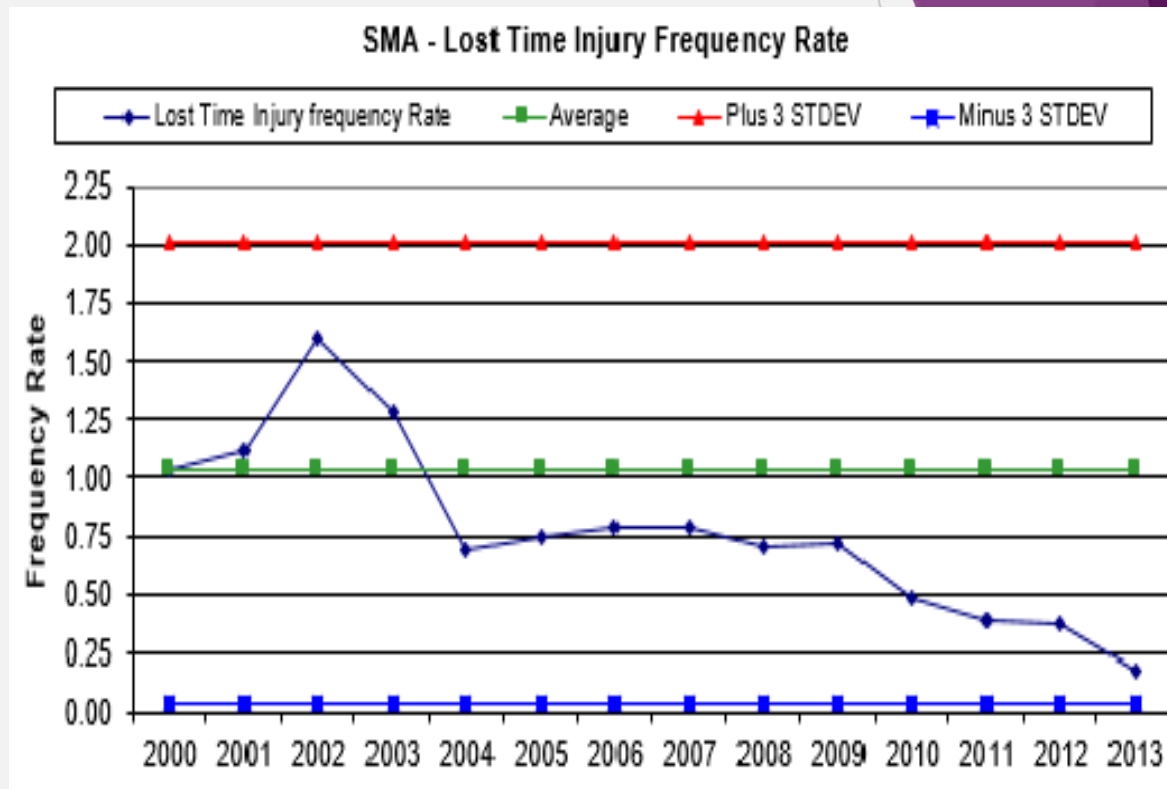


- ▶ Purpose
- ▶ Topics
 - ▶ Conventional Safety in Uranium Mines
 - ▶ Radiation Protection
 - ▶ Saskatchewan Radiation Protection Performance
 - ▶ Conclusion



Conventional Safety in Saskatchewan Uranium Mines

- ▶ Safety - a state of being free from harm, danger, injury and damage
- ▶ Conventional safety (non-radiological safety)
 - ▶ Biological safety
 - ▶ Ergonomic safety
 - ▶ Chemical safety
 - ▶ Physical safety
 - ▶ Psychosocial safety
 - ▶ Operational



Radiation Protection

▶ Purpose

- ▶ Ensure no significant adverse health effect or environmental impact occurs

▶ Objective

- ▶ “As Low As Reasonably Achievable” (ALARA), economic and social factors considered

▶ Regulatory Limits

- ▶ Nuclear Energy Workers (NEW)
 - ▶ 100 mSv in 5 years (20 mSv /year average)
 - ▶ Maximum of 50 mSv in any 1 year
- ▶ Public
 - ▶ 1 mSv/year



(Cameco 2014)



Radiation protection Management Programs

- Radiation safety issues in the design and operation of the mine
- Implementation of comprehensive work procedures and administrative controls
- Development of a radiation Code of Practice specific to the operation
- Use of personal protective equipment
- Monitoring, recording and reporting of radiological exposures, doses and conditions
- Corrective action when exposure and radiation levels exceed normal operating levels



Exposure and Dose Control

- ▶ Regulatory Limits
 - ▶ Nuclear Energy Workers (NEW)
 - ▶ 100 mSv in 5 years (20 mSv /year average)
 - ▶ Maximum of 50 mSv in any 1 year
 - ▶ Public
 - ▶ 1 mSv/year
- ▶ Action Levels
- ▶ Administrative levels



Forms of Radiation that are Controlled

- ▶ Internal radiation (airborne)
 - ▶ Radon Progeny - Alpha
 - ▶ Long Lived Radioactive Dust – Alpha, Gamma
- ▶ External Radiation
 - ▶ Gamma



Contamination Control

- ▶ Single pass ventilation systems
- ▶ Layouts that allow separation of workers from sources
- ▶ Washing down facilities, removal of outer layers of protective clothing
- ▶ Zone control
- ▶ Laundry facilities
- ▶ Changing facilities with clean and dirty sides separated by personal showers
- ▶ Equipment decontamination areas
- ▶ Wash water collection and treatment
- ▶ Appropriate drainage and water collection systems to facilitate routine washing down of areas
- ▶ Routine radiation scanning



Radiation Code of Practice

- ▶ Intended to trigger a two step system of risk based controls to reduce potential exposure before the maximum regulated limits are exceeded.
 - ▶ Administrative levels – signifies higher than normal radiation levels
 - ▶ Action levels – signifies a potential loss of control



ALARA in action

- ▶ As Low As Reasonably Achievable (ALARA), social and economic factors considered
 - Operating Experience
 - Training
 - Radiation Work Permits, change control procedure, and carefully planned maintenance
 - Mine layouts
 - Non-entry ore mining methods
 - Remotely operated equipment
 - Secure storage of nuclear substances for analytical purposes
 - General dilution ventilation augmented by local extraction ventilation systems
 - Shielding



Exposure Reduction

- ▶ Exposures and doses are reviewed on a regular basis with supervisors and workers
- ▶ An ALARA analysis is conducted and where possible, exposure reduction targets are set for individuals or work groups
- ▶ Performance against these targets is routinely monitored
- ▶ Where necessary action is initiated to reduce exposures



Radiation Hazard Risk Analysis

- ▶ Process of identifying risks, assessing potential impacts and developing appropriate control strategies
- ▶ Hazard = ability to cause harm
- ▶ Risk = Hazard X Probability
- ▶ Hazard = Radiation exposure / Dose
- ▶ Probability = likelihood of exposure



Radiation Monitoring



- ▶ Gamma
- ▶ Radon Progeny
- ▶ Long Lived Radioactive Dust
- ▶ Radon Gas
- ▶ Urinalysis
- ▶ Contamination
- ▶ Records & reports



Environmental Monitoring

- ▶ Ongoing operational monitoring of effluent quality (air and water)
- ▶ Monitoring stations set up to monitor air, water and soil
- ▶ Stations strategically located on site and around perimeter
- ▶ Additional stations located preselected distance from the site



Training



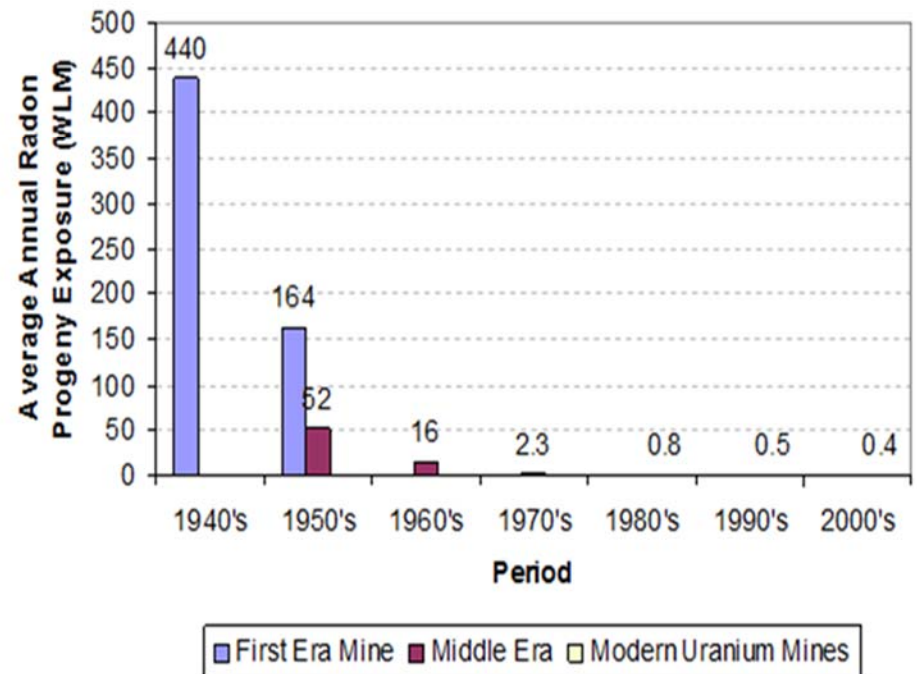
- ▶ Orientation
- ▶ Radiation training
- ▶ Supervisor's training



Radiation Protection Performance - Saskatchewan

- ▶ “Statistics collected by government agencies show that Saskatchewan’s uranium mines are among the safest workplaces in the province, even at times surpassing office jobs” (SMA 2012)
- ▶ **2012 Workers’ average total effective dose:**
3% of the annual average allowable limit (20 mSv)
- ▶ **Highest individual exposure recorded**
27.5% of the annual maximum allowable Limit (50 mSv)

Uranium Miner Average Radon Progeny Exposures



Conclusion

- ▶ Uranium mining can be done successfully
 - ▶ Effective health and safety management systems
 - ▶ Effective radiation protection management systems
- ▶ Modern existing Canadian mines provide useful experience and a template for effective environmental and radiation management programs



Thank you

