Grønlandsudvalget 2014-15 (2. samling)
GRU Alm.del Bilag 10
Offentligt

Governing Uranium Globally

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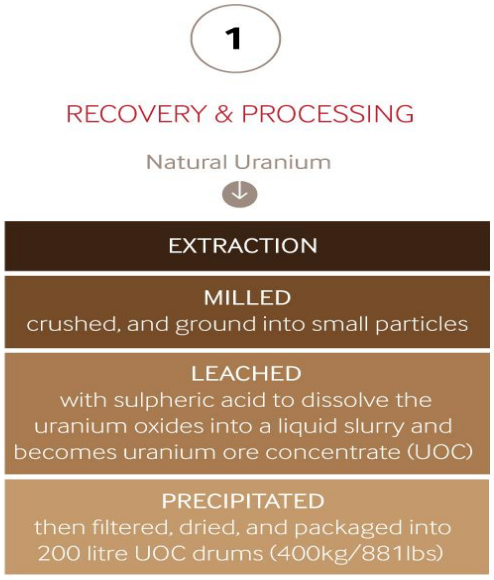
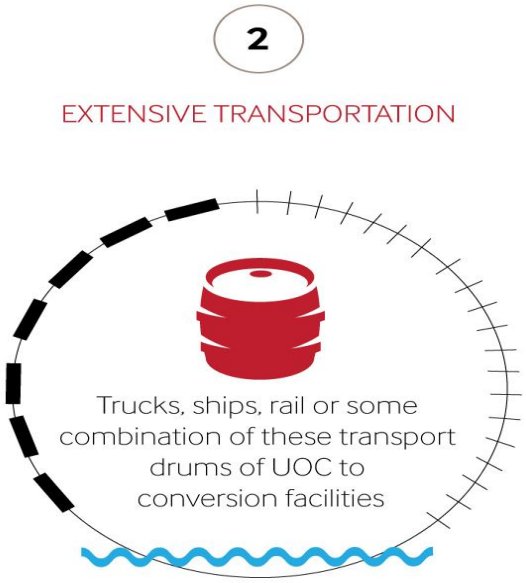
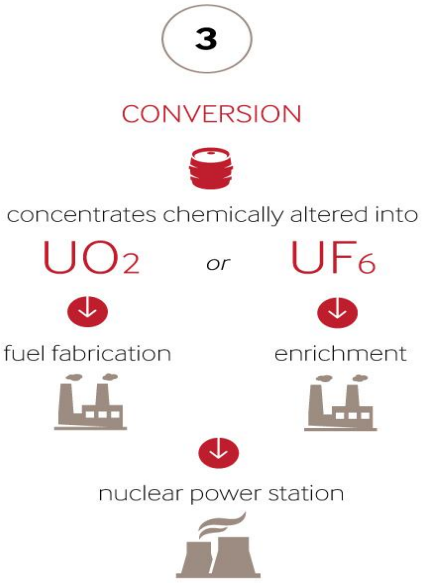
Governing Uranium project

- 2.5 year project -1 January 2013 to 30 October 2015
- 15 uranium producing/consuming countries
- Up to 25 researchers, from 10 countries involved
- Focus on security, safeguards, & industry practices that govern natural uranium production and trade (up to the point of conversion)







The Nuclear Fuel Cycle

Open Pit (Ranger Mine – Aus)

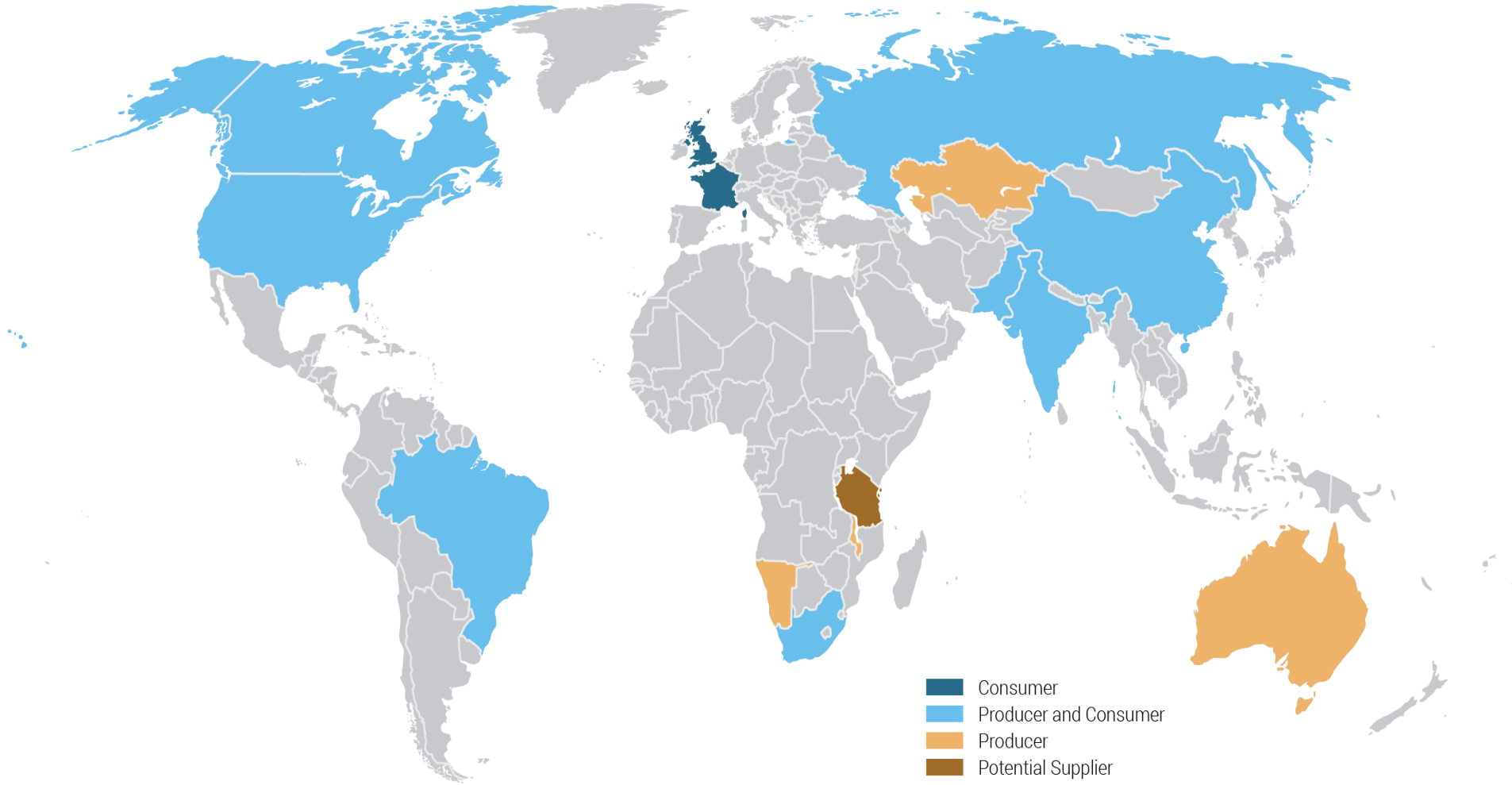
Underground

McArthur River Uranium
Mine Photos: Cameco

In Situ Leaching (ISL) Muyunkum and Tortkuduk Uranium Mine, Kazakhstan (Photo courtesy of KATCO)

15 Countries Studied

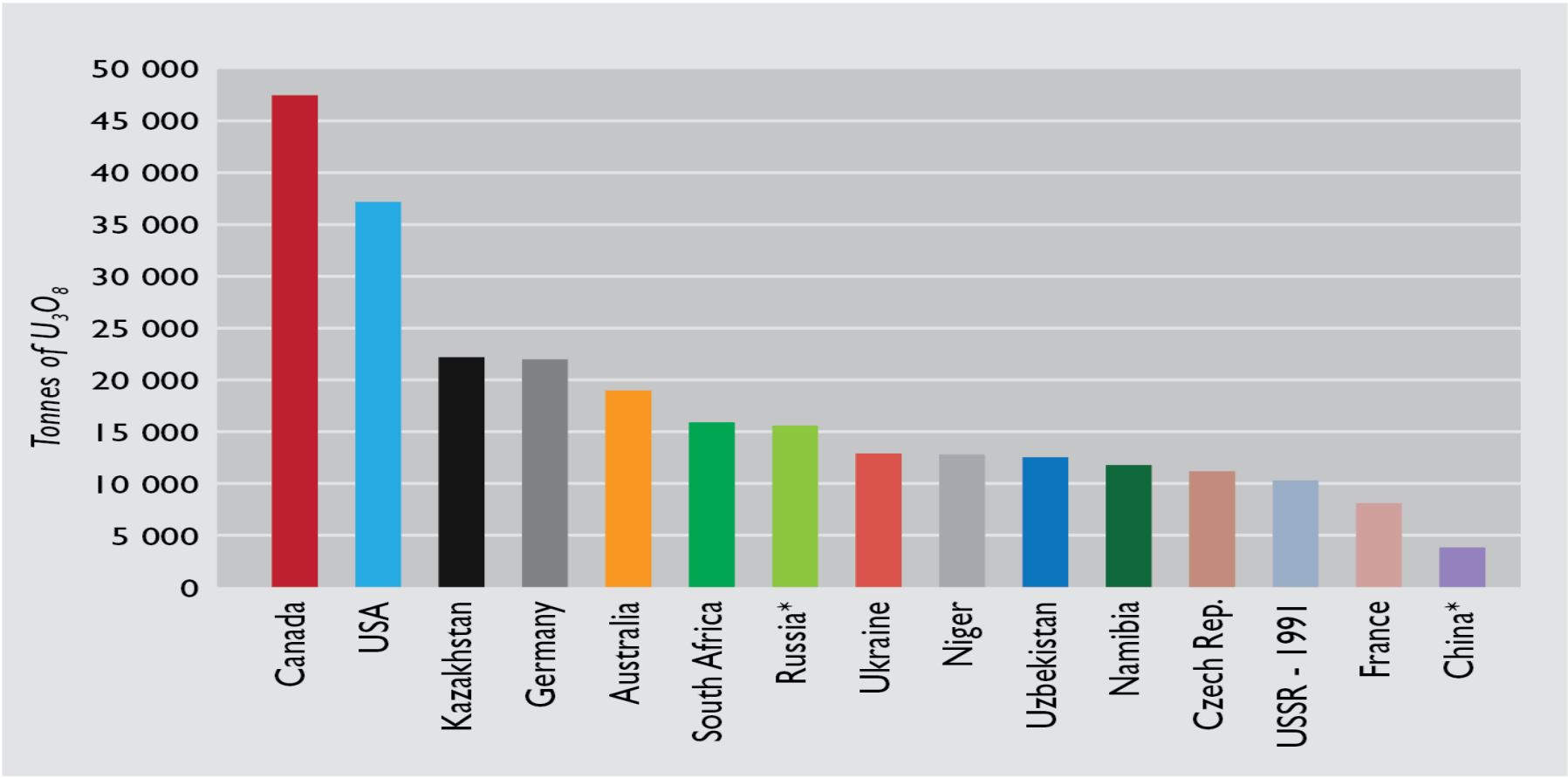
Governing Uranium Countries Studied



GovU Country Membership

Country/Membership	NPT	Additional Protocol	CPPNM (and 2005 amendment)	ICSANT	NSG	NWFZ	Regional Safeguards
Australia	√	√	√√	√	√	√	-
Brazil	√	-	√-	√	√	√	ABACC
Canada	√	√	√√	√	√	-	-
China	√	√	√√	√	√	-	-
France	√	√	√√	√	√	-	Euratom
India	-	√	√√	√	-	-	-
Kazakhstan	√	√	√√	√	√	√	-
Malawi	√	√	√-	√	-	√	-
Namibia	√	√	√-	-	-	√	-
Pakistan	-	-	√-	-	-	-	-
Russia	√	√	√√	√	√	-	-
South Africa	√	√	√-	√	√	√	-
Tanzania	√	√	√-	-	-	√	-
United Kingdom	√	√	√√	√	√	-	Euratom
United States	√	√	√-	-	√	-	-

Total World Production by Country 1945-2013

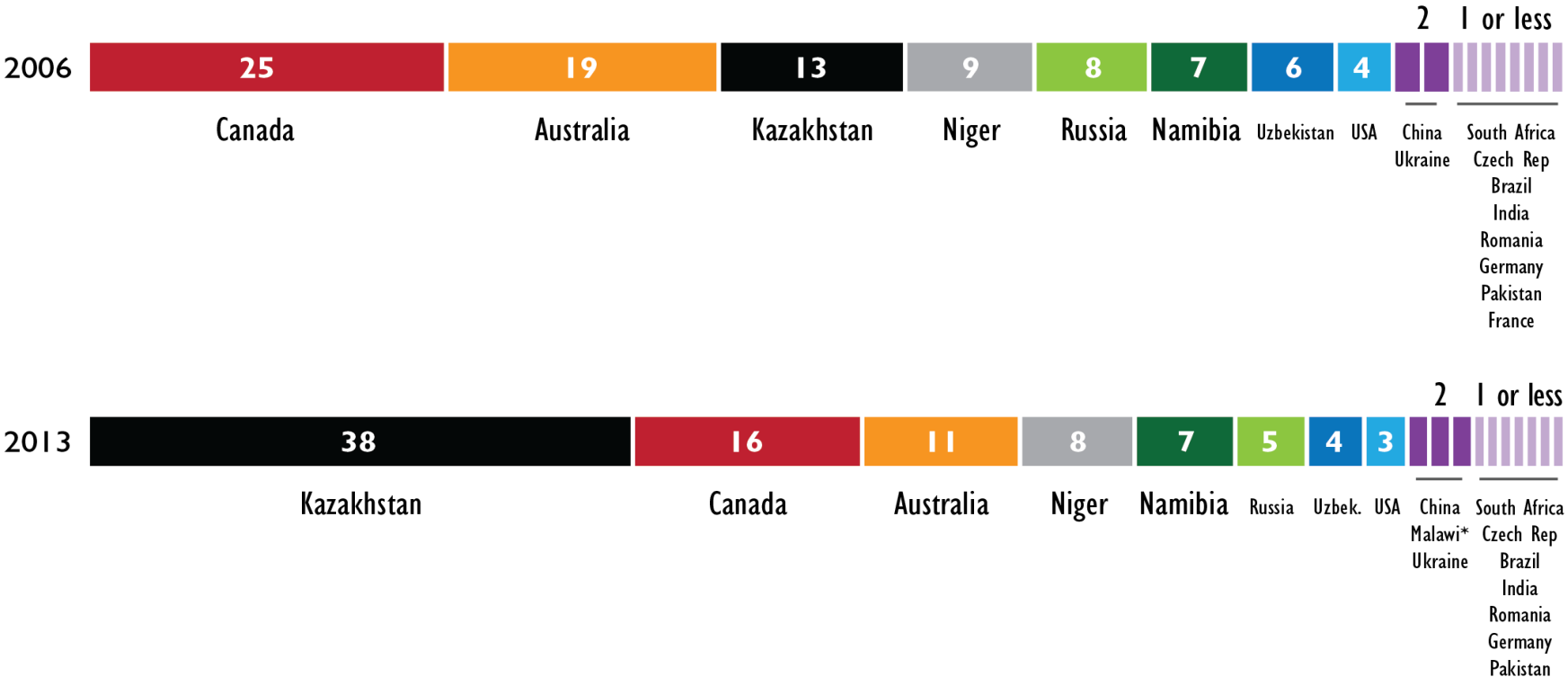


*Estimated by Secretariat of OECD/WNA.

Source: OECD NEA & IAEA, *Uranium 2014: Resources, Production and Demand* ('Red Book') and WNA *Global Nuclear Fuel Market Report* data.

Shifting Geographies of Production

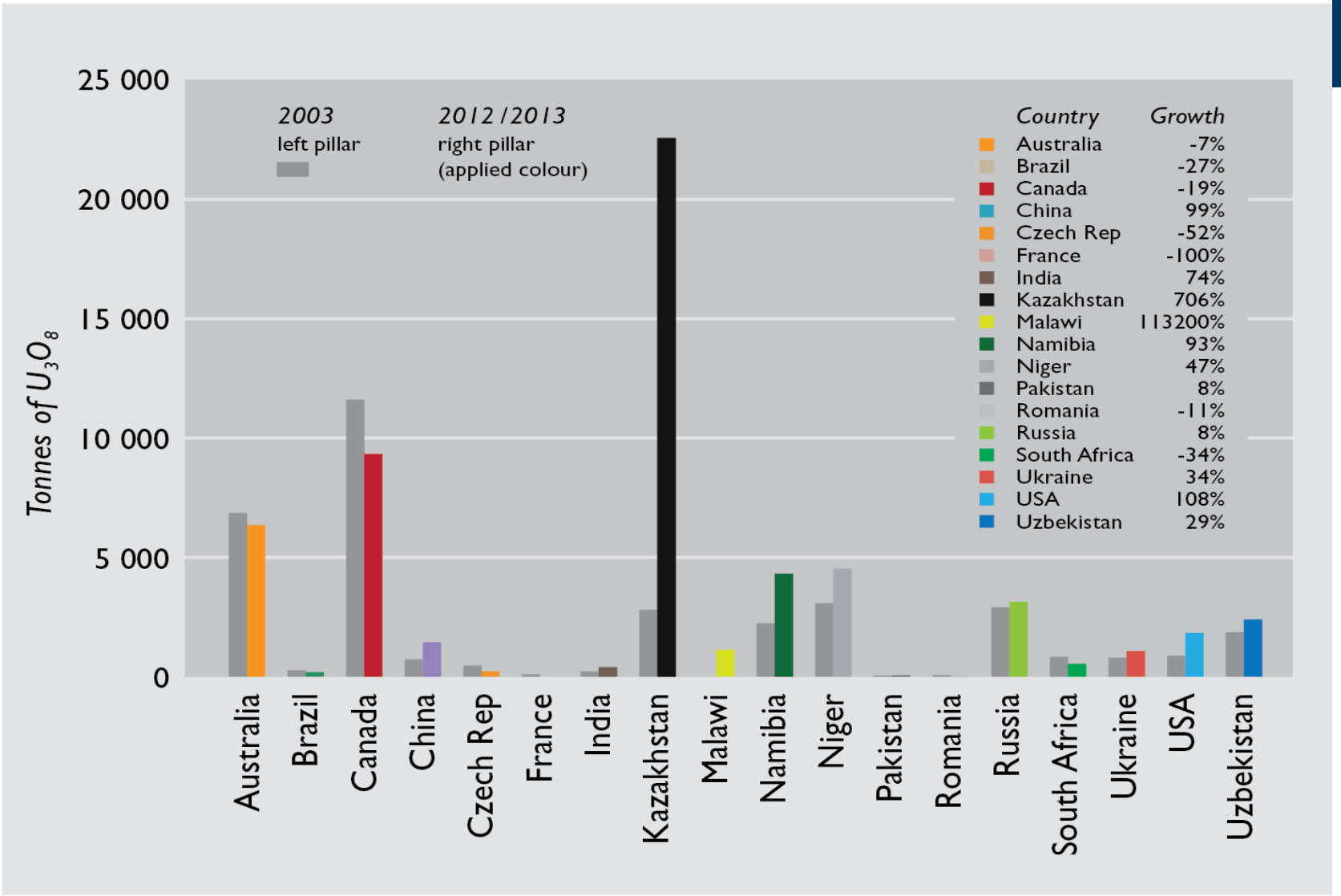
Percentage of World's Uranium Production from Mines, 2006-2013



* Country did not produce uranium from mines in 2006.

Source: *'Governing Uranium - Production'*, CSIS and DIIS: http://uranium.csis.org/production/

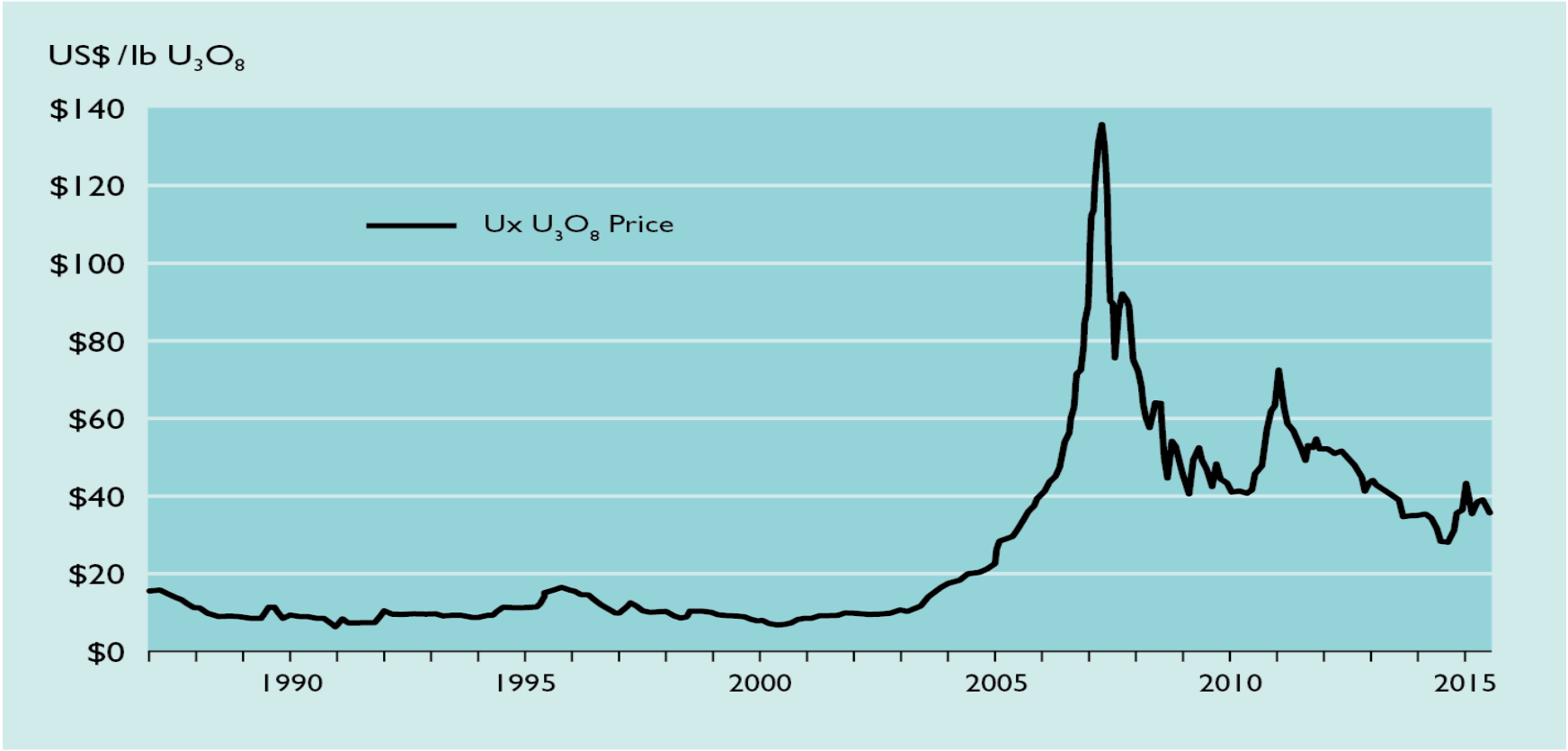
Change in Uranium Production 2003-2012/2013



Source: http://www.world-nuclear.org/info/Facts-and-Figures/Uranium-production-figures/

History of Spot Price of U3O8

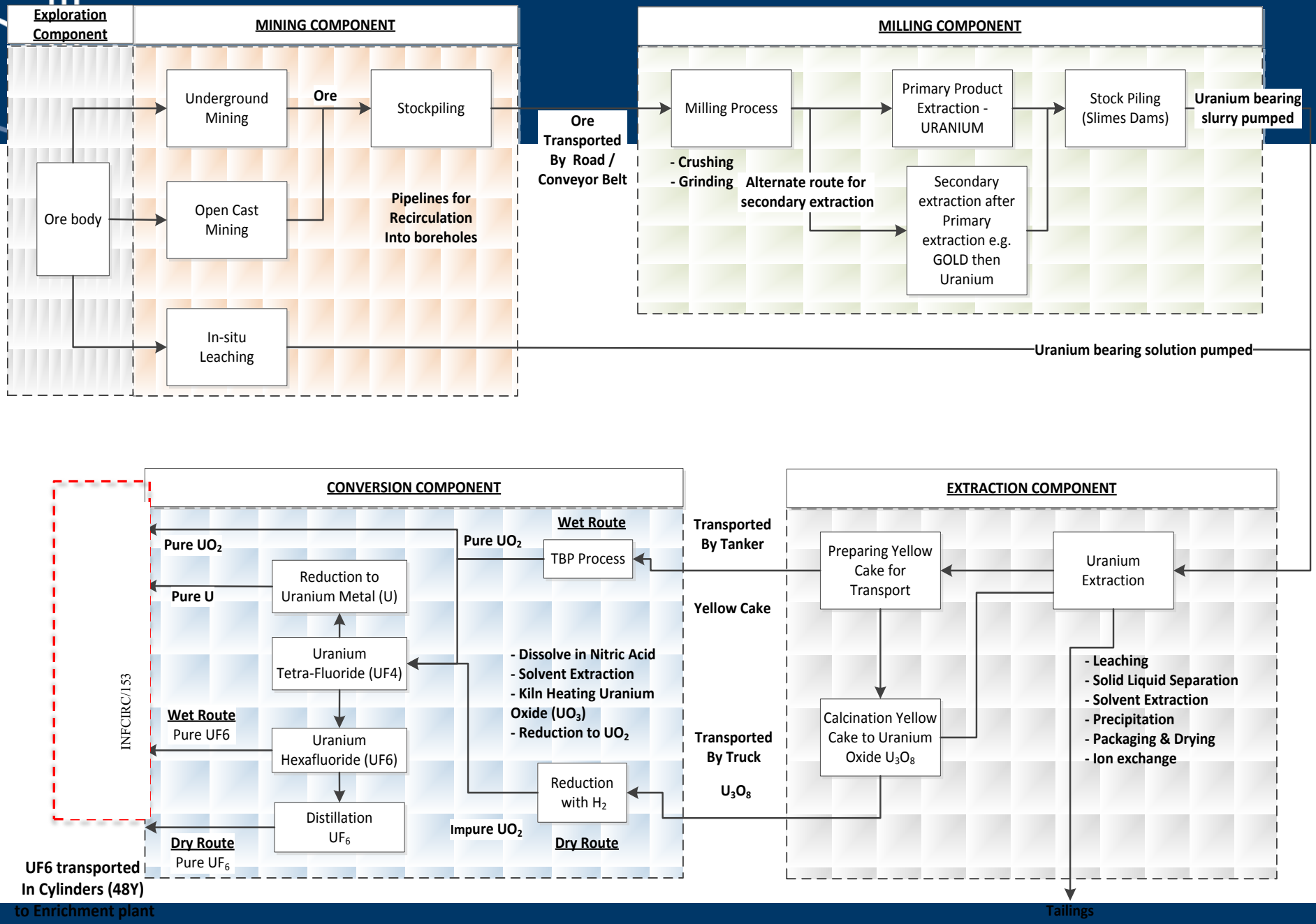
Ux U_3O_8 Price® - Full History (Spot)

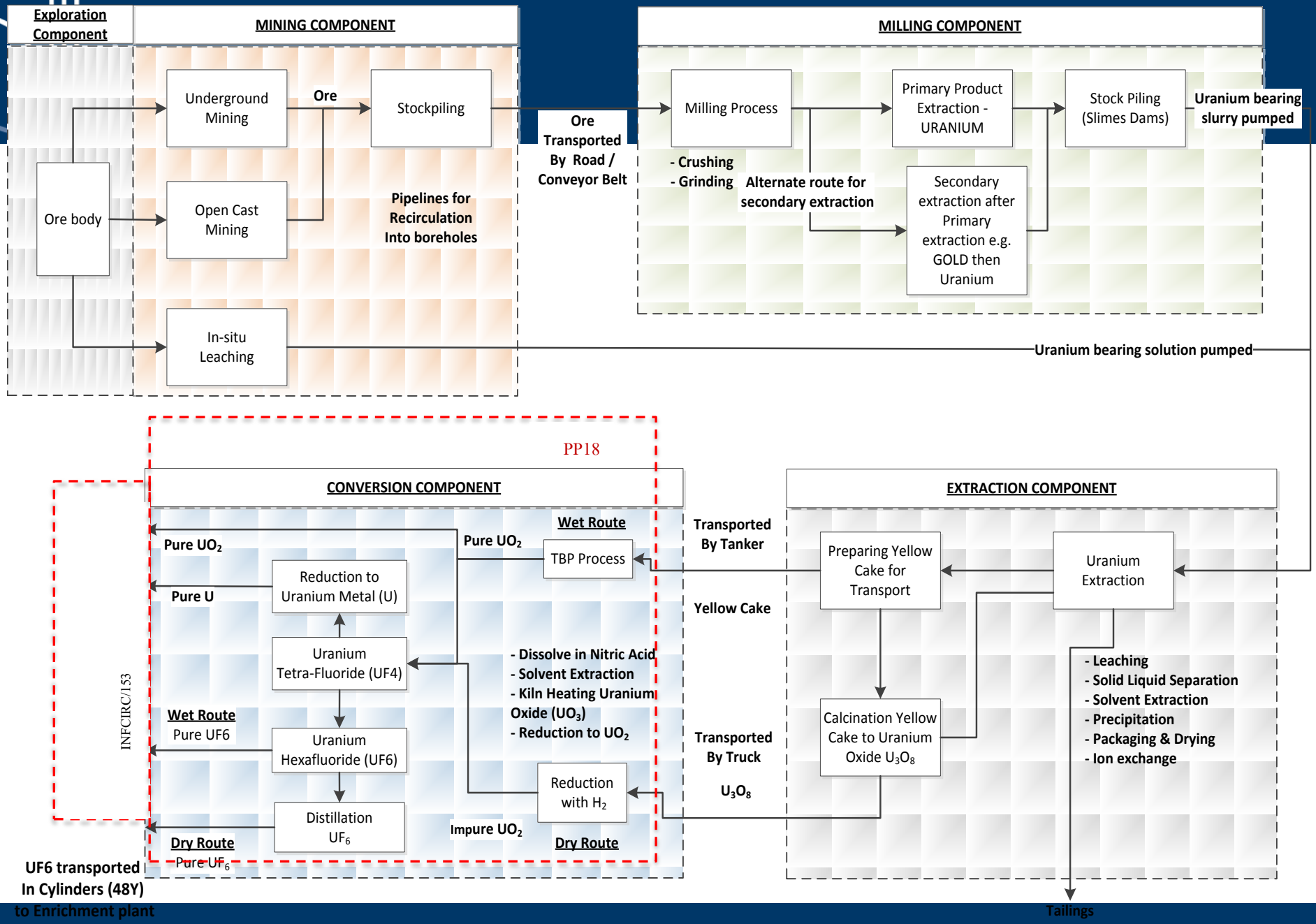


Source: The Ux Consulting Company, LLC: http://www.uxc.com/

Intl Reporting Requirements

- IAEA Comprehensive Safeguards Agreements – INFCIRC/153
  - Reporting exports/imports of uranium for nuclear purposes (paragraphs 34a and 34b)
  - Full material accountancy and control 34c
  - Policy Paper 18 (2003) clarified 34c to the point of uranyl nitrate
  - PP21 (2013) full scope safeguards on 'pure' UOC
- Additional Protocol
    - reporting of # of mines, concentration, production output and potential
    - Unconventional resources for non-nuclear purposes


Exploration Component
MINING COMPONENT
Underground Mining
Ore
Stockpiling
Ore body
Open Cast Mining
Pipelines for Recirculation Into boreholes
In-situ Leaching
Ore Transported By Road / Conveyor Belt
MILLING COMPONENT
Milling Process
- Crushing
- Grinding
Primary Product Extraction - URANIUM
Stock Piling (Slimes Dams)
Uranium bearing slurry pumped
Alternate route for secondary extraction
Secondary extraction after Primary extraction e.g. GOLD then Uranium
Uranium bearing solution pumped
CONVERSION COMPONENT
Wet Route
Pure UO_2
Pure UO_2
TBP Process
Reduction to Uranium Metal (U)
Pure U
Uranium Tetra-Fluoride (UF4)
- Dissolve in Nitric Acid
- Solvent Extraction
- Kiln Heating Uranium Oxide (UO_3)
- Reduction to UO_2
Wet Route
Pure UF6
Uranium Hexafluoride (UF6)
Reduction with H_2
Distillation UF_6
Impure UO_2
Dry Route
Dry Route
Pure UF_6
INFCIRC/153
UF6 transported In Cylinders (48Y) to Enrichment plant
Transported By Tanker
Yellow Cake
Transported By Truck
U_3O_8
EXTRACTION COMPONENT
Preparing Yellow Cake for Transport
Uranium Extraction
Calcination Yellow Cake to Uranium Oxide U_3O_8
- Leaching
- Solid Liquid Separation
- Solvent Extraction
- Precipitation
- Packaging & Drying
- Ion exchange
Tailings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TBP Process
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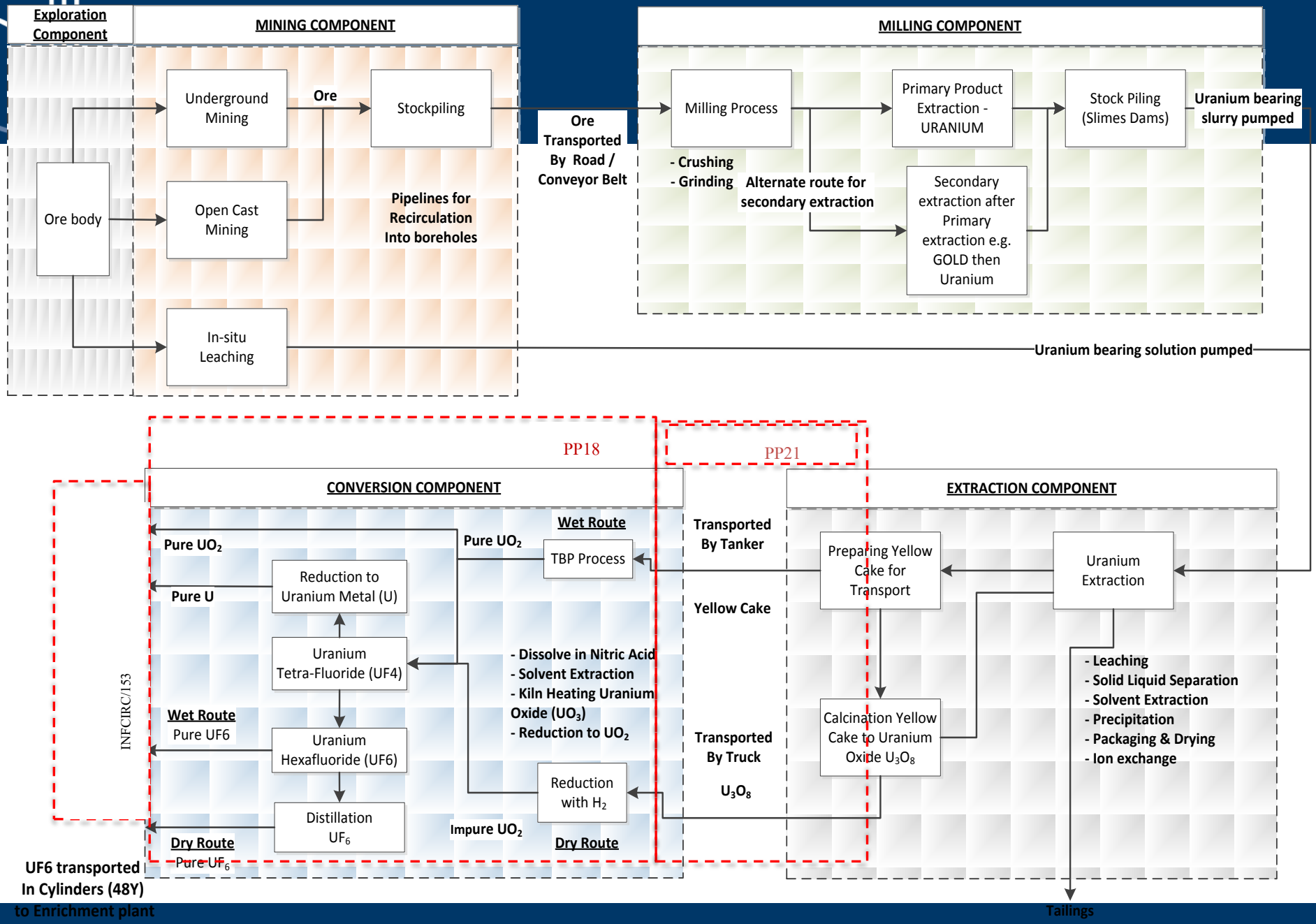
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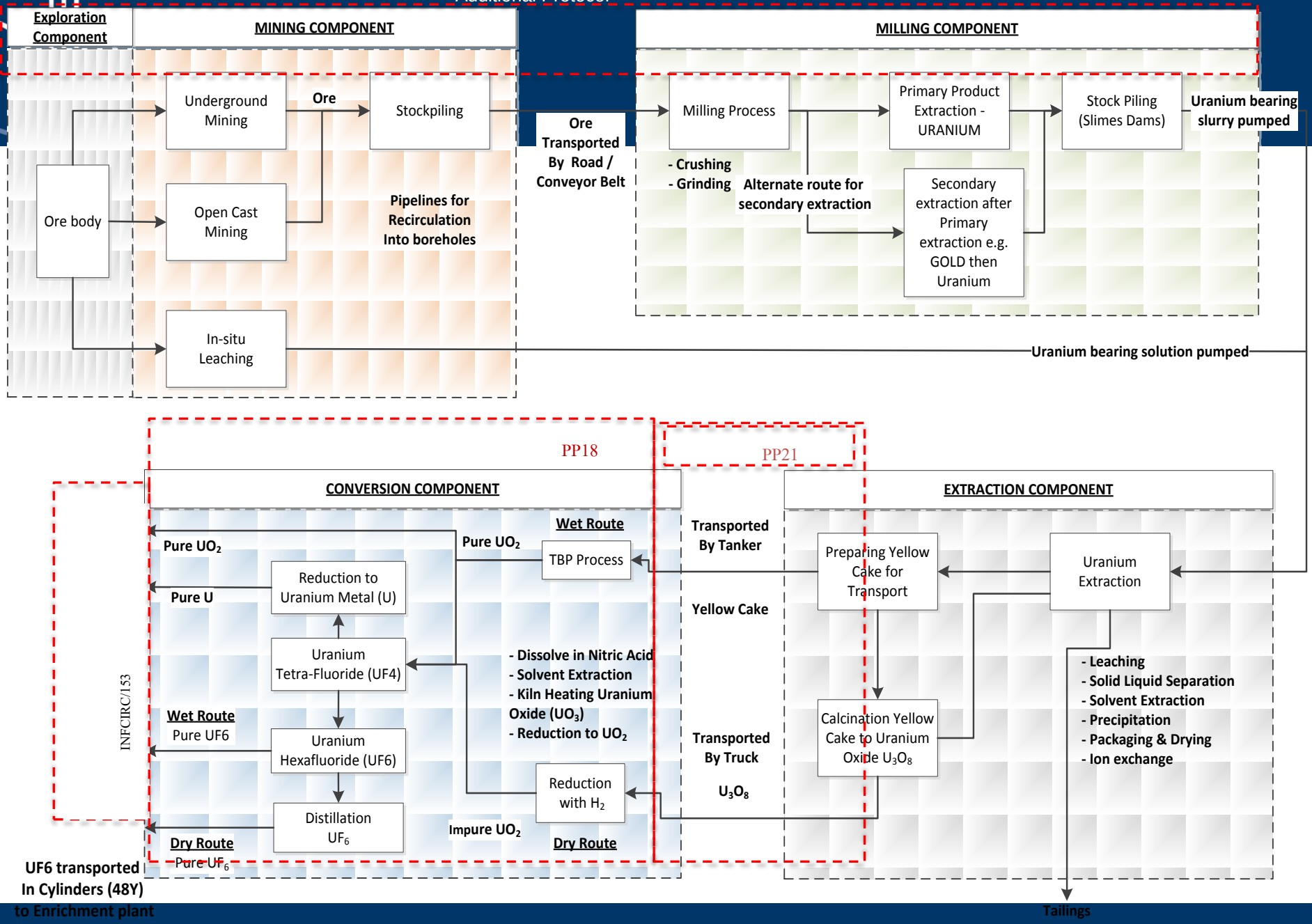
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Four Tiered Safeguards

Four Tiered Safeguards Structure

Haves (NWS)	*Have-nots (NNWS)*	*Have-nots that Have (non-NPT)*	*Exempted Have-nots that Have (India)*
VOAs AP	INFCIRC/153 AP JCPOA*	INFCIRC/66-type (no AP)	INFCIRC/754 AP

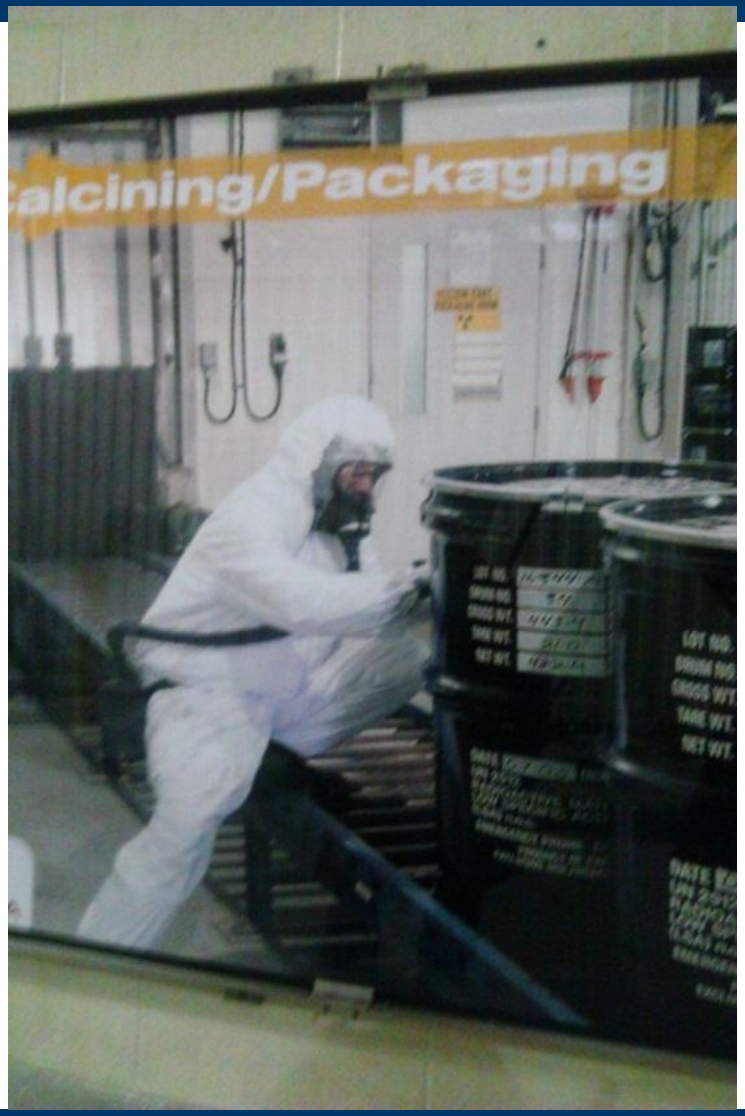
* The JCPOA concluded with Iran on 14 July 2015 could be considered as a subgroup under the NNWS safeguards agreements.

Security

- CPPNM (and 2005 Amendment), ICSANT, UNSCR1540, and INFCIRC/225 (Rev5)
  - Starting point of security earlier than for SG
- Many producers operate in heightened security environments
- Threat assessments and security plans
- Wide regulatory range, inventory and export controls; need for regional/intl harmonisation
- IAEA tecdoc – graded approach
- -nuclear security culture across fuel cycle

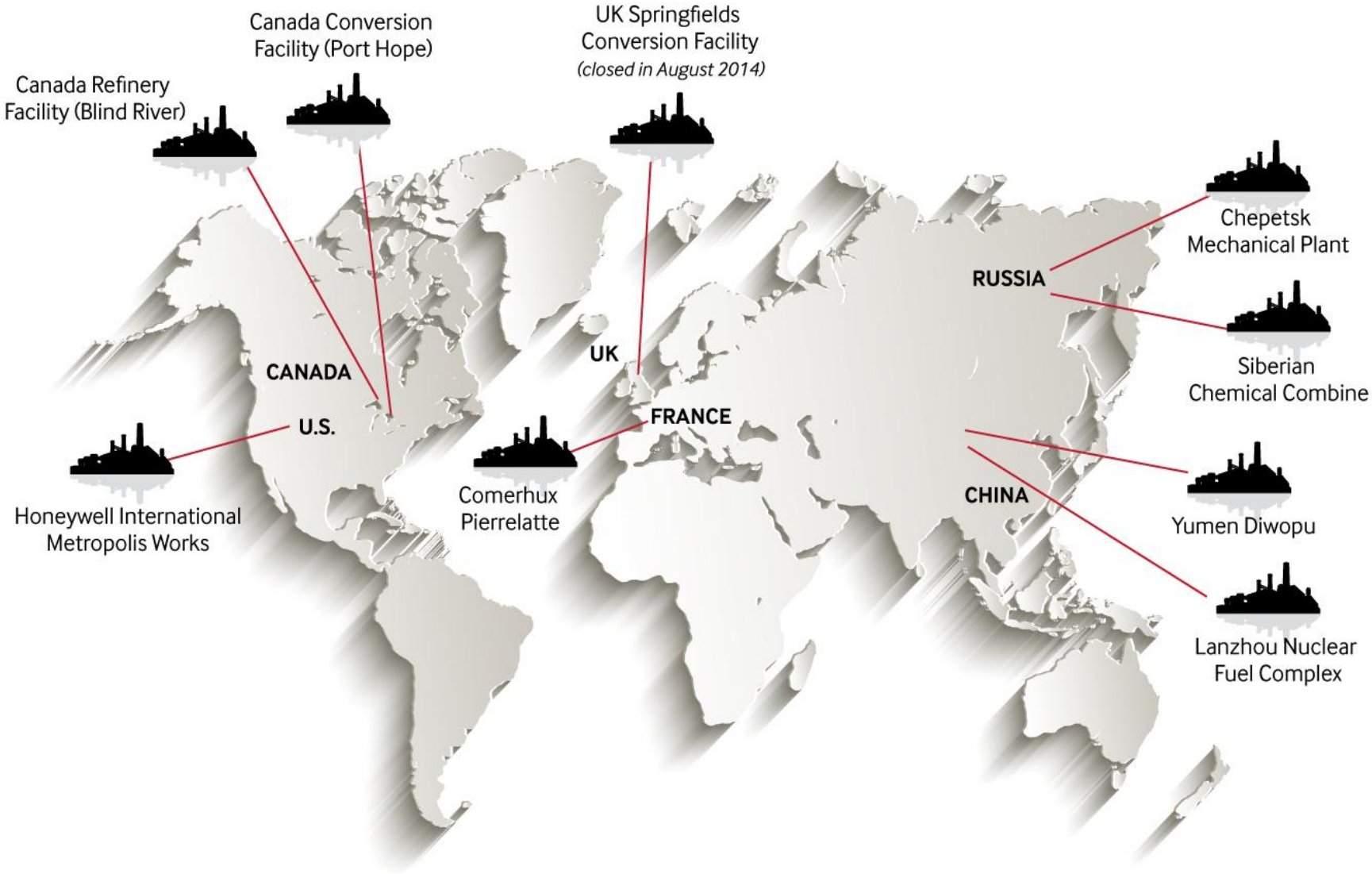
Inventory Controls/Tracking

- Ledger system
  - Slowly moving to digital age
- Natl Databases
  - NMMSS (USA)
  - NMAS (Cda)
  - NUMBAT (Aus)
- Standardised forms
- Regulatory & Guidance docs
- Conversion bottlenecks
- Barcoding



Ready for Transport

COMMERCIAL CONVERSION FACILITIES WORLDWIDE



Questions?

Occupational Safety

- International Commission for Radiological Protection (ICRP)
  - 1mSv/yr for public
  - 20 mSv/yr averaged over 5 years for radiation workers
  - dose limit not to exceed 50 mSv in any single year
  - Rad dose records show average U miner at 1mSv/yr

Occupation/Activity	mSv/yr
7 Hour Airline Flight	0.02
Chest x-ray	0.10
Spine X ray	1.0 - 1.5
Domestic Pilots	2.2
(CT) scan of the whole spine	10