



Diversion signatures in a country scale scenario

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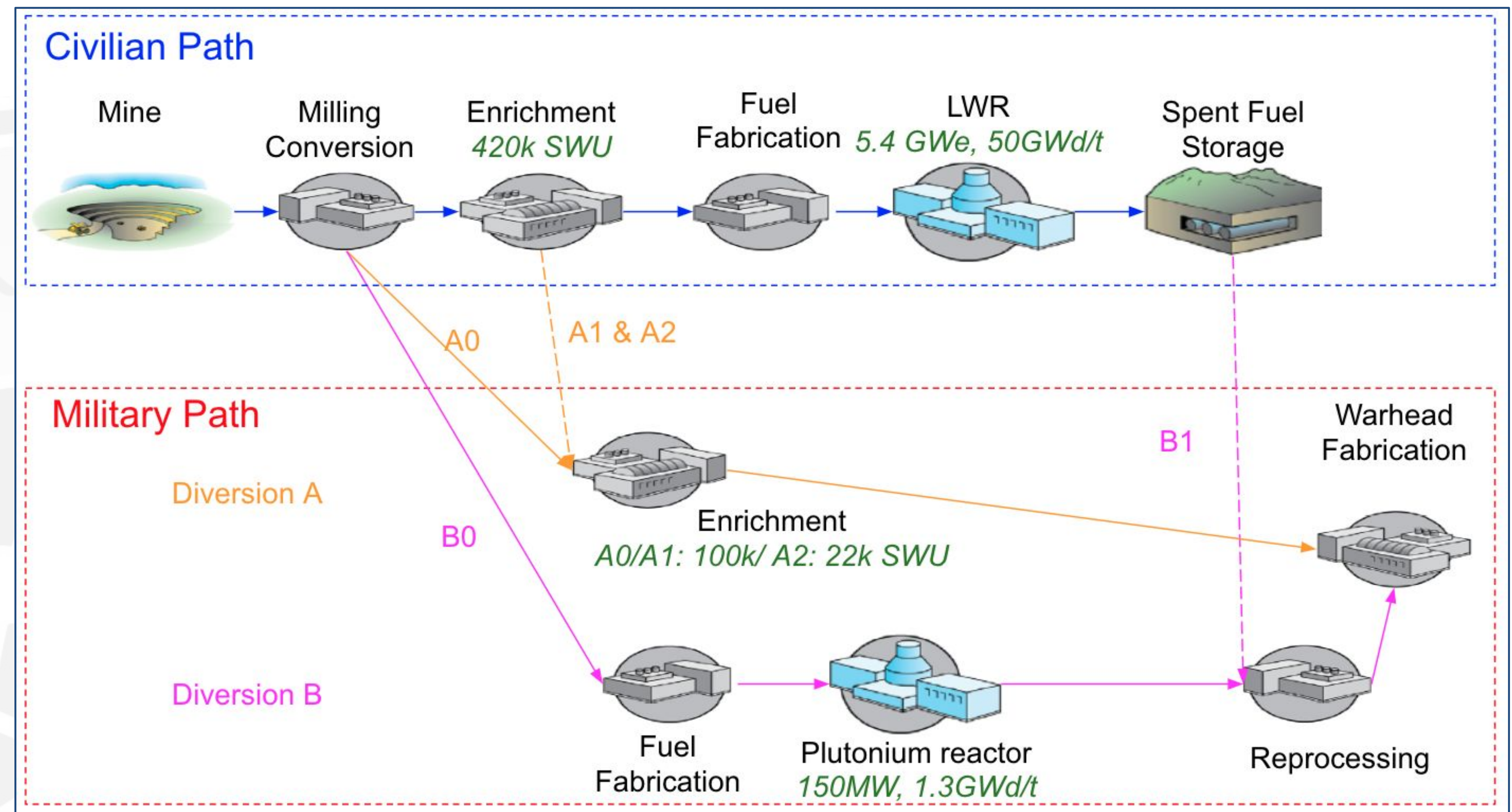


Goals & Objectives

- The Synthetic History workshop aimed to build a set of synthetic documentation produced by a National Weapons Program (based on Cyclus simulations), in order to better understand its role in:
 - nuclear disarmament plan verification
 - trust of completeness of weapon state declaration
- Using this fuel cycle baseline, this work aims to assess the impact of local diversion from a civilian fuel cycle to an undeclared military program using system-scale metrics:
 - SWU usage,
 - Uranium ore consumption,
 - Truck shipments,

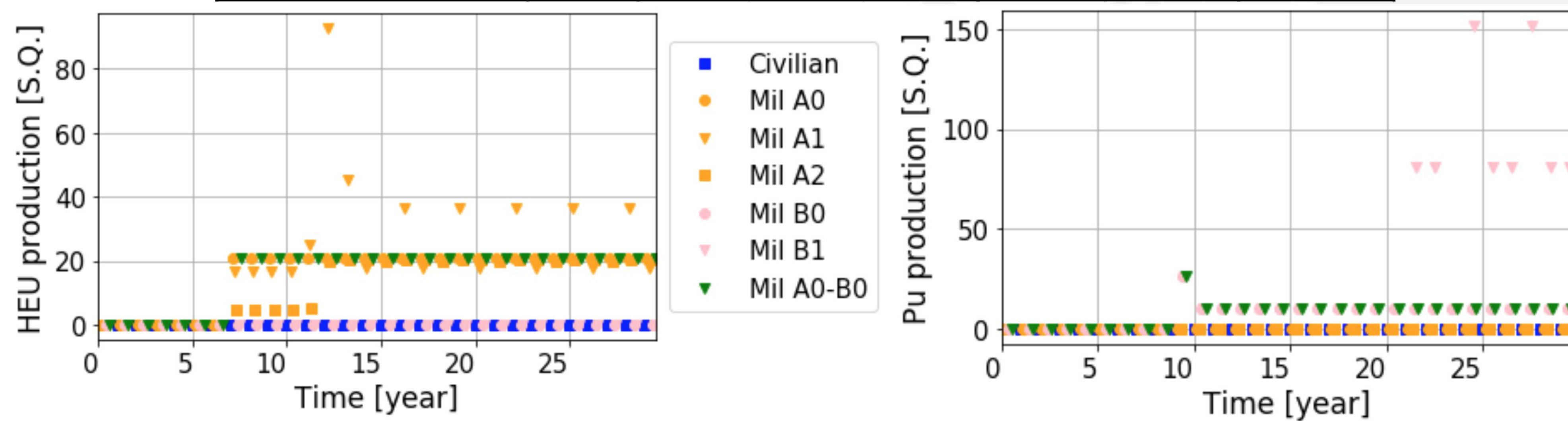
Fuel Cycle

- Civilian fuel cycle:**
 - Mine, Milling & conversion
 - Enrichment
 - Light Water Reactor
 - Spent fuel storage
- LEU production (path A):**
 - A0: natural uranium diversion
 - A1: LEU diversion
 - A2: LEU diversion (military SWU reduced to match A0 HEU prod.)
- Plutonium production (path B):**
 - B0: natural uranium diversion
 - B1: B0 + spent fuel reproc.
- LEU+Pu:**
 - A0+B0: natural uranium diversion



Fissile Material Production Rate

Year Average	Civ	LEU			Plutonium		LEU/Pu
		A0	A1	A2	B0	B1	A0+B0
HEU prod [S.Q./y]	N.A.	20	28	20	N.A.	N.A.	20
Pu prod. [S.Q./y]	N.A.	N.A.	N.A.	N.A.	10	45	10
Civ SWU [SWU/y]	284	284	377	359	284	284	284
U ore Consumption [t/y]	449	564	593	561	492	492	606
LEU shipment [5t/truck/y]	90	90	120	114	90	90	90



Technical Work and Results

- Almost all considered diversions have a specific signature with regards U-ore consumption, civilian SWU usage and LEU shipments.
- Might not be able to discriminate between HEU (A0) and Plutonium (B0) diversion base on those metrics.
- Possible to reduce the diverted quantities to limit the signatures:
 - For each HEU S.Q./y in case (A2):
 - 5.6t/y U-ore
 - 3.75k SWU/y (civilian)
 - 1.2 LEU truck/y
 - For each Plutonium S.Q./y in case (B0):
 - 4.3t/y U-ore

Conclusion & Future works

- Path to country scale diversion signature establishment
- Correlate the facilities operations knowledge and the detectors precision to diversion identifications threshold.
- Assess detectability of such diversion with regards to the uncertainty on the civilian facilities regular operations:
 - tails assays
 - fuel enrichment
 - power production
 - cooling time
- Extend this work to more complex fuel cycle



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