

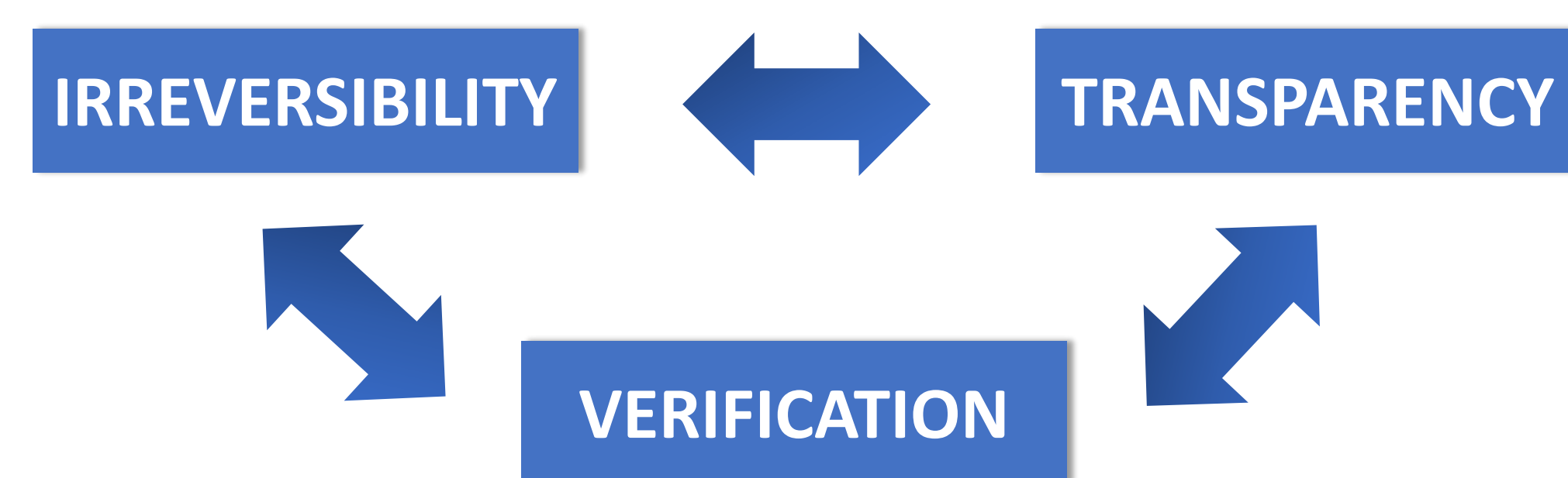
## Verifying Baseline Declarations of Fissile Materials for Stability and Irreversibility of Nuclear Disarmament

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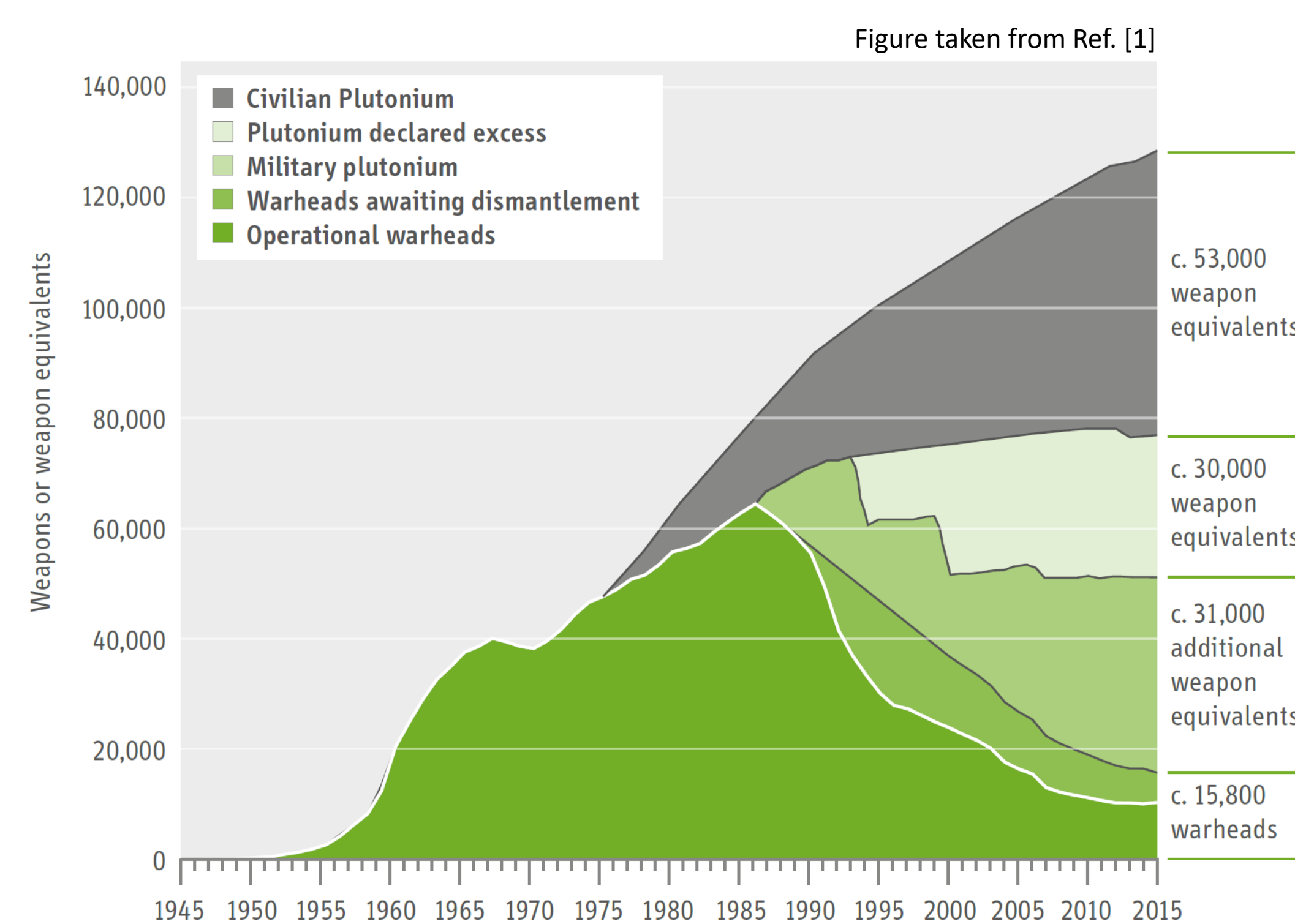
### CONTEXT

The key concepts necessary for achieving and sustaining a world with no nuclear weapons are:



Current disarmament verification focuses mainly on warhead dismantlement. This does not completely fulfil the irreversibility requirement:

- Fissile materials from dismantled weapons may be reassembled with explosives later;
- Plutonium and highly enriched uranium from existing fissile material stocks can be used



Expected stocks today

= Amount produced in the past

- Amount lost / disposed of

### RECONSTRUCTING FISSILE MATERIAL BALANCE:

Large discrepancies between book and physical inventories could be due to:

- Measurement or simulation code uncertainties, recording and rounding errors, etc.
- Deliberately hidden fissile material

# Nuclear archaeology is indispensable for verifying that nuclear disarmament is irreversible & can be used to evaluate stability during nuclear disarmament.

### PROPOSED SOLUTION: NUCLEAR ARCHAEOLOGY

- Verify how much fissile material has been produced and removed
- **The integrated approach:** several sources of information documentation, measurements (see poster A. Figueroa!) to:
  - ✓ reduce overall uncertainty and thus build confidence
  - ✓ reconstruct missing information and resolve inconsistencies
  - ✓ provide less intrusive means to verify material declaration completeness & thus ensure strategic stability during weapons reduction.

### EXAMPLE: SOUTH AFRICA

- Acceded to NPT in July 1991 & provided the IAEA with initial inventory of nuclear installations and material
- **Correctness** verified by physical inventory verification '91-'95
- **Completeness:** IAEA reconstructed the fissile material production history based on documentation and compared it with physical inventory verification results [3].
- **Issue:** discrepancy between declared inventory and calculated isotopic balance in the case of HEU and LEU
- **Solution:** archetype for nuclear archaeology
  - For Y-plant (HEU): large uncertainties on the depleted uranium significantly reduced after record examination and analysis of plant performance
  - For Z-plant (LEU): modelling plant operation & comparison of records showed that the data in accounting documents was based on inaccurate nominal values
- IAEA conclusion: no indications the initial inventory was incomplete or the nuclear weapons program had not been completely terminated and dismantled.

### CONCLUSION

- Reconstructing fissile material balance crucial for building confidence in disarmament & verifying its irreversibility
- Verifying completeness of fissile material declarations important for stability during disarmament

### REFERENCES:

- [1] IPFM, "Global Fissile Material Report 2015", pp. 24  
 [2] S. Fetter, "Nuclear Archaeology: Verifying Declarations of Fissile-Material Production", Science & Global Security, 1993, Volume 3, pp. 237  
 [3] A. von Baeckmann et al., "Nuclear Verification in South Africa", IAEA Bulletin, 1/1995, pp. 42



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