

## **Procedure to determine the SWU attribution to the IR-1, IR-2m and IR-4 centrifuge types**

### **I. General**

- 1) This attachment outlines the procedure to determine the SWU attribution to the IR-1, IR-2m and IR-4 centrifuge types, as per Paragraph 55 of Annex I of the JCPOA.
- 2) The SWU per centrifuge in single cascade operation will be used to determine the installed enrichment capacity during years 11, 12 and 13 in accordance with Iran's enrichment and enrichment R&D plan.
- 3) Measurements of the SWU will be performed for the IR-2m and IR-4:
  - a. Within 6 months before year ten for a small cascade of IR-4 centrifuges with no results to be communicated to the IAEA and Joint Commission.
  - b. In the beginning of year 11, once an IR-2m and/or IR-4 cascade has been installed, for cascade operation mode. The number of additional cascades will be based on this measurement.
  - c. During years 11, 12 and 13 every eight months cascade operation mode.
- 4) The SWU of the IR-1 is being assessed to be 1.0 kg U SWU per year per centrifuge based on historic experience.

### **II. Sets of measurements**

- 1) Cascade measurements to obtain the SWU of IR-2m and IR-4 cascades will include two sets of measurements on the same cascade selected at random by the IAEA. Each set will consist of measurements at the declared nominal feed flow and at feed flow 15 per cent higher and 15 per cent lower than the nominal feed flow.
- 2) The final figure to be taken into account will be the arithmetic mean of the two cascade measurements at the declared nominal feed flow. This procedure to determine the SWU will be repeated if the IAEA deems this appropriate in order to resolve inconsistencies due to abnormal data.

### **III. Measurement procedure**

Under full IAEA monitoring (as described in Section V):

- 1) Iran will operate all centrifuges at the nominal spinning frequency, feed, product and tails flow, temperature and internal settings as specified by Iran.
- 2) Iran will feed the cascade with UF<sub>6</sub> with the natural isotope abundance.
- 3) Each cascade measurement will begin after a lead time of 9 hours. During the lead time, the gas flow will be constant.
- 4) For a measurement time of 3 hours for cascade measurement, Iran will collect product and tail in appropriately sized containers with established tare weights and that are verified to be empty prior to use. All product and tails withdrawn from the cascade during the measurement period will be collected.
- 5) After the measurement time has elapsed, the collected product and tail samples will be weighed by Iran and the Agency.
- 6) Iran will homogenize the product and tail samples.
- 7) Iran will use half of the collected product and tail samples to determine the isotopic composition.
- 8) The Agency will use the other half of the collected product and tail samples to determine the isotopic composition at its laboratory.
- 9) The Agency will report back to Iran the results of the above measurements.

#### **IV. Provision of information by Iran**

- 1) Iran will provide to the Agency, before beginning of measurement, the nominal spinning frequency, the nominal feed, product and tail flows, temperature and the cascade configuration. The specified cascade configuration needs to be the cascade configuration used for production of enriched material.
- 2) Iran will provide the weight and isotopic concentration of the collected product and tail material within the DIQ to the Agency and the final averaged result for the IR-2m and IR-4 to the Joint Commission.

#### **V. Verification measure of the Agency**

- 1) Iran will provide access to the Agency to equipment and local measurement devices, as requested by the Agency, to enable the Agency to verify that Iran implements the agreed measurement procedure (as described in section III). In particular, the Agency will verify that:
  - a. Centrifuges are operated at nominal frequency, gas flow, temperature, the specified cascade configuration, and that all centrifuges are operating,

- b. All valves, the cascade configuration and operating status of all centrifuges, as declared, are set correctly,
- c. The feed material is UF<sub>6</sub> with the natural isotope abundance,
- d. The lead time is 9 hours and the measurement time is 3 hours for cascade measurements, and
- e. The feed flow does not vary during the lead time and the measurement time.

## VI. Communication of results

- 1) The Agency will confirm to the Joint Commission that the weight and isotopic concentration of the collected product and tail provided by Iran in the DIQ is consistent with its own measurements.
- 2) If the Agency deems that the measurements provided by Iran are not consistent with its own measurements, it will raise the issue with Iran in order to resolve the inconsistency. In case this cannot be solved, the Agency will refer the issue to the Joint Commission.

## VII. Calculation of the SWU

- 1) Based on the measurements, the SWU  $dU$  in Kg uranium per centrifuge and per year would be calculated according to the formula

$$dU = (31557600/tn) [PV(x_p) + TV(x_t) - FV(x_f)],$$

where  $V(x) = (1 - 2x)\ln((1 - x)/x)$  and  $P$  is the mass of uranium in kg in the collected product,  $x_p$  is the isotopic concentration of the product (mole fraction),  $T$  is the mass of uranium in kg in the collected waste,  $x_t$  is the isotopic concentration of the waste,  $F = P + T$  and  $x_f$  is the natural isotopic concentration,  $t$  is the measurement time in seconds and  $n$  is the number of centrifuges in a cascade.