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Science, Technology, and
National Security Working Group

How Iran Could Clandestinely Build 10 Low-Technology Atomic Bombs

Deep Dive
July 16, 2025

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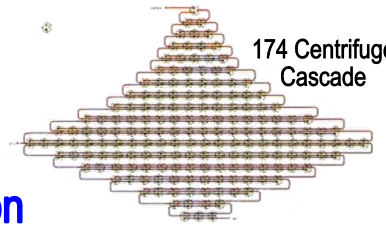
It Is Overwhelmingly Likely That Iran Has the Very Small Amount of Needed Enrichment Capacity to Proceed with Building Atomic Bombs



- The Iranians are Known to Have 408 Kg of 60% Enriched Uranium Hexafluoride (UF_6)
- Prior to the Attack on Fordow There Were 10 Cascades of 174 IR-6 Centrifuges in Operation
- A Single Such Cascade Could Take Up No More Than 60 m^2 of Floor Space, making it Easily Hidden in a Small Laboratory
- 37.5 Kg of 60% Enriched UF_6 is Needed to Produce 25 Kg of 90% Enriched UF_6 For a Single Atomic Bomb
- This Is Enough to Produce Enriched Uranium for 10 or 11 ***Low-Technology*** (Not Designed for Spherical Implosion) Atomic Bombs
- Each of These Atomic Bombs Could Weigh Roughly 100 to 150 kg and Could be Carried by Existing Iranian Ballistic Missiles
- We Do Not Know What Level of Damage, ***If Any***, Was Done to the Centrifuge Cascades at Fordow – But it is Overwhelmingly Likely That Most or All of The Centrifuges Were Not Damaged.
- If We Assume that Only 10% of the IR-6 Centrifuges at Fordow Were Not Damaged, Then One Cascade of 174 IR-6 Centrifuges Will Have Survived.
- Even If All Centrifuges At Fordow Were Destroyed, It Is Overwhelmingly Likely That Iran Has Enough IR-6 Centrifuges From Production Lines to Construct a 174 Centrifuge Cascade.
- A Cascade of 174 IR-6 Centrifuges Can Produce 900 To 1000 Separative Work Units (SWU) Per Year
- Hence, A Single Cascade Would Take 5.5 Years to Produce 25 Kg of 90% Enriched UF_6 for An Atomic Bomb
- If the Same Cascade Was Instead Fed With 60% Enriched HF_6 It Would Instead Take 5 To 6 Weeks to Produce 25 Kg of 90% Enriched HF_6 for An Atomic Bomb
- This Means a Single Cascade, Made from174 IR-6 Centrifuges, Not Necessarily from Fordow, would be enough to produce 25 kg of 90% enriched UF_6 for An Atomic Bomb

Iran's Basic Nuclear Capabilities Described in this Analysis

- A single centrifuge cascade capable of enriching enough 60% enriched Uranium Hexafluoride (UF_6) gas to produce the metallic uranium for an atomic bomb takes up no more floor space than a studio apartment (600 ft^2 – 60 m^2).
- A single Prius Compact Hybrid car can produce enough electric power to run four or More of these cascades at a time.
- One of these cascades could produce the metallic uranium for a bomb roughly every 4 to 6 weeks. Additional cascades could produce bombs at a higher rate.
- Iran also can covertly convert 90% enriched Uranium Hexafluoride UF_6 to 90% enriched weapons grade uranium metal.
- Iran can design and build nuclear weapons with reduced amounts of uranium – roughly relative to what is commonly predicted in public accounts.
- All of these conversion and fabrication activities would require very small facilities that could be easily hidden from foreign intelligence.

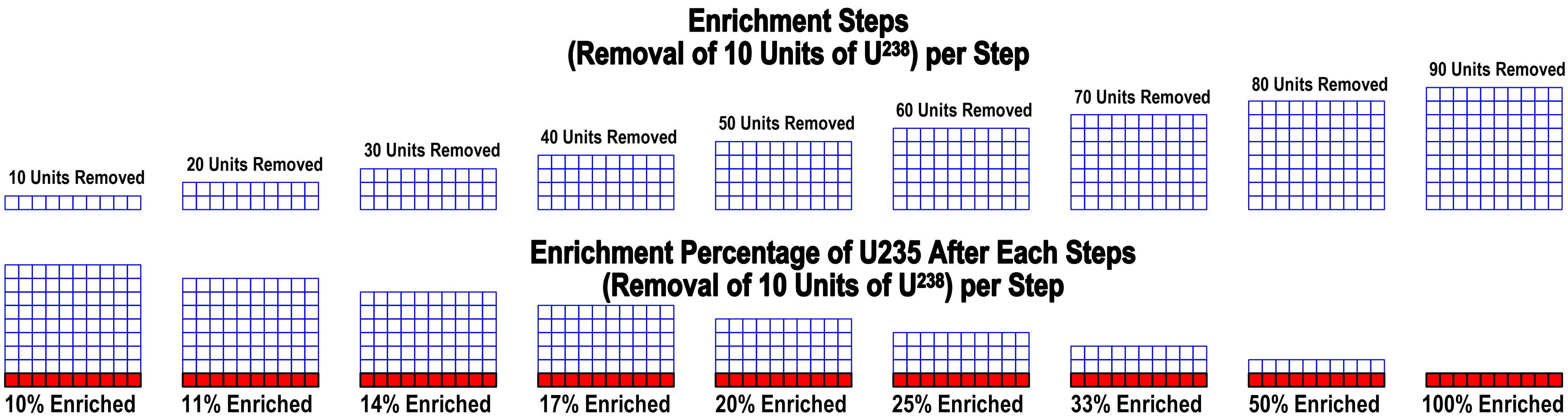
These Facts Indicate Clandestine Nuclear Weapons Construction Could Go Undetected

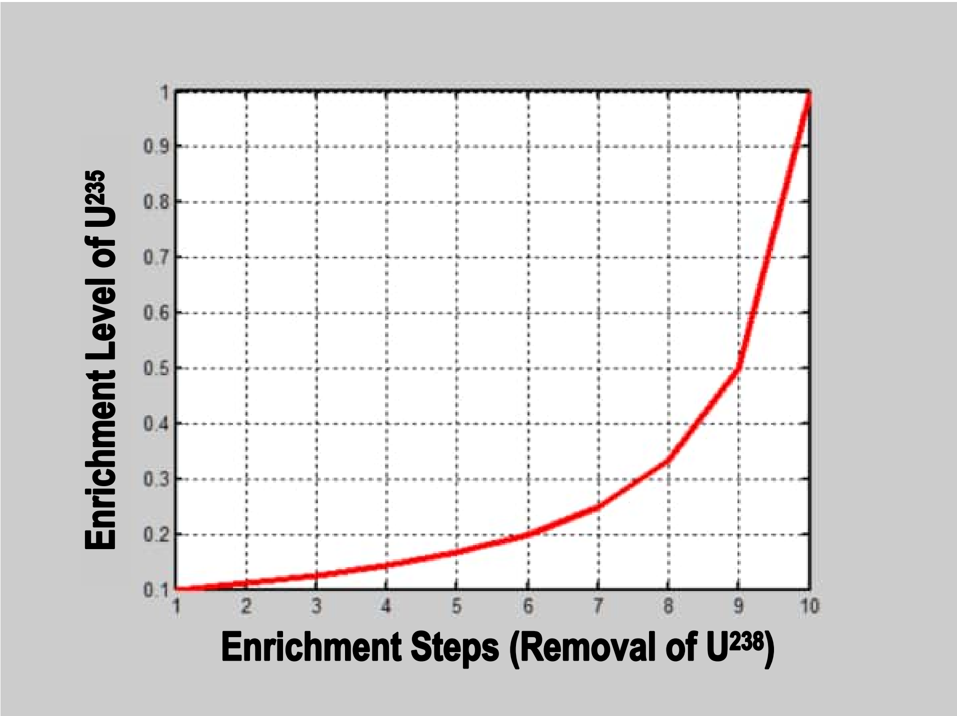
How Iran Could Easily and Covertly Enrich the 408 Kg of 60% Enriched Uranium Hexafluoride (UF_6) They Now Possess to 90% Weapons Grade Uranium Hexafluoride (UF_6)

272 kg of 90% U^{235}

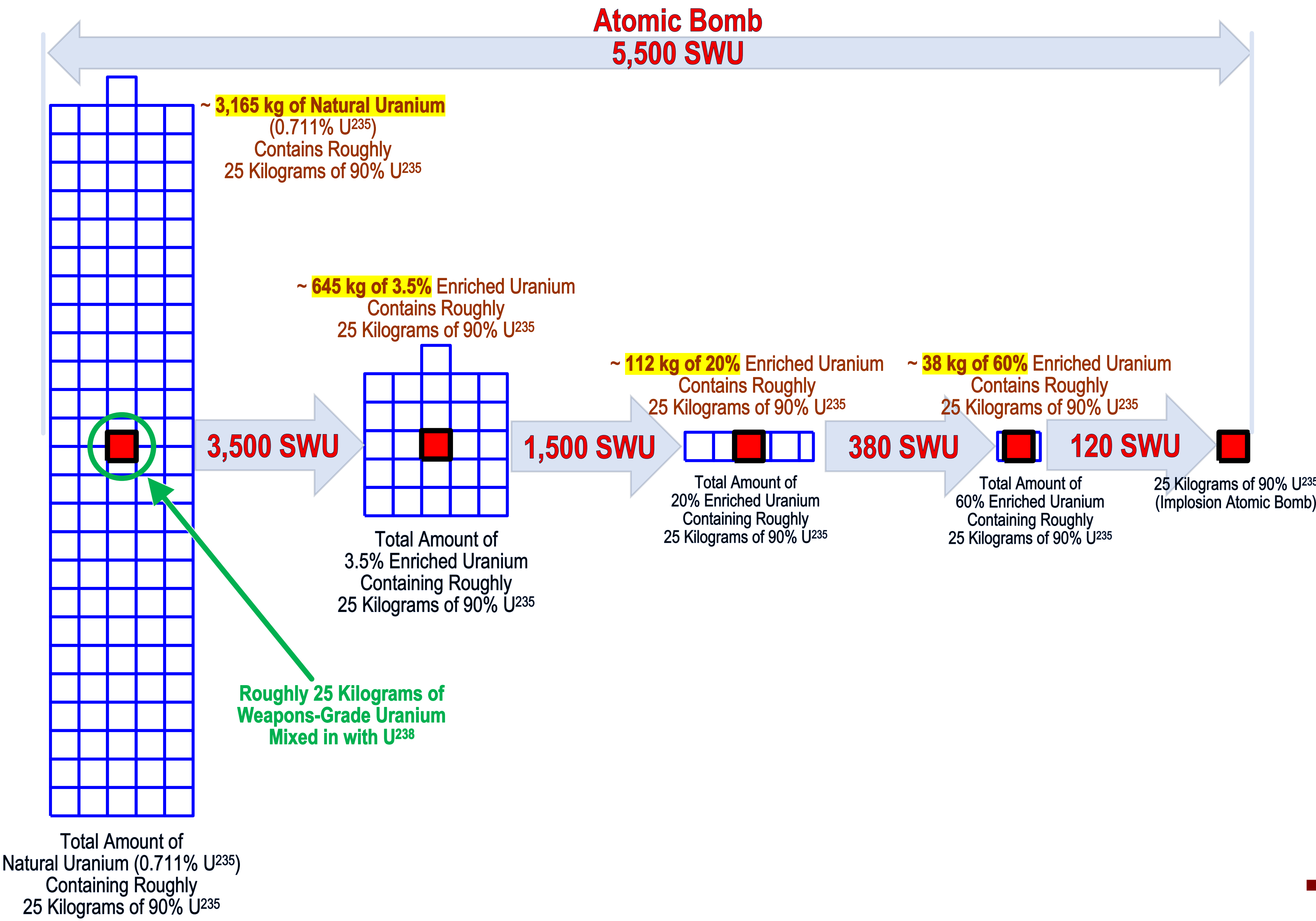
Proceeding to a Bomb Not Easily Stopped
Enriched Uranium and Further Enrichment Capacity Already There

Conceptual Picture of Enrichment Process
Increase in Concentration per "Step" Gets Significantly Larger as Each Enrichment Step Proceeds





Separative Work and Quantities of Uranium Required to Get to Various Levels of Enrichment



How Much Damage to Fardow Centrifuges Needed to Delay Production of Atomic Bombs?

Before Attack

10 Cascades of 174 IR-6 Centrifuges (1740 Centrifuges)

Centrifuge and Cascade Enrichment Capacity

IR-6 Centrifuge ~ 4.5 swu kg/yr

4.5 swu kg/yr ×174 Cascade of IR-6 Centrifuges = 783 swu kg/yr per Cascade

Required Enrichment Capacity to Produce Atomic Bomb

120 SWU for 37.5 kg U^{235} of 60% Enriched to 25 kg 90% Enriched

500 SWU for 112 kg of 20% Enriched U^{235} to 25 kg 90% Enriched

Number of Atomic Bombs Producible from Available Uranium

Bombs per Year from 60% Enriched Uranium =

783 swu kg/yr per Cascade/120 SWU for 60% ~ 6.5 Bombs

In reality 6.5/1.5 = 4.35 (Convert from UF_6 to U^{235} Metal)

Number of Iranian Enriching Centrifuges and Their Enrichment Capacities, As of May 2025

	Number of centrifuges	Enrichment capacity in swu/yr	IR-1 equivalent
Natanz	14192	35993	39992
Fordow	2264	7345	8161
Natanz Above-Ground PFEP*	701	2964	3293
Natanz Below-Ground PFEP*	802	3821	4245
Total	17,959	50,123	55,691

* The values for IR-5 and IR-6s centrifuges at the PFEP areas are rough estimates based on the use of estimated and measured values for the separative output of these centrifuges in cascades, as drawn from IAEA and Iranian information.

Source: Institute for Science and International Security
Analysis of IAEA Iran Verification and Monitoring Report — May 2025
By David Albright, Sarah Burkhard, and Spencer Faragasso
June 9, 2025

Iran’s Indigenous Gas Centrifuge Technologies

Facts That Indicate a Clandestine Enrichment Program Could Go Undetected

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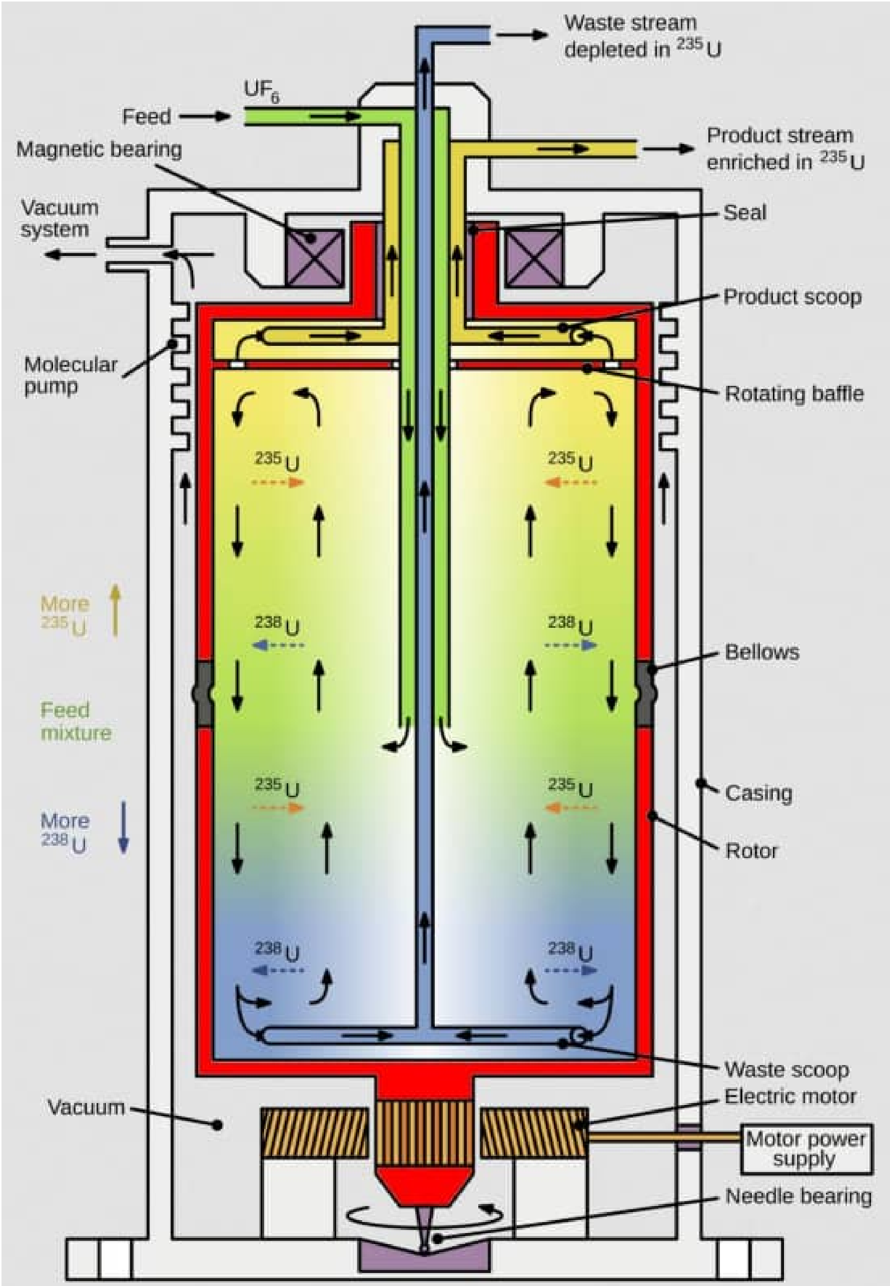
How the Uranium Gas Centrifuge Works: Centripetal Force



IR-6 Centrifuge

Rotation Rate ~ 70,000 RPM ?

Rotor Diameter ~ 20 cm ?

5 to 6 SWU / (kg Year) ?

Centripetal Force at Wall ~ 350,000 – 500,000 G

The Iranian IR-6 centrifuge is approximately 160-168 cm tall with a casing width of 30 cm. It is a dual-rotor centrifuge, likely with rotors and bellows made from carbon fiber. The IR-6 also has a smaller, single-rotor variant called the IR-6s.

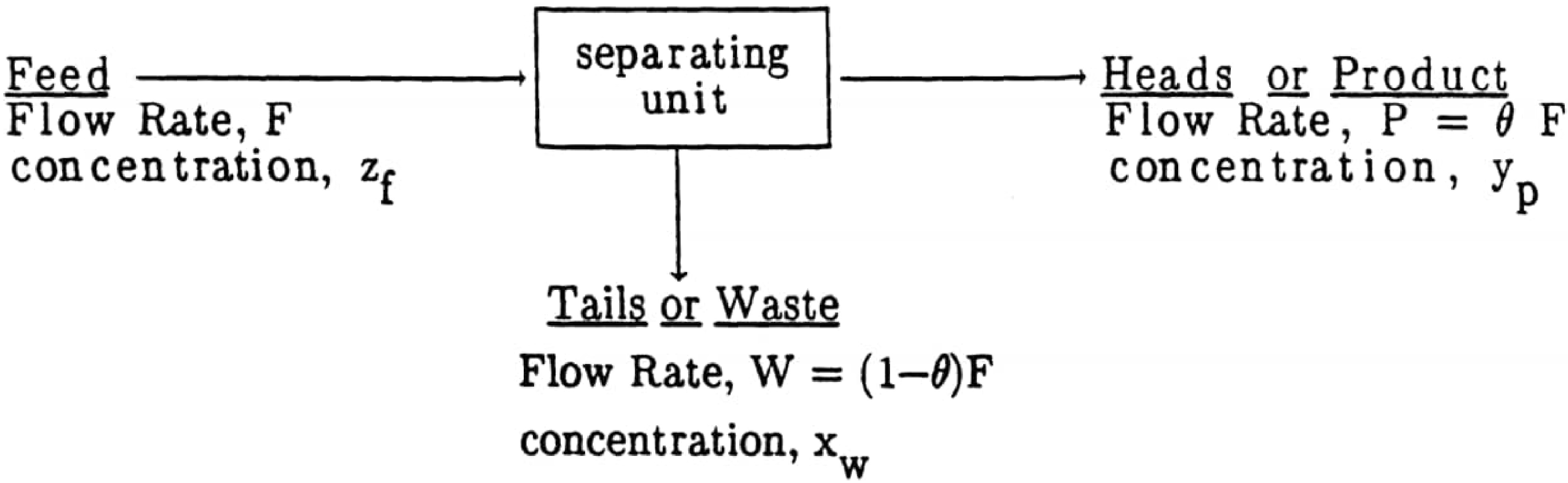
Here's a more detailed breakdown:

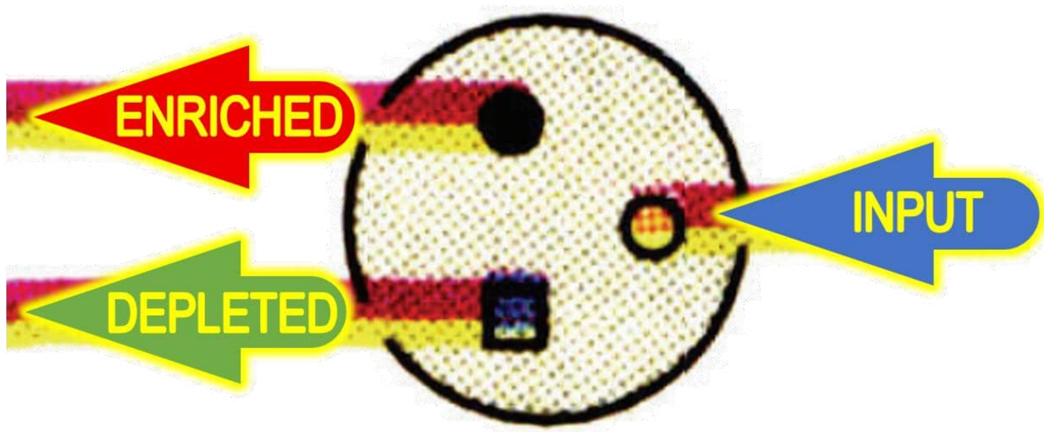
- **Height:** 160-168 cm
- **Width (casing):** 30 cm
- **Rotor Material:** Carbon fiber
- **Rotor Type:** Dual-rotor (likely for the standard IR-6)
- **Variant:** IR-6s (single-rotor)
- **Separation Capacity:** Iran claims 10 SWU/year for the standard IR-6. However, other sources suggest a theoretical output of 6.7 SWU/year per centrifuge, with an average of 5.25 SWU/year in a production cascade.
- **Overall length:** 1100 millimeters, according to some sources.
- **Rotor diameter:** 200 millimeters, according to some sources.

Notes:

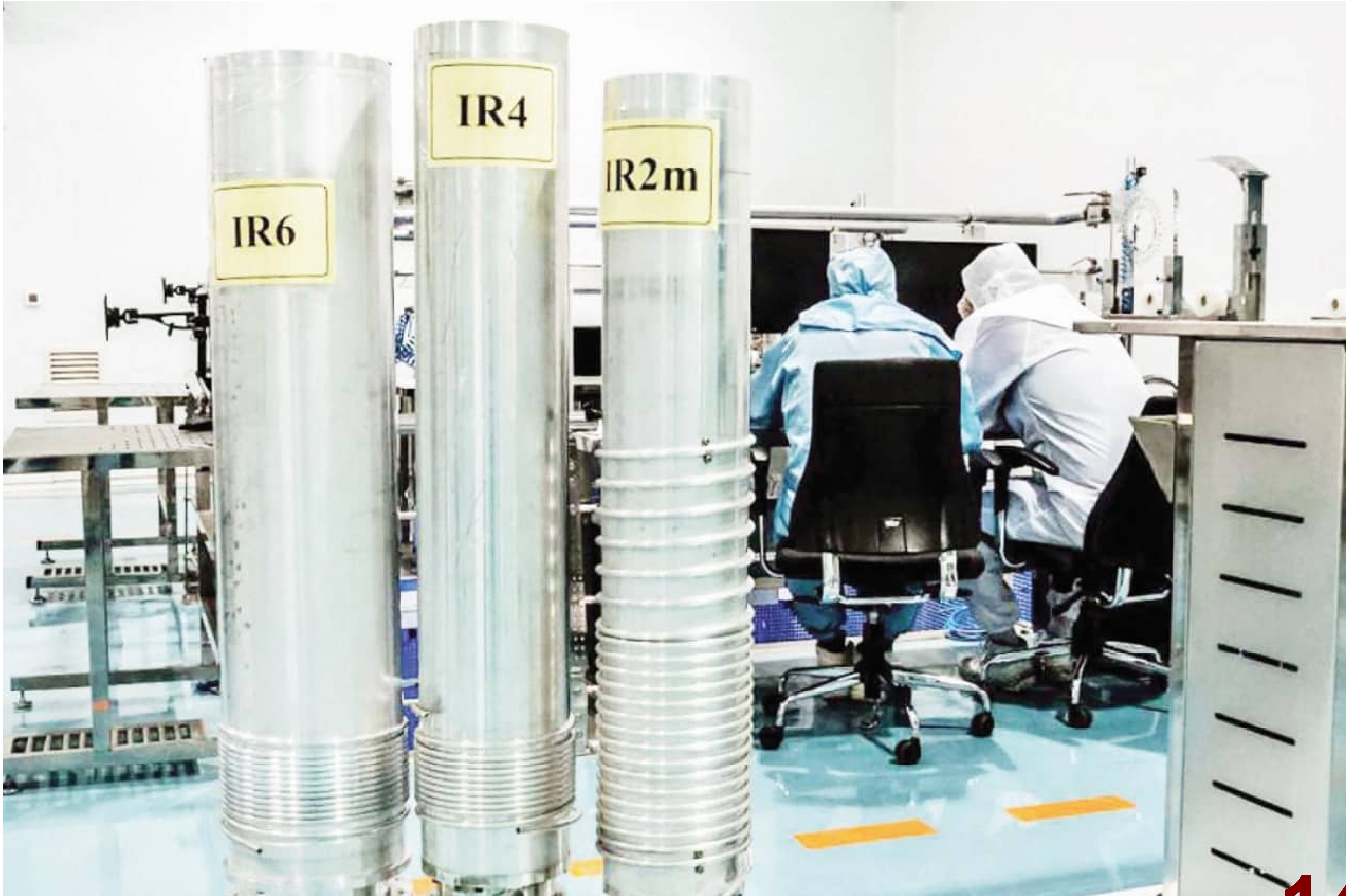
A Flea on the outer wall of the rotor will generate a lateral force of 0.5 kg (~ 1 lb

Enrichment Separation Unit

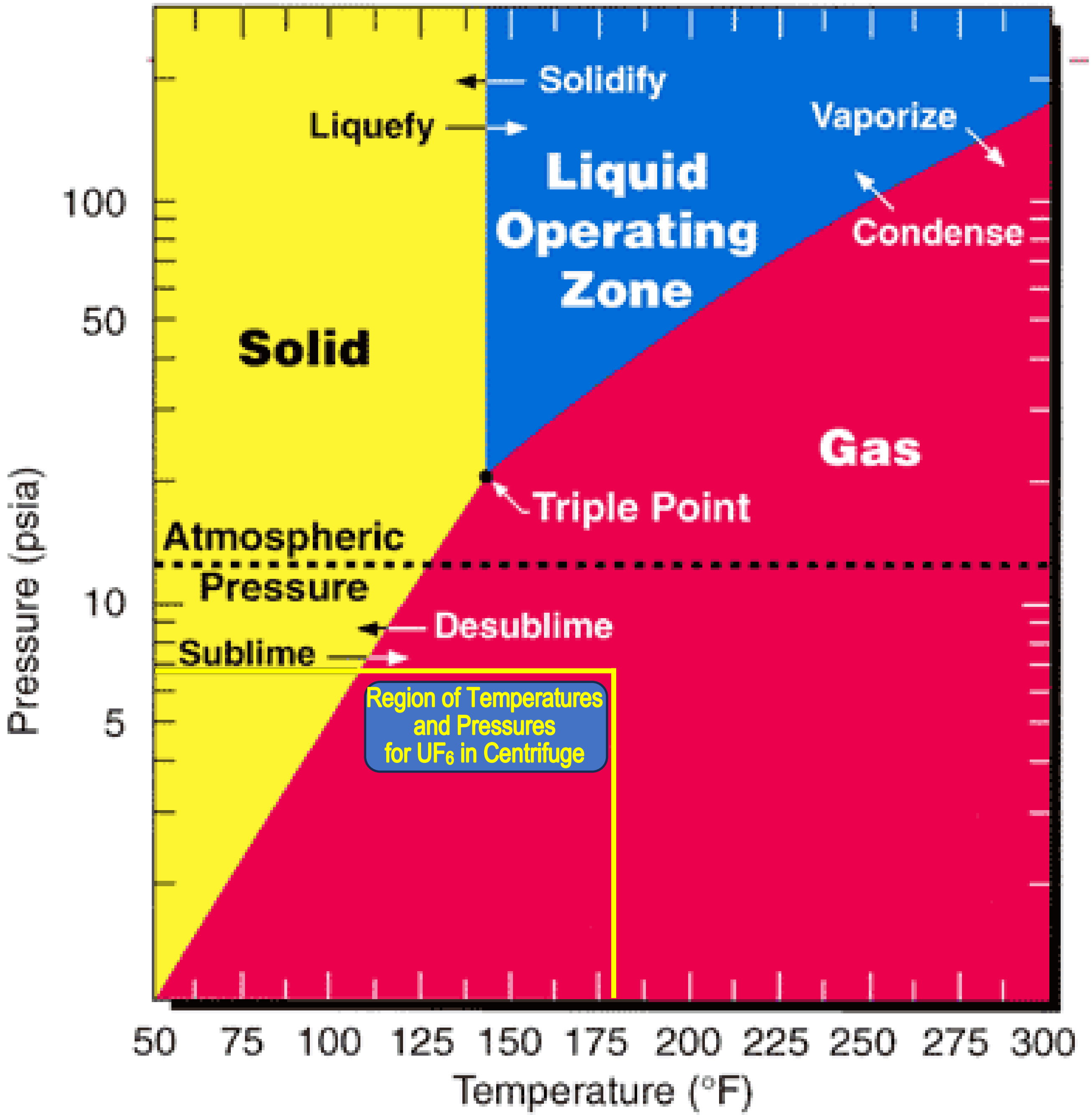




Particular Type of Separation Unit: The Uranium Gas Centrifuge



Properties of Uranium Hexaflouride (UF_6) Gas Inside a Centrifuge



Notes:

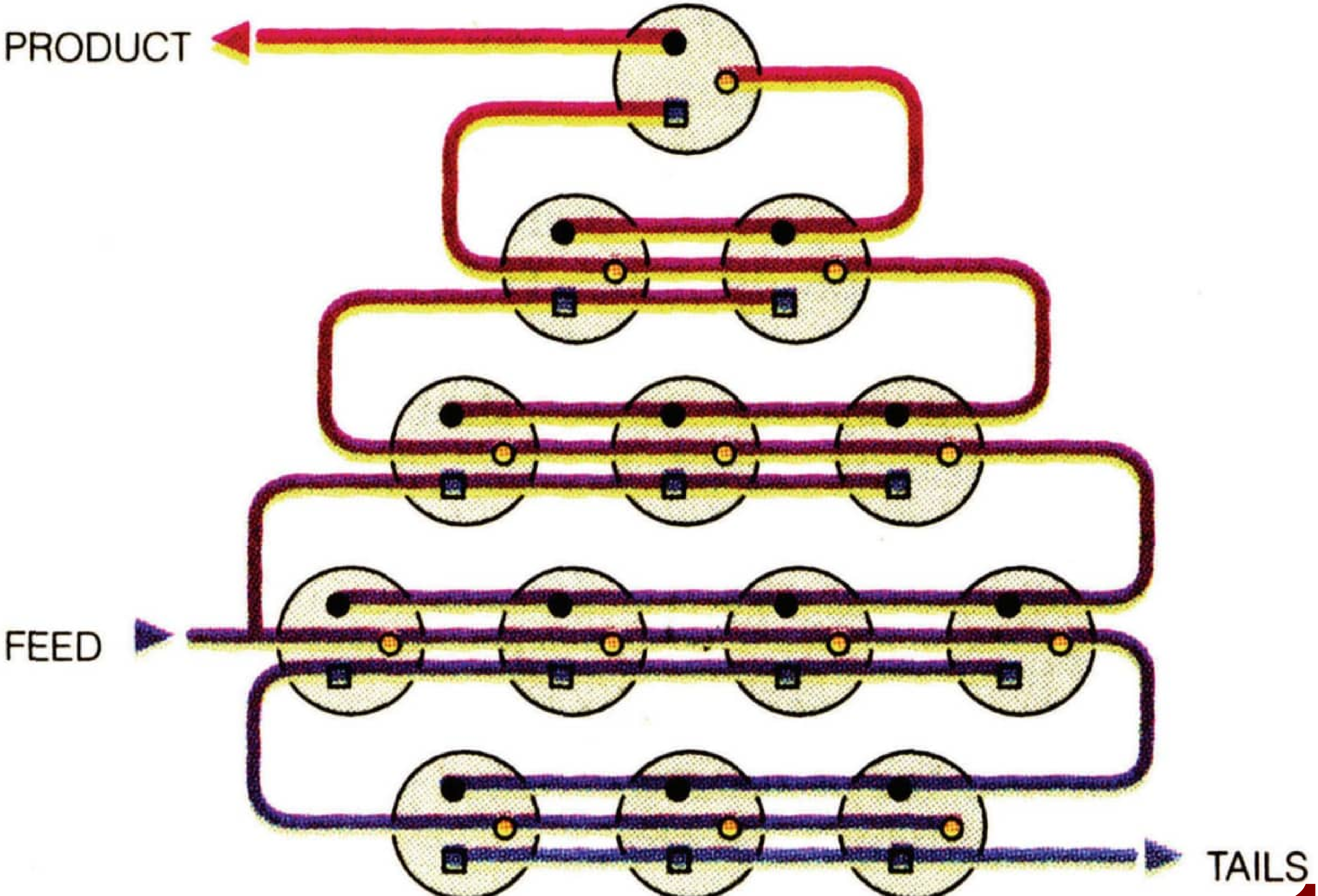
UF_6 = 14.12 g/L at 30° C and 1 Atm Pressure

T1=30+273.15;
T2=80+273.15;

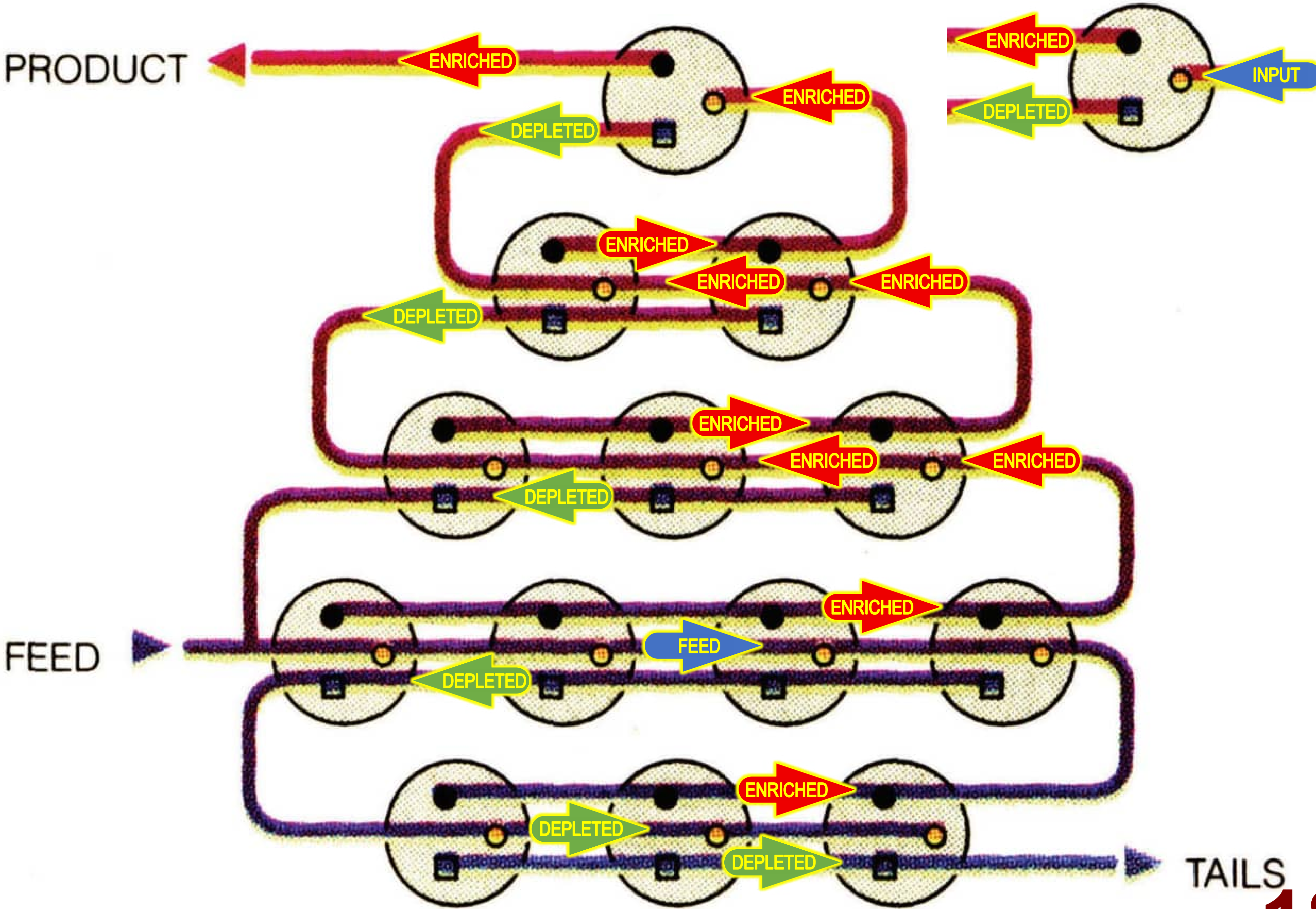
14.12*T1/T2 /2= 6.0604

UF_6 = 6.6 g/L at 30° C and 1 Atm Pressure

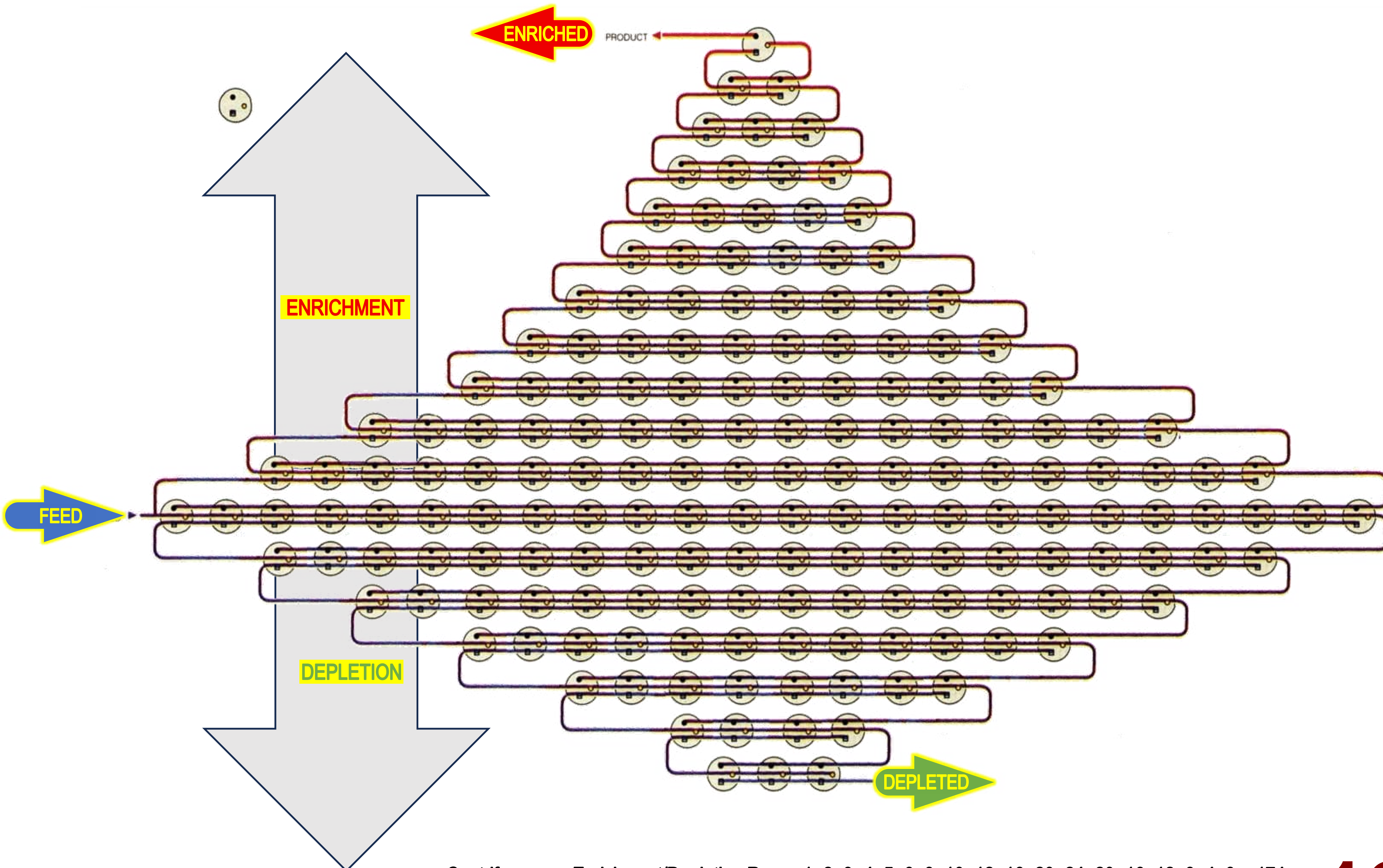
Enrichment Cascade Configuration



Enrichment Paths Through a Cascade of Centrifuges

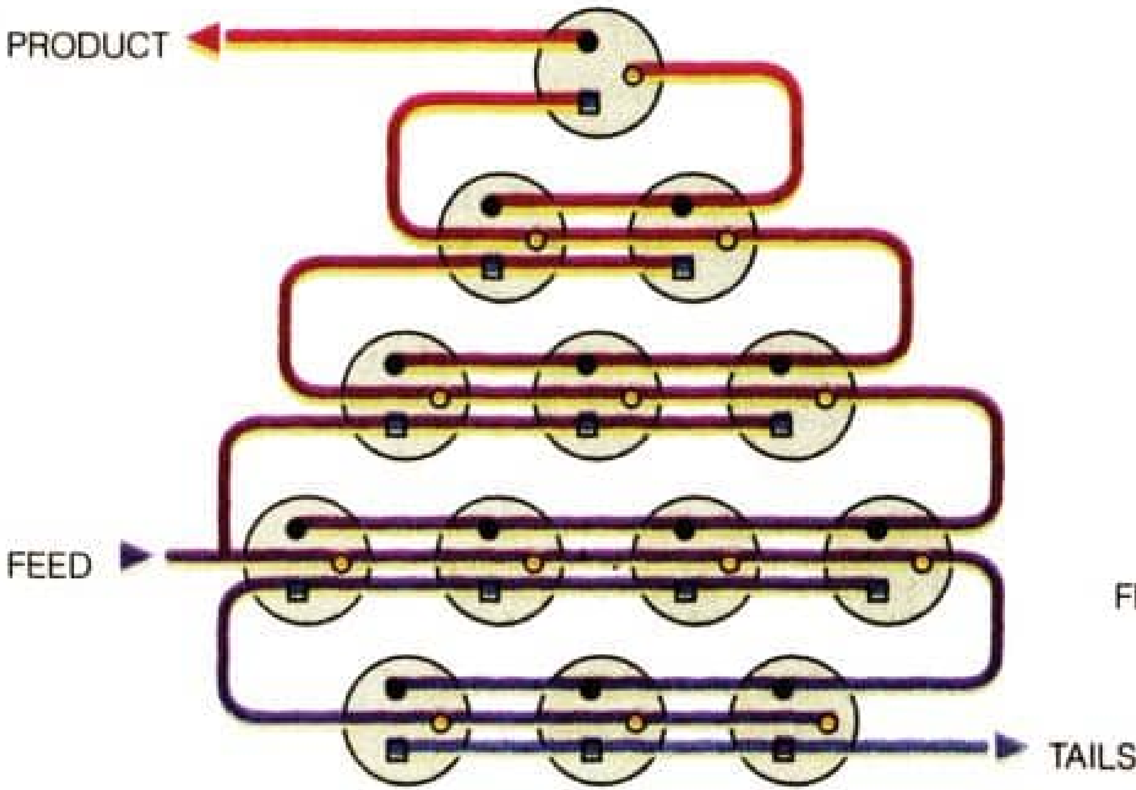


Rough Estimate of the Configuration and Enrichment Paths of a 174 Centrifuge Cascade at Fordow, Iran

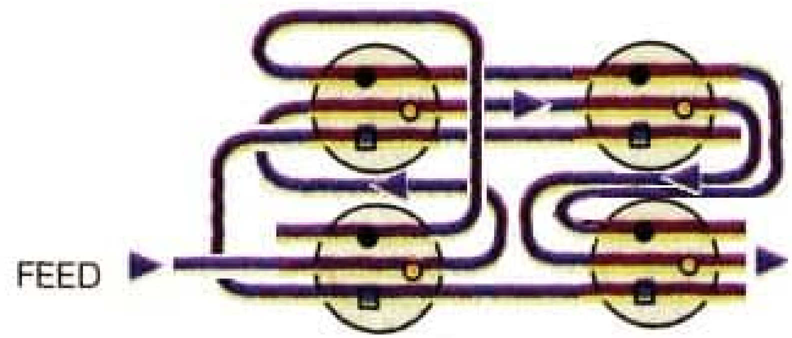


Centrifuges per Enrichment/Depletion Row = 1+2+3+4+5+6+8+10+12+16+20+24+20+16+12+8+4+3 = 174

Spatial Placement of Centrifuges Easily Done for Maximizing Use of Floor Space

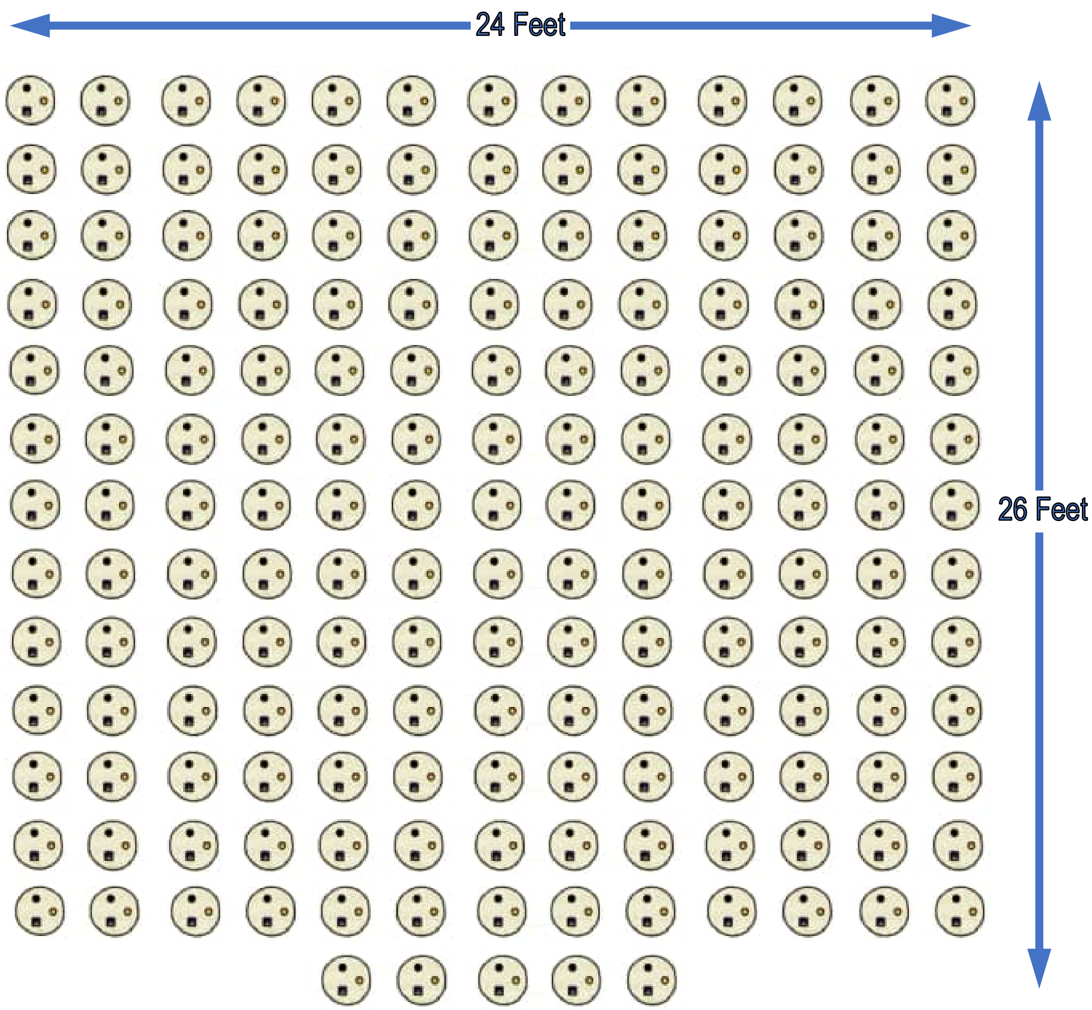


Arrangement Where
Length of Enrichment Row is
Halved and Width is Doubled



Rough Estimate of Floor Space Needed by a 174 Centrifuge Enrichment Cascade

Cascade of 174 IR-6 Centrifuges Produces About 1000 SWU kg/Yr



Total Area = 624 ft^2

Enrichment Paths Through a Cascade Centrifuges

Average Power Requirements to Run Clandestine "Studio-Apartment" Sized Centrifuge

Power ~ 35 Watts per SWU?

(35 Watts / Centrifuge / SWU) × (174 Centrifuges) × (6 SWU/Centrifuge) = 37 kW

Prius Motor and Electric Generator Output ~ 150 kW

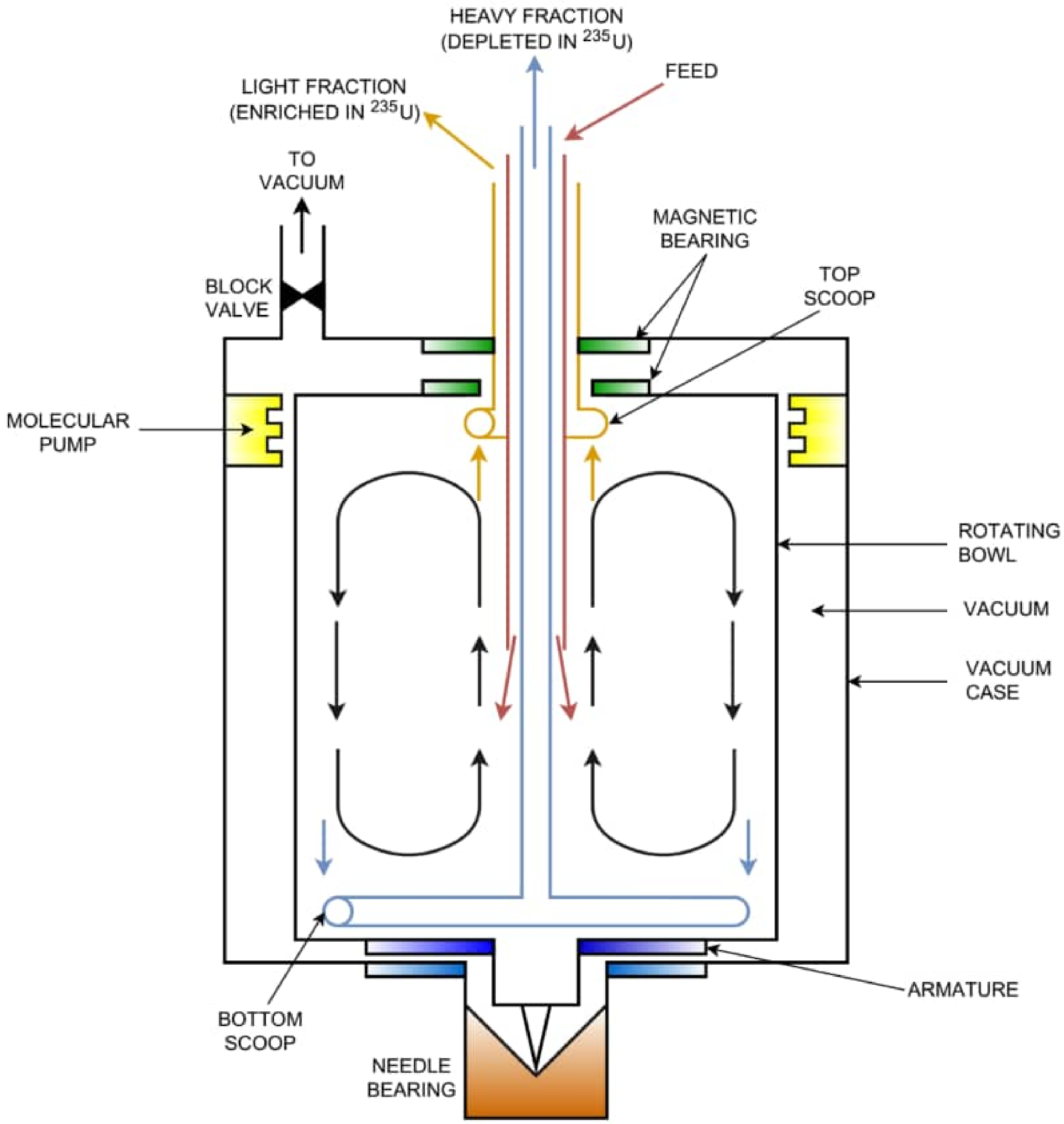
(Enough to Simultaneously Power Four or More Clandestine 174 Centrifuge Cascades)

Summary of Clandestine Enrichment Paths Through Cascade Centrifuges

- Operating and hiding a centrifuge cascade is easy.
- It takes almost no space and draws very small amounts of power
- A significant enrichment capability of 1000 SWUs is easily achieved
- 120 SWU's Are Needed to Enrich 40 kg of 60% UF_6 to 25 kg of 90% enrichment
- Cascade of 174 IR-6 Centrifuges Produces ~ 900 to 1000 SWU
- Hence, One Bomb Every 120/1000 × 52 weeks/yr = 6 – 7 weeks

How Iran Could Easily and Covertly Change the 90% Enriched Uranium Hexafluoride (UF_6) into Uranium Metal for an Atomic Bomb

First Step of Two Secretly Needed Steps is to Convert Uranium Hexafluoride into Uranium Tetrafluoride Which Can Then Be Converted into Uranium Metal for a Bomb



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Uranium hexafluoride

U compounds	More compounds... ▾

- Formula: UF_6
- Hill system formula: F_6U_1
- CAS registry number: [7783-81-5]
- Formula weight: 352.019
- Class: fluoride
- Colour: white
- Appearance: crystalline solid
- Melting point: 64°C (triple point)
- Boiling point: 56.5°C
- Density: 5090 kg m^{-3}

First Step of Two Secretly Needed Steps is to Convert Uranium Hexafluoride into Uranium Tetrafluoride Which Can Then Be Converted into Uranium Metal for a Bomb

30B Cylinder

30B Cylinder

Diameter: ~ 0,75 m (30 inch)

Length: ~ 2 m

Wall thickness: 12,7 mm (1/2 inch)

Volume: ~ 750 l

Tare weight: ~ 635 kg

Max. fill: 2275 kg

Gross weight: ~ 3000 kg

Proof pressure: 28 bar

(5-year inspection)

Max. Operating temp.: 121°C/250°F

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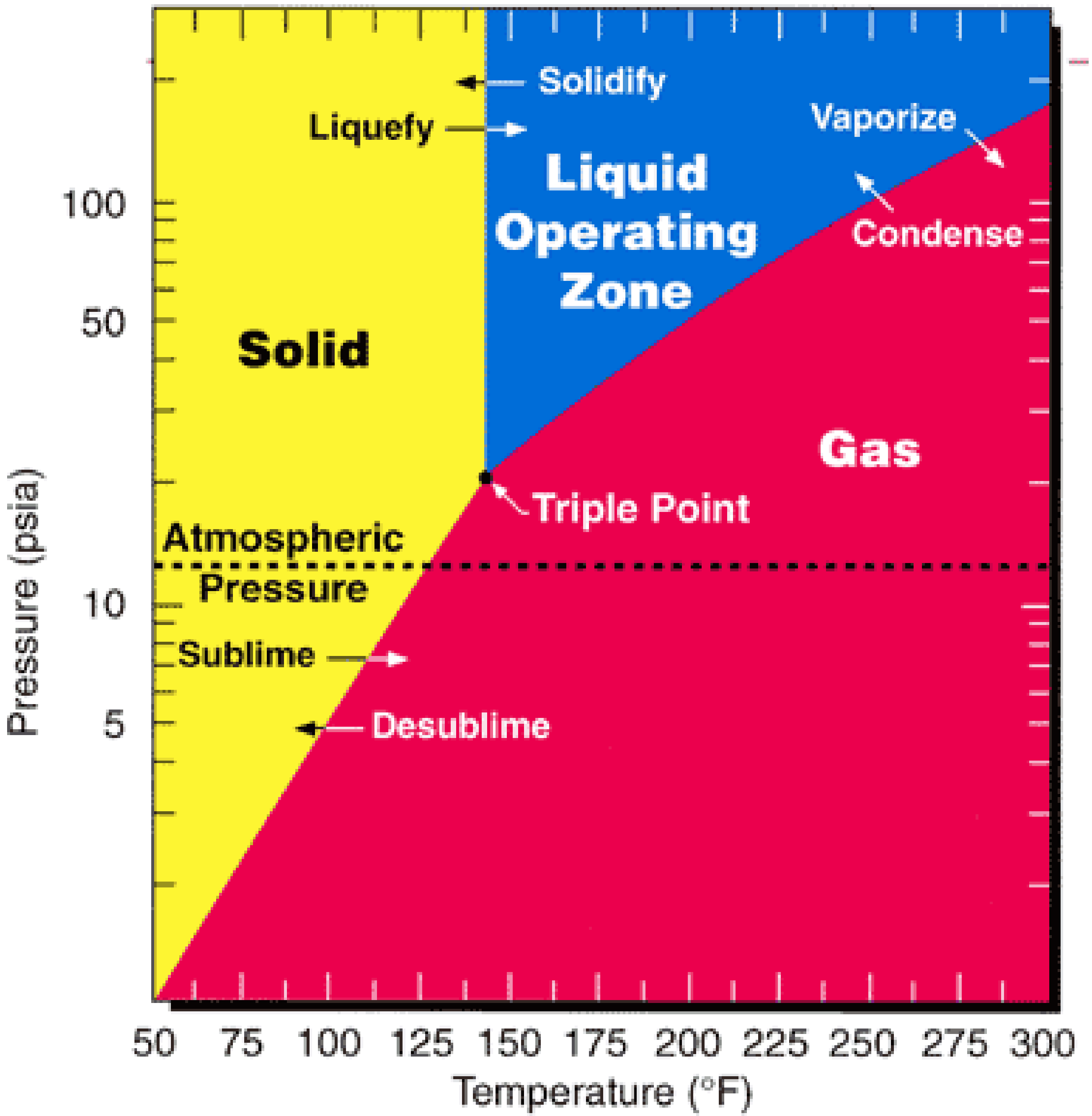

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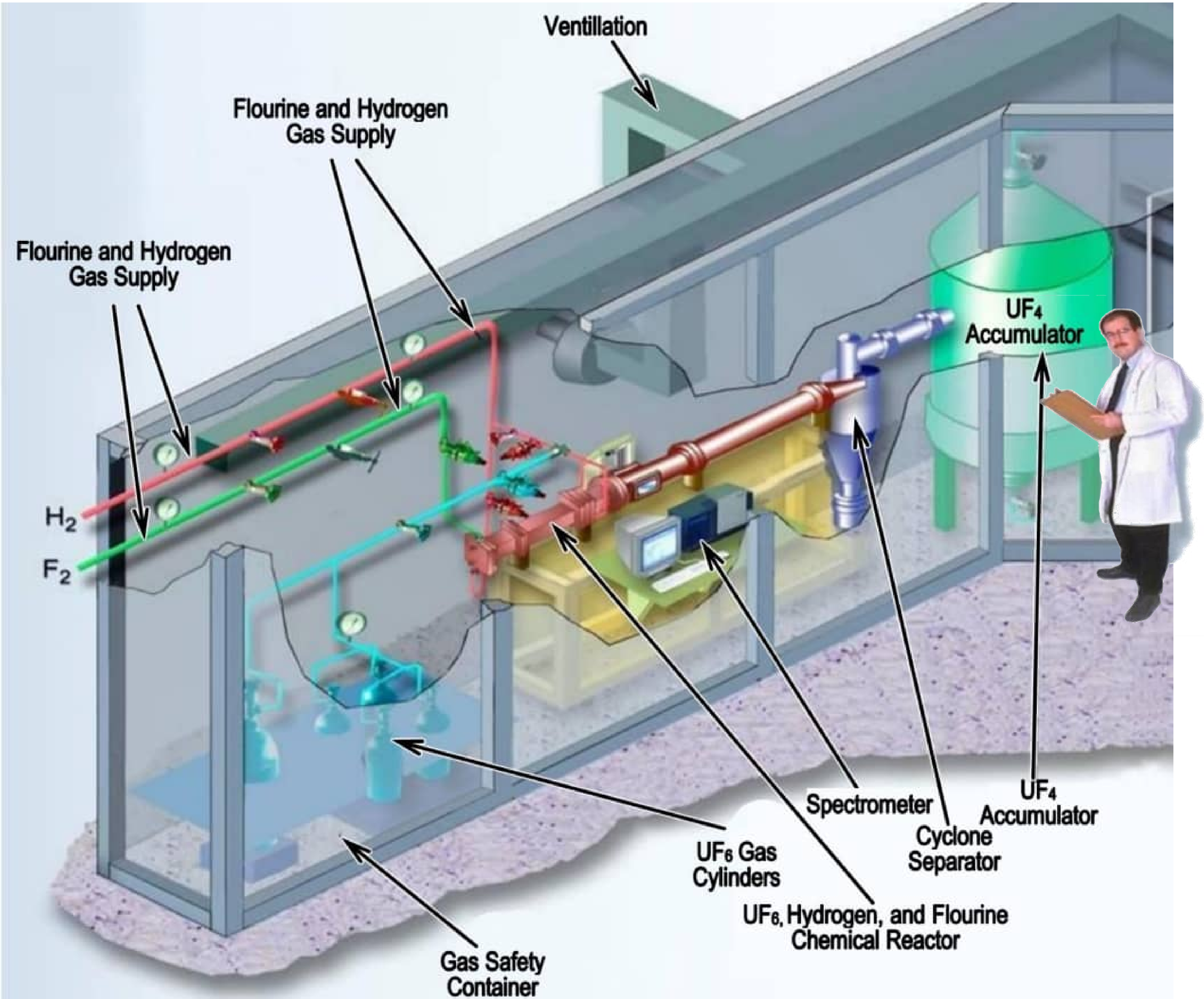
$$UF_6 + H_2 = UF_4 + 2HF$$

Compact and Facility That Can Be Hidden and Buried Deep Where Uranium Hexafluoride Can Be Converted to Uranium Tetrafluoride in Preparation to Produce Uranium Metal



Compact and Facility That Can Be Hidden and Buried Deep Where Uranium Hexafluoride Can Be Converted to Uranium Tetrafluoride in Preparation to Produce Uranium Metal

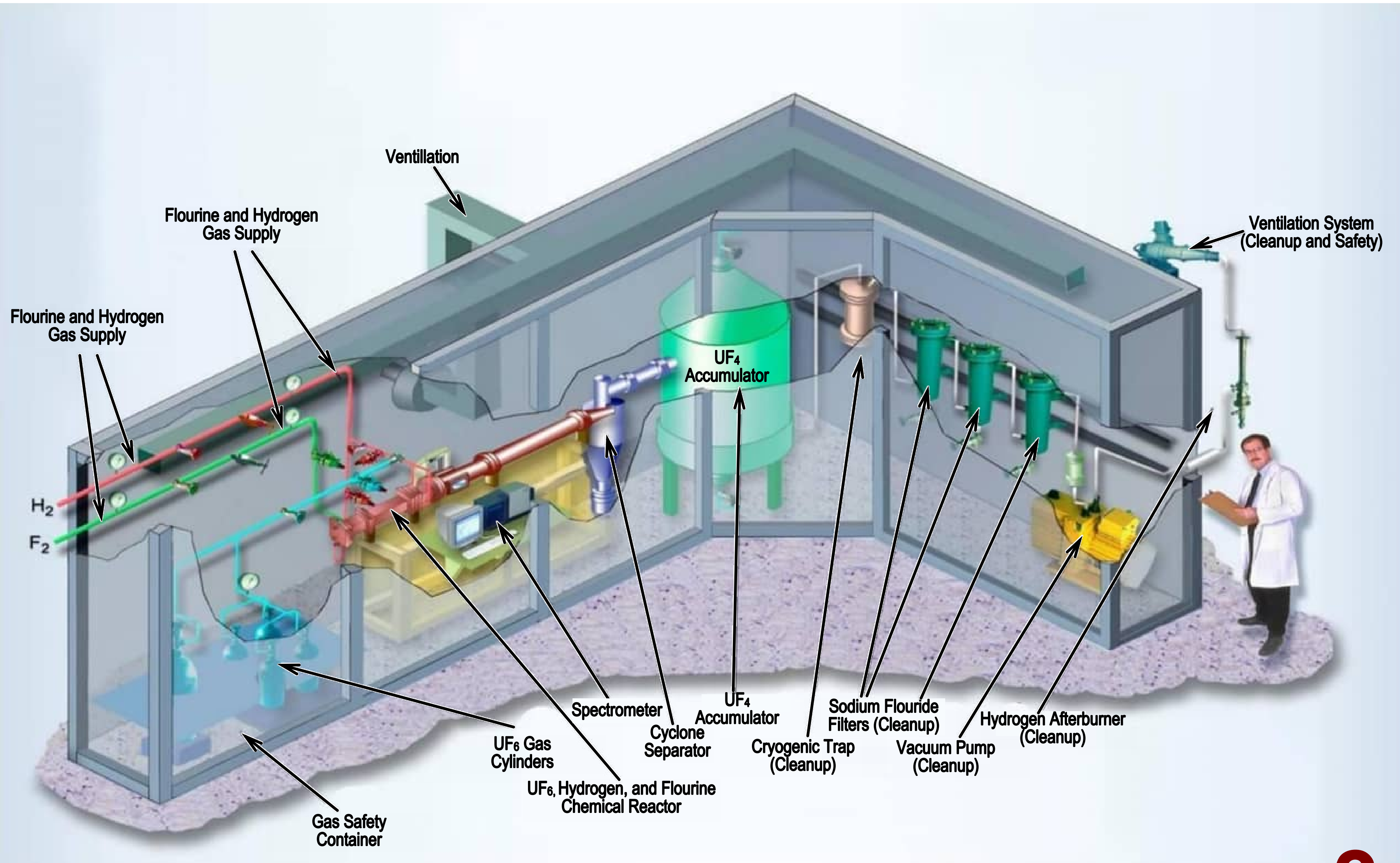


Diagram of Russian HF6 to HF4 Chemical Converter Published in Refereed Scientific Journal

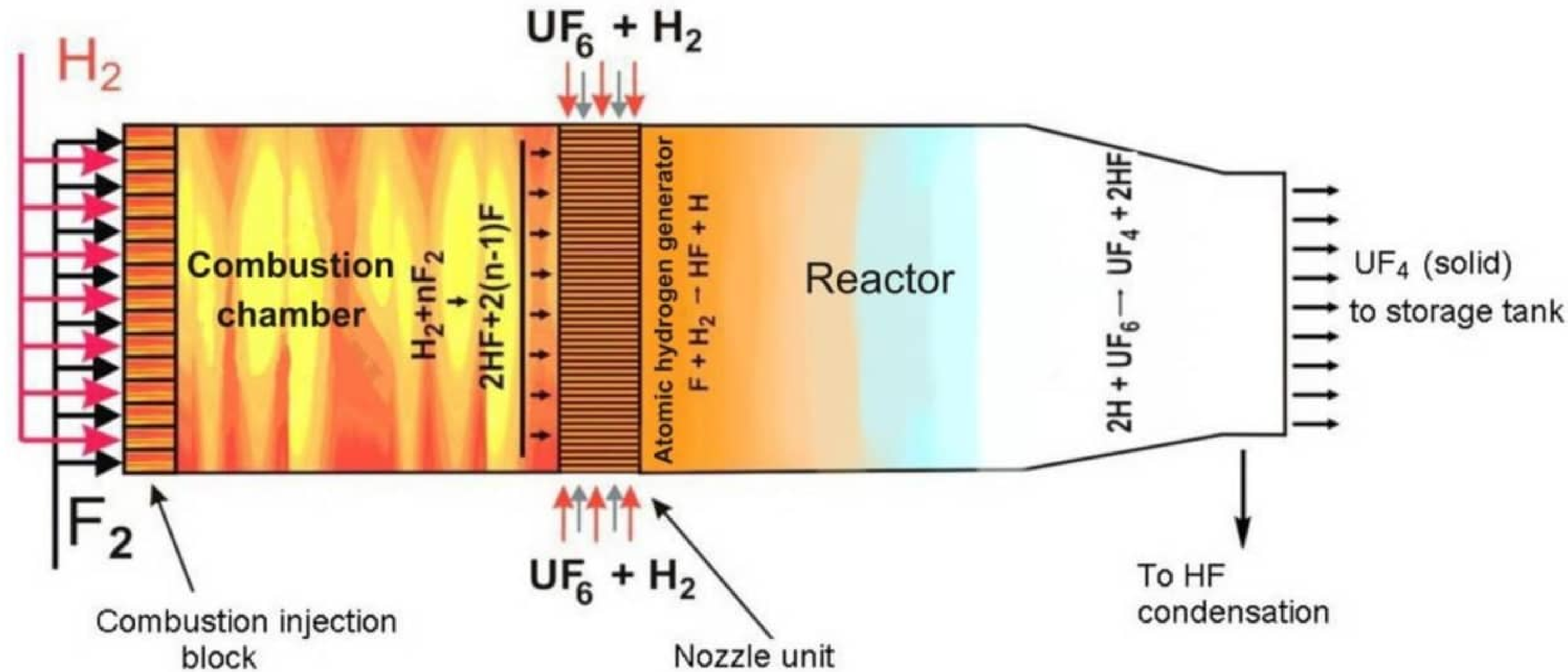
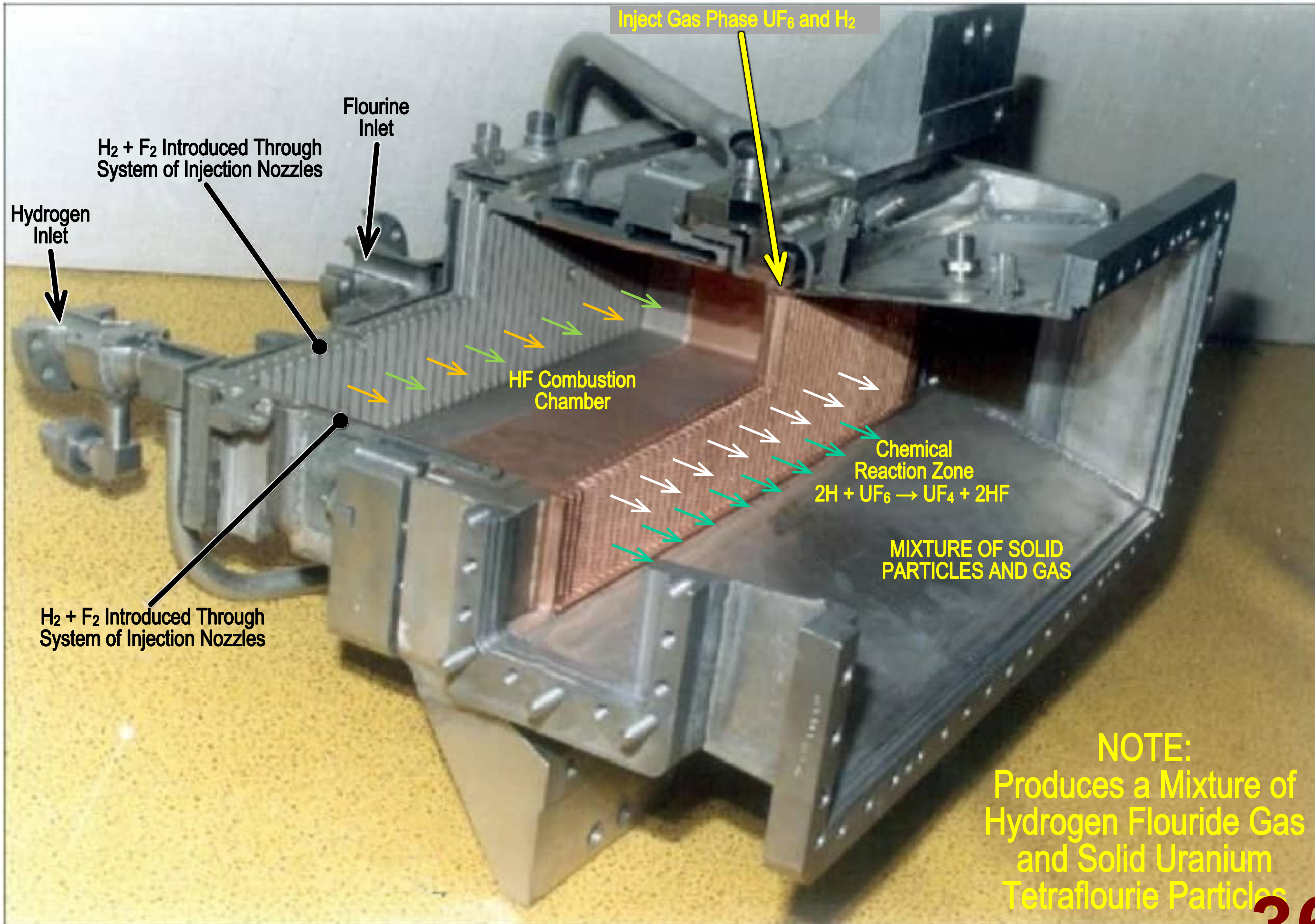
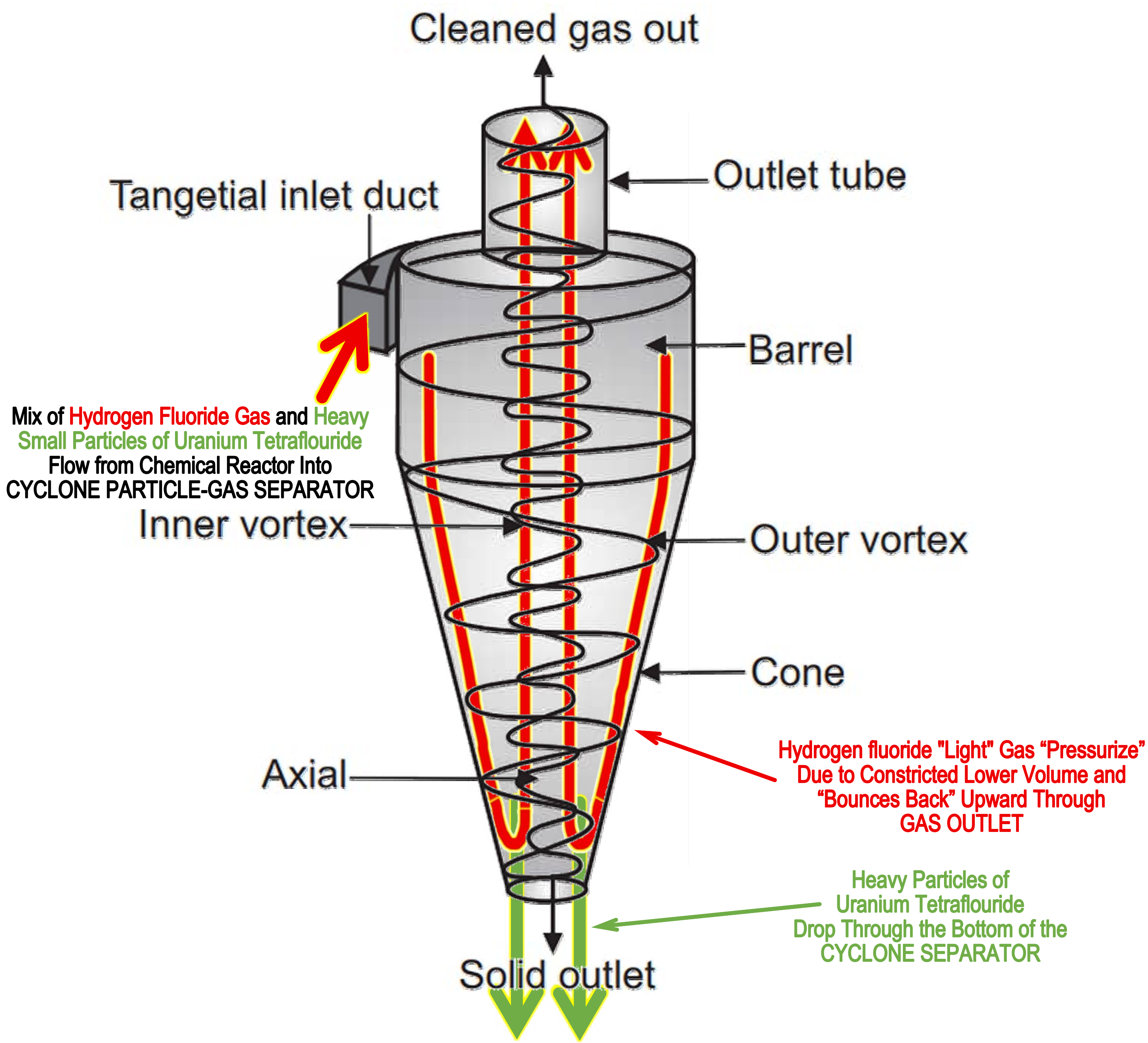


Figure1. The scheme of chemical convertor [6].

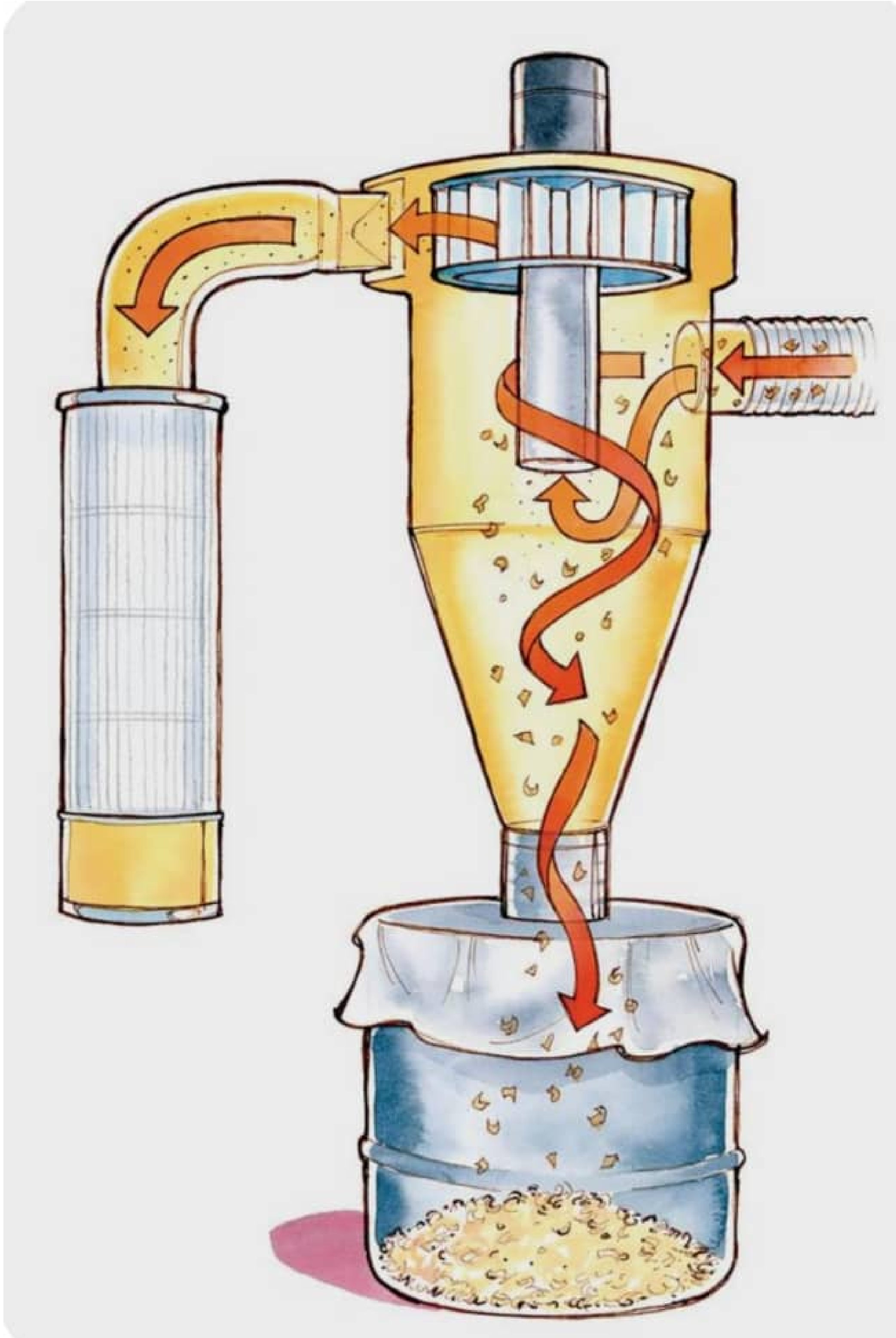
Russian HF_6 to HF_4 Chemical Converter Published in Refereed Scientific Journal



Cyclonic Separator Used to Remove Hydrogen Tetrafluoride Crystals from Hydrogen Fluoride Gas



Uranium Tetrafluoride UF_4
(Also Called “Green Salt”)

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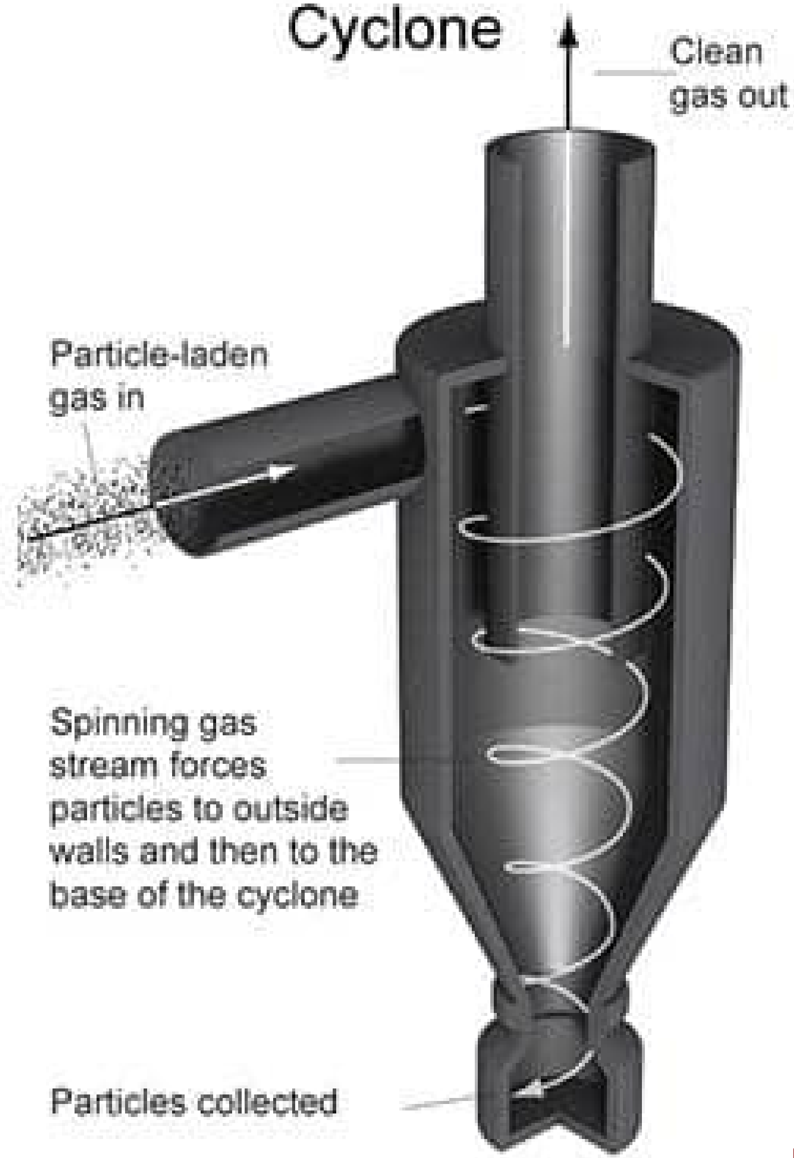
GENERAL



Cyclone
Clean
gas out
Particle-laden
gas in
Spinning gas
stream forces
particles to outside
walls and then to the
base of the cyclone
Particles collected

Conversion of Uranium Tetrafluoride (Green Salt) into Uranium Metal through High Pressure Combustion Reaction by Mixing the Green Salt with Magnesium Chips inside a High-Pressure and High-Temperature Reaction Chamber

Chemical Conversion of the Uranium Tetrafluoride UF_4 into Uranium Metal for a Bomb

$$UF_4 + 2Mg = U + 2MgF_2$$

or

$$UF_4 + 2Ca = U + 2CaF_2$$

Green Salt would be mixed with magnesium (possibly calcium) metal chips in a blender and compacted in a bomb reduction vessel. Bomb reaction vessels are very strong steel containers that hold the charge of UF_4 and magnesium chips. The word 'bomb' is common chemical engineering jargon and not the military sense of a bomb. When heated there is a violent exothermic reaction and uranium metal liquid sinks to the bottom of the chamber to solidify.

Induction Coil Used to Heat the Contents of a High-Pressure and Temperature Crucible Filled with Green Salt and Magnesium Chips

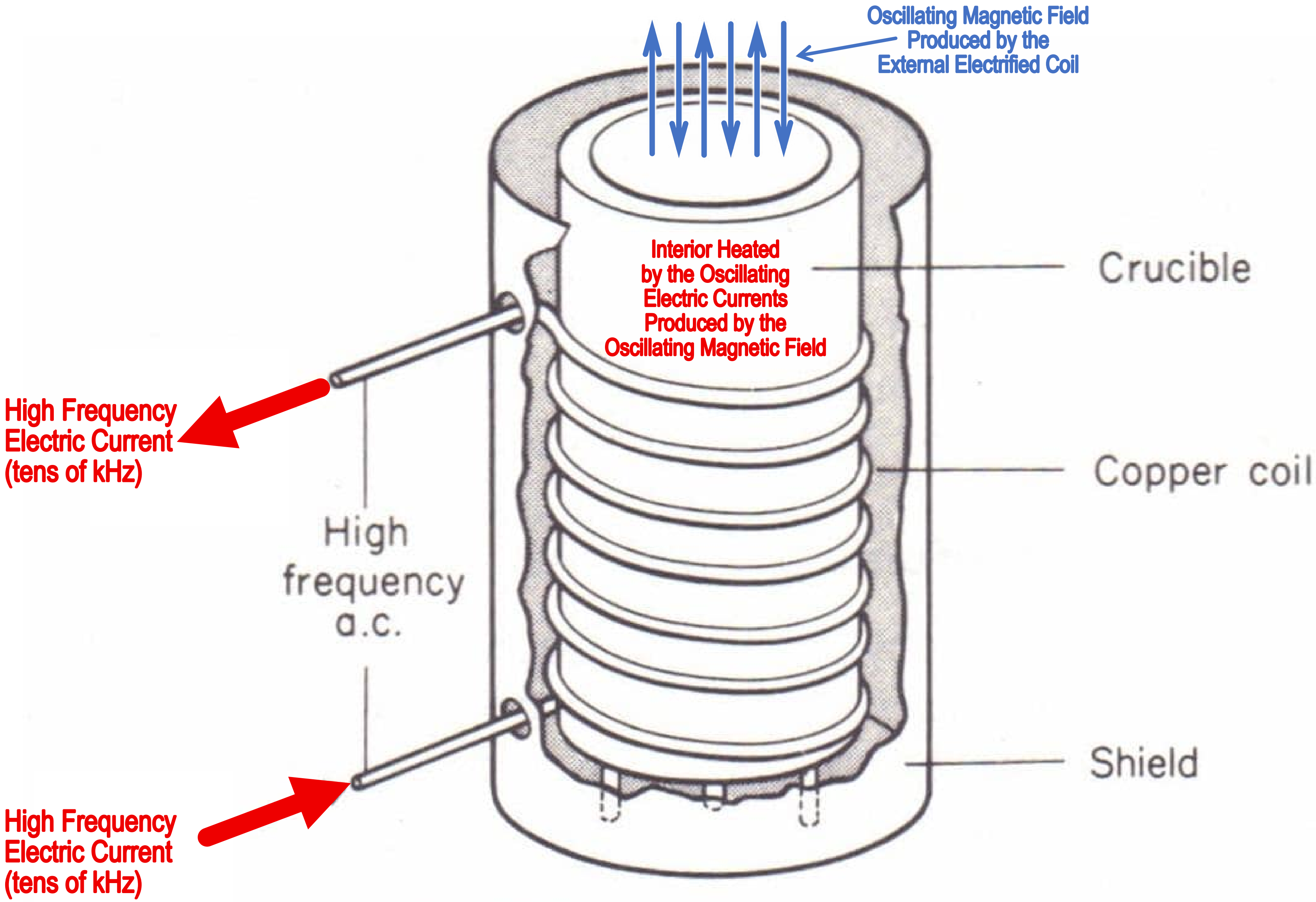
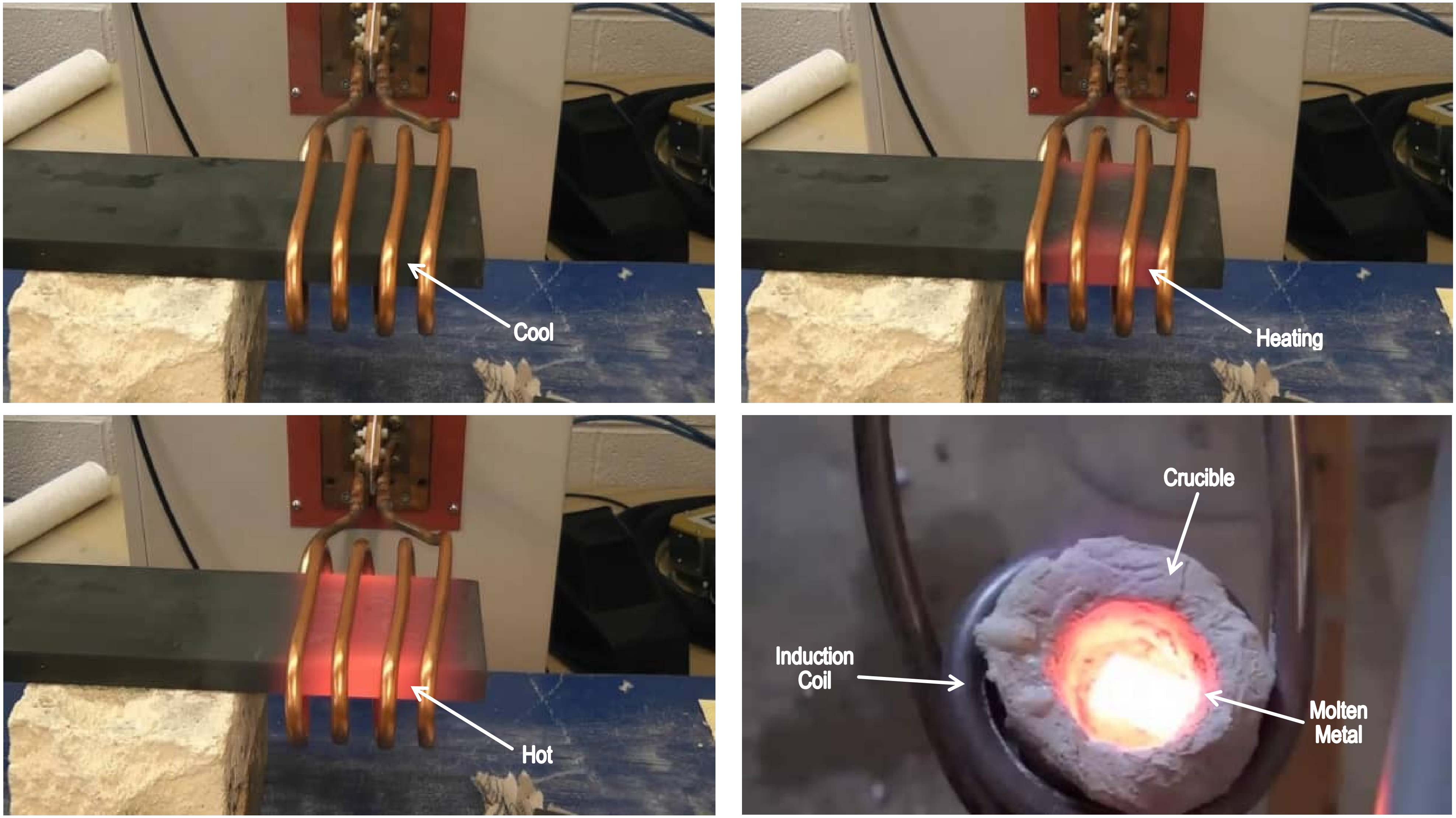
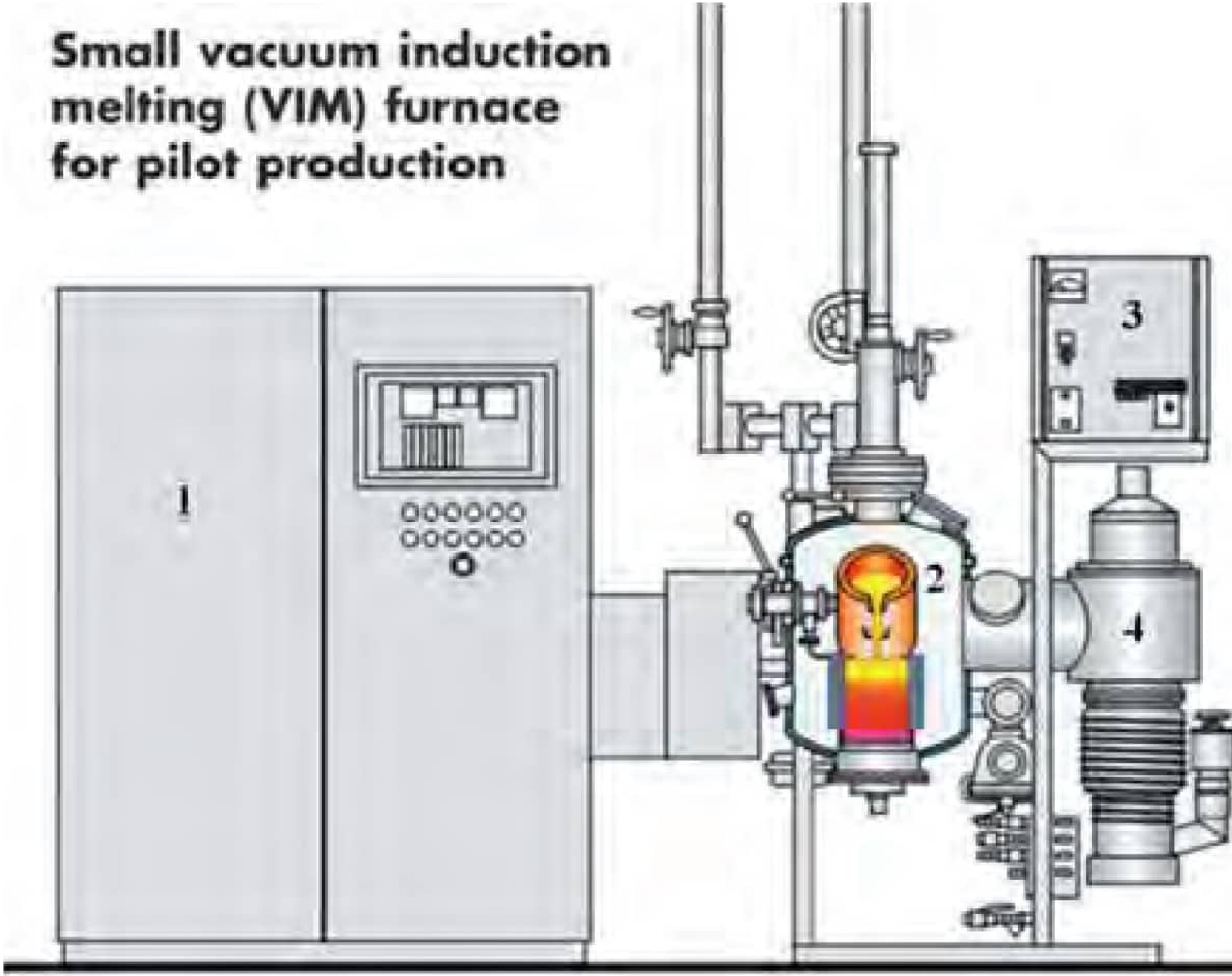


Fig. 43.11. Induction furnace

Examples of Induction Coils Being Used to Heat a Bar of Metal and the Contents of a Crucible



Small vacuum induction melting (VIM) furnace for pilot production



SKU#: IHG60AB

60KW Hi-Frequency Split Induction Heater 30-150KHz

PRICE

$26,990.00

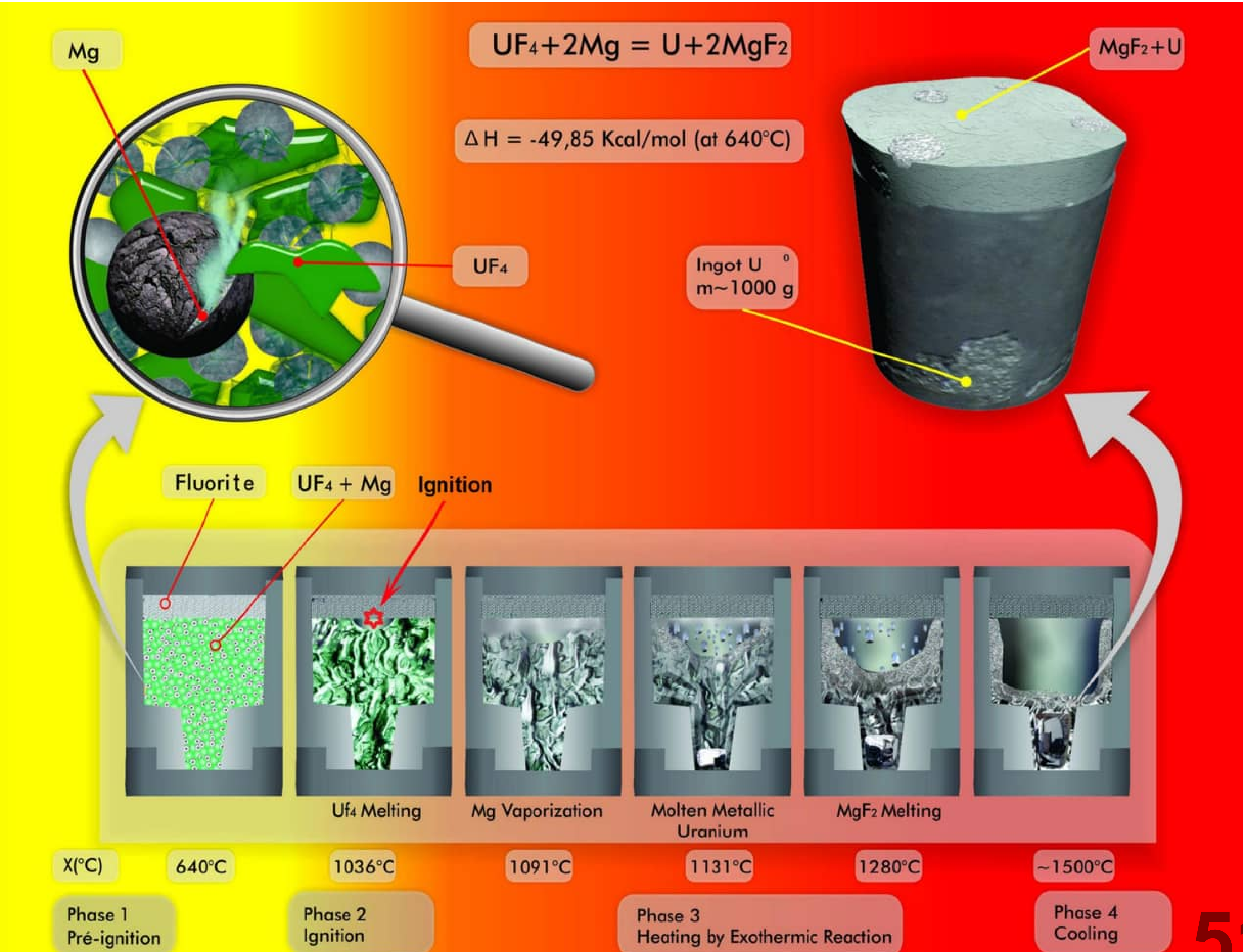
Finance with APPROVE

Apply in 60 seconds

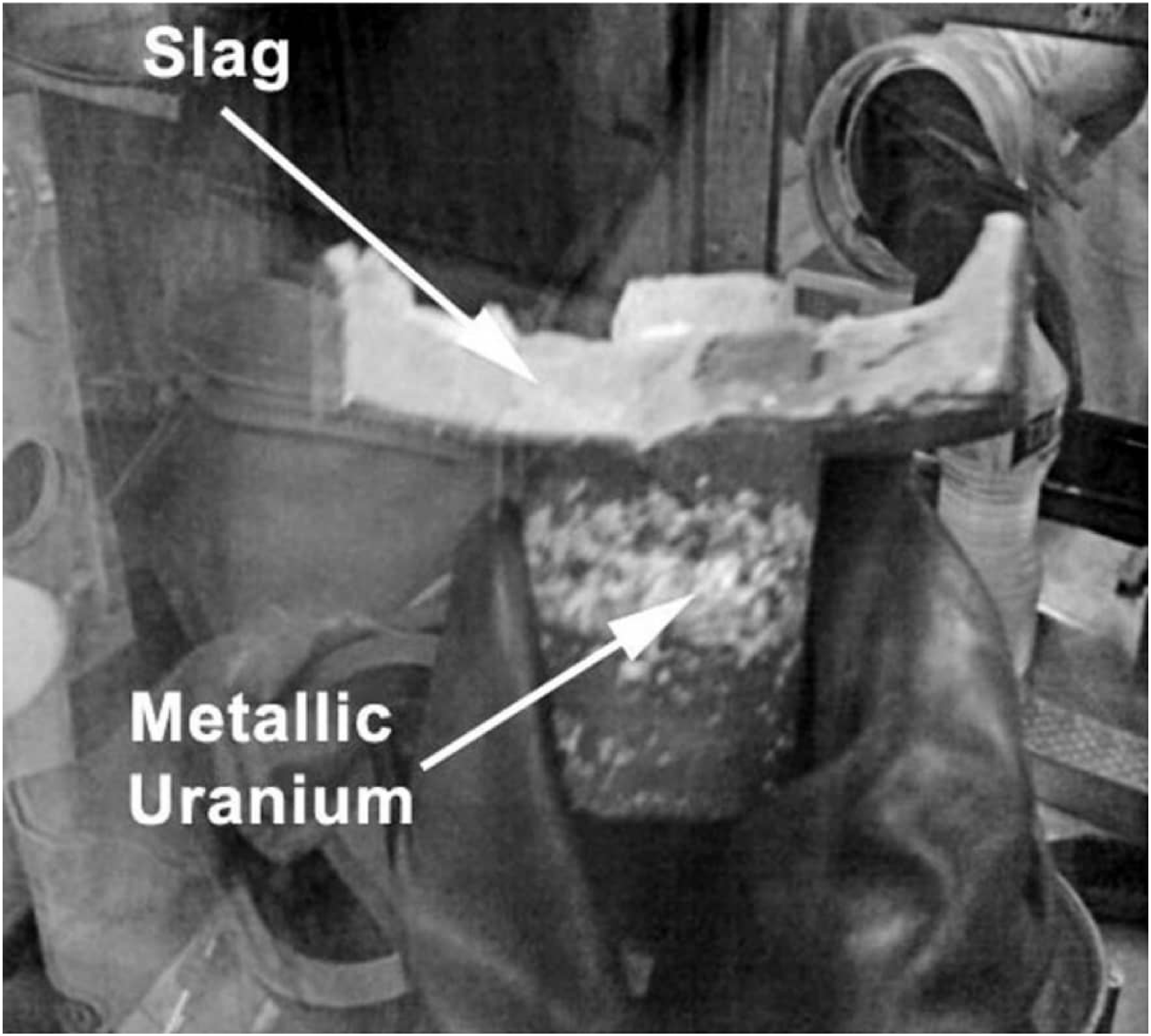
CUSTOMIZE YOUR PRODUCT

Delivery liftgate service

Click to select



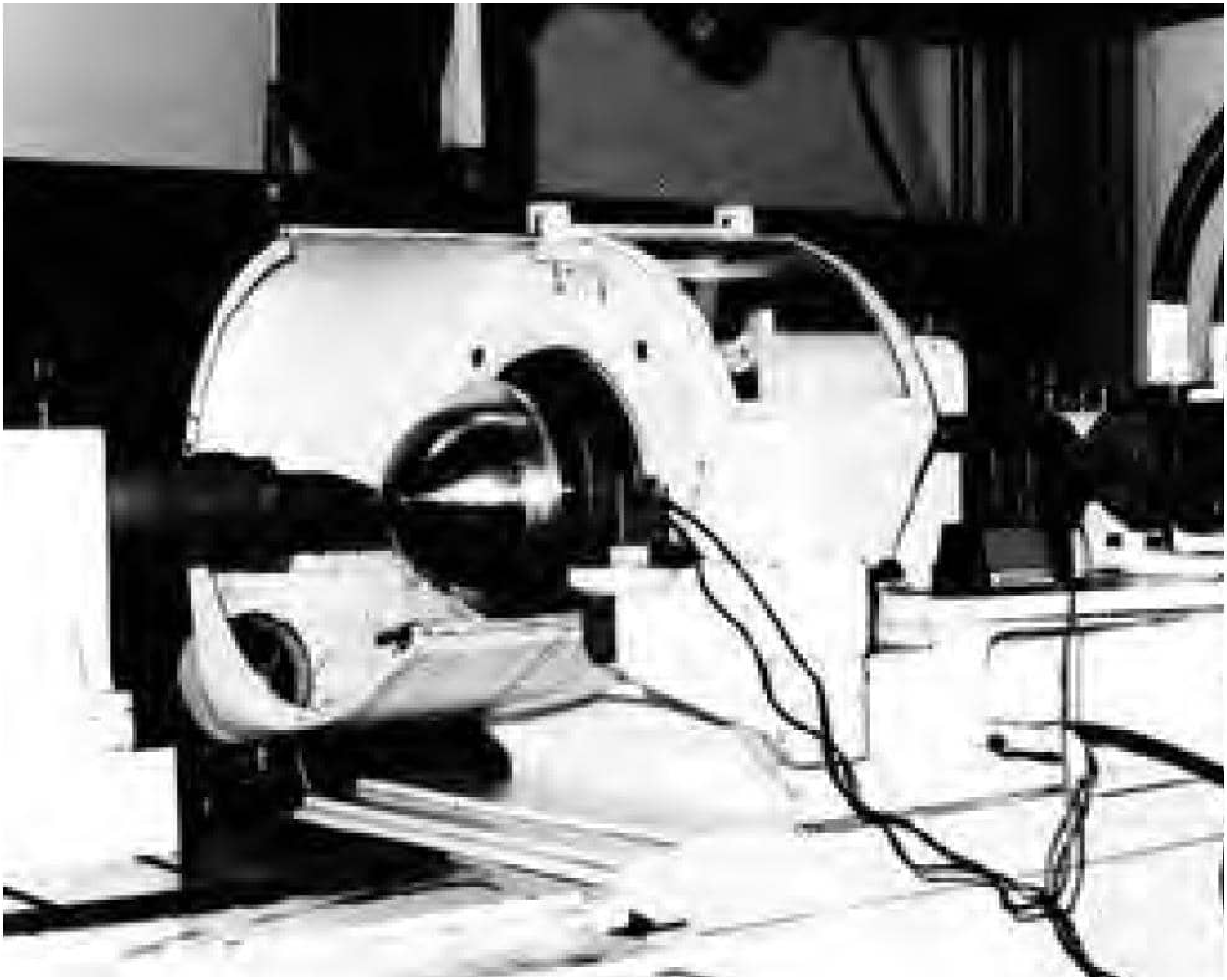
$UF_4 + 2Mg = U + 2MgF_2$
$MgF_2 + U$
Mg
ΔH = -49,85 Kcal/mol (at 640°C)
UF_4
Ingot U^0
m~1000 g
Fluorite
UF_4 + Mg
Ignition
Uf_4 Melting
Mg Vaporization
Molten Metallic Uranium
MgF_2 Melting
X(°C)
640°C
1036°C
1091°C
1131°C
1280°C
~1500°C
Phase 1
Pré-ignition
Phase 2
Ignition
Phase 3
Heating by Exothermic Reaction
Phase 4
Cooling


Slag
Metallic
Uranium

The bomb reduction and casting processes create lots of scrap that has to be dissolved and recycled back to pure metal

Clean metal ingot ready for casting into weapons shape

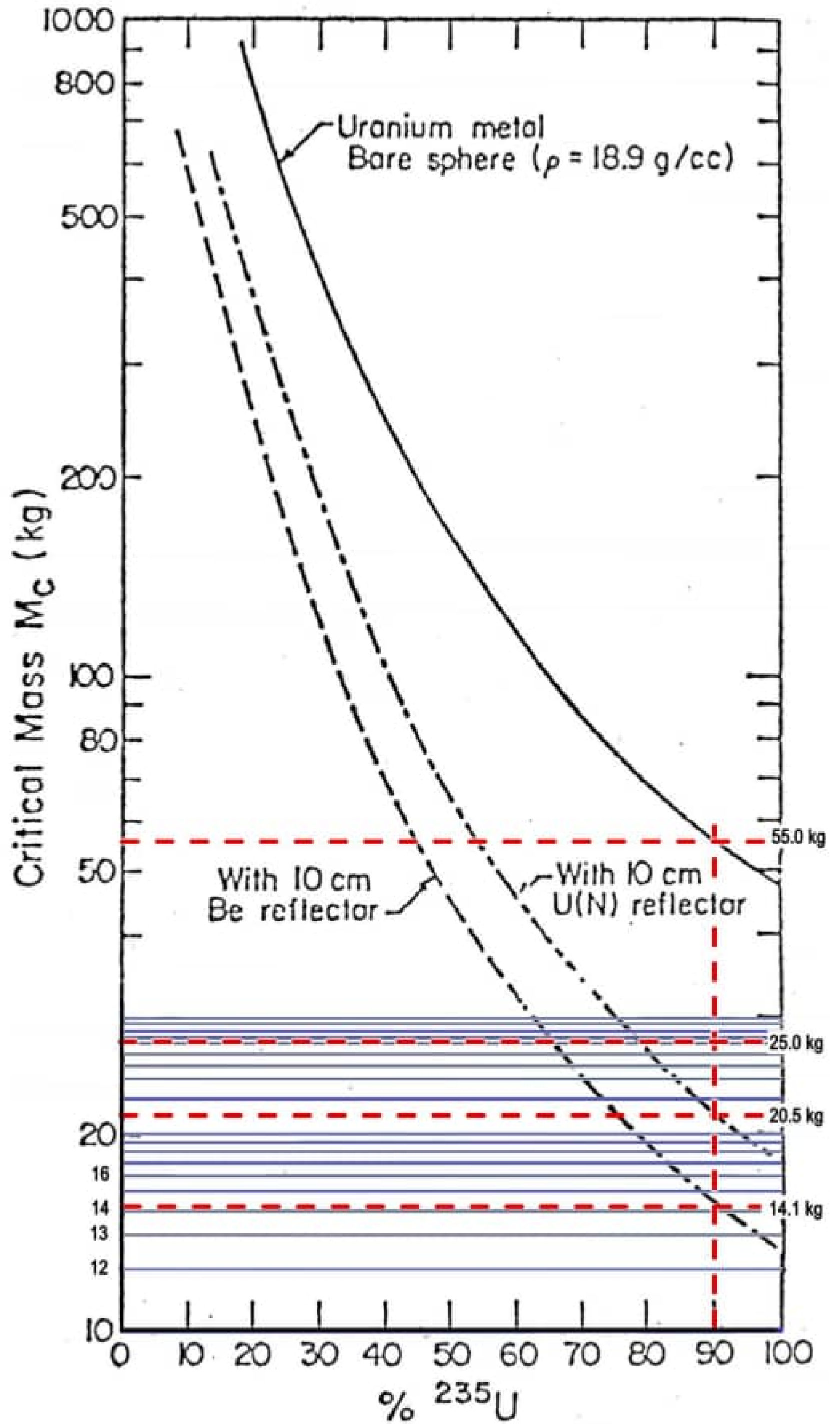
Shape Casted Uranium Metal for an Atomic Bomb Being Machined on a Lathe (Glove Box Not Needed)

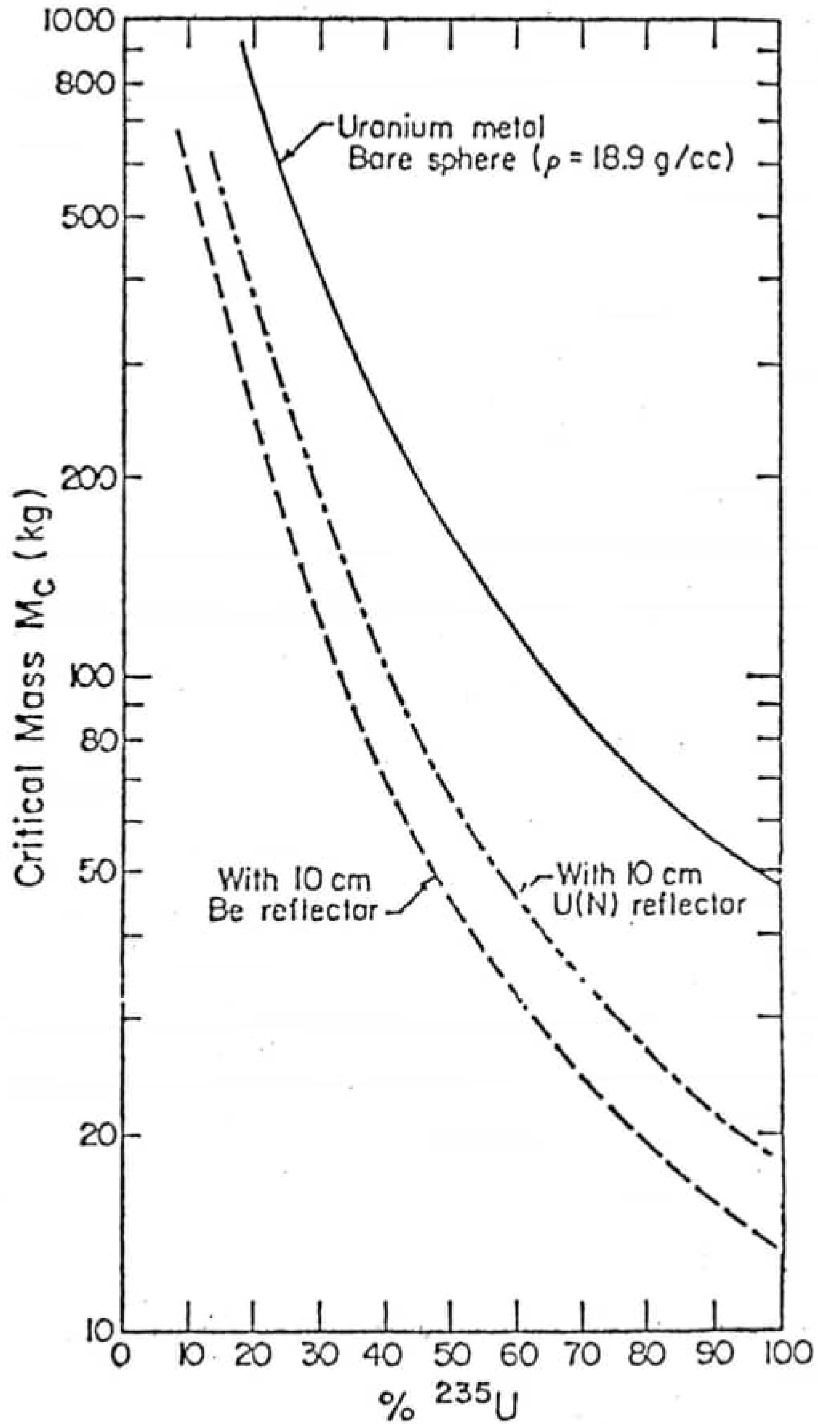


THE FINAL STEP
Making Atomic Bombs with the Remnants of Iran's Uranium Enrichment Program

Critical Mass of Uranium per Bomb
~ 13 – 14 kg of 90 to 95% Enriched Uranium

Critical Masses of Bare, Beryllium Reflected, and Uranium Reflected U^{235} and Pu^{239} Atomic Bombs





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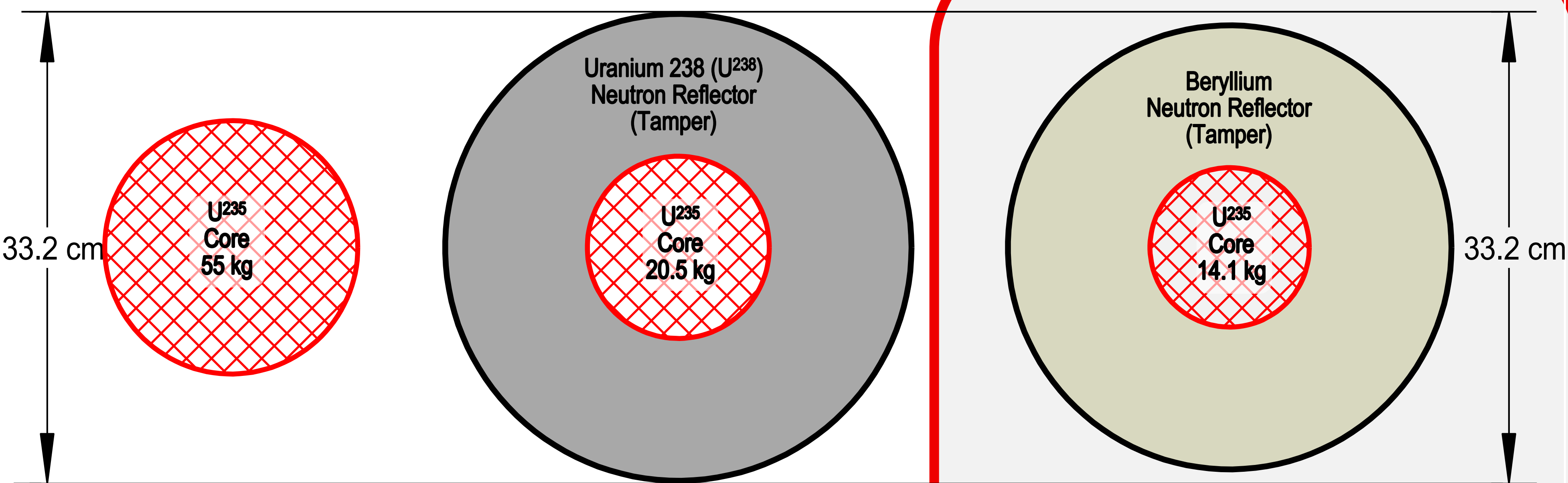
Fully Deliverable Low-Technology Bomb (Beryllium Reflector But No Compression of Uranium Core) Should Weigh Roughly 100 kg (Actual Nuclear Critical Components Should Weigh About 45 kg)

Core and Tamper Masses and Overall Weights of Bare, Beryllium Reflected, and Uranium Reflected U^{235} Atomic Bombs

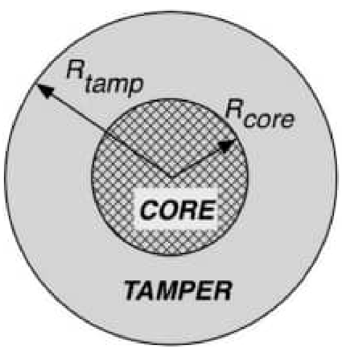
Core Bomb Components ~ 40 – 50 kg



Overall Weight of Bare Core =55 kg

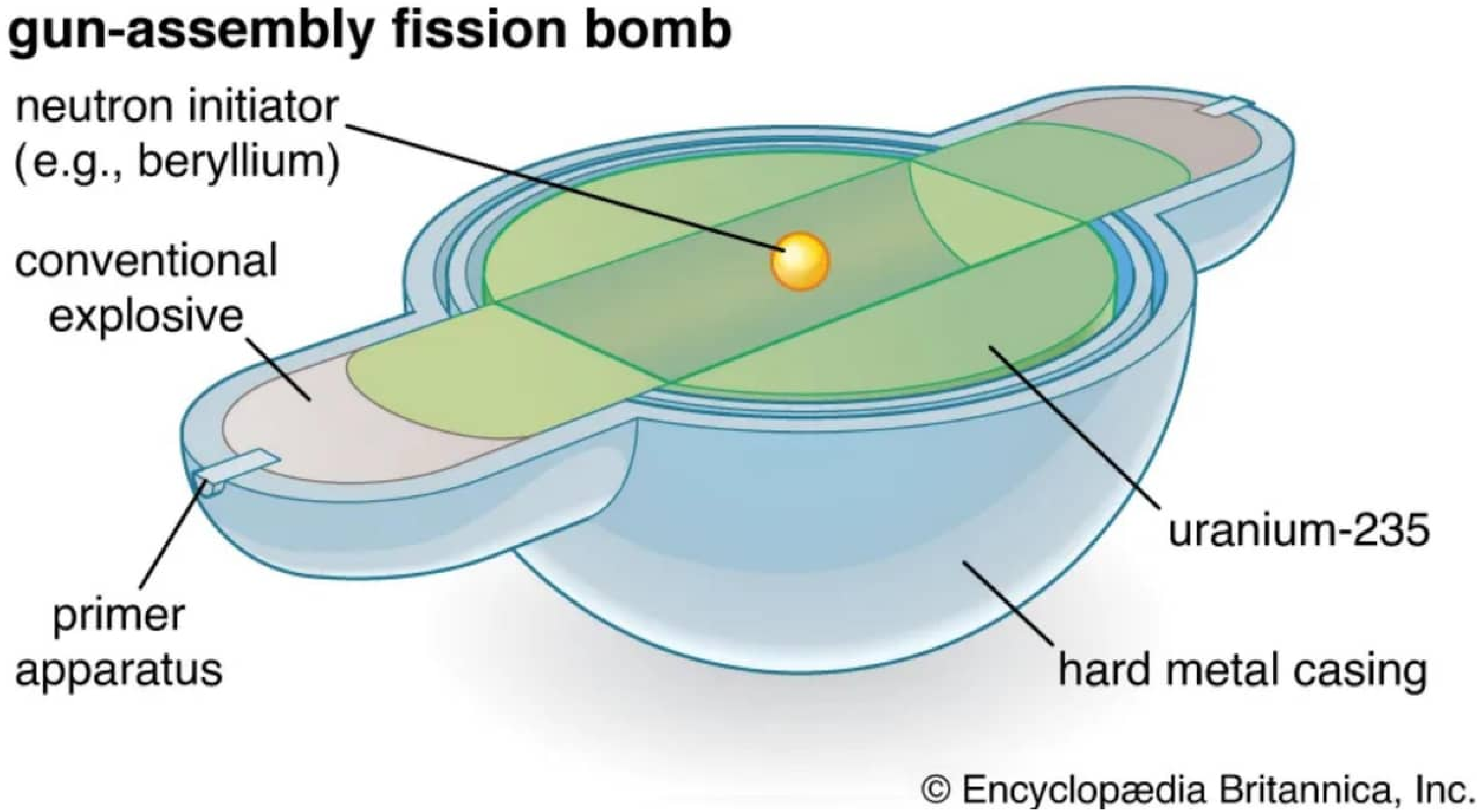
Overall Weight of Core + Reflector = 347.5 kg
Weight of U^{235} Core = 20.5 kg U^{235}
Weight of Reflector = 327 kg U^{238}

Overall Weight of Core + Reflector = 42.3 kg
Weight of U^{235} Core = 14.1 kg U^{235}
Weight of Reflector = 28.2 kg U^{238}



14.1 kg of Uranium Metal U^{235} ⟷ 21 kg of Uranium Hexaflouride (UF_6)

Low-Technology Bomb Would Only Need to be "Gun Assembled"


gun-assembly fission bomb
neutron initiator
(e.g., beryllium)
conventional
explosive
primer
apparatus
uranium-235
hard metal casing
© Encyclopædia Britannica, Inc.

NOTES

408-X = 244.8000→X=408-244.8=27.2

244.8 /(244.8 + 27.2) = 0.90

257.68/13 = 19.8215

U^{235} = 244.8 kg; U^{238} = 163.2 kg

X=163.2; .6*408/(.6*408+X) = 0.6000

244.8000+163.2 = 408

244.8 + 27.2 = 272 kg 90% Enriched

244.8 /(244.8 + 12.88) = 0.95

244.8 + 12.88 = 257.68 kg of 95% Enriched

408 kg of 60% Uranium Hexaflouride = 272 kg of 90% Uranium Hexaflouride = 272×0.66=179 kg of 90% Enriched Uranium Metal

179/14.1 = 12.6950 Bombs

408 kg of 60% Uranium Hexaflouride = 257.68 kg of 95% Uranium Hexaflouride = 257.68×.66= 170.0688 of 95% Enriched Uranium Metal

170.0688/13 = 13.0822 Bombs

CONCLUSION

Iran Has All the Basic Nuclear Technologies to Produc Atomic Bombs in Spite of the "Success" of the Israeli/US Attacks on Its Uranium Enrichment Program

- A single centrifuge cascade capable of enriching enough 60% enriched Uranium Hexafluoride (UF6) gas to produce the metallic uranium for an atomic bomb takes up no more floor space than a studio apartment (600 ft^2 – 60 m^2).
- A single Prius Compact Hybrid car can produce enough electric power to run four or More of these cascades at a time.

One of these cascades could produce the metallic uranium for a bomb roughly every 4 to 6 weeks. Additional cascades could produce bombs at a higher rate.

- Iran also can covertly convert 90% enriched Uranium Hexafluoride UF_6 to 90% enriched weapons grade uranium metal.
- Iran can design and build nuclear weapons with reduced amounts of uranium – roughly 13 — a larger number of nuclear weapons relative to what is commonly predicted in public accounts.
- All of these conversion and fabrication activities would require very small facilities that could be easily hidden from foreign intelligence.

The US and Israeli Intelligence Community (Working Together) Agree that this is the Case

https://www.haaretz.com/opinion/2025-07-08/ty-article-opinion/.premium/israel-won-the-war-it-fought-but-iran-emerged-victorious-in-the-one-that-mattered/00000197-e931-d508-a997-eb751f1b0000

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Moty Kanias is a reservist colonel in the IDF's Intelligence and Operations divisions, and a former senior executive in Israel security agencies.

Israel Won the War It Fought. But Iran Emerged Victorious in the One That Mattered - Opinion - Haaretz.com

Moty Kanias, July 8, 2025

For years, Iran has been enriching uranium and threatening the region with nuclear weapons, resulting in all-out war last month. But what has been presented as one war, with Israel emerging victorious is misleading. The 12-day conflict was two wars: one which Israel won, and the other won by Iran.

Israel and the U.S. had a clear mission in their joint endeavor: To strike Iran's nuclear program and restore regional deterrence by crippling Iran's nuclear and ballistic infrastructure. Hit the facilities. Destroy the capabilities. Eliminate the threats. Annihilate expertise. Set back Iran's nuclear timeline by years.

Yes, these strikes were vital and effective in reaching their targets. But the timing was four years too late. Iran began enriching uranium to 60 percent in April 2021. In the four years since, Tehran has raced toward nuclear weapons capability, which largely went by without retaliation. Iran already built the very stockpile that would ensure their program's survival even after devastating attacks. That stockpile is 408 kilograms of uranium, enriched to 60 percent, just short of weapons grade.

Israel led the campaign while the U.S. landed the heaviest blows, with their awesome bunker-busting bombs. Coordination was tight. Intelligence was precise and even historic, proving the Israel-U.S. alliance is stronger than ever. The world watched with wonderment, glued to their screens, as the Natanz and Fordow enrichment sites were struck in what the U.S. called Operation Midnight Hammer and Israel dubbed Rising Lion.

Missile factories and research sites destroyed. Key scientists and military leaders killed. Iran's nuclear infrastructure and missile programs suffered brutal hits.

But all of that was entirely replaceable. Iran seems to have kept what mattered: those 408 kilograms of uranium enriched to 60 percent. Enough to continue their nuclear program even without the old infrastructure, the Islamic Republic's sacrificial lamb or perhaps its Trojan horse.

Each side fought for different goals and claimed different victories. Israel did manage to achieve a few of its objectives: take out infrastructure, pull the U.S. onto their side and even wreck Iran's aerial defense.

These objectives likely could not have been accomplished four years ago, when they could have actually far more effectively prevented Iran's nuclear program from enriching uranium. Only now, after the regional, strategic developments following October 7 were they feasibly attainable. First came the degradation of Iran's air defense systems after the April 2024 volley of attacks between the Islamic Republic and Israel. Then, Israel's victory over Hezbollah, taking out Iran's strongest proxy. Finally, came the collapse of the Assad regime in Syria. Iran's protective shield was systematically dismantled, one piece at a time.

All this needed to happen in order for Israel to even attempt striking Iran's nuclear infrastructure. But doing so now was too late. The uranium is already enriched.

Iran fought a different war entirely. The Islamic Republic was likely not trying to win militarily – they were trying to survive politically while gaining strategic legitimacy. Turn losses into proof of importance. Make getting hit look like playing with the big kids, being respected by the world's superpowers. Yes, their nuclear infrastructure was severely damaged, but they had three outcomes in mind that to them were far more important than Fordow, than any general or even than strikes during a live TV broadcast.

In the meantime, Iran fought a second war – on the narrative front.

Domestically, Tehran censored footage of the destruction helped by their 95 percent shut down of the internet while exaggerating the success of its own attacks on Israel. To their public, they showed strength and control, thus preventing regime change.

Internationally, global calls for restraint gave Tehran something more valuable: legitimacy. The world treated Iran as a negotiating partner – not a rogue regime.

And so in addition to keeping its 408 kilogram of uranium safe from combined U.S. and Israeli attacks, they also managed to hold on to control while improving their standing on the global stage. Iran's ability to absorb punishment, control the story and avoid collapse may be its biggest win.

Plus, with its uranium stockpile likely dispersed and intact, Tehran no longer needs to rebuild everything – just maintain ambiguity. In this way, they can maintain their position as a partner that must be negotiated with. You don't need to test a bomb if everyone assumes you have one.

Iran can now mirror other regional powers, namely Israel: never confirm, never deny – just imply. This "threshold" position brings maximum strategic benefit with fewer consequences.

From Tehran's perspective, Iran may have emerged stronger: More legitimate at home, more respected abroad and closer to nuclear threshold status without crossing it. While the world watched explosions, Tehran quietly moved toward its real goal.

Their ultimate victory? Being treated as a nuclear power – without the risks of officially becoming one. In redefining what winning looks like, Iran may have changed the rules of modern conflict itself.

Moty Kanias is a reservist colonel in the IDF's Intelligence and Operations divisions, and a former senior executive in Israel security agencies.