Technical Brief: Risk Assessment of UF_6 Storage Facility Destruction in Iran

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Executive Summary
Iran's stock of 60% enriched uranium is stored predominantly in the form of **uranium hexafluoride (UF_6)**—a **condensed solid under ambient conditions**, which can **easily transform into a chemically dangerous gas** when moderately heated above 64.1 °C. UF_6 is used for centrifuge-based uranium enrichment, but its toxicity emerges only upon exposure to moisture, where it rapidly forms hydrofluoric acid and uranium oxyfluoride—both harmful compounds.

However, in the event of an attack on such storage, **the physical behavior of UF_6 and the physics of atmospheric dispersion limit the area of concern**. Under real-world dispersion conditions, **leaks would pose minimal health threats**, and **the plume radius would likely not exceed 1–2 km**. Moreover, given UF_6's chemical profile, **lack of detection within a few days post-strike would strongly suggest either successful evacuation of material or the survival of cylinders**.

Separately, **the enrichment infrastructure itself—especially centrifuges—is hyper-sensitive to physical disturbances**. Even minor shocks may render them permanently inoperable. Given their reliance on micron-precision balancing at ultrahigh speeds, it is **almost certain that a successful strike would reduce Iran's enrichment capability to zero**. Recovery would require a **complete rebuild over several years**.

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1. Overview of UF_6 and Its Storage

Physical and Chemical Characteristics

Property	Description
Form in Storage	Condensed solid (UF_6) at room temperature
Volatility	Sublimates at ~64 °C; forms corrosive HF gas on contact with moisture
Storage Type	Steel cylinders (30B) under ambient pressure
Toxicity Mechanism	Not radioactive, but chemically reactive and toxic upon hydrolysis

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2. Hypothetical Scenario: Bombing of Storage Facility

Assumptions

- Facility with 60% enriched UF_6 is **bombed directly**.
- **No prior evacuation** of cylinders.
- Storage is **underground or hardened**.
- Resulting structural damage includes **rupture of containment**.

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3. Consequences of Cylinder Breach

a. Chemical Behavior Upon Breach

- **Solid UF_6 exposed to air** may sublimate if temperatures rise above 64 °C.
- Moisture in the air triggers **hydrolysis**, producing:
  - **Hydrofluoric acid (HF)** – corrosive and harmful to tissue
  - **Uranium oxyfluoride (UO_2F_2)** – particulate contaminant

b. Atmospheric Dispersion

- Due to molecular weight and rapid reactivity, **UF_6 disperses in small, short-range plumes**.
- Estimated **impact radius: ≤2 km** under average meteorological conditions.
- **Plume quickly dissipates**, especially in open-air settings.

c. Environmental & Health Impact

- **Minimal to negligible**, unless exposure occurs in **confined or humid environments** near ground zero.
- Long-term environmental contamination is **localized**.

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4. Time to Surface & Detection

Migration to Surface

Burial Depth	Time to Surface
<10 m (shallow)	Hours to 1 day
10–30 m (medium)	1–3 days
>30 m (deep)	3–7 days (unless vented)

Key Indicator:

If no trace of UF_6 is detected within a few days, two conclusions are likely:

(a) The **cylinders were intact**, or

(b) They were **evacuated pre-strike**.

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5. Monitoring and Remote Detection

Feasibility of Monitoring

Method	Feasibility	Notes
Aerial chemical sensors	High	Can detect HF, fluorides in air
Drone spectroscopy	High	Practical for early detection in hard-to-reach zones
Satellites (hyperspectral)	Medium	May detect chemical events with delay
Ground sensors	Low	Requires pre-placement, unlikely in Iran

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6. Strategic Consequences for Iran's Enrichment Program

a. Vulnerability of Centrifuges

- Centrifuges operate at **50,000–70,000 rpm**, requiring **sub-micron precision**.
- Even minor shockwaves or tremors can **unbalance or fracture rotors**.
- Bombing would likely result in:
  - **Loss of structural alignment**
  - **Warping of casings**
  - **Complete failure of internal components**

b. Resulting Enrichment Capacity

Verdict: Iran's **enrichment capability post-strike is effectively zero**.

Restoration will require:

- Re-fabrication of all critical equipment
- Recalibration of facilities
- Rebuilding the supply chain
- **Timeframe: equivalent to building a new program**

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7. Conclusion

Destruction of Iran's UF_6 storage and centrifuge infrastructure would result in **minimal chemical fallout but maximal strategic damage**. UF_6 leaks, even if they occur, will have a **small toxic footprint**—unlikely to pose significant public health threats. **Absence of detectable UF_6 within a few days would confirm either successful pre-evacuation or survivability of the storage units**.

Critically, **the real blow is to the mechanical infrastructure**: centrifuges are so delicate that any successful strike likely obliterates enrichment capability. **Iran would need years to restore it**, assuming no foreign supply chain support.