Proposed Department of Energy Protective Action Criteria for Uranium Hexafluoride

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DOE Emergency Management Policy

- Quantitative analyses of possible chemical releases as technical bases for planning
- Exposure (concentration) criteria determine need for protective action planning

Protective Action Criteria (PAC)

….. *levels of hazardous material impact that, if observed or predicted, indicate action is needed to prevent or limit exposure of people to the hazard.*

DOE Emergency Management Guide, Volume II

The PAC Hierarchy

1. Acute Exposure Guideline Level (AEGL)-2
2. Emergency Response Planning Guideline (ERPG)-2
3. Temporary Emergency Exposure Limit (TEEL)-2

Uranium Hexafluoride

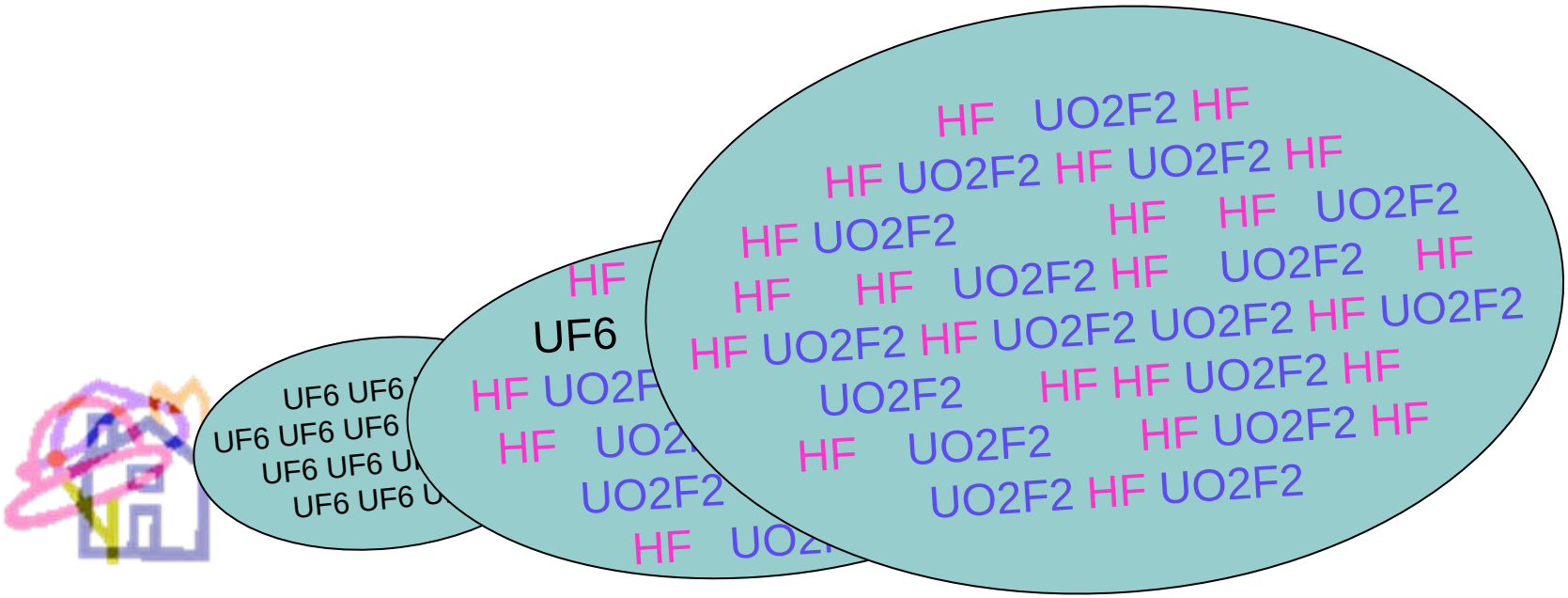
$$UF_6 + 2\ H_2O \rightarrow UO_2F_2 + 4\ HF + Heat$$

1 pound UF_6 → 0.23 pounds HF

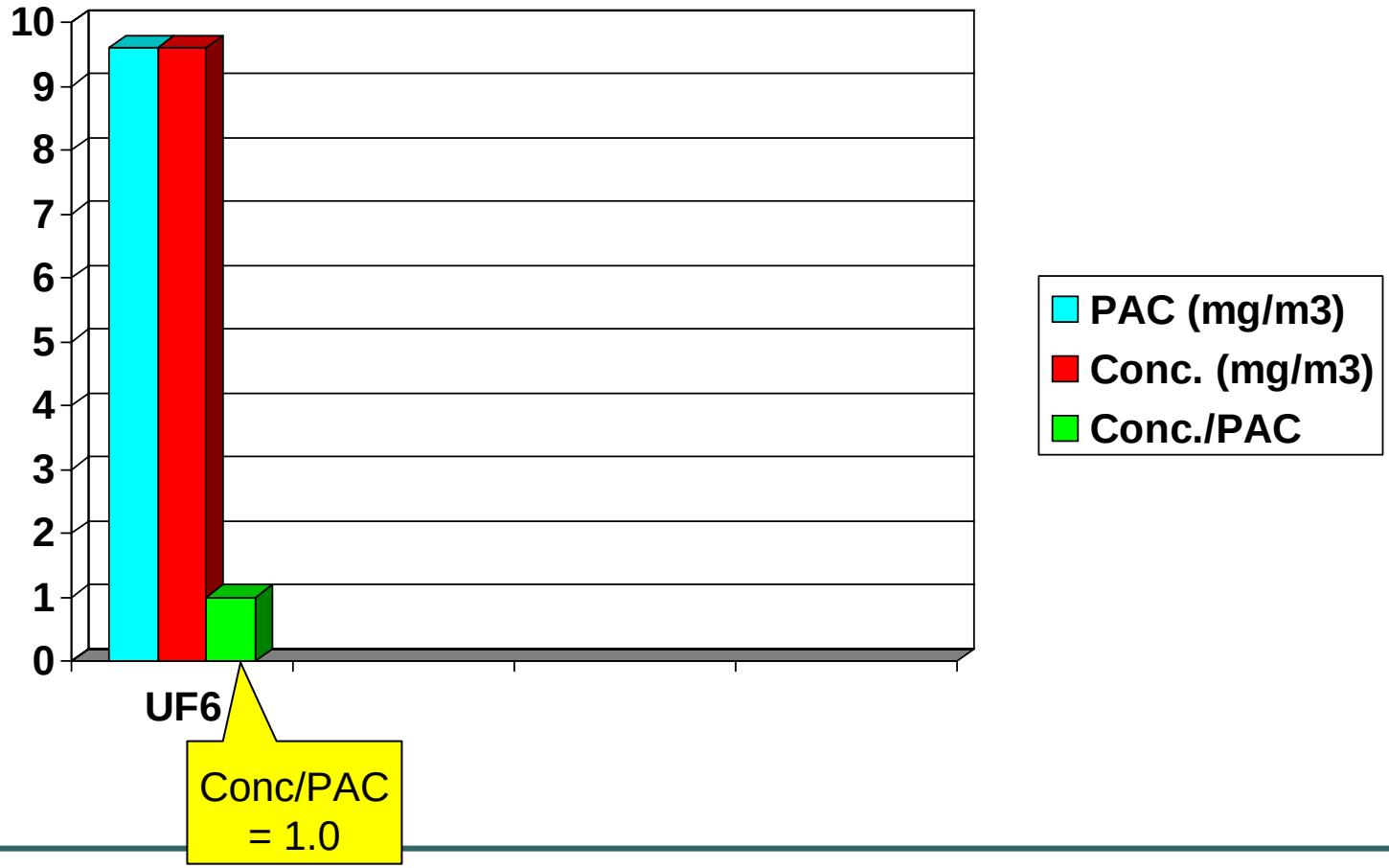
+0.88 pounds UO_2F_2

(or 0.676 pounds of “soluble U”)

Hydrolysis during plume transport



Hydrolysis or No Hydrolysis??



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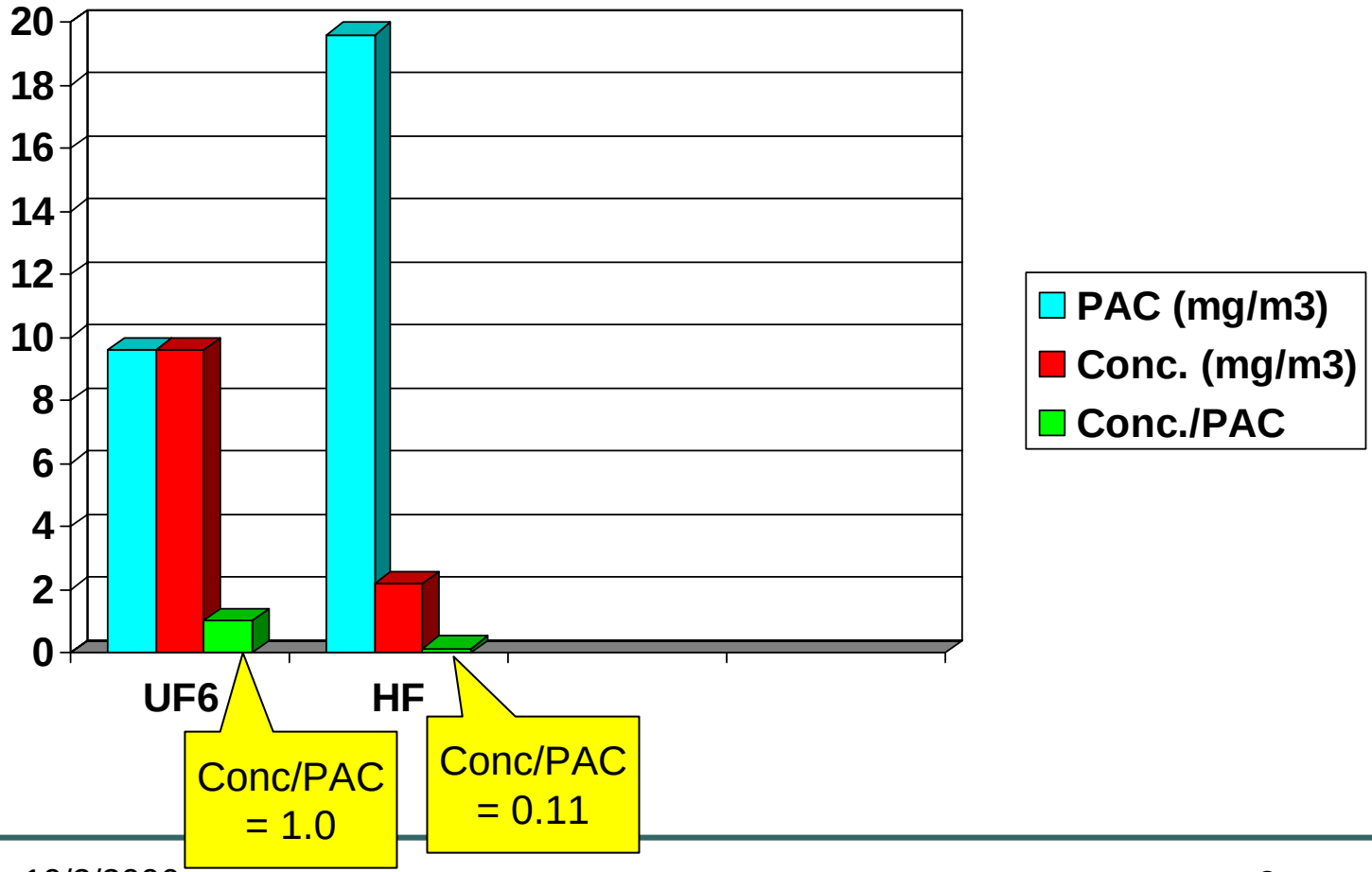

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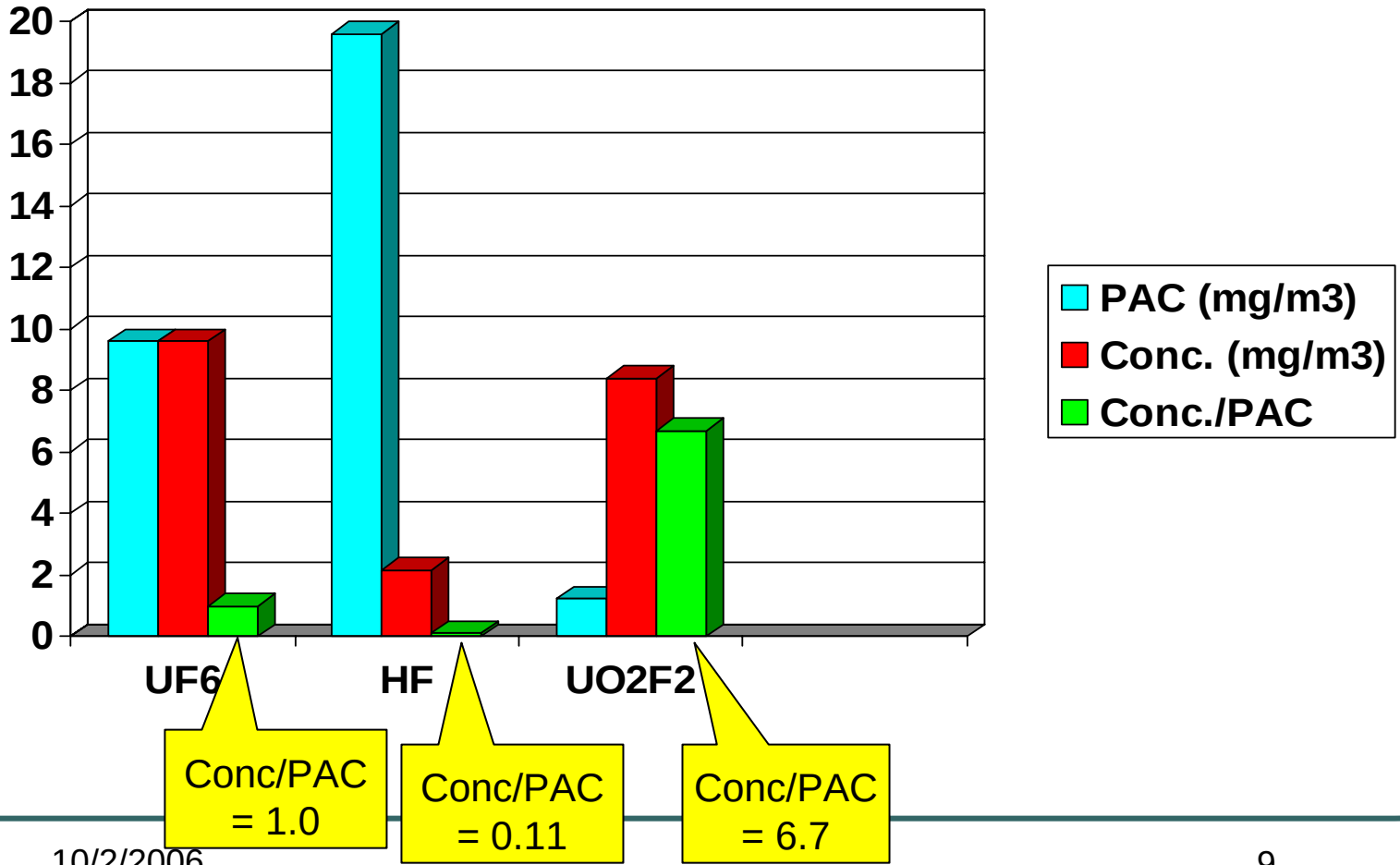

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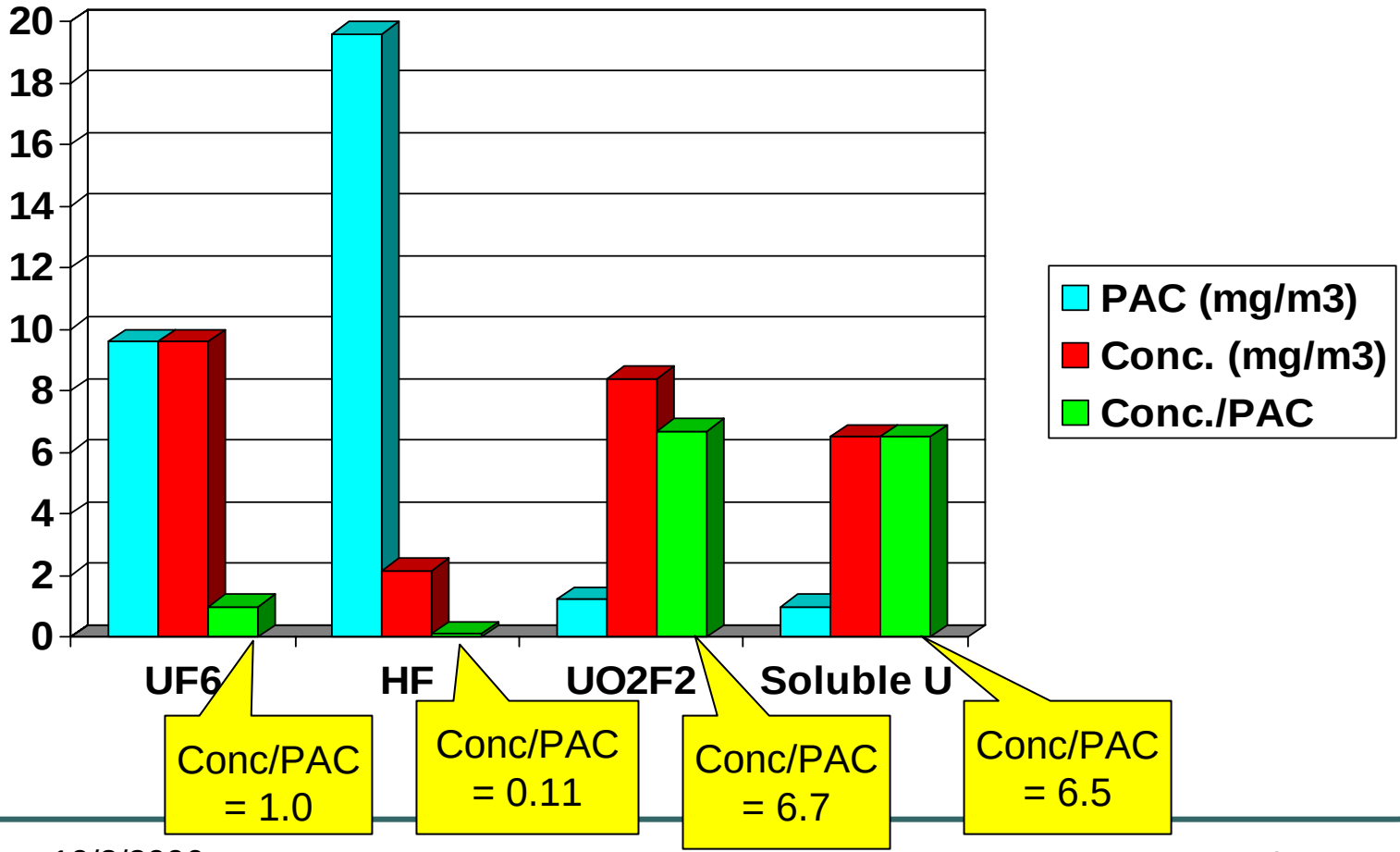

Which Criteria?

- AEGLs (UF_6 & HF)
  - Based on toxicological data
  - Peer reviewed
  - Public & NAS involvement
- TEELs (UO_2F_2 & “soluble uranium”)
  - DOE internal effort
  - Based largely on workplace limits
  - Conservative (by design)

From the AEGL Basis Document..

- Inhaled UF_6 is quickly hydrolyzed in airways & lungs
- Chemical toxicity of UF_6 is *"…due to the two hydrolysis products, UO_2F_2 and HF."*

From the AEGL Basis Document..

- AEGL-2 value based on renal pathology exhibited by dogs
- "*Although the UO_2F_2 is not the title compound, it is the hydrolysis product of UF_6 likely responsible for the renal effects.*"

Therefore…

- Health impact is the same, whether inhaling UF_6 or equivalent mix of hydrolysis products
- Kidney damage from uranium is basis for UF_6 PAC value
- Uranyl fluoride & soluble uranium PACs are quite conservative (~6.5 x) when compared with UF_6 PAC

Conclusions

1. Kidney damage is the health impact endpoint that should guide DOE protective action plans.

2. Hydrolysis during plume transport is not a big issue for health effects (may be very significant for modeling plume depletion)

Conclusions

3. AEGL value for UF_6 should take precedence for estimating health impacts.

4. Planning and response decisions based on UF_6 concentration and AEGL values will be conservative with regard to HF exposure.

Plume Modeling Recommendation

- Calculate total uranium concentration (all species)
- ***Equivalent*** UF_6 concentration (mg/m^3)
  = total U (mg/m^3) x 1.48
- Use UF_6 AEGL-2 value as PAC