



Legacies Shaping the Future: Uranium Production, Inventories & Prices – 1947 - 2004

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LES Exhibit 61



U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of Louisiana Energy Services, L.P.

Docket No. 70-3103 Official Exhibit No. ES 61

OFFERED by: Applicant/Licensee Intervenor

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Reporter/Clerk Bethany Pugh

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OFFICE OF THE SECRETARY
RULEMAKING AND
ADJUDICATIONS STAFF

LEGACIES SHAPING THE FUTURE:

**URANIUM PRODUCTION,
INVENTORIES & PRICES**

1947 - 2004

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WESTERN URANIUM HISTORY

□ The Weapons Procurement Era (1940 – 1969)

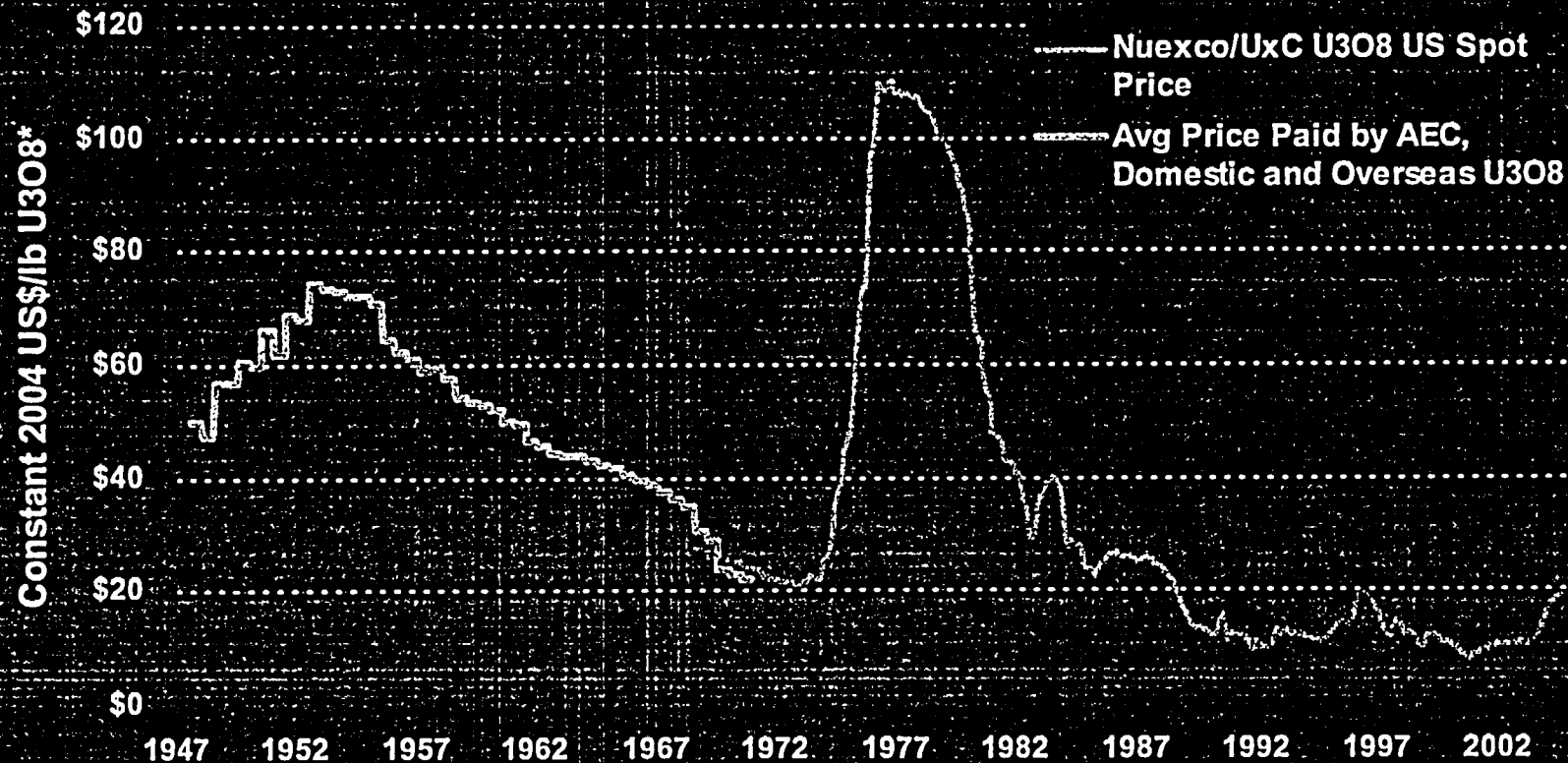
□ The Commercial Inventory Accumulation
Era (1970 – 1984)

□ The Inventory Liquidation Era (1985 – 2003)

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URANIUM PRICE 1947 – 2004

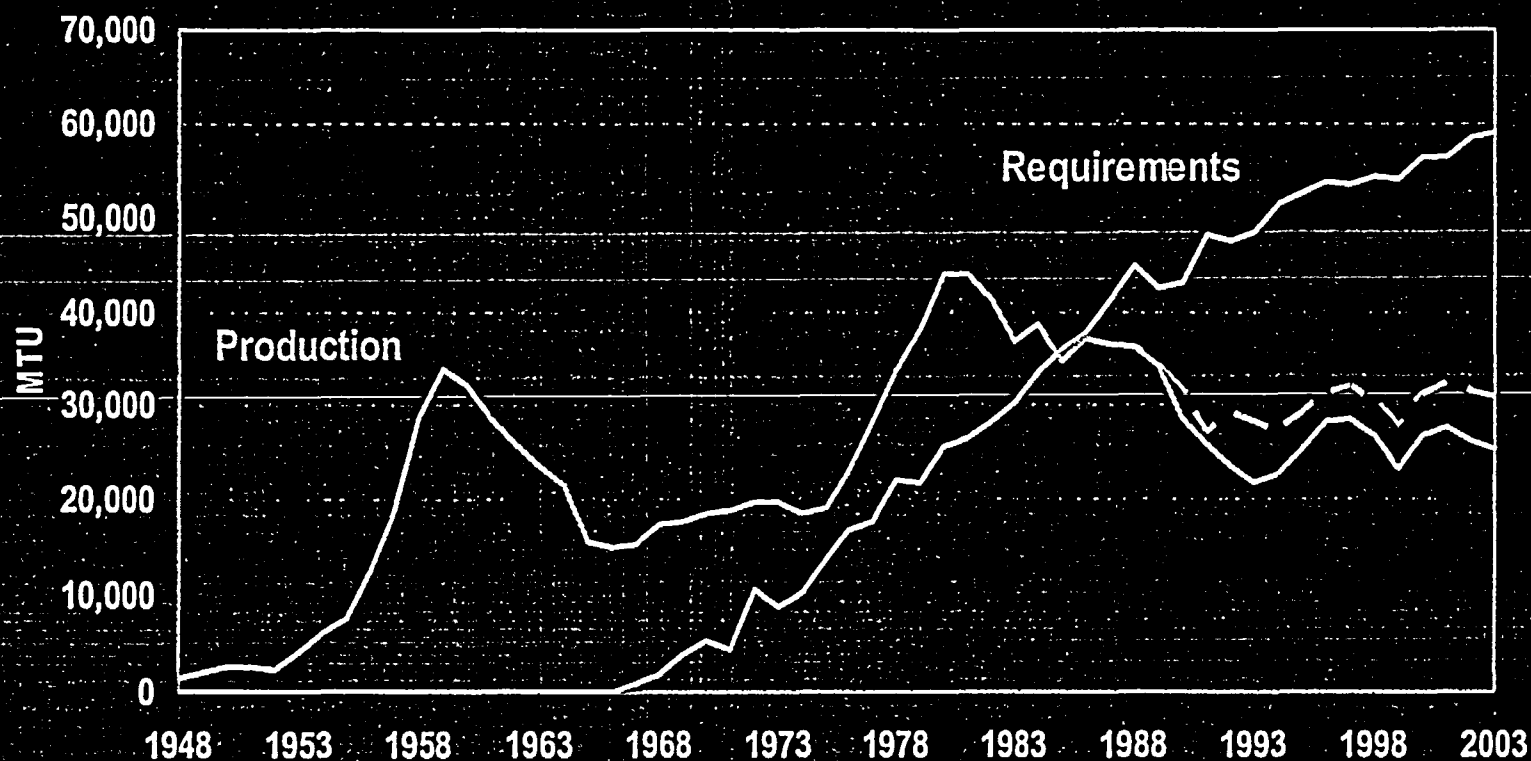
(Constant 2004 U.S. \$)



*Adjusted by U.S. GDP IPD, 2nd Q, 2004

111111

WESTERN URANIUM PRODUCTION & REQUIREMENTS: 1948 – 2003



W.World Production includes Former E Germany (1985), Kazakhstan (1992), Uzbekistan (1992) and Czech Rep (1993)

1948
1953
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1993
1998
2003

WEAPONS PROCUREMENT ERA

(1940 – 1969)

☐ U.S. Atomic Energy Commission (CDA) – Posted Price for Uranium

- Average Domestic U.S. Purchase Price: \$42.59/lb (\$111.28/kgU)
- Average Foreign Purchase Price: \$56.62/lb (\$147.94/kgU)

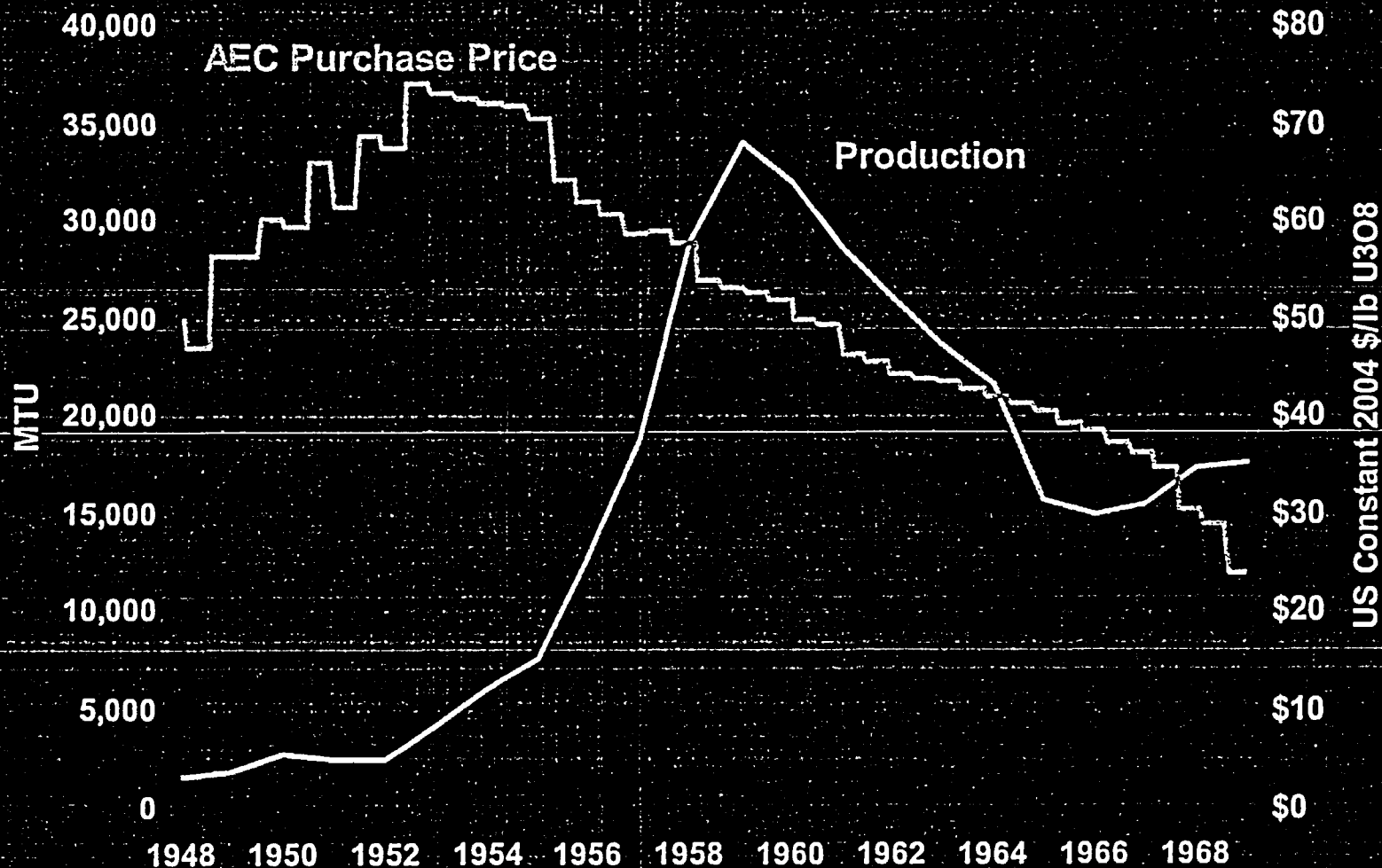
☐ Production Lags Price by Ten Years

☐ U.S. Closes Borders to Imports

☐ Producing Countries Implement Stretch-Out & Stockpile Programs

PRODUCTION RESPONSE TO PRICE

1948 - 1969



Source: U.S. Energy Information Administration, "Uranium: A Guide to the Industry," 1970.

PRODUCTION & DISPOSITION OF URANIUM

1947 - 1969

UNITED STATES	153,600	
AEC Purchases	146,000	(95%)
Commercial Purchases	7,600	(5%)
CANADA	84,500	
U.S. AEC Purchases (1956 – 1967 only)	54,200	(64%)
Canadian Gov. Stockpile (to Eldorado)	6,500	(8%)
Britain & Unaccounted*	23,800	(28%)
AUSTRALIA / S. AFRICA / BELGIAN CONGO	80,200	
U.S. AEC Purchases	35,500	(44%)
Britain & Unaccounted*	44,700	(56%)
FRANCE & GABON	18,500	
WESTERN WORLD TOTAL	336,800	
U.S. AEC Purchases	235,700	(70%)
Reported Commercial Purchases	14,100	(4%)
Britain, France & Unaccounted	87,000	(26%)

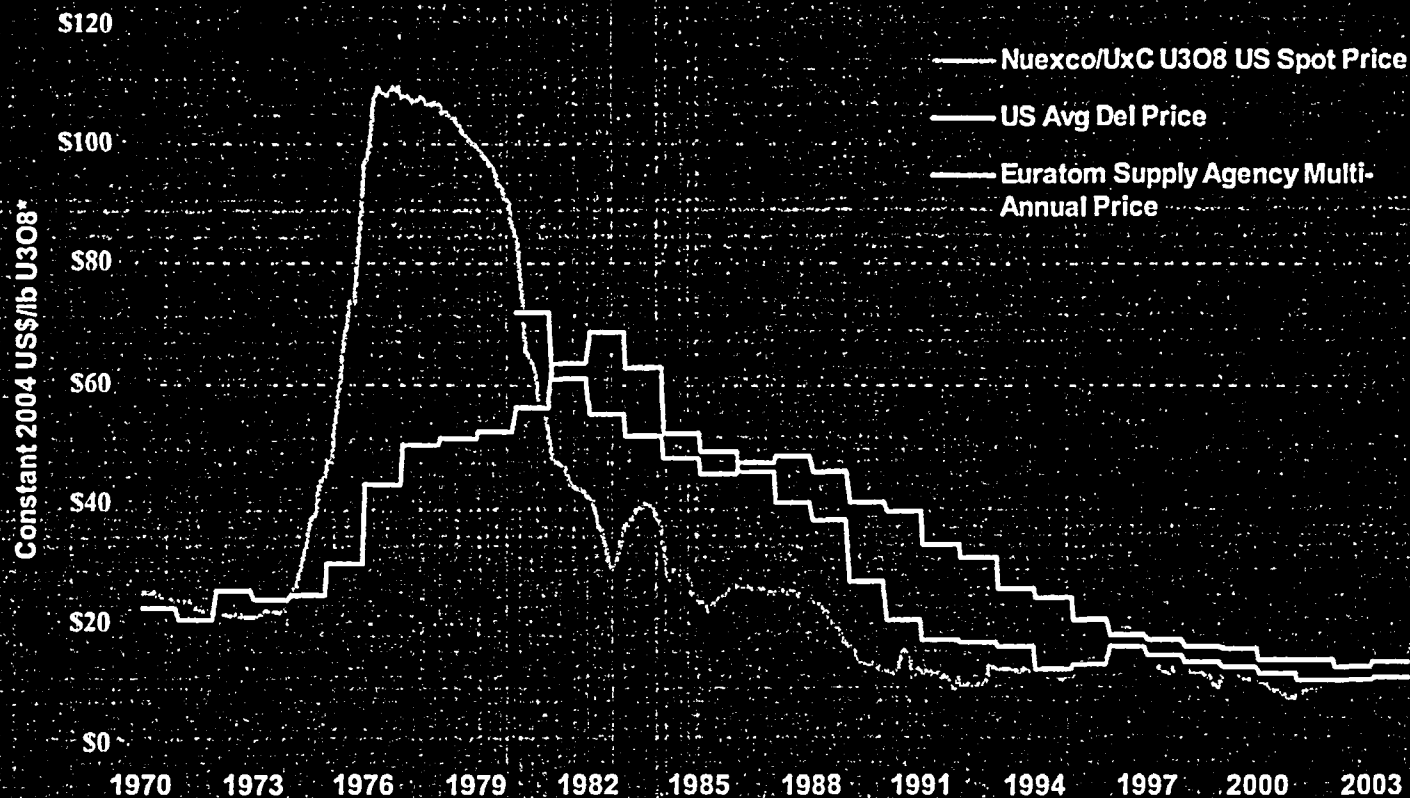
*The U.S. AEC may have purchased up to 4,000 MTU from Canada prior to 1956 and up to 15,000 MTU from Australia, S. Africa and Congo prior to 1956 – actual purchases have not been disclosed.

COMMERCIAL INVENTORY ACCUMULATION ERA (1970 – 1984)

- ☐ Price Reaches Low of \$20.90/lb in January 1973
- ☐ Price Rises to \$110/lb 45 Months Later (September 1976) – Expectations Driven
- ☐ Production Revives From Existing Centers, Not New Mines
- ☐ Production Lags Price Increase by Four Years
- ☐ Production Exceeds Requirements for Entire Period – Surplus 170,000 tU
- ☐ Long-Term & Multi-Annual Prices Moderate Price Swings

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U.S. AVERAGE DELIVERED & EURATOM MULTI-ANNUAL PRICES (Constant 2004 US\$)



*Adjusted by U.S. GDP IPD, 2nd Q, 2004

U.S. Avg delivered price paid to domestic suppliers through 1993, weighted avg delivered price for domestic and foreign purchases 1994-2004

U.S. AVERAGE DELIVERED & EURATOM
MULTI-ANNUAL PRICES (Constant 2004 US\$)

INVENTORY SITUATION AT END 1984

	tU
U.S. Commercial Inventory	71,000
Other Excess Production	99,000
Pre -1970 Production Used Commercially	30,000 – 80,000
TOTAL INVENTORY	200,000 – 250,000

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INVENTORY LIQUIDATION ERA

1985 - 2003

- ❑ Production Below Requirements Despite Central Asia Addition
- ❑ Cumulative Shortfall of 339,000 tU
- ❑ Long-Term Secular Decline in Price

CHANGE IN COMMERCIAL INVENTORY SITUATION 1985 - 2003

	tU
Beginning Inventory 1/1/85	200,000 - 250,000
USEC Addition to Inventory	28,600

Ending Inventory	
U.S.	32,600
Europe & Asia	80,000

Net Reduction In Commercial Inventory	116,000 - 166,000
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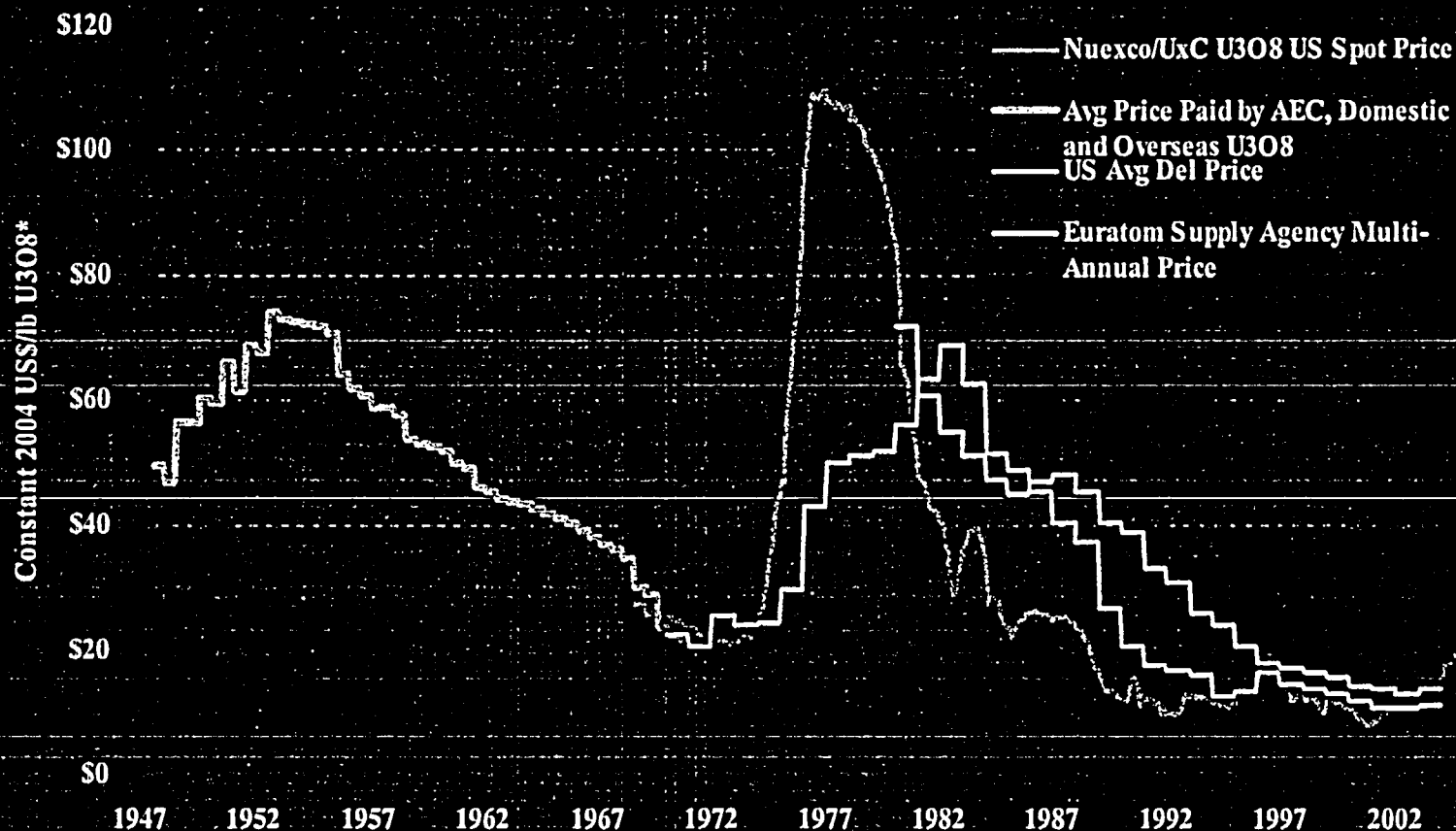
SUPPLY TO FILL PRODUCTION DEFICIT

1985 - 2003

Production Deficit	tU 339,000
Sources of Supply:	
Inventory Drawdown	116,000 – 166,000
HEU Feed	20,000
Re-Enriched Tails	6,000
MOX	8,000
Remaining Deficit	139,000 - 189,000
WNA Estimated Supply From Russia	150,000

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U.S. AVERAGE DELIVERED & EURATOM MULTI-ANNUAL PRICES



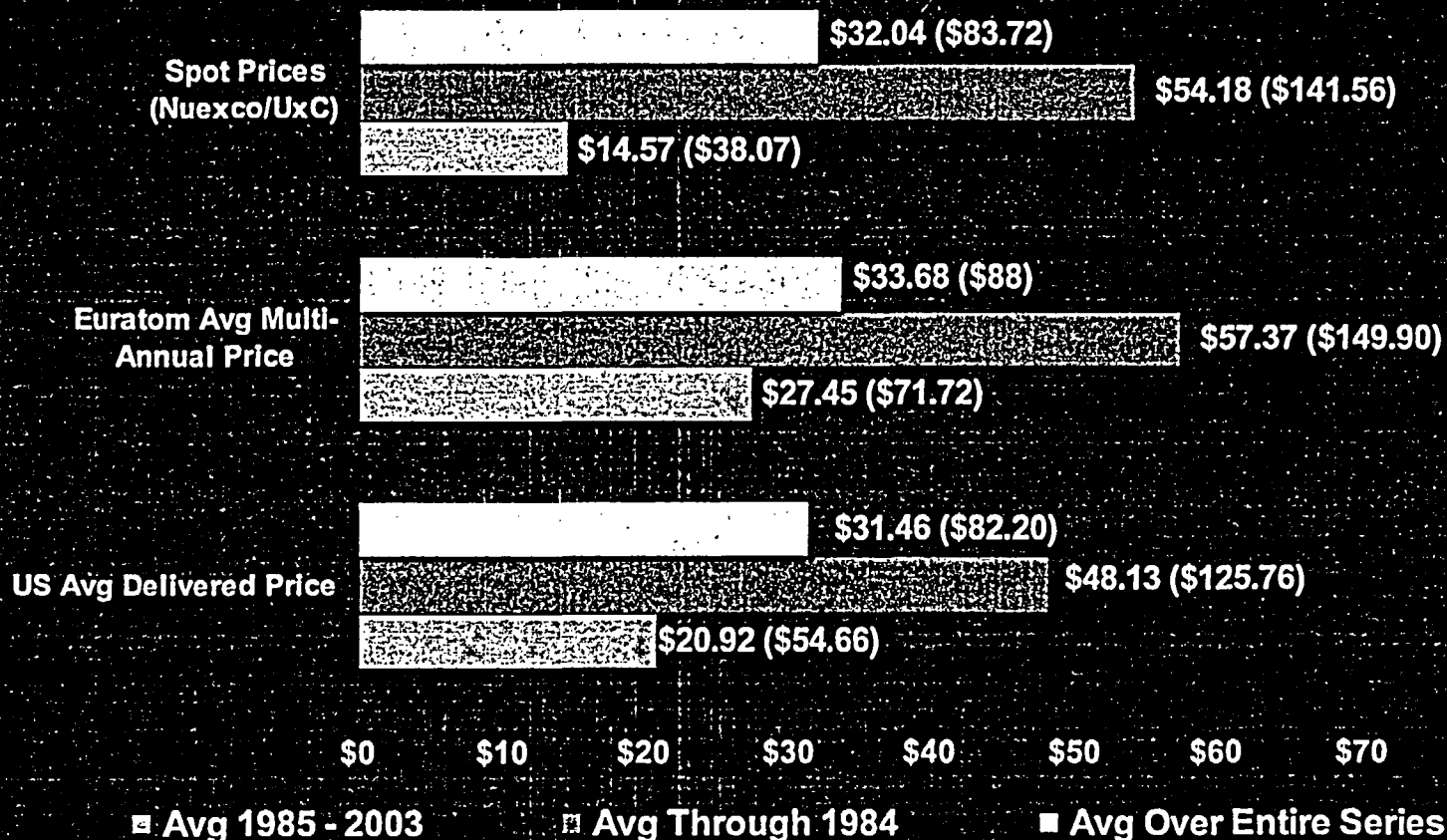
*Adjusted by U.S. GDP IPD, 2nd Q.

US Avg delivered price from Domestic suppliers through 1993, weighted avg delivered price from domestic and foreign purchases 1994-2004

U.S. AVERAGE DELIVERED & EURATOM
MULTI-ANNUAL PRICES

HISTORICAL AVERAGE URANIUM PRICES

Simple Average in Constant 2004 U.S. \$/lb (U.S. \$/kgU)



U.S. \$/lb
U.S. \$/kgU
2004

PRICE FORMATION

"Price Formation Refers To How Price Is Set In A Market"

□ Weapons Era:

- Government Sets/Adjusts Price Needed to Bring Forth Desired Supply

□ Inventory Accumulation Era:

- Reactor Orders, U.S. Enrichment Contract Requirements, Westinghouse Default, Expectations of Future Shortfall—Expectations Drive Price Up

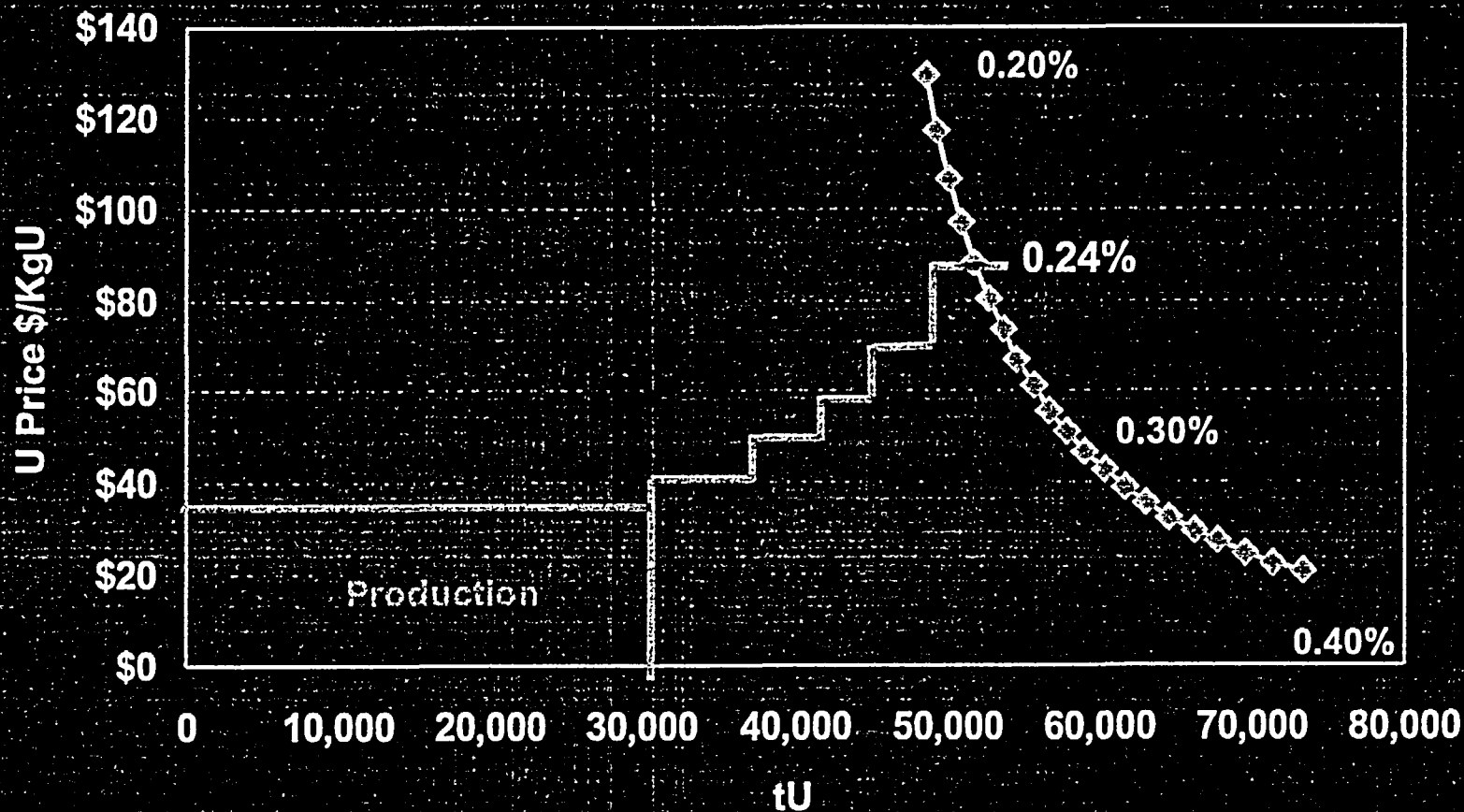
□ Inventory Liquidation Era:

- Expectations of Future Surplus Supply Based on Commercial and Russian Inventory Liquidation

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PRODUCTION-BASED PRICE FORMATION

(Based On LT Avg. \$32/lb U & \$100 SWU)



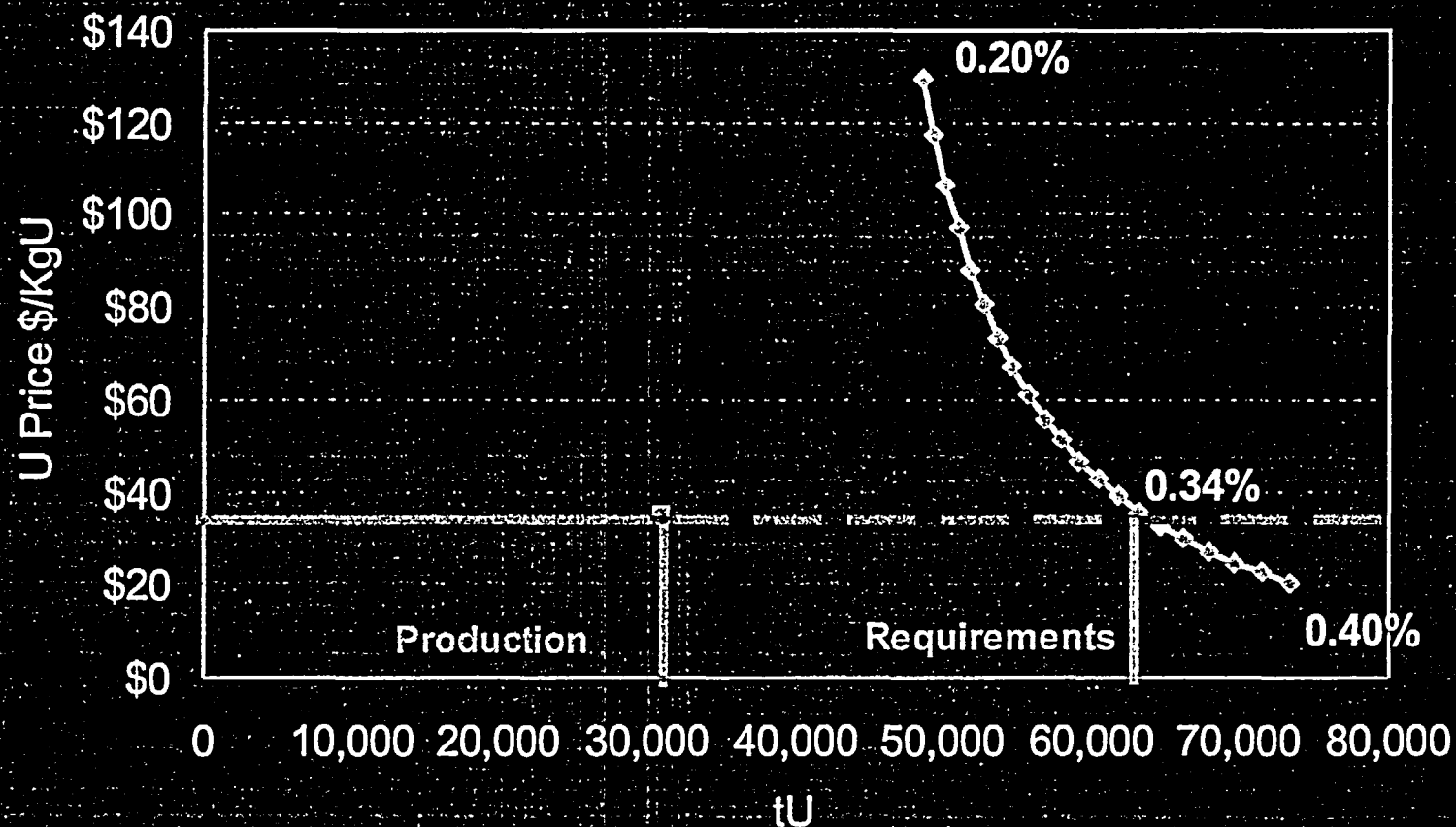
U Price
\$/KgU

PRODUCTION BASED MARKET

- ☐ Market Price Set By Highest Cost Production Needed to Meet Requirements
- ☐ Producer Surplus Invested in Exploration/New Mine Development
- ☐ Higher Uranium Market Price Means Lower Tails Assay, Reduced Uranium Requirements
- ☐ Lower Economic Tails Assay Stimulates Expansion of Enrichment Capacity

EXPLORE
PRODUCE
ENRICH
FUEL
POWER

INVENTORY-DRIVEN PRICE FORMATION



1. ☐ **Production**
 2. ☐ **Requirements**
 3. ☐ **Price**

INVENTORY LIQUIDATION MARKET

❑ Inventory Sellers Sold Below Long-Run Replacement Cost & Discounted Present Value Of Higher Future Price

❑ Low Prices:

- Drove All But Lowest-Cost Production Centers Out of Business
- Discouraged Exploration/Too Few New Mines In Pipeline
- Reduced Mine/Mill Investment (& Maintenance)
- Undermined Investment In Enrichment (High Tails)

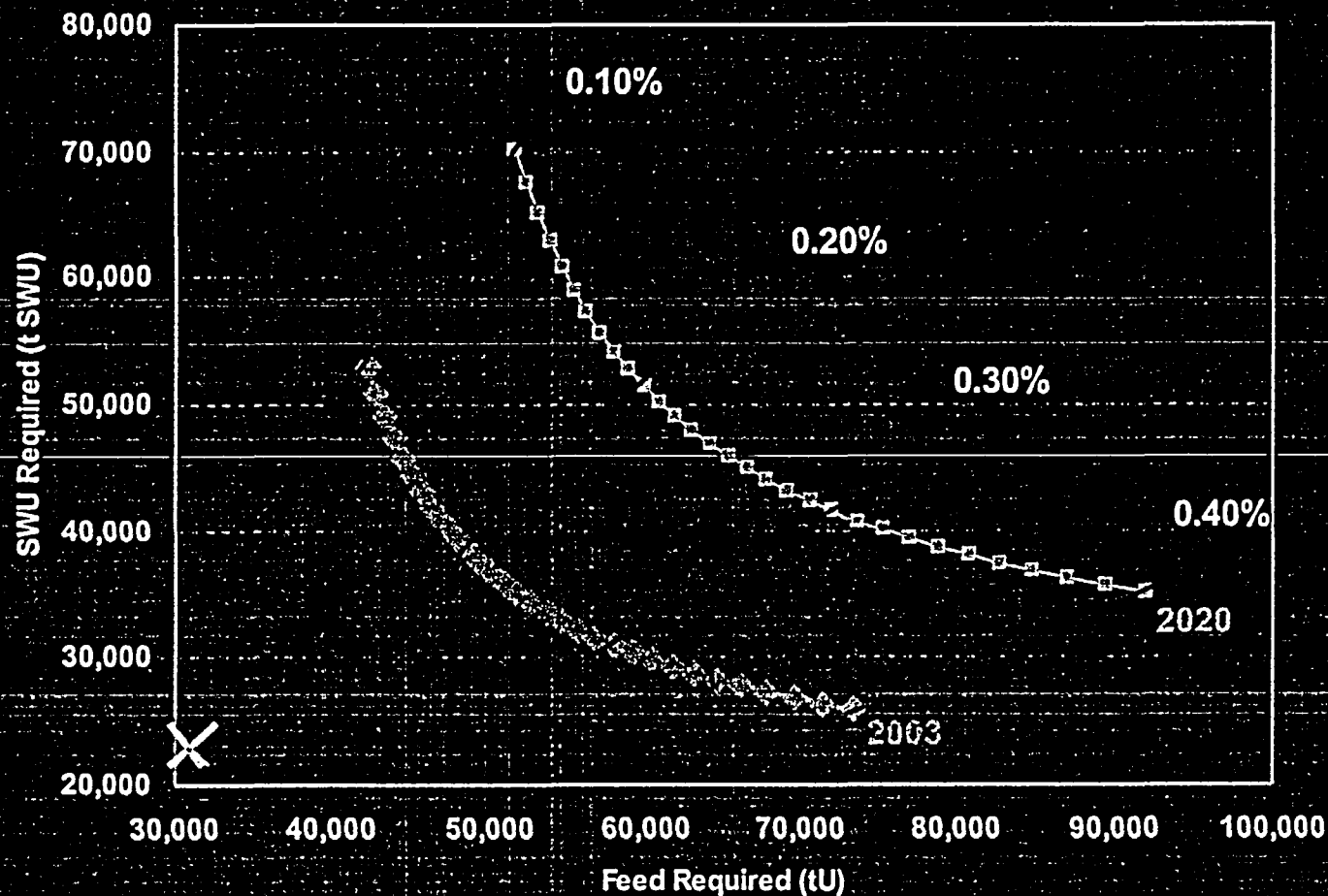
❑ Little Chance of Rebound in Production as in 1970s

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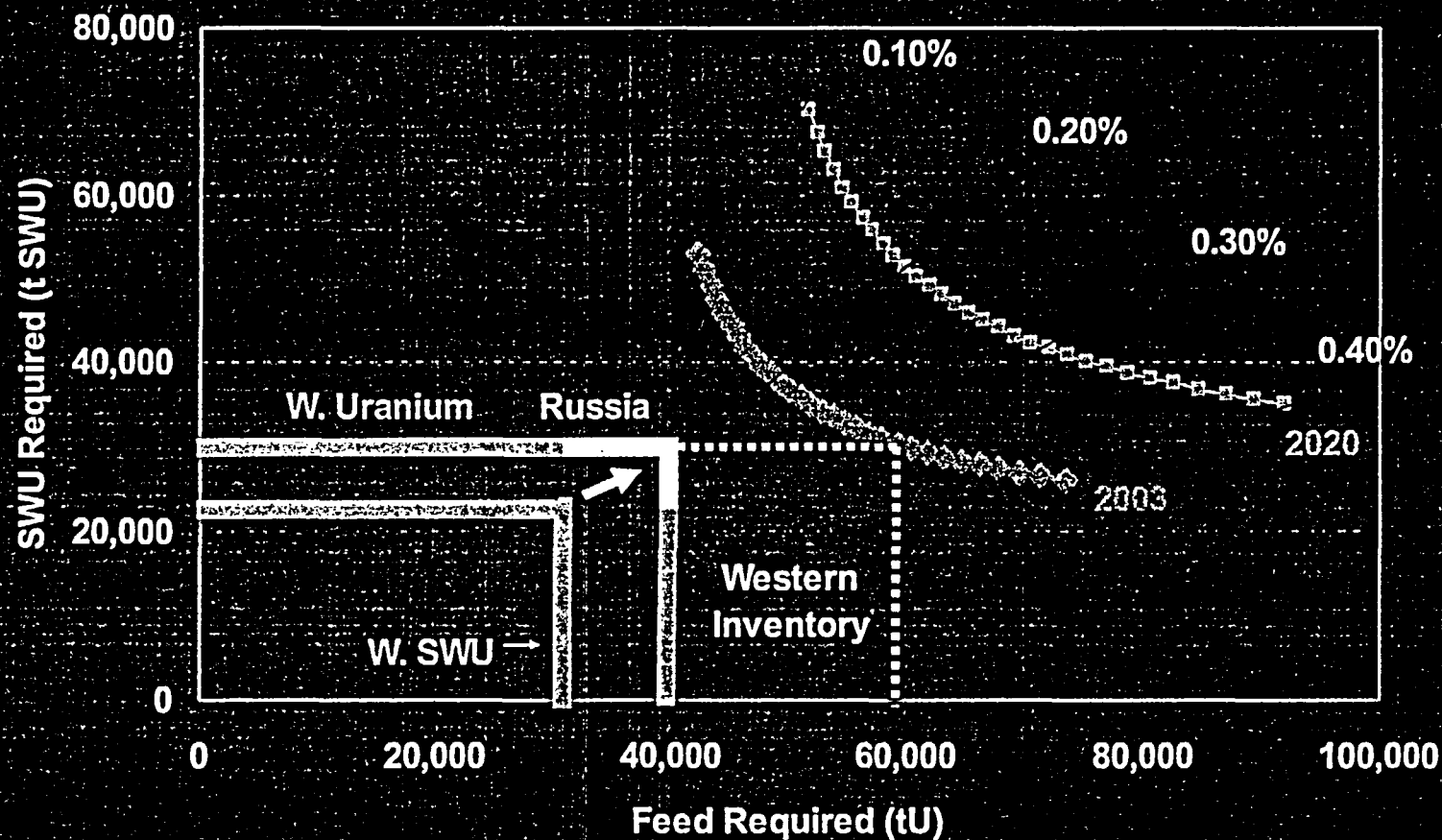
FILLING THE GAP WITHOUT INVENTORY SUPPLY

- ☐ Commercial Uranium Inventory Liquidation Appears to Be Ending
- ☐ SWU & Uranium Are Substitutes
- ☐ Need Combination of Additional SWU & Uranium to Meet Requirements:
 - Increase Enrichment Capacity & Reduce Tails Assay
 - Expand Uranium Production
 - Draw On Government Inventories

SWU/U COMBINATIONS TO MEET WNA REQUIREMENTS—2003-2020



SWU & URANIUM SATISFYING WNA REQUIREMENTS 2003 & 2020



1. W. Uranium
 2. W. SWU
 3. Russia
 4. Western Inventory

CLOSING THE GAP

- ☐ Russian Supply (7.5 MM SWU, 9,000 tU) Does About Half the Job—Until 2013
- ☐ To Reach Closest Point On Requirements Curve Need Additional 8 MM SWU + 8,000 tU
- ☐ Alternatively, More SWU (Less U) or More U (Less SWU)
- ☐ Requirements Horizon Moving Out Over Time
- ☐ Where Will Required U/SWU Supply Come From?



RUSSIA

- ❑ Already Large Contribution To Western Supply
- ❑ SWU Capacity Fully Utilized (HEU Blendstock, RET, Reprocessed Uranium, Domestic & Export Requirements)
- ❑ China & Russia Short Of Uranium—Compete for Western Supplies
- ❑ End Of HEU Deal Approaching—Mines & Enrichment Plants To Replace HEU Need to Start Now

U.S. GOVERNMENT INVENTORIES

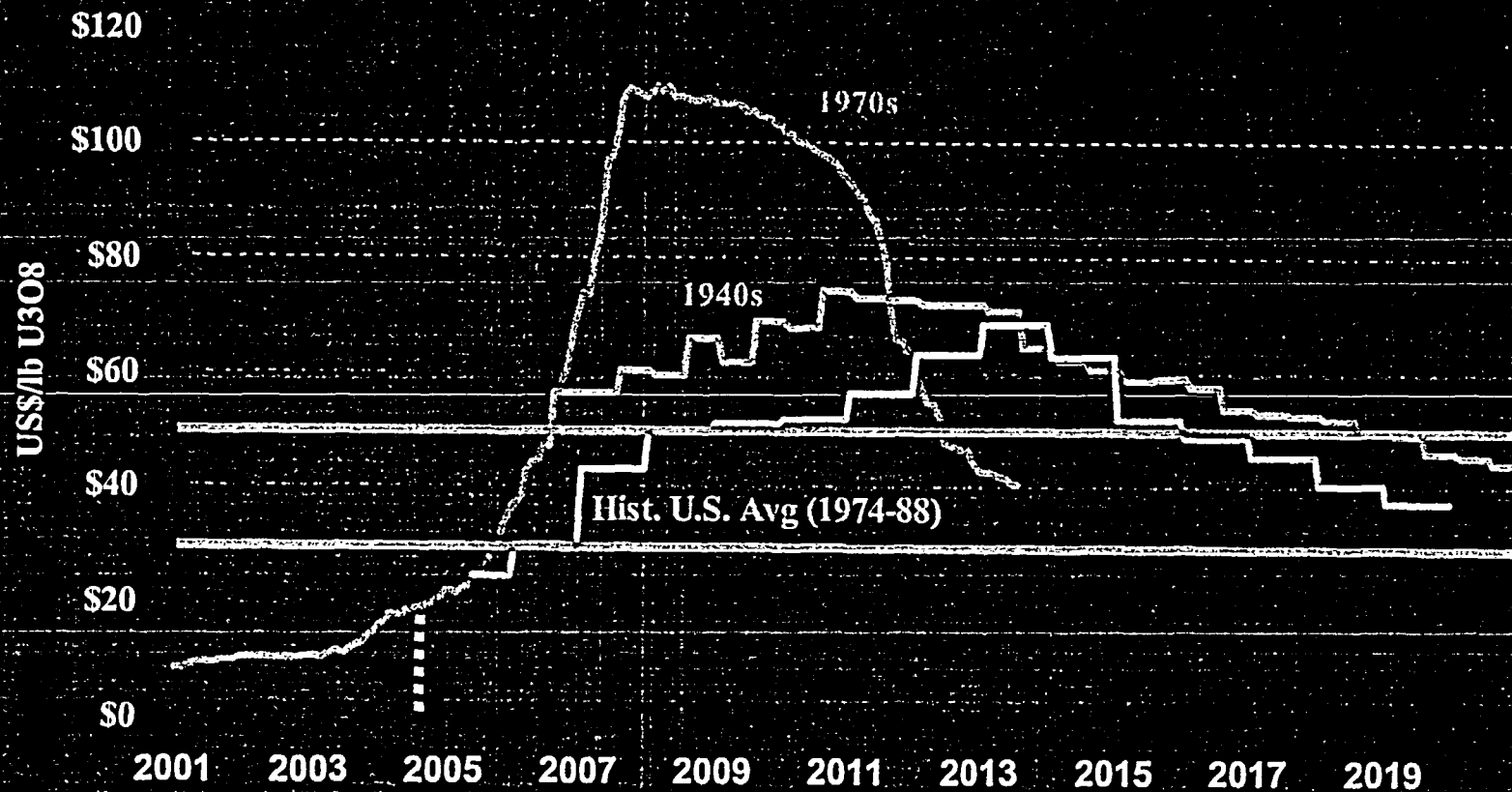
- ☐ Natural Uranium Stocks Are Small and Contaminated or Locked Up
- ☐ Cleanup Possible But Slow (2,000 t/yr)
- ☐ U.S. HEU Cleanup & Blending Capacity Limited (No U.S. Fluorination Capacity)
- ☐ DOE Tails Mostly Below 0.30%--Not Enough Enrichment Capacity To Process Them
- ☐ But Government Inventory Uncertainties Threaten New Mines

DOE
1997

ALTERNATIVE FUTURES

- ☐ Smooth Price Path Difficult w/o Inventory Bridge
 - Not Enough Uranium or SWU Projects In Pipeline
 - Long Lead-Times for SWU & U Projects
- ☐ Higher Prices Needed to Induce Needed Investment
- ☐ Historical Averages Between \$30-\$50/lb.
- ☐ Possibility of Transient High Prices, As In 1970s

HISTORICAL PRICE CHANGES: A MODEL FOR THE FUTURE?



U.S. GEOLOGICAL SURVEY
MINERAL RESOURCES DIVISION
WASHINGTON, D.C. 20508

LONG-RUN PICTURE IS GOOD-- HARD PART IS GETTING THERE

- ☐ Uranium Is Not Scarce, But Time Is Required to Bring On Large Amounts of New Production
- ☐ Enrichment Can Be Expanded Greatly, With Enough Time
- ☐ But Time Appears to Be Running Out
- ☐ May Have Squandered Opportunity Provided By Inventory Liquidation Era