COMMERCIAL IMPOSSIBILITY, THE URANIUM MARKET AND THE WESTINGHOUSE CASE

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I. INTRODUCTION

ON September 8, 1975, Westinghouse Electric Corporation, a major vendor of nuclear reactors and a major contractor for uranium fuel, announced that it would not honor fixed price contracts to deliver about 70 million pounds of uranium.[1] Westinghouse claimed that it was not legally bound to honor these contracts by appealing to § 2-615 of the Uniform Commercial Code (U.C.C.) which allows excuse from the performance of contractual obligations for reasons of "commercial impracticability." In particular, it claimed that for "unforeseeable" reasons uranium prices had risen to several times the price at which Westinghouse had agreed to deliver uranium to utilities and that performance on such contracts, with a potential loss of as much as $2.0 billion,[2] was "commercially impracticable". Subsequent to this announcement 27 utilities in 14 separate actions brought suit against Westinghouse to either fulfill its contractual commitments or pay damages. Thirteen of these suits were brought in Federal District Courts and have been consolidated for pretrial procedures in the U.S. District Court for the Eastern District of Virginia. The fourteenth suit was brought in a state court in Pennsylvania. Trial was in progress in December 1976 as this paper was completed, but has subsequently been settled out of court.[3]

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Unless an out of court settlement is reached in the cases now pending in Virginia, litigation will be in progress as this paper is published. The author has neither used nor had access to any of the material contained in the private files of the parties to this litigation or other information that may become available as a result of the pre-trial discovery process or through expert economic testimony presented in the litigation.

[1] Wall Street Journal, Sept. 9, 1975, at 5, col. 2.

[2] Kidder, Peabody & Co., Westinghouse Electric Corporation: Nuclear Power and Uranium 3 (Sept. 25, 1975).

[3] Nucleonics Week, Dec. 18, 1975, at 9; Westinghouse Electric Corp. Uranium Contracts Litigation, 405 F. Supp. 316 (1975); Wall Street Journal, Mar. 31, 1977, at 4.

These events present an opportunity to evaluate a particular body of legal doctrine utilizing both theoretical and empirical techniques in economics. The case at hand is especially interesting since neither the doctrine of commercial impracticability nor the uranium market itself has been the subject of extensive economic analysis.[4] In addition, given the size of the potential losses and the visibility of the case, its outcome may have important implications regarding the doctrine of commercial impracticability, a doctrine which may be an important aspect of contract law as buyers and sellers adapt to an economy characterized by inflation, violent swings in commodity prices, and the increasing dominance of large firms and government intervention in commercial transactions. My task in this paper is therefore threefold.

The first part of the paper is devoted to a discussion of the evolution of the uranium mining and milling industry in the United States. The aim of the discussion is to develop an understanding of the nature of the supply and demand sides of this market and the evolution of mechanisms linking supply and demand to determine uranium prices. This study is interesting in and of itself because it represents a rare opportunity to examine the evolution of a specific and increasingly important market from its birth to its maturity. The study also provides useful empirical information to perform an economic analysis of the case at hand.

The second part of the paper is devoted to an economic analysis of the doctrine of commercial impracticability as it has been embodied in § 2-615 of the Uniform Commercial Code. This section includes a brief discussion of the evolution of the doctrine of "impossibility" and a detailed discussion and evaluation of its interpretation for contracts involving sales of goods in the U.C.C. The final section of the paper integrates the material of the previous two to discuss and evaluate the issues surrounding the Westinghouse case itself.

[4] After this paper was written I received a copy of a paper dealing more generally with the economic analysis of "impossibility" by Richard Posner & Andrew Rosenfield, Impossibility and Related Doctrines in Contract Law: An Economic Analysis, 6 J. Leg. Studies 83 (1977). That paper provides a more general theoretical treatment of the subject and does not focus on U.C.C. § 2-615 as does this paper. In addition, papers by Stephen S. Ashley, The Economic Implications of the Doctrine of Impossibility, 26 Hastings L.J. 1251 (1975), and Robert L. Birmingham, A Second Look at the Suez Canal Cases: Excuse for Nonperformance of Contractual Obligations in the Light of Economic Theory, 20 Hastings L.J. 1393 (1969), have dealt with the subject from the perspective of microeconomic theory. None of these papers makes an effort to integrate a detailed empirical study of industry behavior and performance with the theoretical analysis of the underlying contract doctrine in the context of an actual case. The analysis of Posner-Rosenfield and Ashley is generally consistent with the analysis of this paper. Both stress the need to examine the *ex ante* costs of risk bearing and information procurement rather than the *ex post* allocation of losses in particular cases as has been more common in legal analysis.

II. The Evolution of the Uranium Market in the United States: 1948-1975

A. *Background: The Nature of Uranium Supply*

Before proceeding with a discussion of the evolution of the uranium market in the United States, it is necessary to develop some background information on the technology and costs of supplying uranium oxide. Raw uranium ore is mined from open pit and underground mines. The primary world suppliers today are the United States, Canada, Australia, South Africa, Gabon, and France. Mined ore normally has only a very small proportion of uranium oxide (on the order of .2 percent by weight). Therefore, near the mines a milling or processing plant is usually built which uses chemical processes to separate the uranium oxide from the rest of the ore, leaving concentrated uranium oxide called yellowcake. It is the price of yellowcake at the mill that is normally quoted. Since many mills are vertically integrated backward into mining, we will not necessarily observe a transactions price for ore of various uranium oxide contents, but rather only a price for yellowcake.

Mine-mill complex life has been estimated to average about ten years,[5] depending on the size of the ore body near which it is located. Current milling capacity in the United States is 18-20,000 tons U_3O_8 per year. Development of new production capacity is thought to take between three and eight years, depending upon whether we begin with developed reserves, whether open pit or underground mines are necessary, and whether new reserves must be fully developed.[6]

The costs of building and operating a mine-mill complex are composed of the following factors:

(1) The costs of exploration and development of uranium reserves. These costs are a function of the U_3O_8 yield per foot drilled and the costs of drilling. These costs are incurred long before actual production takes place and must be appropriately capitalized to determine the long-run marginal cost of uranium oxide.
(2) The construction costs of constructing a mine-mill complex and associated interest charges. In 1975 the construction cost of a mill with a capacity of 1,000 tons of ore per year was estimated at $17–24 million.[7]
(3) The costs of operating and maintaining the mines.
(4) The costs of milling the uranium ore. These costs are a function of the processing materials costs and the U_3O_8 content of the ore milled.

[5] Development, Growth, and State of the Nuclear Industry: Hearings Before the Joint Comm. on Atomic Energy, 93d Cong., 2d Sess. 195 (1974) (statement of Dean A. McGee).

[6] U.S. Federal Energy Ad., National Energy Outlook, Feb., 1976, at 258.

[7] The S. M. Stoller Corporation, Report on Uranium Supply, Task III of EEI Nuclear Fuels Supply Study Program 92 (Dec. 5, 1975).

TABLE 1
AVERAGE U_3O_8 CONCENTRATION OF ORE DELIVERED

	Percentage
1951	0.31
1952	0.32
1953	0.31
1954	0.32
1955	0.30
1956	0.28
1957	0.28
1958	0.27
1959	0.26
1960	0.24
1961	0.24
1962	0.24
1963	0.25
1964	0.25
1965	0.24
1966	0.23
1967	0.20
1968	0.195
1969	0.21
1970	0.20
1971	0.20
1972	0.21
1973	0.21
1974	0.18
1975	0.17

Source:
1951-1971: Minerals Yearbook, (issues for 1959-1971) (chapters on uranium).
1972-1975: U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 86.

(5) Taxes, costs of land and mineral rights, costs of access roads, transportation and other miscellaneous expenses.

Over the past twenty years there has been a continuous reduction in the U_3O_8 content of ore delivered to mills, falling from a high of .32 per cent U_3O_8 in 1952 to a low of .17 per cent ore content in 1975 (see Table 1). The average reserve ore content today is .12 per cent U_3O_8. We will refer to this reduction in U_3O_8 content of ore as ore depletion. In addition, the average depth of exploratory holes has increased from 148 feet in 1958 to 482 feet in 1975 (see Table 2), with an associated decline in discovered reserves per foot drilled.[8] Finally, drilling costs increased from $1.49 per foot in 1973 to $2.09 per foot in 1974, and another 40 per cent in 1975.[9]

Based on observed ore depletion alone, other things held constant, the

[8] See Kidder, Peabody & Co., *supra* note 2, at 21.

[9] U.S. Energy Research & Dev. Ad., [1976] Statistical Data of the Uranium Industry 64.

TABLE 2
AVERAGE DEPTH OF EXPLORATORY HOLES DRILLED

	Feet
1958	148
1959	146
1960	191
1961	160
1962	230
1963	104
1964	162
1965	187
1966	313
1967	425
1968	422
1969	428
1970	409
1971	401
1972	439
1973	480
1974	580
1975	482

Source: U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 56.

costs of mining and milling uranium should have increased by nearly 90 per cent in real terms since the early 1950's. Based on average reserve ore content, costs have increased by nearly 170 per cent. In addition, wages for miners have increased considerably more rapidly than the average rate of inflation.[10] While detailed assessments of the current long-run incremental costs of exploration and development and building and operating mine and mill facilities are not readily available, it appears from an examination of the ore quality statistics that discovery rates and costs of key components of the overall real cost of uranium oxide have increased substantially in real terms since the 1950's.

As with any exhaustible resource, the expected uranium price trajectory depends critically on the reserves of the resource that are expected to be available at various costs of production. Uranium reserve data are reported and referred to in the United States and abroad with thoroughness beyond that given most other fuel resources. Instead of merely publishing figures for the locations, depth, concentrations, and nature of the host rock as is common for coal, oil and natural gas, the Atomic Energy Commission (AEC) began very early on to report reserves based on a "forward cost" concept. Uranium reserves are reported in terms of tons of uranium oxide that could

[10] Series on hourly earnings in the mining industry. U.S. Bureau of Labor Statistics, Handbook of Labor Statistics 48 (1975).

be mined at less than *forward costs* of $8, $15, $30, etc. Forward costs include essentially the variable costs of mining, hauling and milling uranium. Property acquisition costs, exploration and development costs, costs of money, capital costs, ore replacement costs, profits and taxes are not included in the cost estimates.[11] This forward cost concept, therefore, only includes some of the costs that would make up the true long-run marginal opportunity costs of uranium that would determine the floor on uranium prices for a competitive market in long-run equilibrium.[12] (The other component of price other than long-run marginal production costs would be "user cost" associated with a nonreplenishable resource.) As a result, the "forward cost" of a particular reserve deposit being mined reflects primarily the short-run variable costs of producing from a developed facility. We would only expect prices to equal forward costs in a situation in which a competitive industry were in a position of excess capacity where demand is not pushing against the constraints of existing capacity. In long-run equilibrium prices would be considerably higher reflecting total long-run marginal costs.[13]

Nevertheless, it is apparent from reading the literature on uranium prices and uranium reserves that many people in the industry thought of forward costs of reserves being mined as good approximations to market prices. The AEC and international organizations such as the Organization for Economic Cooperation and Development (OECD) discuss the costs of uranium for power reactors in terms of the forward cost concept and tend to equate expected prices with forward costs.[14] The fact that actual transactions prices were for several years approximately equal to the reported forward cost figures for the low cost reserves that formed the major basis for discussion of future reserves reinforced such tendencies to confuse forward costs with long-run market prices.

Although recent AEC publications[15] contain footnotes indicating that

[11] See U.S. Atomic Energy Comm'n, The Nuclear Industry 1974, at 39; Nat'l Academy of Sciences, Reserves and Resources of Uranium in the United States 12 (Mineral Resources & the Environment, Supp. Rep., 1975).

[12] See Deutsches Atomforum, Natural Uranium Supply 208 (Int'l Symposium Nov. 18 & 19, 1974); $8 Uranium Reserves—Cost vs. Price, Nuclear Industry, June, 1972, at 36.

[13] Long-run marginal production costs today including taxes and profits appear to be in the range of $30-$40 per pound. See discussion below. It should also be noted that neither these estimates nor any others that have been put forward incorporate a value for the "user cost" associated with a resource with differential extraction costs. See Paul G. Bradley, Increasing Scarcity: The Case of Energy Resources, 63 Am. Econ. Rev., pt. 2 at 119 (Papers & Proceedings, May 1975) and Robert W. Solow & Frederic V. Wan, Extraction Costs in the Theory of Exhaustible Resources, 7 Bell J. Econ. & Manag. Sci. 359 (1976). These estimates must be viewed, therefore, as lower bounds on the optimal long-run resources prices.

[14] See, for example, [Organization of European Community Development] OECD Nuclear Energy Agency and International Atomic Energy Agency, Joint Report: Uranium 11 (August 1973).

[15] See Nat'l Academy of Sciences, *supra* note 11, at 12.

forward costs would not necessarily represent market prices, the distinction was never emphasized until prices began to rise far above the forward cost of $8 to $10 which were normally thought of as the price of the reserves that would be exploited in the medium term. In December 1975, the National Research Council of the National Academy of Sciences recommended that the forward cost system of reporting reserves be abandoned. The report says that the forward cost concept is inherently misleading and confusing and that forward costs are misinterpreted since forward costs do not represent the prices at which uranium will be marketed.[16]

This discussion should not be interpreted to suggest that everyone in the nuclear industry was fooled into thinking that the forward cost figures associated with low cost reserves were representative of the long-run price of uranium oxide in an expanding market. On the contrary, many of those familiar with the economics of the supply sector perceived an inconsistency between expected supply and expected demand at the prices being quoted by government agencies, reactor vendors and utilities. We will discuss this further in the sections below. It should be noted here, however, that the use of the forward cost concept and the tendency to equate forward cost with the long-run market prices provided many agents with bad information on which to base price expectations.

B. *The Uranium Market in the United States: 1948-1975*

The uranium "market" can only be understood by viewing it in an historical context composed of several distinct historical periods:

(1) 1948–1958: Vigorous expansion of the uranium industry in response to attractive payments offered by the AEC. (First Expansionary Period)

(2) 1958–1962: Expansion ceased as the AEC receives deliveries on existing contracts but would no longer encourage expansion of the industry. Uranium deliveries peaked, but exploratory and other expansionary activity came to a virtual halt. (Full Capacity Utilization Period)

(3) 1962–1969: A period of industry decline as the AEC purchased a reduced amount of uranium from reserves discovered prior to November 1958 at prices at or below $8 per pound in order to keep some private uranium firms in business until commercial demand would develop. (Supply Side Decline Period)

(4) 1969–1973: A commercial market began to develop but with serious inconsistencies between demand and supply expectations at prevailing prices. The market developed slowly and was characterized by continuing excess capacity and a failure of the uranium consuming sector to match long-term requirements with long-term supply contracts. (Buyers' Market Period)

[16] *Id.* at 12.

TABLE 3
URANIUM MILLING CAPACITY 1957-1975

	Number of Mills Operating (Year end)	Capacity* (Tons of ore per day)
1957	16	11,000
1958	23	21,000
1959	24	22,000
1960	25	22,300
1961	26	22,500
1962	24	22,000
1963	21	N/A
1964	20	N/A
1965	16	N/A
1966	17	N/A
1967	16	N/A
1968	13	N/A
1969	15	23,450
1970	15	26,450
1971	17	27,500
1972	20	31,900
1973	18	28,450
1974	14	25,450
1975	15	23,000

* Unfortunately, estimates of U_3O_8 production capacity are reported for only a few years. The relationship between column 2 and yellowcake capacity depends on the ore grade of the rock and the amount of ore left in the rock by the particular process used. In 1972 yellowcake production capacity was estimated at 19,000 tons per year and at 18,000 tons per year in 1973. For 1970 and 1971 it was estimated at 15,000 to 16,000 tons per year. Since mills operated near full capacity through 1962, the figures given in Table 5 for deliveries to the AEC are probably equal to the capacity levels of the mills for those years.

Source: 1957-73: Minerals Yearbook (issues for 1957-73) (chapter on uranium).
1974: U.S. Atomic Energy Comm'n, [1975] Statistical Data of the Uranium Industry 80.
1975: U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 80.

(5) 1973–1975: The commercial market reached maturity. The demand side and the supply side of the market began to come into balance as utilities went to the market to try to cover medium- and long-term requirements. Uranium prices rose dramatically. (Second Expansionary Period or Sellers' Market Period)

Let us examine each period in detail. (Refer to Tables 3, 4, and 5.)

(1) 1948–1958: The First Expansionary Period. The Atomic Energy Commission was the only buyer of uranium during this period of time in the United States. Purchases were primarily for weapons acquisition and to provide material for government–owned plutonium producing and experimental reactors. At the beginning of this period there was essentially no domestic uranium industry. AEC requirements came from foreign sources, primarily Canada and the Belgian Congo. Beginning in 1948 the AEC set as one of its primary goals the rapid expansion and development of a domestic uranium mining and milling industry composed of privately owned firms. To accomplish this goal, the AEC embarked on a program to purchase ore

TABLE 4
U_3O_8 RECEIPTS BY DOMESTIC MILLS

	Tons U_3O_8
1950	810
1951	1,088
1952	1,288
1953	2,315
1954	3,539
1955	4,425
1956	8,434
1957	9,837
1958	14,003
1959	17,377
1960	18,842
1961	18,513
1962	17,085
1963	14,721
1964	13,881
1965	10,578
1966	10,051
1967	10,866
1968	12,850
1969	12,595
1970	13,037
1971	13,089
1972	13,863
1973	13,787
1974	12,400
1975	12,000

Source:
1950-1973: U.S. Atomic Energy Comm'n, [1974] Statistical Data of the Uranium Industry 7.
1974-1975: U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 10.

and contract for milling services at prices which would encourage private firms to enter the industry.

The AEC established a fixed minimum price schedule for the purchase of uranium ore of various qualities and provided firms with additional bonus payments for initial production of uranium, for development expenditures, and for the production of ore with U_3O_8 contents of greater than .20 per cent. The AEC also let participation contracts to encourage uranium exploration and paid for access roads to mining areas. The AEC ran the milling part of the supply stream something like a regulated utility. A prospective mill owner would have to apply to the AEC for a certificate of need. If granted, the AEC would sign a long-term (five to seven year) cost plus profit contract for the delivery of a specified quantity of U_3O_8 over the contract period. The pricing procedure was favorable in a number of respects; in particular, rapid depreciation of mill plant and equipment was allowed.[17]

[17] H. D. Keiser, Uranium, Radium, and Thorium, [1952] 1 Minerals Yearbook 1083, 1086-

TABLE 5
DELIVERIES OF U_3O_8 FROM DOMESTIC MILLS

	Tons U_3O_8	
	To AEC	To Commercial Buyers
1950	323	
1951	639	
1952	824	
1953	968	
1954	1,435	
1955	2,125	
1956	4,179	
1957	7,505	
1958	10,708	
1959	15,029	
1960	16,394	
1961	17,646	
1962	17,244	
1963	15,752	
1964	12,607	
1965	11,240	
1966	10,178	
1967	8,902	900
1968	7,937	4,800
1969	7,124	4,200
1970	4,010	9,300
1971	1,295	12,700
1972	—	11,600
1973	—	12,100
1974	—	11,900
1975	—	12,500

Source: U.S. Energy Research & Dev. Admin., [1976] Statistical Data on the Uranium Industry 11, 78.

The result of the AEC policy was the rapid expansion of the mining and milling industry. By 1957 24 mills had either been built or were under construction with a combined capacity of over 21,000 tons of ore per day (about 18,000 tons of U_3O_8 per year at then prevailing levels of U_3O_8 content in ore).[18]

(2) 1958–1962: The uranium industry reached its peak in terms of production but expansion was halted by the AEC. In 1958 the AEC began to change its policy regarding the expansion of the mining and milling industry. It was decided that it was no longer in the government's interest to encourage additional expansion of the industry.[19] Existing contractual arrange-

1087; John E. Crawford, Uranium, Radium, and Thorium, [1953] 1 Minerals Yearbook 1203, 1207; and John E. Crawford, Uranium and Radium, [1954] 1 Minerals Yearbook 1241, 1244 and 1249.

[18] James Paone, Uranium, [1957] 1 Minerals Yearbook 1219, 1224.

[19] *Id.*, at 1222.

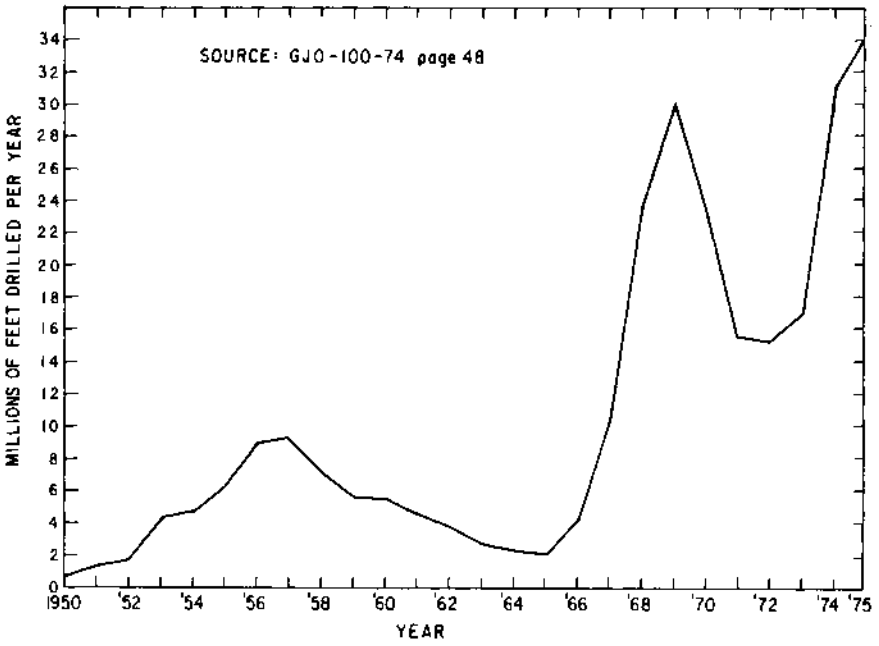

FIGURE 1
SURFACE DRILLING: WESTERN U.S. 1950–1975

ments running until March 1962 would be honored and ore purchased at the stipulated contract prices. No new contracts were to be signed for the period up to 1962 except under special circumstances. Beginning April 1, 1962, through December 31, 1966, the AEC would purchase not more than 500 tons U_3O_8 per property at a fixed price of $8.00 per pound. Reserves developed prior to November 1958 were the only ones eligible. Quantities beyond 500 tons might be purchased after negotiation but at prices below $8 per pound. When the policy was officially announced in 1958, no purchases from new reserves were anticipated.

During this period the uranium industry reached its peak in terms of production and capacity (see Tables 3, 4, and 5). More uranium oxide was produced by the industry during 1961 and 1962 than has ever been produced subsequently (see Table 4). However, exploration activity peaked in 1957 and then began to decline in response to AEC procurement policy (see Figure 1).

(3) 1962–1969: The uranium industry contracted. This period was a critical hiatus for the industry. No major new AEC contracts were let and deliveries to the AEC declined as old contracts had expired and the new "maintenance" contracts for limited quantities of uranium at prices of $8 per pound

were initiated. The AEC procurement policy was apparently designed to maintain some uranium mining and milling capacity in operation so that a base load industry would exist and be available for the commercial uranium requirements that were expected to begin to materialize at the end of the decade. The $8 price was deemed sufficient to allow at least some of the existing firms to continue operating rather than to encourage entry. As a result, the prices were set sufficiently high to cover at least the variable operating costs of at least some of the larger and more efficient mines and mills in the industry.[20]

Many mines and mills closed during the period (see Table 3) as U_3O_8 requirements declined and since the $8 price combined with restricted orders led to losses for many of the smaller operations.[21] There was also substantial merger activity with the takeover of mining properties by the larger mills and the merging of companies engaged primarily in uranium mining and milling by larger companies engaged in the large minerals and fuels industries. The AEC also stretched out some of its 1962-1966 contractual arrangements until 1970 and agreed to purchase additional quantities of uranium at prices below $8 to help keep some of the mills in business until a substantial commercial market developed. The first deliveries to commercial buyers began in 1967, but commercial purchases did not surpass even the meager AEC purchases until 1970 (see Table 5).

The uranium industry during this period of time had many of the characteristics of a declining industry. There were many exits of mines and mills, and exploratory activity declined dramatically (see Table 3 and Figure 1). Supply was provided by more intensive utilization of existing reserves rather than new reserves and the production from reserves with the lowest short-run costs of production. This behavior is reflected in the declining grade of ore mined beginning in 1963 (see Table 1) and the gradual shift away from high operating cost underground mines to low operating cost open pit mines (see Table 6). This latter movement occurred despite the fact that the majority of low cost uranium reserves (58 per cent) were estimated to be located in deposits requiring underground mining.[22]

Drilling activity was very low through 1966 (see Figure 1) reflecting the

[20] During the final two years of this period (1969 and 1970), often called the "stretch-out" phase, the AEC used a cost-based pricing formula based essentially on variable costs of production. The formula set prices equal to 85 percent of operating costs plus $1.60 with a price ceiling of $6.70. This figure gives us a good feeling for what the variable costs from existing developed deposits were at that time. The average price paid during this period was about $6.00 per pound.

[21] In 1963 there were 730 mines and 24 mills operating. By 1968 the industry was reduced to 320 mines and 13 mills in operation. See Charles T. Baroch, Uranium [1963] 1 Minerals Yearbook 1169, 1171-1172; Richard F. Stevens, Jr., Uranium, [1968] 1 Minerals Yearbook 1117, 1118.

[22] See U.S. Energy Research & Dev. Ad., [1975] Statistical Data of the Uranium Industry 25.

declining nature of the industry. Beginning in 1967 there was a rapid upturn in exploratory drilling, and new commitments for milling capacity to come on line in the early 1970's. Given the supply lead times indicated previously, such activity was probably in anticipation of a large commercial market developing by 1973. This is consistent with AEC projections made in the late 1960's that there would be 48,000 MWe of nuclear capacity on line in 1973 and uranium requirements of 14-15,000 tons of U_3O_8 by 1973.[23]

(4) 1969–1973: A commercial uranium market develops. It was in the context of this "depressed" supply side situation that a commercial uranium market began to develop in 1969 and 1970. Uranium producers were willing to sign fixed price contracts for future delivery primarily out of reserves that had already been discovered and developed. Such contracts reflected both the low variable costs of producing out of existing reserves and a desire to keep mines operating to avoid flooding and other types of deterioration that would otherwise make future production very expensive.

The first two years of the period witnessed vigorous exploratory activity and a large increment in milling capacity put into the construction stage. However, by 1970 a number of things became evident. First, the growth in nuclear power was not nearly as rapid as indicated by optimistic projections made three years earlier. Construction delays, technical problems, regulatory delays, etc., all slowed the nuclear program. Actual nuclear capacity in 1972 and 1973 was only half of what had been predicted. In response to reduced demand expectations, drilling activity peaked in 1969 and did not reach an equivalent level until 1975.

Perhaps more importantly, by 1971 the uranium mining and milling industry began to argue that uranium prices were simply not high enough to attract new exploration, development, mine and mill investment.[24] The mine and mill operators were reluctant to sign long-term fixed price contracts because much of the requirements would have to come from reserves which had not been either developed or even discovered, and the costs of developing, building and operating these new facilities were highly uncertain.[25] But consumers of uranium were also reluctant to sign long-term contracts at open ended prices for at least two reasons. There remained great uncertainty as to the timing of nuclear facility operating dates. There also *appeared to be* plenty of uranium around in the spot market for a price no higher than $8 because (1) the supply sector had short-run excess capacity, (2) one large seller (Westinghouse) was willing to sell at particularly low prices and (3) until July 1973 the AEC was willing to sell limited amounts of

[23] U.S. Atomic Energy Comm'n, [1969] Statistical Data of the Uranium Industry 41.

[24] Uranium: Discouraging Market Prospects Hurt Investment Incentive, Nuclear Industry, Dec., 1969, at 14, 16-17; Nucleonics Week, Mar. 6, 1969, at 4; *id.*, Oct. 21, 1971, at 3.

[25] Deutsches Atomforum, *supra* note 12, at 186-87.

TABLE 6
PROPORTIONS OF U_3O_8 PRODUCTION FROM OPEN PIT AND UNDERGROUND MINES

	Percent open pit	Percent underground
1951	16	84
1952	21	79
1953	25	75
1954	26	74
1955	19	81
1956	38	62
1957	34	66
1958	39	61
1959	25	75
1960	28	72
1961	28	72
1962	25	75
1963	30	70
1964	24	76
1965	29	71
1966	31	69
1967	30	70
1968	37	63
1969	42	58
1970	46	54
1971	54	46
1972	59	41
1973	63	37
1974	59	41
1975	56	44

Source: U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 26.

uranium from its large stockpile at $8 per pound. By 1972 the industry found itself in the peculiar position of facing expected demand growth for uranium of prodigious magnitudes while the supply side of the market was expanding very slowly. A number of commentators noted the growing gap between supply realities and demand expectations.[26] Yet, exploratory drilling activity fell off dramatically in 1971 and 1972, and milling capacity peaked out in 1972 (see Figure 1 and Table 3).[27] Many remaining small mines went bankrupt or merged with the large integrated firms remaining in the market. Uranium prices in the market remained below even the $8 that the AEC paid in the middle and late 1960's through 1973 despite the fact that a

[26] Nucleonics Week, Nov. 2, 1972, at 6; AEC-Industry Uranium Supply Outlook, Nuclear Industry, Feb. 1973, at 48.

[27] [Nuclear Exchange Corporation] Nuexco, Monthly Report to the Nuclear Industry, no. 48, at 1 (July 19, 1972) [hereafter cited as NUEXCO]; U.S. Atomic Energy Comm'n, The Nuclear Industry (selected issues).

"market view" indicated a serious inconsistency between long-run demand and supply side behavior at prevailing prices.

How could such a serious inconsistency between demand expectations and supply side behavior possibly evolve? The first thing to recognize about the uranium market in the early 1970's is that it was a very new market. Commercial sales of any appreciable amounts did not develop until 1970, and the commercial market began with an already existing excess supply situation. Since uranium had never been used as a commercial fuel before, utility purchasers had virtually no experience with uranium, uranium prices or uranium contracts. While expected demands for uranium for the late 1970's and early 1980's were quite high, actual private consumption was quite low in the period from 1970 to 1972. Since the uranium-producing industry was in an excess supply situation, there was plenty of uranium around in the spot market at very low prices. Utilities were concentrating their attention on getting the early plants built, licensed and operating, and were apparently not generally concerned at this stage with long-term uranium requirements. Many potential buyers appear to have assumed that there would be plenty of uranium available in the $8 to $10 range for the life cycles of their plants. These expectations were based on a number of factors. Uranium prices had in fact been at or below $8 per pound for nearly ten years and little recognition was given to the fact that this price was observed in a declining and unprofitable supply sector. The AEC, upon which industry depended heavily during these early years, emphasized reserve statistics for so-called $8 and $10 per pound forward cost uranium which was generally interpreted as reflecting the relevant market price for uranium (see discussion above). Finally, Westinghouse, acting as a major buying agent and fuel fabricator, was signing fixed price contracts for uranium at $8 to $10 per pound, reinforcing expectations held by less knowledgeable agents in the market.[28] Those buyers who in fact perceived the inconsistency between demand expectations and supply behavior at prevailing prices and contractual arrangements could simply sign a contract with Westinghouse to cover their medium-term uranium requirements.

Ordinarily, one would expect that such inconsistencies would quickly disappear as buyers entered the market to purchase uranium and, finding it unavailable at the current prevailing market prices, bidding the prices up high enough to give incentives to the supply side to provide additional uranium producing capacity. However, one of the striking characteristics of the consuming sector during this period of time was a pervasive tendency to fail to match even closely long-term expected uranium requirements with

[28] New AEC Supply-Demand Survey Provides Data for Uranium Watchers, Nuclear Industry, June 1969, at 46.

TABLE 7
FIRM FUTURE DELIVERY CONTRACTS BY U.S. BUYERS AS OF VARIOUS DATES: TONS U_3O_8 PER YEAR CONTRACTED FOR

	1/1/72	1/1/73	1/1/74	1/1/75
1973	12,400	12,300	—	—
1974	13,100	12,500	13,700	—
1975	13,500	15,800	15,500	16,400 (800)
1976	5,700	7,600	10,900	14,100 (1500)
1977	4,800	7,600	11,600	15,300 (2600)
1978	4,900	6,400	13,200	18,400 (3100)
1979	4,100	7,100	12,100	16,900 (3000)
1980	2,900	5,100	10,200	14,300 (2700)
1981	—	3,700	7,700	13,900 (3500)
1982	—	2,000	6,600	12,500 (3700)
1983	—	—	5,900	10,700 (3600)
1984	—	—	4,000	8,100 (3600)
1985	—	—	3,400	7,500 (3400)
1986	—	—	1,700	4,200 (2300)

Numbers in parentheses indicate that portion of total future delivery contracts made with foreign suppliers primarily in 1974.
Source: U.S. Atomic Energy Comm'n, Statistical Data of the Uranium Industry (issues for 1973-75).
U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry.

long–term supply contracts.[29] As can be seen by comparing Tables 7 and 13, there was a substantial gap between expected uranium requirements and firm supply commitments for a period of more than four or five years into the future. The demand side, in the aggregate, maintained a substantial "short" position in the uranium market to the extent that long–term uranium requirements were not even closely matched by long–term supply contracts. The aggregate figures are somewhat misleading since a number of utilities thought that they were making at least medium–term supply contracts when they ordered uranium from Westinghouse, which itself maintained a large but publicly unknown "short" position. (Westinghouse's behavior is discussed in more detail in the following section.) This contracting failure resulted from the factors discussed above and reinforced the inconsistency between demand expectations and supply side behavior by failing to provide the contracting mechanism which would have otherwise signaled the inconsistency, led to higher prices in the 1970-1972 period, and a supply response to the resulting higher prices. The contracting failure resulted from a combination of buyer misperceptions about the long–run price and availability of uranium and a tendency during this early period for utilities to concentrate on plant construction rather than on uranium procurement.

[29] AEC Uranium Market Survey Confirms Hesitant Utility Buying Trend, Nuclear Industry, June 1972, at 36-37; Office of Ass't Dir. for Raw Materials, U.S. Atomic Energy Comm'n, Survey of United States Uranium Marketing Activity 15 (1974); Deutsches Atomforum, Natural Uranium Supply 184-85.

Despite the failure of demanders to match long–term requirements with long–term supply contracts, there remains the question of why the supply side itself did not respond more vigorously and expansively to the emerging gap between expected demand requirements and production capabilities that became evident during the 1970-1972 period and in fact responded in just the opposite way. The reluctance of suppliers to expand capacity in anticipation that the expected uranium requirements would eventually have to be met with procurement contracts is understandable. The uranium industry had not been profitable throughout the late 1960's and early 1970's.[30] A number of firms which had engaged in vigorous exploratory activity and built additional mining and milling facilities in the late 1960's were badly "burned" as expected uranium demands did not materialize. Much of the "gap" between expected requirements and production capacity would have to come from new reserves, mines and mills, the costs of which were highly uncertain. In addition, given a slowdown in the rate of growth in nuclear power, there were growing demand side uncertainties as well. Suppliers were understandably cautious about bearing all of the risks of supply expansion, preferring instead both higher contract prices and different types of contracts which would shift more of the risks to the consumers of uranium. But, at least through 1973, utilities were reluctant to either sign contracts at prices above their low price expectations or to change the nature of the contracts so that they would bear more of the risks.[31]

Uncertainties about demand were not the only factors causing reluctance on the part of potential suppliers to bear all of the risks associated with supply expansion. The AEC owned 50,000 tons of uranium which, if released to the market for sale at the then prevailing price of $8 per pound, would have provided sufficient additional supply to fill any gap between existing private production capacity and requirements until perhaps 1980 and put an effective $8 lid on prices during that period of time. But by mid-1971 the AEC announced its "split-tails" policy as a method of disposing of its uranium stockpile without putting it directly on the market, eliminating this uncertainty. Another uncertainty on the supply side leading to reluctance to sign long-term contracts on the part of utilities was imports.[32] Throughout this period the enrichment of imported uranium was prohibited which effectively prohibited imports. It was not until late 1973 that the AEC announced its proposed import policy which would allow limited enrichment of imported uranium beginning in 1977 and would remove all restrictions by 1984.[33] Finally, one large supply intermediary, Wes-

[30] Forum Stages Debate over Uranium Embargo Policy, March 1974, at 5, 8-9.

[31] Deutsches Atomforum, *supra* note 12, at 184-87.

[32] Future Structure of the Uranium Enrichment Industry, pt. 1: Hearings Before the Joint Comm. on Atomic Energy, 93d Cong., 1st Sess. 96 (1973).

[33] NUEXCO, no. 64, addendum (Nov. 26, 1973).

tinghouse itself, was an important factor. Westinghouse had contracted to deliver for a very large proportion of the expected domestic uranium requirements (see Section IV below). As far as anyone knew, these requirements would be met by a combination of Westinghouse supply contracts and production from its own uranium reserves. Since Westinghouse did not reveal its short position until July 1975, both potential suppliers and potential demanders could have legitimately viewed this proportion of the market as "covered".

Under the circumstances it is understandable that supply agents would be reluctant to make investments in new capacity without some kind of contractual arrangements which at least shared the risks with potential customers. Both because of weak incentives and general unfamiliarity with the overall market situation, utility customers did not show interest in either long-term contracts or risk sharing arrangements. As a result, the inconsistency between demand and supply expectations was created and persisted through mid-1973.

Spot prices in the commercial market stayed in the range of about \$6 to \$6.50 per pound (see Table 8, Column 1) during this period with forward prices approximately in line with these figures, but including about a seven per cent per year increment, which was in line with prevailing interest rates.[34] These prices were slightly higher than the prices paid by the AEC under the stretchout program during 1969 and 1970. However, these AEC prices were based essentially on only the *variable costs* of production from the existing mines still under AEC contract.[35] Given the temporal excess supply situation and the failure by consumers to engage in substantial long-term contracting, it is not surprising that the commercial price during this period would have been approximately equal to only the variable costs of production. But there was no reason to believe that such "distress" prices would prevail in the long run once the supply side was pushed toward its capacity constraint and moved once again into an expansionary phase.

(5) 1973-1975: Demand and supply expectations were rationalized as the supply sector entered a new expansionary phase. This period began with a profound inconsistency between demand expectations and supply side behavior at prevailing prices for uranium. An agent evaluating the market as a whole at the beginning of 1973 should have seen clearly that one of three things was going to happen inevitably sometime soon. Demand expectations would be revised downward sufficiently to make additional supply expan-

[34] We would expect the price for delivery in year $t + 1$ to be equal to the price in period t plus the relevant market rate of interest for the one year waiting period times the price in period t. If the future price for year $t + 1$ were higher, it would pay to hold uranium in the ground rather than produce in year t because the associated capital gain would be greater than the profit from production.

[35] See *supra* note 20.

TABLE 8
AVERAGE URANIUM PRICES PER POUND U_3O_8

	(1) $	(2) $	(3) $	(4) $	(5) $
1950	9.21	12.63			
1951	10.01	12.62			
1952	11.19	13.45			
1953	12.30	14.49			
1954	12.25	14.24			
1955	12.51	14.20			
1956	11.63	12.45			
1957	10.53	10.68			
1958	9.57	9.57			
1959	9.25	9.01			
1960	8.75	8.41			
1961	8.47	8.02			
1962	8.00				
1963	8.00				
1964	8.00				
1965	8.00				
1966	8.00				
1967	8.00				
12/31/68	6.50				
12/31/69	6.20				
12/31/70	6.20				
12/31/71	5.95				
12/31/72	5.95				
6/73	6.50	3.57	3.21	2.86	2.50
12/73	7.00	3.72	3.35	2.98	2.60
6/74	10.50	5.25	4.73	4.20	3.68
12/74	15.00	7.08	6.37	5.66	4.96
5/75	21.00	9.63	8.67	7.70	6.74
8/75	26.00	11.87	10.68	9.50	8.31
12/75	35.00	15.84	14.26	12.67	11.09

(1) Nominal Price Per Pound U_3O_8
  (a) 1950-1967 AEC purchases (U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry 11.)
  (b) 1968-1975 Spot Market Price (*NUEXCO* Reports)
(2) Real Prices Deflated by GNP Structures Index (1958 = 100)
(3) Equivalent Real Prices Adjusted for 10% Depletion ((2) ÷ 1.10)
(4) Equivalent Real Prices Adjusted for 20% Depletion ((2) ÷ 1.20)
(5) Equivalent Real Prices Adjusted for 30% Depletion ((2) ÷ 1.30)

sion unnecessary (unlikely). The uranium supply industry was bluffing, and capacity expansion would begin quickly at prevailing market prices and under existing contractual arrangements, or the AEC would extend the termination date of sales from its stockpile at $8 per pound beyond July 1, 1973, and ease the requirements for availability (also unlikely). The price of uranium would rise sufficiently to clear the market (very likely).[36]

[36] Wall Street Transcript, Mar. 27, 1972, at 27; Office of Ass't Dir. for Raw Materials, U.S. Atomic Energy Comm'n, Nuclear Fuel Supply 5 (1973).

A number of things occurred between mid-1973 and mid-1975 that helped to close the gap between demand expectations and supply behavior. These events combined to encourage many utilities to go to the market to try to cover their expected uranium requirements with long-term contracts. As firms began to sign contracts for forward delivery of uranium, it soon became evident that existing capacity of the uranium mining and milling industry was insufficient to cover the industry's uranium needs for the period beginning in about 1980.[37] This situation was gradually revealed as low cost proven reserves were gradually contracted for and existing capacity became fully committed, as many utilities could not obtain bids for uranium under fixed price contracting arrangements, and finally as it became evident that Westinghouse had substantial unfilled uranium requirements. The result was a large and rapid increase in uranium prices. The events which led to the rationalization of the inconsistencies between demand and supply expectations appear to be the following:

(a) Prior to 1973, only a small number of the commercial reactors which made up the expected uranium requirements for the late 1970's had actually been completed. As indicated above, during this period of time many utilities were concentrating on getting the early plants licensed, built and operating, and were not too concerned about tying down long–term uranium supplies. However, beginning in 1973 there was a dramatic increase in the number of reactors beginning commercial operation. In the three years 1973-1975 over 26,000 MWe of nuclear capacity began commercial operation (see Table 9). This can be compared to the 10,000 MWe capacity beginning commercial operation during the five year period 1968-1972. As the 31 reactors finally began operation in the 1973-1975 period, utilities began to turn their attention more toward uranium procurement to keep the plants operating and began to enter the market in an effort to secure long-term contracts (see Table 7).

(b) Change in AEC Enrichment Contract Criteria. In January 1973 the AEC announced a change in its enrichment contracting procedures. The AEC proposed that purchasers of its enrichment services would have to sign long-term (ten year) fixed commitments contracts for enrichment services. These contracts would have to be signed eight years in advance of initial enrichment service and included penalty clauses for changes in schedules. Although the AEC announced its proposed contracts at the beginning of the year, the new policy could not be final until Congressional hearings were held by the Joint Atomic Energy Committee (JAEC). Since AEC proposals had frequently been changed in the past as a result of opposition by segments of the industry during JAEC hearings, there remained great uncertainty

[37] Proposed Modification of Restrictions on Enrichment of Foreign Uranium for Domestic Use: Hearings Before the Joint Comm. on Atomic Energy, 93d Cong., 2d Sess. 78 (1974).

TABLE 9
ADDITIONS TO OPERATING NUCLEAR POWER PLANT CAPACITY IN THE U.S.

Year	Capacity Additions MWe	Number of Reactors Added
1968	1005	2
1969	1275	2
1970	2436	4
1971	2074	3
1972	3464	5
1973	7764	10
1974	10826	13
1975	7696	8

Source: General Information, *Nuclear Engineering International*, April 1976 Supplement, at 20-22.

about the nature of the AEC's contracting requirements and their timing until after approval was granted by the JAEC and contracts became available.[38] While there had been suggestions for changes in AEC enrichment contracts even prior to 1973 and while the discussion during 1973 indicated that some movement to long-term contracts would be forthcoming in the future, the contracts themselves were not available in final form until September 1973 and none were signed until December 1973.

There is substantial evidence to indicate that the primary motivation of the AEC in changing its enrichment criteria was to create an environment which would encourage private industry to enter the enrichment market. The long-term contracts were required because of the difficulties private firms would have in obtaining financing without substantial long-term commitments from utilities, which as in the uranium market itself, utilities had been reluctant to sign.[39] By requiring long-term contracts, the AEC could make it clear that its own enrichment capacity was fully committed and provide a standard contracting format which would force utilities to reveal in the market their own long-term requirements and thus encourage private investment to meet it. In some sense the enrichment portion of the fuel cycle was in a situation similar to the mining and milling sector. It appeared at that time that substantial additional capacity would be needed in the 1980's to meet demands, but private industry was not able or willing to make the substantial investments required without firm commitments from utilities. By changing to a long-term contract framework, the AEC

[38] NUEXCO, no. 55, at 1 (Feb. 21, 1973).

[39] Proposed Changes in AEC Contract Arrangements for Uranium Enriching Services: Hearings Before the Subcomm. on Energy of the Joint Comm. on Atomic Energy, 93d Cong., 1st Sess. 88 (1973).

hoped that it was creating contracting institutions that would make it economically desirable for firms to begin to build private enrichment facilities.[40]

The effect of the long-term contracting requirements for enrichment services combined with the simultaneous completion of a large number of nuclear plants appears to have been to accelerate utility attempts to tie down uranium requirements that would go along with the enrichment contracts. The industry literature is filled with discussions beginning in late 1973, but especially during 1974, as fixed commitment enrichment contracts are signed, that the vigorous activity on the buying side was a result of utilities' attempts to fill the uranium requirements associated with their long-term enrichment contracts rather than a response to increased demand expectations for uranium or the oil embargo.[41] In short, the result of the change in enrichment contract criteria appears to have been a rapid movement to match up long-term enrichment contracts with long-term uranium supply contracts.

(c) AEC Uranium Stockpile. By early 1972 the uncertainties regarding the disposition of the government's huge U_3O_8 stockpile discussed above were eliminated. As a result the AEC would no longer act as an "overhang" on the market discouraging utilities from making long-term contracts in the hopes of getting cheap U_3O_8 from the AEC. This factor should have given some encouragement to utilities to go into the private market to obtain uranium commitments and also relieved some of the uncertainty faced by the mining and milling sector.

The increased buying activity by utilities is evidenced by the large increases in forward purchases recorded by the AEC in 1973 and 1974.[42] In the course of this purchasing activity, the medium- and long-term supply problems were gradually revealed as utilities had difficulties getting "acceptable" bids on contract requests and went to the foreign market for contracts extensively in 1974. The Tennessee Valley Authority's well-publicized difficulties in securing contracts for about 84 million pounds of uranium in late 1973 at anything close to historical prices provided an important signal to the rest of the industry regarding the increasing tightness of the uranium market.[43] The industry literature of 1973 and 1974 is filled with discussions

[40] Main Feature of New "Fixed Commitment" Enrichment Contract, Nuclear Industry, Jan. 1973, at 14.

[41] NUEXCO, no. 59, at 1.1 (June 20, 1973); *id.*, no. 60, at 1.2 (July 20, 1973).

[42] During 1973 there were forward purchases of about 46,000 tons of uranium. During 1974 there were forward purchases of over 50,000 tons of uranium (over half of which were foreign purchases). This can be compared with forward purchases of only 5,500 tons in 1971 and about 16,000 tons in 1972.

[43] See Canada, Ministry of Energy, Mines & Resources, Background Paper on the Canadian Uranium Industry's Activities in International Uranium Marketing 3 (unpublished mimeo Sept. 26, 1976).

about increased activity by uranium consumers to cover their requirements, capacity shortages and difficulties in obtaining contracts. As a result uranium prices began to increase rapidly as utilities actively bid against each other to secure uranium to operate the expensive plants that had been completed and were under construction (see further discussion below).[44] In addition, in late 1974 the first large "unpriced" contracts were publicly announced, which was a major departure from the traditional fixed base price plus escalation contracts that had characterized uranium sales previously.[45]

(d) Rumors of Westinghouse's short position apparently began circulating in the industry by early 1974,[46] but it was not until July 1975 that Westinghouse confirmed that it was indeed short and the large magnitude of that short position. On July 14, 1975, Westinghouse announced that it was short between 40 and 60 million pounds of uranium for the period 1978–1995. Outside estimates have put that short position at close to 70 million pounds of uranium concentrate.[47] This amounted to about thirty per cent of total industry uncommitted uranium requirements (see Table 10) for the period around 1980 and made absolutely clear the extent to which firm long-term contracts fell below industry requirements. Westinghouse's confirmation of its short position, especially its size, raised the possibility that there might be an absolute shortage of uranium for the period around 1980 due to lead time constraints on new mining and milling ventures and the near zero price elasticity of demand over this period.[48]

Uranium prices began to rise in 1973 (see Table 8, Column 1). They increased about twenty per cent during 1973 reflecting increased forward purchasing activity by utilities as well as rising labor and operating costs. But it was in 1974 that prices really begin to increase dramatically as the inconsistencies between supply and demand expectations were revealed in the market. Prices rose 50 per cent during the first six months and another 50 per

[44] NUEXCO, no. 61, at 1.1-1.2 (Aug. 20, 1973); NUEXCO, no. 62, at 1.1-1.3 (Sept. 20, 1973) and Changing Rules for a Changing Game: Uranium Market Surge Opens New Era for Buyers, Sellers, Nuclear Industry, Dec. 1973, at 20.

[45] These contracts provided that the seller would be paid the higher of the market prices, to be determined prior to delivery, or a price that guaranteed the producer a minimum rate of return on investment. This mode of contracting significantly shifted the risks of price fluctuation to buyers. That utilities with expensive nuclear plants coming on line, not facing competition, and with automatic fuel adjustment clauses would be willing to sign what were essentially fixed quantity contracts is not surprising. See Nuclear Exchange Corporation, Significant Events in the Uranium Market 1969-1976, at 8 (Oct. 15, 1976).

[46] Kidder, Peabody & Co., *supra* note 2, at 5.

[47] *Id.* at 1.

[48] Reactors that would be operating in 1980 are already either completed or under construction. Since generating system dispatch is based on relative operating costs, uranium prices would have to rise well above current levels to displace nuclear plants from the most favored position in the "merit order."

TABLE 10
WESTINGHOUSE'S SHARE OF UNFILLED URANIUM REQUIREMENTS

	Tons U_3O_8		
	Total Reported by Utilities and Vendors	Westinghouse Short*	
	1/1/75	1/1/75	as % of Total**
1975	0	0	0
1976	1,000	0	0
1977	1,400	0	0
1978	6,600	0	0
1979	11,500	3,199	28%
1980	18,800	6,768	36%
1981	18,700	5,302	28%
1982	22,500	4,930	22%

* Includes liquidation of 4,800 tons of Westinghouse's 5,900 ton inventory on 1/1/75.

** This assumes that Westinghouse accurately reported its own short position in the AEC survey.

Source: U.S. Energy Research and Development Administration, Survey of Uranium Marketing Activity, ERDA no. 14 (April, 1975), and Kidder, Peabody & Co., Westinghouse Electric Corporation, Commercial Nuclear Power and Uranium 8 (September 25, 1975).

cent during the second half of the year. This price rise is consistent with the events discussed above and represents a movement from prices based on short-run variable cost to prices based on long-run marginal cost as the demand side of the market finally pulled the supply side into an inevitable second expansionary phase. The tight domestic supply situation is evidenced by both the rapidly rising price for uranium, the fact that the majority of contracts signed by utilities during that period were with foreign suppliers, and the changing nature of the domestic contracts themselves.

Prices continued their rapid rise in 1975. In March, Westinghouse acknowledged for the first time that it was short of uranium, although it minimized the extent of its exposure.[49] By June 1975, just prior to Westinghouse's announcement of its huge short position, the price had risen to $22 per pound, about double what it had been a year earlier. In September, Westinghouse announced that it would not honor its contracts for uranium delivery beyond the uranium that it had itself already contracted for, and by the end of December the spot price had risen to $35 per pound. Between February 1975, just before Westinghouse first acknowledged its short position, and December 1975 the price of uranium doubled.

The price run-up in 1974 and 1975 appears to reflect the rationalization between demand expectations and supply expectations caused by a variety of factors encouraging firms to reveal and fill their long-term requirements by actually contracting with suppliers. If consumers of uranium had made timely medium- and long-term commitments with suppliers for uranium,

[49] Kidder, Peabody & Co., *supra* note 2, at 5.

prices would have begun to rise earlier and would have risen more gradually. It is also likely that prices would not have risen so far because timely additions of supply would have eliminated any possibility of a bottleneck around 1980, and allowed expansion on the long run supply function rather than on the portion of the short run supply function lying above the long run supply function.

Before proceeding with a more detailed discussion of Westinghouse's behavior in the market, it is worth examining the uranium prices reported a bit more closely. A careful examination of the price series in Table 8 gives us some useful information. We know that the prices that the AEC paid during the First Expansionary Period (1950-1958) were at least high enough to encourage entry for the simple reason that there was substantial entry. Therefore, the first question to ask is how do the prices which we observed in the 1973-1975 period (which I have called the Second Expansionary Period) compare with the prices the AEC paid during the First Expansionary Period? In Column 2 of Table 8, real price data are presented using the "structures" price index component of the GNP deflator (1958 = 100). We can see that at least until the summer of 1975, when Westinghouse revealed its short position, real prices remained well within the range of prices paid by the AEC during the first expansionary period of the uranium industry. Even the post–July 1975 prices are close to the range of prices paid by the AEC.

But merely deflating for inflation is not enough. The average grade of ore mined has declined fairly substantially since the mid-1950's, implying an associated increase in the real cost per pound of yellowcake. The ore content in 1974 was only about 60 percent of the ore content during the early 1950's and only about 70 per cent of the ore content in 1961. Average reserve ore content is only about 50 per cent of that for ore mined in 1961 and the ore content of reserves discovered in 1975 even less. In Columns 3, 4, and 5 of Table 8, I have, therefore, adjusted the prices in the 1973-1975 period for depletion as well as inflation, assuming 10, 20, and 30 per cent depletion since the First Expansionary Period. Even for an assumption of ten per cent depletion, the equivalent real prices of uranium prior to July 1975 are well within the range of prices paid by the AEC during the First Expansionary Period. There are other adjustments in real costs that we could make, such as tightened radiation standards, increased mine safety standards, etc. But this is unnecessary to make the point that the *real* prices of uranium certainly in July 1975 and probably even in December were no higher and perhaps even somewhat lower than the prices the AEC paid to encourage entry into the industry.

C. *Westinghouse's Behavior in the Market*

During the late 1960's and early 1970's Westinghouse offered to supply fuel for light water reactors in the U.S. and abroad. In general, Westing-

house offered a complete nuclear fuel system, including the reactor and steam generating system, initial fuel core and a variable number of reloads. Westinghouse also agreed to supply fuel reloads to several reactors supplied by other vendors. Westinghouse generally offered uranium fuel at a fixed base price plus some escalation. The escalation factor apparently reflected changes only in certain labor and materials cost indices,[50] however, and was not directly geared to the market price of uranium oxide. The base prices at which uranium was sold were in the range of $8 to $10 per pound. As of January 1, 1975, Westinghouse signed uranium contracts with 23 U.S. utilities and three foreign utilities involving 49 reactors, of which 11 were reactors supplied by other vendors.[51] As of January 1, 1975, it is estimated that Westinghouse had uranium oxide commitments of approximately 60,000 tons for the period 1975-1988 and contracts to purchase only 14,000 tons during that period plus an inventory of 6,000 to 7,000 tons.[52] This leaves a "short" position of about 40,000 tons (see Table 11), of which about 5,000 tons are associated with contracts which have full cost pass-through provisions. In summary, as of January 1, 1975, Westinghouse had commitments to supply 60,000 tons of uranium but had only 20,000 tons available, either in hand or contracted for. This was a short position which Westinghouse refused to acknowledge until July 14, 1975. The deficit was a rather large shock to a market which in 1975 was producing about 13,000 tons per year, and including facilities then under construction had a capacity to produce between 18,000 and 20,000 tons per year.

It is fairly easy to understand why Westinghouse would have found it advantageous to act as a uranium agent for utilities buying its reactors as well as for others willing to buy fuel fabrication services. Nuclear energy was a new technology to the vast majority of the nation's utilities in the early 1970's. Since a commercial market for uranium really did not begin to develop until 1969 or 1970, there were very few individuals who had any expertise as uranium fuel buyers. The utilities themselves certainly had no expertise, and there was probably very little around to be bought. It was only natural, therefore, for Westinghouse, interested in marketing its reactor system, to act as a buying agent for utilities. By acting as an agent for several firms Westinghouse presumably could accumulate some expertise in dealing with suppliers, be able to make intelligent analyses of the market, and pool risks associated with uncertainties over exactly when particular reactors would be operating. Utilities which might have been hesitant to employ nuclear technology because of ignorance of the uranium market and future prices might now be encouraged to do so once Westinghouse was willing to

[50] *Id.* at 6.

[51] *Id.* at 9-11.

[52] *Id.* at 8.

TABLE 11
WESTINGHOUSE POSITION IN URANIUM MARKET[1]
AS OF JANUARY 1, 1975

Westinghouse Commitments 1975-1988:	60,084 tons U_3O_8
Westinghouse Inventory Jan. 1, 1975:	5,896 tons U_3O_8
Westinghouse Purchase Agreements 1975-1988:	14,075 tons U_3O_8
Westinghouse Short 1975-1988:	40,113 tons U_3O_8

In addition General Electric is short 5,000 tons for the period 1982-1984.

[1] Kidder, Peabody & Co., Westinghouse Electric Corporation, Commercial Nuclear Power and Uranium 8 (September 25, 1975).

guarantee supply at a fixed price. So it made good commercial sense for Westinghouse to set itself up as an uranium buying agent. It might also have been a more efficient buying arrangement than having each utility develop fuel expertise on its own. The fact that utilities found the fixed price contracts to be attractive is also not surprising since it eliminated uncertainty at a relatively small premium and saved the utility the expense of searching and contracting for uranium.

But why Westinghouse would sign fixed price contracts without *also* securing associated uranium supplies through forward contracting or development of its own uranium reserves is difficult to understand. There does not appear to have been very much room for speculative profit in the uranium industry. It was generally acknowledged as early as 1971 that the direction of prices was upward and given that the industry in the 1970-1972 period still remained slack with prices just covering extraction costs, there could not have been any real possibility of Westinghouse profiting from a price break by going short. Yet by going short on fixed price contracts, Westinghouse opened itself up to the possibility of fantastic losses if uranium prices rose. So it appears that by going short Westinghouse exposed itself to the possibility of large losses with no possibility of speculative profits. At least at first glance, Westinghouse's policy of going short appears to be irrational. Westinghouse's chief competitor, General Electric, engaged in relatively little actual uranium contracting in its fuel fabrication agreements and does not find itself in a position as serious as that of Westinghouse.[53]

Assuming that Westinghouse's "short" policy was a conscious, rationally thought out policy, there are a number of factors that might account for its development. Westinghouse might have hoped that the AEC would indeed release its stockpile of uranium to the market at $8 per pound, providing sufficient supply at low prices for several years. Alternatively, Westinghouse might have hoped that once import restrictions were eliminated, cheap

[53] *Id.* at 7.

uranium could be obtained from foreign sources. Finally, it is possible that Westinghouse hoped to fill its remaining requirements from its own reserves. If Westinghouse's policy turned on these considerations, it was indeed a high risk policy. The traditional AEC concern for protecting the domestic mining and milling industry combined with vigorous opposition by the industry to the AEC's marketing its uranium stockpile made such an occurrence extreme unlikely. In any case this possibility was eliminated by December 1972. Similarly, a very rapid elimination of import controls was unlikely because of opposition from the domestic uranium industry. But perhaps more importantly, the assumption that foreign uranium would be either easily available or cheap is questionable. During this period of time Westinghouse was engaged in vigorous activity to sell its reactors in a number of foreign countries. Germany, Japan, Great Britain, France and other countries had fairly substantial nuclear programs under way by 1972, most of which would require uranium from foreign sources. In addition, as discussed above, a careful examination of the prices that the AEC had to pay during the First Expansionary Phase to encourage entry should alone have raised questions about the full economic cost of additional uranium mining and milling capacity. If Westinghouse's policy of signing fixed price contracts while remaining short was a conscious policy, it was a risky one with little prospect of large gains.

Given the extraordinary risk associated with Westinghouse's uranium policy, one must at least raise the possibility that it was not a well thought out corporate policy, but in part evolved by accident. Of the total of about 70,000 tons of uranium that Westinghouse committed itself to deliver between 1966 and January 1, 1975, it appears that nearly half was contracted for during 1973 and 1974.[54] It appears also that prior to 1973 Westinghouse had contracted for delivery of at least 15,000 tons and perhaps as much as 29,000 tons of U_3O_8.[55] This means that a substantial portion of Westinghouse's short position was accumulated during the two year period of 1973 and 1974. Apparently, Westinghouse contracted to deliver nearly as much uranium during these two years as it had during the past seven years. It may simply have been that Westinghouse was slow to cover its requirements and that it got caught when the prices began to rise rapidly in 1974. Those charged with selling reactors and fuel may simply not have been properly communicating with those in the corporation charged with purchasing uranium. This is a distinct possibility since Westinghouse had good reason to be concentrating on plant construction and operation which were of imme-

[54] Based on an examination of announced dates of reactor orders and fuel supply contracts.

[55] I have been able to find announcement of purchases of 15,000 tons of uranium prior to 1973. A contract for 6,670 tons with a South African firm was also almost certainly prior to 1973. I was unable to find purchase dates for the remaining contracts.

diate concern and on which Westinghouse was losing large amounts of money[56] rather than on future fuel supplies. The possibility that careful scrutiny of the uranium situation might not have been occurring is reinforced when we recognize that the nuclear power division was run essentially autonomously from the rest of the corporation[57] and that these are the same years in which Westinghouse was facing serious cash flow problems and a rather substantial reorganization of the company.[58] Failures of command, communication, and control of this type have been well documented in the literature on organizational behavior. Unfortunately for Westinghouse, this was a particularly inopportune time for such failures of command, control, and communications to occur. Such behavior is also consistent with Cyert and March's observations regarding the tendency of organizations to respond slowly to changes in the economic environment and to solve problems sequentially rather than simultaneously.[59]

Whatever the reasons for Westinghouse's marketing behavior, it had important implications for the uranium market as a whole. During the 1973 to 1974 period, Westinghouse was engaged in selling substantial quantities of uranium to U.S. utilities but not covering these sales with supply contracts. The 1973-1974 period was a critical time for the uranium mining and milling industry, because it was during this period that timely additions of capacity would be necessary to meet uranium requirements efficiently for the late 1970's and early 1980's. By "efficiently", I mean providing additional supply at minimum costs. Uranium supply from existing mines and mills and those under construction is somewhat elastic in that low grade ore can be mined and milled from existing reserves, but this increases the cost per pound of U_3O_8 dramatically. Westinghouse's behavior exacerbated the failure of aggregate industry demand expectations to be matched by an associated supply response because Westinghouse appears to account for a very large part of the difference between "firm demand" and total aggregate "expected demand" for the period in question (see Table 10). Since Westinghouse was itself engaged in uranium exploration and processing activity and owned substantial amounts of land with potential uranium reserves, it was possible, prior to Westinghouse's announcement, that it itself would provide for its residual requirements. By failing to reveal its true requirements in the market by securing uranium, Westinghouse failed to give the necessary demand signals to get the market prices moving toward long-run equilibrium during

[56] It has been estimated that Westinghouse lost between $200 and $250 million on the initial "turnkey" reactor contracts that it signed.

[57] For an interesting discussion of the management responsibility at Westinghouse, see Nucleonics Week, Nov. 11, 1976, at 3-4.

[58] Kidder, Peabody & Co., *supra* note 2, at 31-32.

[59] See Richard M. Cyert & James G. March, A Behavioral Theory of the Firm 26-127 (1963).

1973-1974 as would have occurred if it had followed a policy of covering its requirements in a timely fashion. As a result, when Westinghouse suddenly announced that it was short 70 million pounds, the true gap between industry demand and supply was finally revealed. This revelation representing about 30 per cent of unfilled industry requirements around 1980 (see Table 10) may have pushed uranium prices above the long-run equilibrium level reflecting the possibility that a minimum cost supply response to demand expectations was impossible by 1980, given the long lead-times required for efficient supply sector response. Since demand for the early 1980's has essentially zero price elasticity and since short-run supply of total industry demand above 18,000 pounds is also extremely inelastic, the sudden revelation that another 30 percent of unfilled uranium demand would in fact have to be supplied could easily have driven the price of uranium up substantially. Since the price of uranium was already being driven up as other uranium buyers were covering their positions in 1973 and 1974, Westinghouse's sudden revelation no doubt expanded the extent that firm demand was pushing on medium term supply capabilities. As a result medium term uranium prices appear to have been driven above long run marginal cost.

If Westinghouse had made timely purchases of uranium to match its commitments and had not engaged in fixed price contracting that gave the impression to others in the industry that they could get all the uranium they needed at $8 to $10 per pound, prices for uranium would have begun to rise earlier than 1974 and probably would not have risen so far. If Westinghouse had contracted earlier, it would have become evident that additional supply would only have been forthcoming at higher prices, and these prices would have risen in the market. In addition, the supply sector would have had another two years to adjust capacity to meet demand efficiently. It appears that Westinghouse's own buying behavior probably affected both the timing of the price rise and the levels to which prices eventually rose.

Finally, I have attempted to make a crude estimate of the relevant long-run marginal cost of uranium and the average uranium price that would encourage new entry for production in the mid-1980's based on the following assumptions:

(1) Exploration and development expenses, uranium "find" rate, and average ore concentration (about 0.10 per cent) remain equal to 1975 experience (a very conservative assumption).

(2) Sufficient reserves must be accumulated to operate mines and mills for ten years before mines and mills are built. At current find rates this would take between three and four years of exploration to obtain the required reserves for the production rates expected in the 1980's.

(3) Once sufficient reserves are found it takes three years to put the mine-mill complex into operation. A 1,000 ton of ore per day mine-mill complex costs $20 million and operates 300 days per year.

(4) Required return of 15 per cent on capital after tax with a 48 per cent corporate tax rate.
(5) Entry prices reflect average extraction costs of *new* reserves found rather than average forward costs of all reserves, and real forward costs do not increase.

Under these assumptions I arrive at a long-run marginal cost of uranium of between $30 and $40 per pound. While this estimate is admittedly crude, it "brackets" the prices prevailing in late 1975. While legitimate variations in the assumptions could increase or decrease this value somewhat, unless there is a dramatic improvement in the ore content of new reserves, even without any exploration and development costs or capital costs, the marginal extraction cost alone for the mid-1980's will be at least $15 per pound.

Given these calculations it appears that current base prices being quoted for uranium oxide (over $40 per pound) are above the long run marginal costs of uranium for the mid-1980's. This disequilibrium situation reflects the fact that to meet uranium requirements over the next few years, the uranium mining and milling industry has to produce at a point on its short run marginal cost function that is above long run marginal cost. The various reasons why this result has emerged have been discussed above. A further implication of these calculations is, however, that the *real* price of uranium may very well decline in the future as the uranium mining and milling industry expands efficiently and real uranium prices decline to reflect the long run marginal costs of uranium production in the mid–1980's. In addition, it is possible that if nuclear plant orders continue to decline below current expectations or if ERDA's enrichment contracts and tails assay targets are revised to reflect actual uranium and enrichment requirements, a "collapse" in the market price of uranium is a distinct possibility in the short run. These issues are obviously ripe for a further, more detailed study than is presented here.

Westinghouse's behavior appears to have had two types of undesirable effects on resource allocation in the nuclear energy industry:

1. By helping to give utilities the impression that uranium would be cheaper than it actually would be in long-run equilibrium, it encouraged overinvestment in nuclear generating facilities. While it is often stated that uranium prices have an insignificant impact on the overall long-run economics of nuclear energy, Joskow and Baughman have shown that a doubling of uranium and enrichment costs would reduce installed nuclear capacity by 25 per cent in 1995.[60] In addition, in a presentation before the Connecticut Public Utilities Control Authority one utility showed that the increased uranium price changed its decision to replace an oil-burning plant with a nuclear plant and delayed the need for the nuclear plant by two years.[61]

[60] Paul L. Joskow & Martin L. Baughman, The Future of the U.S. Nuclear Energy Industry, 7 Bell J. Econ. & Manag. Sci. 3, 19 (1976).

[61] Statement of Walter T. Schultheis, Capacity Planning Director of the Northeast Utilities

2. Westinghouse's behavior helped to distort the efficient feedback mechanisms that should have evolved to effectively link demand and supply expectations and lead to appropriate price responses and a timely and efficient response by the supply sector to expected uranium requirements. As a result uranium prices in the near and medium terms will probably be higher than they would have been with more timely additions to mining and milling capacity.

III. U.C.C. § 2-615: An Economic Analysis

The preceding sections described the economic context in which the Westinghouse uranium contract litigation has arisen. We shall now turn to the legal context through which these events will be viewed in arriving at a decision regarding Westinghouse's claim for excuse for reasons of "commercial impracticability". This section discusses the evolution of the legal doctrines underlying § 2-615 of the Uniform Commercial Code and endeavors to evaluate the requirements for excuse under U.C.C. § 2-615 in the context of their effects on the efficient allocation of resources. The final section of the paper integrates the specific economic factors underlying the behavior and performance of the uranium market with the legal doctrines discussed and evaluated here with reference to the Westinghouse litigation itself.

An economy based on voluntary exchange can function without a system of contract law. However, especially when we are dealing with exchanges which involve delivery of the promised service or commodity over time and/or payment for the service or commodity over time or where the promised service or commodity is complicated, contract law can help to facilitate voluntary exchange. Posner indicates that the law of contracts can facilitate voluntary exchange in a number of important ways.

(1) By protecting parties who perform in good faith from those who do not, the law of contracts reduces the uncertainty of exchange transactions and the costs associated with this uncertainty.[62]

(2) Contract law will reduce the costs of transactions directly by setting up a set of normal terms applicable to transactions of a particular type and therefore relieving the parties of the task of negotiating and specifying these terms in every transaction, and its related costs.[63] "Good" contract law will not try to override the inherent economics of exchange transactions by requiring, for example, that the party whose costs of inspecting goods would be higher do so, because this will only increase transactions costs by leading to the specification of a clause shifting the burden back ultimately to the other party.[64]

Service Co., before the Connecticut Public Utilities Control Authority, Docket No. 751206, (1975).

[62] Richard A. Posner, Economic Analysis of Law 42 (1972).

[63] *Id.* at 44.

[64] *Id.*

(3) Contract law will serve as an aid to parties engaged in voluntary exchange by providing them ". . . with information concerning the many contingencies that may defeat an exchange, and hence to assist them in planning their exchange sensibly."[65]

The objectives of contract law no doubt are considerably broader than the achievement of an efficient allocation of resources. The discussion here will, however, concentrate on issues related to the efficiency of a system of voluntary exchange.

Despite the layman's view of the "sanctity" of contracts, there are a variety of situations in which the terms of a contract may not be enforceable.[66] In addition, breaches of contract combined with appropriate rules for assigning damages are important aspects of commercial relationships which together can facilitate efficient exchange relationships. Of concern to us here are the particular situations in which performance on a contract may be excused for reasons of "commercial impracticability".

Prior to the middle of the 19th century, English common law required absolute performance on a contract. Under the "rule of absolute liability" a party to a contract who did not perform his obligations was liable for damages even if such performance had been rendered impossible by events which had occurred subsequent to negotiation and had not been stipulated as exemptions in the contract itself.[67] The rule requiring absolute performance was first relaxed in 1863 in the case of *Taylor v. Caldwell.*[68] In this case both parties to a contract for the rental of a music hall were excused from performance when the music hall was destroyed by fire prior to the date of performance even though this contingency had not been specifically included in the contract. The court held that the parties must have contemplated that the contract would only be honored if the music hall ("some particular specified thing") continued to exist. As a result, the fact that performance would not be required if the music hall burned down was an implied condition of the contract and the contractor could be excused from performance for reasons of "impossibility of performance".

The English courts also developed a related concept whereby excuse might be allowed when the purpose of the contract was "frustrated" by events occurring subsequent to the time the contract was signed. In *Krell v. Henry*[69] a party who had rented a room for the purpose of viewing a corona-

[65] *Id.*

[66] *Id.* at 44-45.

[67] See Thomas R. Hurst, Freedom of Contract in an Unstable Economy: Judicial Reallocation of Contractual Risks under U.C.C. § 2-615, 54 N.C.L. Rev. 545, 549 (1976); Paradine v. Jane, Aleyn 26, 82 Eng. Rep. 897 (1647).

[68] 3 B. & S. 826, 122 Eng. Rep. 309 (1863).

[69] [1903] 2 K.B. 740.

tion parade was released from having to pay for the room when the parade was cancelled because of the King's illness, even though the ability to satisfy the "purpose" of the renter was not explicitly part of the contract.

Both doctrines have been adopted and expanded by American courts. A number of decisions by American courts have allowed somewhat weaker conditions than strict impossibility as a qualification for excuse. In *Mineral Park*[70] the defendants contracted to haul sufficient sand and gravel from the plaintiff's land to build a bridge. They agreed to pay 5¢ per cubic yard for the sand and gravel taken from the property. The defendants removed only part of the sand and gravel required for the project from the plaintiff's land and acquired the rest elsewhere. The plaintiff sued the defendant to pay him the original contract price of 5¢ per cubic yard for the gravel purchased elsewhere. The defendant claimed excuse because the rest of the sand and gravel on the plaintiff's property was under water and the cost of removing it would have been ten to twelve times the contract price. The court accepted the defendant's contention on the ground that it was "impracticable" for reasons of excessive and unreasonable cost.

Commercial impossibility and frustration are both treated at some length in the *Restatement of Contracts*. The *Restatement of Contracts* seems to favor discharge of performance under conditions somewhat weaker than strict impossibility, including also ". . . impracticability because of extreme and unreasonable difficulty, expense, injury or loss involved".[71] The *Restatement* provides a list of situations in which performance should be excused. Among these are rules, regulations and actions by the government which makes performance either illegal or impossible, the destruction of physical things (like the music hall) which makes performance impossible or impracticable, the illness of individuals necessary for performance, and the non-existence of other conditions, the existence of which are necessary for performance, which were either expressly provided for or implied by the agreement of the parties.[72]

Frustration of purpose is discussed separately in the *Restatement*. "Where the assumed possibility of a desired object or effect to be attained by either party to a contract forms the basis on which both parties enter into it, and this object or effect is or surely will be frustrated, a promisor who is without fault in causing the frustration, and who is harmed thereby, is discharged from the duty of performing his promise unless a contrary intention appears."[73]

Impossibility and frustration of purpose are normally discussed together

[70] Mineral Park Land Co. v. Howard, 172 Cal. 289, 156 P. 458 (1916).

[71] Restatement of Contracts § 454 (1932); and Thomas R. Hurst, *supra* note 67, at 551.

[72] Restatement of Contracts §§ 458-61 (1932).

[73] *Id.* at § 288.

despite their separate treatment in the *Restatement.*[74] Corbin indicates that both situations involve the occurrence of supervening events that have made something impossible, and indicates that it is this common factor which leads to the cases being discussed together.[75] As indicated above, the common law interpretation of "impossibility" (an absolute which rarely occurs in practice) has become gradually broader over time evolving more into a doctrine of "impracticability". Exactly what is meant by "impracticability"[76] has important implications for contracting procedures and resource allocation and appears to be sufficiently vague to lead to considerable variance in practical application.[77] Corbin does indicate that under common law, discharge may be granted when the costs of performance have become extreme, but that this would be an uncommon and extreme case.[78]

The Uniform Commercial Code in § 2-615 appears to have adopted the somewhat weaker doctrine of "commercial impracticability" rather than strict impossibility with regard to contracts involving sales of goods. According to Hawkland,[79] this relaxation in the doctrine of commercial impossibility was largely an effort to give *force majeur* relief to small businessmen who were not well represented and did not have the proper exemption clauses written into their contracts. But the change in the legal doctrine almost certainly also reflects important changes in the nature of commercial transactions and the development of extensive insurance markets and futures markets. Despite the apparent erosion of the doctrine of strict or objective impossibility toward a doctrine of "commercial impracticability," U.C.C. § 2-615 establishes a fairly strict set of conditions for granting a discharge, which are discussed further below.

The doctrine of commercial impossibility and frustration of purpose essentially deal with the allocation of risks associated with performance of the contract between the promisor and the promisee. A doctrine of absolute liability essentially puts all of the risks not otherwise provided for in the contract on the promisor, while a weaker rule of discharge inherent in the impossibility doctrine shifts the burden of some of these risks to the promisee. An economic evaluation of the current status of the law must turn on the relative costs of the parties of insuring against these risks and the asso-

[74] Arthur Linton Corbin, Corbin on Contracts 1088 (one vol. ed. 1952); and U.C.C. §§ 2-613 through 2-616.

[75] Arthur Linton Corbin, *supra* note 74, at 1089-90.

[76] *Id.* at 1100-01.

[77] Thomas R. Hurst, *supra* note 67, at 555; and Arthur Linton Corbin, *supra* note 74, at 1101.

[78] *Id.* at 1111.

[79] William D. Hawkland, The Energy Crisis and § 2-615 of the Uniform Commercial Code, 79 Com. L. J. 75, 77 (1974).

ciated effects of the law on exchange and the behavior of the economic agents involved.

A strict interpretation of the rule of discharge which puts too much of the risk on the promisor would only create an incentive for him to write a more detailed and complicated contract, entailing additional negotiating costs, so as to shift some of the risks to the other party. Similarly, a lenient interpretation of the rule of discharge, which, for example, discharged obligations if costs rose by, say, 50 per cent, would either make such contracts unattractive to some parties, negating an important risk-diversifying function of fixed price contracts and forcing the promisee to provide for such contingencies in other more costly ways by providing for some form of self-insurance, or require that the promisee more completely specify all contingencies under which he expects performance under the contract. In either case an inappropriate rule of discharge can easily lead to increased transactions costs associated with the process of voluntary exchange. In addition, it could limit further the set of available contingent claims opportunities and lead to inefficiencies arising from an inability to fully diversify risks.

Another unattractive consequence of a rule of discharge might occur if the rule were extremely vague or randomly applied with differing requirements for discharge. This would not only increase the complexity and costs of the contracting process but also lead to more extensive negotiation and more frequent litigation, resulting in additional costs and delays in performance.

On the other hand, a well designed rule of discharge can facilitate the process of exchange and reduce its cost. It would be costly if not impossible to lay out a complete contingent claims contract. There are a number of possible contingencies, the occurrence of which can be contemplated by both parties, and provision for the effects of which would be desirable to one or both of the parties. Wars, embargoes, changes in government rules and regulations, destruction of key supply facilities, hyperinflation, etc., can all lead to effects on the supply and demand of the commodity in question which would make performance by one or both parties unattractive. These contingencies could all conceivably be listed in a contract along with the possible occurrences of each and the nature of performance in each instance. It may facilitate the contracting process, however, if it is understood or implied in the contract that when events such as this occur *and* lead to dramatic increases in the cost of performance or the impossibility of performance that the contract will simply be discharged or renegotiated. If parties wanted to provide otherwise, they could write it into the contract explicitly. The key to such a rule of discharge working well is to provide an appropriate and well understood list of occurrences and an appropriate and well-defined standard for calculating what a dramatic increase in cost is.

Finally, a rule of discharge on grounds of impossibility or impracticability

should rule out excuse in situations in which the impossibility results from the actions of one of the parties to the contract or where the promisor could have relatively easily taken actions to avoid the failure of the underlying condition. To provide otherwise might lead to an increase in opportunistic behavior[80] or encourage inefficient risk-taking behavior on the part of the promisor, which in the long run might result in contracting and exchange responses by the promisee which would increase transaction's costs.

The discussion of the Westinghouse case must proceed with regard to the more recent doctrines of commercial impracticability inherent in U.C.C. § 2-615 rather than in the context of the older common law cases for a number of reasons. First, the economic environment in which cases such as *Taylor v. Caldwell* arose is far different from the current economic environment. If well developed insurance markets or futures markets had existed in the mid-19th century, the outcome of such cases might very well have been different. In addition, the Westinghouse case is simply not a situation of "impossibility" since Westinghouse could perform on its contracts, although with substantial losses resulting for the company. Given the publicity surrounding Westinghouse's position, it is conceivable that it would be more efficient for Westinghouse to breach its contracts and pay damages rather than provide specific performance, but that is not at issue here. Nor has the purpose of the contract been "frustrated" in any meaningful sense. The early English common law cases appear to be simply irrelevant to the case at hand. Finally, the amount of money involved in the Westinghouse case is far larger than in *Mineral Park* or for that matter in any other related common law case that the author has been able to find. If the contract in *Mineral Park* had involved $500 million rather than only $5,000, the outcome might very well have been different since it would have made much more economic sense for the buyer to have invested resources to determine the level of the water table prior to signing the contract. Simple application of old common law cases in which the "facts" of the case are similar would not be appropriate here without careful consideration given to both the general economic institutions existing in the 1970's and the specific economic factors that characterized the uranium market.

There are, therefore, a number of general questions which must be answered regarding the application of the doctrine of commercial impossibility for contracts involving sales of goods as embodied in U.C.C. § 2-615 in the context of commercial transactions in the U.S. economy today. The answers to these questions must then be applied to the Westinghouse case in light of the economic characteristics of the uranium market developed in the previous sections.

[80] See Oliver E. Williamson, Markets and Hierarchies: Analysis and Antitrust Implications 4-7 (1975).

U.C.C. § 2-615, the associated official comments, and the cases which have arisen under it indicate that a party seeking to be discharged from his contractual obligations must show all of the following and that the party seeking excuse has the burden of proof:[81]

(1) A failure of an underlying condition of the contract must occur. Part (a) of U.C.C. § 2-615 reads:

> (a) Delay in delivery or non-delivery . . . is not a breach of his duty under a contract for sale if performance as agreed has been made impracticable by the occurrence of a contingency the non-occurrence of which was a basic assumption on which the contract was made or by compliance in good faith with any applicable foreign or domestic governmental regulation or order whether or not it later proves to be invalid.

This requirement essentially sets the stage for a discharge. It indicates that certain occurrences may in general appropriately be part of the dickered terms of the contract and an associated insurance premium included in the price with the risk being borne by the seller. In addition, it indicates that certain occurrences may not be part of the dickered terms, the risks not accounted for in the contract price and the associated risks borne by the buyer. The definition of the appropriate occurrences to fall under this requirement depends primarily on the associated requirements of "foreseeability" and "assumption of risk" which help to define the appropriate boundary (discussed further below).

It appears that the courts and the U.C.C. have circumscribed an indefinitely large set of occurrences which are often perceived to fall outside the scope of the dickered terms of the contract. These include fires, incapacity of key personnel, changes in government rules and regulations, wars, embargoes, and acts of God which also lead to large increases in the costs of performance. The assumption is that these are uncertain events with low probabilities and with consequences that are difficult to predict and insure against and for which the risks would ordinarily be borne by the seller in bilateral exchange transactions. But whether or not a particular underlying condition of the contract has failed and led to the increased cost of performance rests on the simultaneous consideration of the "foreseeability" test and the "assumption of risk" test discussed below. In laying out this particular set of occurrences the U.C.C. is alerting contracting parties to the kinds of occurrences which will often satisfy the foreseeability and assumption of risk test. If in a particular circumstance they wish to provide otherwise, then the provision should be written into the contract explicitly; otherwise they don't have to bother with it and it will generally be assumed that the buyer bears the risk.

[81] See Ocean Air Tradeways, Inc. v. Arkay Realty Corp., 480 F.2d 1112-1117 (9th Cir. 1973).

This type of provision makes good sense. It helps the contracting process by laying out the kinds of situations in which the courts have generally felt that the buyers have borne or should bear the risk. It therefore helps to save on transactions costs for ordinary exchanges that satisfy "normal" criteria. In extraordinary situations the parties are alerted to the fact that they have to work a little harder in drawing up the contract if they wish the risks to be divided differently.

(2) The failure must have been unforeseen at the time the contract was signed. Official Comment 1 reads:

> This section excuses a seller from timely delivery of goods contracted for, where his performance has become commercially impracticable because of unforeseen supervening circumstances not within the contemplation of the parties at the time of contracting.

The foreseeability doctrine appears to raise a number of difficulties. To some extent every occurrence is foreseeable. There is always some probability that a fire will destroy the anticipated source of supply, that a key person will die, that various acts of God—like floods—will occur, that there will be an embargo or war, etc. In an objective sense, virtually nothing is truly unforeseeable to the extent that theoretically every possible state of the world could be enumerated and some probability assigned to its occurrence.

The foreseeability requirement may only make sense if we introduce the concept of "bounded rationality." Following Simon[82] and Williamson,[83] the concept of bounded rationality recognizes that human beings cannot evaluate all possible states of the world or all available information that might affect a particular situation. One way of thinking about the foreseeability doctrine is as delineating the boundary between those contingencies that are reasonably part of the decisionmaking process and those that are not. This recognizes that most contracts are not complete contingent claims contracts, commonly including only some subset of all possible occurrences as a reasonable basis for decisionmaking and appropriately included either explicitly or implicitly in the terms of the contract.

The foreseeability doctrine is therefore more of a "contemplation" doctrine. What occurrences were or should have been included in the negotiations underlying the contract and what contingencies were not?[84] In recognizing such cognitive realities, the courts effectively enforce the contract only over that set of contingencies that was or should have been part of the decisionmaking process. Such a requirement makes good sense because it

[82] Herbert A. Simon, Models of Man: Social and Rational 198 (1957).

[83] Oliver E. Williamson, *supra* note 81, at 65-67.

[84] The U.C.C. has this "contemplation" or "reason to know" standard running through it. See for example U.C.C. § 2-715.

recognizes the realities of voluntary exchange. To require performance under contingencies that could not efficiently be part of the decisionmaking process would encourage the costly and difficult enumeration of a large number of contingencies, raising the costs of private exchange.

Under a "contemplation" test we would ask: "Did one of the parties to the contract contemplate or should one of the parties to the contract have contemplated a certain occurrence based on his superior economic ability to do so and make the probability of this occurrence one of the bases on which the terms of the contract (including the price) were negotiated?" If the answer is no, then an additional requirement for excuse has been satisfied, the occurrence not being covered by the contract. If the answer is yes, then the reverse is the case, and we would assume that the risk of the occurrence which has now occurred was covered in the contract.

Under the circumstances it would appear that the "foreseen" interpretation of this requirement would be sufficient. We would ask the evidentiary question of whether one or both parties contemplated the occurrence and whether it formed the basis of their negotiating position. However, a "foreseen, should have foreseen, or reason to know" test appears in principle to have certain advantages. It allows us to ask a normative question: whether one or more of the parties *should* have contemplated such occurrences and made them a basis of the terms of the contract. This stronger interpretation provides an incentive to both parties to carefully evaluate available information about uncertain occurrences involving supply and demand and make this information part of the dickered terms of the contract. The test then is not only whether the parties contemplate an occurrence and made it a basis of the contract, but stronger, should they have done so? This stronger test should encourage more efficient use of available information and help to insure that contingencies are properly reflected in contract terms. This has the effect of not penalizing a shrewd buyer (or, alternatively, rewarding an incompetent seller) who recognizes that the possibility of certain occurrences which should increase the price of the contract even if the seller fails to. In the long run this will serve to eliminate those sellers from the market who do not utilize information about alternative states of the world efficiently, as would occur in a competitive market without transactions costs.

(3) The risk of failure must not have been assumed either directly or indirectly by the party seeking excuse. Official Comment 8 indicates that:

> The provisions of this section are made subject to assumption of greater liability by agreement and such agreement is to be found not only in the expressed terms of the contract but in the circumstances surrounding the contracting, in trade usage and the like. Thus the exemptions of this section do not apply when the contingency in question is sufficiently foreshadowed at the time of contracting to be included among the business risks which are fairly to be regarded as part of the dickered terms, either consciously or as a matter of reasonable, commercial interpretation from the circumstances.

This requirement indicates that the assumption of risk by one of the parties may be found not only in the contract itself, but also in the events surrounding the process of exchange for the commodity in question. In essence this is an extension of the foreseeability or contemplation test and allows the courts to examine circumstances surrounding the particular bargain in question. It allows the court to determine whether or not the circumstances surrounding the contract imply the assumption of risk of failure of an underlying condition by one of the parties or the other. In particular, it encourages the court and the contracting parties to examine what the "ordinary business risks" are that appear to be implicit in contracts such as this in the marketplace. It bolsters the "contemplation" test by assuming, unless specified differently, that the implied distribution of risks in the particular contract is as normally occurs in general contractual relationships of this type, and appears to make sense given the type of contract negotiated and the nature of the economic environment in which it takes place. For example, since one of the primary reasons for a fixed price commodity contract from the viewpoint of the buyer is to insure against fluctuations in price, it might be ordinarily assumed that the seller implicitly assumes all risks of price fluctuations unless otherwise specified and that the contract will be honored except in the most extraordinary circumstances.

(4) Performance must be impracticable. While relaxing the doctrine of strict impossibility, the U.C.C. appears to have replaced it with fairly strict requirements for "impracticability". This is an apparent departure from the older common law cases and no doubt reflects the response of the law to the changing nature of commercial transactions and the increased availability of insurance markets and commodities futures markets. Official Comment 4 states that:

> Increased cost alone does not excuse performance unless the rise in cost is due to some unforeseen contingency which alters the essential nature of the performance. Neither is a rise nor a collapse in the market in itself a justification, for that is exactly the type of business risk which business contracts made at fixed prices are intended to cover. But a severe shortage of raw materials or of supplies due to a contingency such as war, embargo, local crop failure, unforeseen shutdown of major sources of supply or the like, which either causes a marked increase in cost or altogether prevents the seller from securing supplies necessary to his performance, is within the contemplation of this section.

The comment makes clear that increased cost alone is not sufficient; rather that the increase must be "marked".[85] In *Mineral Park*, discussed above, a

[85] The official comment is consistent with recent case law interpretations. "The fact that performance has become economically burdensome or unattractive is not sufficient for performance to be excused." Neal-Cooper Grain Co. v. Texas Gulf Sulphur Co., 508 F.2d 283, 293, 294 (7th Cir. 1974). The cost increase necessary to excuse performance ". . . must be more than merely more onerous or more expensive. It must be positively unjust to hold the parties bound."

ten- to twelvefold increase was considered sufficient. The *Restatement of Contracts* indicates that the increase should be "extreme and unreasonable" and mentions a tenfold increase as illustrative of the kind of increase that might be sufficient.[86] Hurst indicates that the courts have been reluctant to allow excuse merely because the cost of performance has increased and the contract become unprofitable.[87] Courts have not allowed excuse in cases arising directly under U.C.C. § 2-615 for costs which increase by as much as double.[88] It appears, then, that moderate increases in cost of up to 100 percent do not satisfy the requirement, while extreme increases of 1,000 percent or more do. This leaves a considerable area for controversy. Contracts will be enforced even if it hurts, but at some point between a doubling and a tenfold increase in price the contract may become impracticable.

Even if a seller is able to show that there was a failure of an underlying condition of the contract, the contemplation of which had not and should not have been part of the dickered terms of the contract, given the relative economic opportunities to insure against risks, and that he did not implicitly assume the risk by events or normal procedures in the environment surrounding the contract, he still must prove that the occurrence was "impracticable". While it is generally believed that the notion of "impracticability" is somewhat weaker than the older doctrine of "impossibility", this wording of U.C.C. § 2-615 may also reflect the fact that modern commercial transactions rarely involve situations in which performance is objectively impossible. No matter what the occurrence, an equivalent source of supply can often be found, although at a price substantially higher than that in the contract.

In essence the impracticability doctrine says that contracts will be enforced even if the above conditions are satisfied, unless it really hurts. Other things being equal, the seller bears all of the risk unless performance is extremely burdensome, in which case the buyer bears all of the risk. Superficially, this requirement appears to imply sharp boundaries between similar physical occurrences, some of which are "impracticable" and some of which are not. For example, if we had two similar occurrences, let's say embargoes, the seller would have to perform if the price rise were small, but would not be required to perform if the resulting cost increase were very large. Such asymmetric treatment of differing consequences from similar events only appears to make sense if we expand our notion of possible contingencies to

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Ocean Tramp Tankers Corp. v. V/O Sovfracht (The Eugenia), [1964] 2 Q.B. 226, 239. See also Transatlantic Financing Corp. v. United States, 363 F.2d 312, 319 (D.C. Cir. 1966).

[86] Restatement of Contracts § 460 (1932). See Mineral Park Land Co. v. Howard, 172 Cal. 289, 156 P. 458 (1916).

[87] Thomas R. Hurst, *supra* note 67, at 563-64.

[88] *Id.*

include elements identified by both event and consequence, and assume that, given a particular type of occurrence, the size of the consequence and the probability of the consequence occurring are negatively correlated. That is to say, given the set of possible embargoes, those with small consequences are much more probable than those with large consequences. Then we could appeal to the notions of bounded rationality discussed above and argue that the low-probability events are outside of the boundary and not legally part of the contract. For the impracticability test to make sense, it appears that this negative correlation must hold. The impracticability test extends the boundary between those events that are implicitly part of the contract and those that are not. It is not so much that a fire has destroyed the music hall, but that a fire has destroyed the music hall *and* there is no readily available alternative: a more improbable occurrence. It might be presumed that the occurrence of a fire and the fact that the supplier would supply an alternative is ordinarily (or should be) part of the terms of the contract and an insurance premium included in the price, while real disasters are not part of the contract terms and insurance generally provided by the buyer himself.

(5) The seller must have made all reasonable attempts to assure himself that the source of supply will not fail. Official Comment 5 states:

> . . . There is no excuse under this section, however, unless the seller has employed all due measures to assure himself that his source will not fail.

Official Comment 5 refers to a 1932 case, *Canadian Industrial Alcohol Co. v. Dunbar Molasses Co.* In this case a buyer sued a seller for failure to deliver molasses that had been contracted for. The seller claimed that its contract implied that it would only deliver if its exclusive source of supply had sufficient production to meet its needs. It turned out that this source of supply, a refinery, had cut its production and could not meet the needs of the seller.

The court held that the contract was still binding:

> There is nothing to show that the defendant would have been unable by a timely contract with the refinery to have assured itself of a supply sufficient for its needs . . . . The defendant does not even show that it tried to get a contract from the refinery during the months that intervened between the acceptance of the plaintiff's order and the time when shipments were begun. It has wholly failed to relieve itself of the imputation of contributory fault. 3 Williston on Contracts, § 1959. So far as the record shows, it put its faith in the mere chance that the output of the refinery would be the same from year to year, and finding its faith vain, it tells us that its customer must have expected to take a chance as great. We see no reason for importing into this bargain this aleatory element.[89]

[89] Canadian Industrial Alcohol Co. v. Dunbar Molasses Co., 258 N.Y. 194, 199-200, 179 N.E. 383, 384-85, 80 A.L.R. 1173, 1176 (1932).

So it appears clear that both the official comment and the supporting common law case indicate that the promisor must make all reasonable attempts to avoid the failure of the underlying condition. In two cases handed down under U.C.C. § 2-615, the court has held that the seller did not qualify for excuse if the failure to perform would not have occurred if the seller had proceeded reasonably to attempt to perform what he had promised.[90]

When a buyer signs a contract with a seller, he himself is not concerned with how the specified products will be obtained. He will ordinarily simply assume that the seller will secure supplies in the way that seems most efficient to him.[91] The seller could, if he wanted to, specify how he intended to secure supplies and gear the contract price to his success in his endeavors. But this would be a very unusual contract. The buyer who wants a commodity will ordinarily be concerned only with its price and quality (broadly defined). Economic efficiency will be served so long as the contract law does not give incentives to the seller to engage in inefficient procurement activities after the contract has been signed. This requirement essentially reflects the buyer's understanding that the risks associated with procurement of the commodity contracted for are being borne by the seller and that presumably a premium for bearing any risks associated with procurement, except those discussed under other requirements, has been included in the contract price.

As a result the law should not excuse performance if it has become "impracticable" because the seller has not made appropriate attempts to secure supplies. This means, for example, that if a seller has contracted to deliver potatoes three months from now, waits until the last day to obtain supplies, and then finds that potatoes can only be found at a very high price, he will not be excused from performance if he could have contracted for the potatoes at lower costs during the course of the three months or engaged in other activities to efficiently insure against any losses. Any additional risks which the seller incurs due to his own procurement activities, and beyond those implicit in the risk premium built into the contract price, are his to bear and will not lead to a discharge under U.C.C. § 2-615. This provision makes good sense. To allow excuse when the speculative activities of suppliers have led to bad outcomes would inefficiently encourage risk-taking behavior, raising contracting costs both directly and indirectly through an increase in transactions costs that would be associated with buyers trying to counteract the behavior of risk-taking sellers. Another way of thinking about this provision is to say that it discourages certain kinds of "opportunistic" behavior on the part of suppliers speculating on the hope that in the event of a serious loss, the contract will not be enforced.

[90] Deardorff-Jackson Co. v. Nat'l Produce Distributors, Inc., 26 Agric. Dec. 1309 (1967); Chemetron Corp. v. McLouth Steel Corp., 381 F. Supp. 245 (N.D. Ill. 1974).

[91] This appears to be a general assumption of the Code. See U.C.C. § 2-210.

(6) Finally, it also appears that under the common law and implicit in Official Comment 5, the seller's own conduct must not have created the situation leading to the impracticability of performance. This is especially relevant to the Westinghouse case, because Westinghouse was such a large agent in the market that its own contracting behavior probably affected the response of the entire supply side of the market, and may have resulted in an increase in market prices beyond what would have occurred if it had made more timely contracts or revealed its true "short" position much earlier. As a result both Westinghouse and other consumers must pay higher prices for uranium in the medium-term than they would have had to pay if Westinghouse had behaved differently. The kind of contracting behavior in which Westinghouse engaged does not lead to efficient market operation and should not be encouraged by the contract law itself. This requirement encourages all firms to adopt an efficient procurement policy and discourages *large* firms from using their market power to try to manipulate prices and distort the workings of the market.

All things considered, U.C.C. § 2-615 as now interpreted does appear to promote voluntary exchange by reducing transactions costs and providing guidance and encouragement for efficient use of information about alternative future states of the world in contract negotiations and efficient procurement policies by suppliers. In general, it sets a fairly strict standard that contracts will be performed unless certain low-probability events occur. It also insures that a rule of discharge will not reward suppliers who, for one reason or another, do not behave efficiently. This section of the U.C.C. does, however, provide an opportunity to create severe market distortions if the various requirements are interpreted too loosely or inconsistently. This is of special concern if we continue to live in a world of rapid inflation, increased uncertainty in commodity prices, protection of "key" corporations, cartelization of the market for key commodities, etc. It is in the context of these ongoing changes in the economic environment that the Westinghouse case itself, given its size and its visibility, is especially important. The outcome of the case will not only affect Westinghouse, but will also affect the interpretation of U.C.C. § 2-615, which itself may be of increasing importance in today's economic environment.

IV. WESTINGHOUSE AND U.C.C. § 2-615

In September 1975 Westinghouse announced that it would not honor contracts signed with utilities to deliver about 120 million pounds of uranium beyond the uranium it had either in inventory or under contract at that time. This involved the abrogation of contractual agreements involving about 70 million pounds of uranium over a period extending through 1988.

Along with the notification to its customers regarding this action Westing-

house also provided a legal and economic memorandum justifying its position.[92] Basically, Westinghouse claimed that uranium prices had risen so substantially (to about $26 prior to the announcement) that performance on its contracts would be commercially impracticable and that the increase had been the result of unforeseeable events, specifically the Arab oil embargo and subsequent increase in oil prices, and that given these two factors, and in light of U.C.C. § 2-615 considered its actions justified. If we assume that the average price at which Westinghouse had agreed to deliver uranium was $10 per pound, at the then current market price of about $26 Westinghouse stood to lose over $1 billion if it performed on its contracts. Since then prices have risen to about $40 per pound; should these prices prevail, and specific performance be ordered or equivalent damages levied, Westinghouse would lose $2 billion. In light of the discussion in the previous sections, let us proceed to evaluate Westinghouse's position.

To qualify for excuse Westinghouse must first show that a failure of the underlying condition of the contract had occurred. Presumably, under Westinghouse's initial contention, the underlying condition that failed was the assumption that the dramatic increase in oil prices *which in turn led to a rise in uranium prices* would not occur. This argument is essentially a "demand side" argument.

The demand for uranium in the United States today is primarily a function of four factors:

(1) The amount of installed nuclear capacity.
(2) The extent to which the nuclear generating capacity is utilized.
(3) The tails assay at which the uranium enrichment facilities are run (since the light water reactors in the U.S. require enriched uranium).[93]
(4) The possibility of reprocessing spent reactor fuel and recycling the recovered uranium and plutonium.

The amount of installed nuclear capacity is a function of the demand for electricity and the relative economics of nuclear capacity compared to alternative generating techniques such as coal and oil. The demand for electricity is itself a function of the price of electricity, the price of substitutes such as oil and natural gas and various demographic variables and weather characteristics.

One could argue that the rapid rise in oil prices would lead to a shift away from the use of oil as a generating fuel, increasing the demand for nuclear

[92] See legal memorandum provided by Westinghouse's counsel, Kirkland and Ellis (Chicago, July 17, 1975) and a companion document by James Lorie and Celia Gody, Economic Analysis of Uranium Prices (July 9, 1975).

[93] The "tails assay" refers to the amount of U_{235} left as waste in the enrichment process. The larger the waste level, the more uranium ore is needed to provide a particular amount of enriched uranium fuel.

power facilities directly *plus* a tendency to shift from the use of oil by final consumers toward the use of electricity (for heating, for example), increasing the demand for electricity and the derived demand for nuclear power facilities. In short, if one is to conclude that the change in oil prices increased the demand for nuclear power facilities, one must compare nuclear capacity expectations before the oil embargo with capacity expectations after the embargo.

There are at least two reasons to believe *a priori* that the effect of an increase in oil prices on nuclear capacity expectations would both be small and take a long time to work its way through the system. First, it takes nearly ten years to plan and complete construction of a nuclear generating facility in the United States. The *maximum* number of nuclear facilities that could have been in operation by 1984 was already determined at the time of the Arab oil embargo. Capacity additions could be *less* than this amount since construction can be delayed either deliberately or due to technical and regulatory problems at almost any point within the planning-construction cycle. Second, the increase in oil prices will not necessarily lead to a net increase in electricity demand expectations if real electricity prices rise along with real oil (and natural gas) prices. The effects of increased oil prices on electricity demand depend upon the movement in the price of electricity relative to its substitutes and the values of the own-price and cross-price elasticities of demand.

In Table 12 projections of installed nuclear capacity for the United States for 1985 and 1995 are presented by year. It is evident that not only have expectations for installed nuclear capacity for this period not increased, but they have decreased fairly consistently since 1970. Factors such as reduced expectations for the demand for electricity, increased costs of nuclear generating facilities, construction delays, financing difficulties, etc., have all led to *reductions* in expected nuclear capacity, counterbalancing any effect that increased oil prices might have had. In addition, if we examine the expectations for installed nuclear capacity in the rest of the non-communist world for 1985, we find that official projections made since the Arab oil embargo are lower than those made prior to it (see Table 15).

Other things held constant, the reduction in expected nuclear capacity for the period of the next ten years should have also *reduced* substantially expected uranium requirements. The reduced expectations for installed nuclear capacity are, of course, due to factors that are largely associated with nuclear technology itself and have nothing in particular to do with the oil situation.

Considering nuclear power capacity alone, we might think that expected demand for uranium would have fallen along with the reduction in nuclear generating capacity. However, we must also consider the other factors that

TABLE 12
PROJECTIONS OF NUCLEAR CAPACITY

	(in gigawatts)	
	1985	1995
AEC 1970[1]	300	—
AEC 1971[1]	254-321	—
AEC 1972[2]	231-275	602-972
AEC 1974[3]	256-332	620-960
FEA 1974[4]	204	—
ERDA 1975[5]	160-245	445-790
Baughman-Joskow (75)[6]	190	552
FEA (76)[7]	142	—
OECD (76)[8]	152	—
ERDA (76)[9]	145	370

Sources:

[1] Dir. of Operations Analysis & Forecasting, U.S. Atomic Energy Comm'n, Forecast of Growth of Nuclear Power 1 (1971); and Office of Planning & Analysis, U.S. Atomic Energy Comm'n, Growth of Nuclear Power 1972-1985, at 2 (1971).

[2] Office of Planning & Analysis, U.S. Atomic Energy Comm'n, Nuclear Power 1973-2000, at 1,3 (1972).

[3] Office of Planning & Analysis, U.S. Atomic Energy Comm'n, Nuclear Power Growth (1974-2000, at 2,8 (1974).

[4] U.S. Federal Energy Administration, Project Independence Report 127 (1974).

[5] U.S. Energy Research and Development Administration, unpublished projections, February 1975.

[6] Paul L. Joskow, & Martin L. Baughman, The Future of the U.S. Nuclear Energy Industry, 7 Bell J. Econ. & Management Sci. 3, 19 (1976) (Base case).

[7] U.S. Federal Energy Administration, National Energy Outlook, Feb., 1976, at 36.

[8] World Energy Outlook, OECD (Paris), EP (76) 34, Revised Draft, Oct. 22, 1976.

[9] Nuclear Fuel, Oct. 11, 1976, at 7.

determine uranium requirements. Other things equal, an increase in the enrichment tails assay from .20 percent to .30 percent increases uranium requirements by about 20 percent. The economics of enrichment indicate that the tails assay should vary directly with the cost of enrichment, primarily the cost of electricity, and indirectly with the price of uranium.

Until 1973 the AEC (now ERDA) ran its gaseous diffusion plants at .20 percent tails assay. In December 1972 the AEC announced that it would begin to operate its diffusion plants at an actual tails assay of 0.275 percent while maintaining a transactions tails assay of .20 percent until the end of 1974.[94] Thereafter, it would run the enrichment plants an 0.275 percent tails assay or above for both operating and transactions purposes. The change in transactions tails assay was delayed until July 1, 1976, early in 1975 with an increase in the operating tails assay to .30 percent beginning July 1, 1981.[95] This plan was revised again in mid-1975 providing for a reduction in the operating tails assay to 0.25 percent and the maintenance of the transactions tails assay at .20 percent until July 1, 1977, and then to rise gradually to .30 percent in 1981.[96] Differences between the uranium requirements arising

[94] New Master Policy for Fuel Supply, Nuclear Industry, Mar. 1972, at 11, 12.

[95] "Operating Plan" Revealed for ERDA Diffusion Plants, Nuclear Industry, Feb. 1975, at 5.

[96] Reactor Fuel Outlook, Nuclear Industry, July 1975, at 4.

from this "split-tails" policy are being made up by dipping into the ERDA uranium stockpile. This behavior on the part of ERDA reflects anticipated enrichment capacity constraints in the early 1980's rather than an economic tradeoff between enrichment costs and the value of uranium. The result is that uranium consumption per MWe will increase by between 10 and 20 percent as a result in the increase in the operating tails assay of the enrichment facilities.

Estimates of uranium requirements made prior to 1974 assumed that limited recycling of uranium and plutonium derived from spent fuel reprocessing would begin by 1977.[97] This date appears to be impossible to meet for several reasons. Today there is no commercial reprocessing capacity in existence and even under the most optimistic projections only limited reprocessing capacity will be available until the mid-1980's.[98] In addition, the costs of reprocessing have increased so much that there remain uncertainties about whether or not it will even be economical to reprocess spent light water reactor fuel. Finally, major environmental issues surrounding the reprocessing of plutonium have not yet been settled. The absence of reprocessing facilities and recycling would in the long run increase uranium requirements by at least ten percent.

Taking all of these factors into account we can re–examine the demand expectations for uranium itself for the U.S. The reduction in nuclear generating facilities should have acted to reduce uranium demand expectations substantially. The increase in the tails assay and the unavailability of recycling of uranium and plutonium should have increased demand expectations. Projections reported in table 13 are for uranium oxide requirements made prior to the Arab oil embargo and subsequent to it. We see that all things considered, projected uranium requirements through 1985 are well below projections published prior to the Arab oil embargo and the increase in oil prices.

The "OPEC argument" just cannot explain the increase in uranium prices because events particular to the nuclear reactor market itself have led to a *reduction* in expected uranium requirements both in the United States and in other developed countries over the next ten to fifteen years which is the opposite kind of response one would expect to observe if the rise in oil prices were the cause of the increase in uranium prices. Any effect that oil prices alone may have had on increasing nuclear generating capacity with an associated increase in uranium requirements has simply been overwhelmed by other factors.

[97] U.S. Atomic Energy Comm'n, Office of Planning & Analysis, Nuclear Power 1973-2000 (1972); *id.*, Nuclear Power Growth 1974-2000 (1974); Statistical Data of the Uranium Industry, Jan. 1, 1972, at 51.

[98] See Fuel Reprocessing and Storage, Nucleonics Week, Special Rep. 1976.

TABLE 13
FORECASTS OF UNITED STATES URANIUM REQUIREMENTS MADE IN VARIOUS YEARS
ANNUAL REQUIREMENTS IN TONS OF U_3O_8

	1/1/72[1]	1/1/73[1]	1/1/74[1]	1/1/75[1]	9/76[2]
1975	18,200	15,100	12,800	10,800	—
1980	37,600	31,600	34,300	25,800	20,000
1985	66,000	58,800	54,000	50,900	34,000
1990	—	—	—	87,600	45,000

Sources:
[1] U.S. Atomic Energy Comm'n, Statistical Data of the Uranium Industry (issues for 1973-75); and U.S. Energy Research & Dev. Admin., [1976] Statistical Data of the Uranium Industry.
[2] ERDA "mid-case" projection, Nuclear Fuel October 11, 1976, at 7.

In an earlier draft of this paper,[99] I suggested that a more reasonable claim might have been based on the argument that uranium suppliers had successfully cartelized the industry and artificially raised prices above competitive market levels. Since that paper was written Westinghouse has initiated private antitrust suits against foreign and domestic uranium producers alleging that they engaged in a general price fixing conspiracy and made special efforts to "freeze" Westinghouse out of the market.[100] In the only case which had come to trial by the time this paper was written, in a state court in Pennsylvania, initial testimony appeared to indicate that Westinghouse will be relying much more on the uranium cartel argument in its contracts case as well,[101] even though the cartel was not advanced as a significant cause of the rise in uranium prices in the initial documents circulated by Westinghouse. As a result, it appears worthwhile to explore this argument a little more deeply here.

It is difficult to get good information on the structure of the uranium mining sector in the U.S. The Census of Manufacturers does not report separate concentration ratio information for uranium mining. We do have information on uranium milling and since about 90 percent of all uranium reserves are owned or controlled by the millers, concentration ratios for the milling portion of the product stream should give us a fairly good upper bound estimate for the concentration ratios of the mining and milling sector as a whole. In Table 14 are reported four, eight and sixteen-firm concentration ratios for the uranium milling capacity. Four and eight firm concentration ratios are on the moderate to high side relative to other primary energy

[99] See Paul L. Joskow, Commercial Impossibility, The Uranium Market and the Westinghouse Case (MIT Dep't of Econ., Discussion Paper no. 186, Sept. 1976).

[100] See Nuclear Engineering International, Nov. 1976, at 9.

[101] Nucleonics Week, Nov. 11, 1976, at 3.

industries.[102] It should be remembered, however, that since transportation costs for uranium concentrate are small relative to the value of the product transported, the relevant geographical market is a national market, whereas the relevant geographical market for uranium's chief substitute, coal, is probably a set of regional markets.[103] An examination of the concentration ratios alone would seem to put this industry in a gray area with regard to the potentials for competition. The industry has concentration ratios higher than those in industries that would be generally conceded to be vigorously competitive, but lower than those industries that have been often cited for potential or actual antitrust abuse.[104] The structure of the industry, as measured by these concentration ratios, does not give us enough information by themselves to draw conclusions regarding the real or potential existence of oligopolistic pricing behavior. At least during the period 1969-1975, uranium mining and milling appears to have been quite unprofitable with many major firms achieving accounting losses. At least during this period of excess capacity, there does not appear to have been sufficient market power to lead to price levels consistent with even positive profits. The ability to coordinate supply behavior so as to raise prices above competitive levels may be even more difficult today since import restrictions are lifted and firms in many other countries have become eligible to sell uranium in the U.S.

102 *Concentration Levels in U.S. Coal Production*

Percentage of Coal Production

	1972
four firms	30.4
eight firms	40.5
twenty firms	55.1

Source: Thomas D. Duchesneau, Competition in the U.S. Energy Industry 76 (1975).

103 *Concentration Level in Midwestern Coal Production*

Percentage tons of coal produced

	1960	*1962*
four firms	52.3	54.6
eight firms	69.7	74.2
twenty firms	89.2	N/A

Source: Thomas D. Duchesnau, Competition in the U.S. Energy Industry 78 (1975).

104 *1972 Concentration Ratios for Industries Often Thought to be Characterized by Oligopolistic Pricing Behavior*

Industry	*Four Firm*	*Eight Firm*	*Twenty Firm*
Cigarettes	84	N/A	100
Primary aluminum	79	92	100
Primary copper	72	N/A	100
Metal cans	66	79	92
Turbines & turbine generator sets	90	96	99
Transformers	59	75	90
Motor vehicles	93	99	99+

Source: U.S. Bureau of the Census, 1972 Census of Manufacturers: Concentration Ratios in Manufacturing, at tab. 5 (1975).

TABLE 14
CONCENTRATION LEVELS IN URANIUM MILLING
PERCENT OF CAPACITY

	(tons of processed ore)	
	1967	1971
four firms	57.0	54.4
eight firms	78.7	78.5
sixteen firms	100.0	99.8

Source: Thomas D. Duchesneau, Competition in the U.S. Energy Industry 88 (1975).

The structure of the industry is such that any collusive pricing behavior by U.S. firms would almost certainly have to be via direct price fixing activities rather than through "conscious parallelism". But this appears to be a particularly difficult industry in which to police such a price fixing agreement without a very formal cartel administration mechanism. The number of firms involved is relatively large and cheating would be fairly easy because contracts are often secret, involving deliveries over long periods of time. Contracts may be for uranium ore, yellowcake, for uranium feed (UF_6), or for fabricated fuel. As a result, the actual price involved in any particular contract would be very difficult to determine.

The primary evidence regarding actual price fixing agreements involves foreign firms for sales of uranium outside of the United States. Beginning in early 1972 a number of foreign firms, including firms in Canada and Australia, got together at the behest of their governments to fix minimum price levels and to allocate the non-U.S. uranium market. The Canadians claim that this action was precipitated because of the excess supply in the world market at that time and the fact that they were effectively not permitted to sell uranium in the United States. The initial pricing and market sharing agreement commenced in August 1972 and was revised several times until March 1974. In March 1975 the agreements were cancelled.[105]

Of particular interest, however, is that the minimum price levels fixed by the cartel were almost invariably below those prevailing in the U.S. market and were rapidly overtaken by price increases both within the U.S. and around the world in 1974. While the foreign cartel may have been successful in increasing foreign prices above short-run variable costs in 1972 and 1973, it appears that contracting pressures in 1973 and 1974 drove uranium prices far higher than the minimum prices that the international cartel attempted to set.

No evidence of a formal agreement by U.S. firms for the U.S. market comparable to the foreign producer–government agreements has come to

[105] See Canada, Ministry of Energy, Mines and Resources, *supra* note 43.

light to date. That U.S. producers might have liked to have had such an arrangement in 1972 and early 1973 cannot be doubted given prevailing uranium prices and producer profit performance. But desire and ability are two very different things. In any case, it appears unlikely that the increase in uranium prices was the result of artificial cartel pricing because the prices of late 1975 were in line both with entry promoting prices of the late 1950's and approximately equal to the crude estimates of the economic costs of bringing forth additional uranium supplies today that were presented above. It is also surprising that Westinghouse, being such a pervasive factor in the uranium market, including a joint venture with a large producer, could have been unaware of such a cartel. Yet the cartel argument is not even raised in the initial Westinghouse documents justifying its actions. However, since current uranium prices appear to be above or at the high end of my crude long run marginal cost calculations for the mid-1980's, it is at least arguable that these prices have resulted from cartel behavior rather than a short run market disequilibrium as I argued above.

While I am skeptical of the argument that the increase in uranium prices was the result of cartel pricing behavior, it is certainly more plausible than the "OPEC argument" originally advanced. Since prices not only rose in the past, but have continued to rise to date, Westinghouse would also have to argue that the cartel is still operating to keep uranium prices high, if this is the reason for the increase. In any case, the proper remedy would appear to be through the antitrust laws and not U.C.C. § 2-615.[106]

Under U.C.C. § 2-615 Westinghouse must also show that the failure was "unforeseeable" at the time the contract was signed. Since the "OPEC argument" does not appear to satisfy the "failure" requirement, I will not try to argue whether it was foreseen or should have been foreseen. In any case, in a recent federal court opinion the court held that the events in the Middle East, at least as of 1972, were sufficiently "foreseeable" that sophisticated agents should have included the possibilities of increased prices and supply interruptions in the terms of their contracts.[107]

Under the circumstances let us allow a broader interpretation and ask whether a rise in uranium prices, given prevailing expectations prior to 1973, was either foreseen or should have been foreseen by a buying agent *like Westinghouse*. I have already argued that an examination of the demand

[106] The Supreme Court has held that the proper redress for antitrust violations are the antitrust laws, unless the enforcement of the contract would make the courts a party to the carrying out of the antitrust violation, in which case relief from contract performance might be granted. The exception is not relevant here. See Bruce's Juices, Inc. v. American Can Co., 330 U.S. 743 (1947); and Kelly v. Kosuga, 358 U.S. 516 (1959). See also Response of Carolina v. Leasco Response, Inc., 498 F.2d 314, 317, 318 (5th Cir. 1974), and Q-T Markets, Inc. v. Fleming Companies, Inc., 394 F. Supp. 1102, 1105 (D. Colo. 1975).

[107] See Eastern Air Lines, Inc. v. Gulf Oil Corp., 415 F. Supp. 429, 441 (E.D. Va. 1975).

projections and the commitments the supply sector was making for future capacity were obviously inconsistent with one another in 1972 and 1973 for the period beginning around 1979 and 1980, given the lead times required to bring on additional mining and milling capacity, unless one believed both that the AEC would dump its stockpile on the market and that all import restrictions would be completely and rapidly eliminated and substantial amounts of low cost uranium made available from foreign sources. This inconsistency was apparently recognized by many in the industry. Numerous people familiar with the uranium industry indicated that the supply picture and the demand picture would only be brought into balance if prices rose and government policy regarding the disposition of the AEC U_3O_8 stock and imports was cleared up.[108] Some people predicted a price rise while others just spoke about tight markets developing throughout the 1972-1973 period. Since we cannot assume that all of the commentators were well trained in economics, it is not at all strange that some planners spoke of the tight market in terms of an emerging gap between quantities required and supply capabilities at prevailing prices without translating this into the need for a price increase. The question of actual price estimation required a detailed understanding of the costs of bringing on new supply and the timing of that supply, both of which were highly uncertain. That something had to give, whether it was price or demand, was, I think very clear by the beginning of 1973 and perhaps earlier from an examination of the inconsistencies between demand projections and plans for additional capacity. But a careful examination of the price data for uranium transactions gives us even more reason to believe that well informed entrepreneurs should have expected prices to rise once the industry moved out of an excess capacity situation.

In the discussion above we indicated that prior to July 1975 real prices of uranium were generally below the prices prevailing in the 1950's, when there was substantial entry into the industry. That prices would have to rise to such levels once again to encourage entry into the industry would only be surprising if one believed that the AEC paid prices far above what was really necessary to encourage entry or that there had been important cost–reducing technological change. There does not appear to be any evidence for either proposition and, if anything, tightening mining criteria and reserve depletion have probably raised the real costs of uranium extraction. A buyer could, of course, have easily been fooled if he only looked at prevailing market prices and AEC "cost" estimates in making his price expectations. Uranium prices were indeed low for many years, reflecting the excess capacity in the uranium industry. The forward cost system did give misleading information about possible future uranium prices unless used correctly. Westinghouse was willing to supply all comers at prices between \$8 and \$10 per pound. But a large buyer in the market, like Westinghouse, should have

been more than a naive price taker and would have done a more sophisticated analysis of price formation in the uranium market. After all, Westinghouse did commit itself to deliver about 140 million pounds of uranium. Westinghouse had an additional advantage; it knew that a large part of this commitment had not been contracted for and that Westinghouse itself represented a huge hidden future demand on the market. A price rise of some size was foreseen by many in the industry and should reasonably have been foreseeable by perhaps the largest agent in the market, Westinghouse. I have been able to find no evidence indicating that Westinghouse had, prior to 1973, performed an extensive analysis of uranium price behavior over the life of its contracts, as would have been economically appropriate given the large volume of uranium contracted for and the risk associated with a "short" selling policy. Perhaps if it had conducted such analyses, Westinghouse would have at least included an escalation clause tied more closely with the price of uranium itself rather than tying it to variables reflecting only primarily the general rate of inflation.

All things considered, it does not appear that Westinghouse satisfied the "foreseeability" requirement either. To hold otherwise would encourage suboptimal use of available information and the introduction of incorrect price information into the process of exchange.

Under U.C.C. § 2-615 Westinghouse must also show that the risk of failure must not have been assumed either directly or indirectly by the party seeking excuse. Recall that Comment 8 to U.C.C. § 2-615 indicates that the allocation of risk to the party seeking excuse may be found in the circumstances surrounding the contract as well as in the terms of the contract. But the reason for many of the contracts was to convince utilities to buy reactors from Westinghouse by performing a role as uranium buying agent insuring them against fluctuations in the price of uranium. Why would somebody buy a long-term fixed price contract other than to insure against fluctuations in the price of uranium? The general commercial reasons for signing long-term fixed price commodity contracts seems to preclude excuse under U.C.C. § 2-615 simply because the nature of this kind of commodity contract implies the assumption of the risk of price fluctuations on the seller. The inherent uncertainties within the uranium market itself associated with enrichment, reprocessing and recycling, foreign imports, etc., were the reasons why utilities were attracted by the fixed price contracts. To hold that the risks of such uncertainties were not implicitly or explicitly to be borne by the seller from the viewpoint of buyers seems to be inconsistent with the intent and good sense of this requirement under U.C.C. § 2-615.

Even assuming that Westinghouse satisfied all of the foregoing require-

[108] See *supra* notes 24, 26, 36, 37; and Nucleonics Week, June 28, 1973, at 2-3.

ments, its case based on "impracticability" due to the rise in costs is still unclear. The three- to fourfold increase in uranium prices is larger than the doubling, which clearly is not sufficient, and smaller than the ten- to twelvefold increase that has been mentioned as being clearly enough in previous interpretations of impracticability.[109] But to complicate the matter even more, many of Westinghouse's uranium contracts were written in conjunction with reactor contracts. If we were to consider the total value of the contract, including perhaps hundreds of millions of dollars for the nuclear steam supply system and other components, the increase in the cost of uranium would add a much smaller proportionate cost to the total contract. Whether Westinghouse satisfies even the impracticability test is at best questionable.

Westinghouse must also show that it did everything possible to insure itself of an adequate source of supply. Westinghouse's problem arises from the fact that it was short over 67 percent of its uranium commitments. It could have covered these shorts in a timely fashion by purchasing U_3O_8 forward when it signed the sales contracts or by developing its own reserves more quickly. Westinghouse gambled that its requirements could alternatively be obtained from the market at a favorable price. It gambled (either consciously and unconsciously) and lost. Westinghouse could have covered its requirements by obtaining long-term supply commitments as it made sales of uranium. In fact, if it had engaged in more timely contracting, market prices would have begun to rise more quickly as the market moved to a long-run equilibrum. Westinghouse would probably have realized sooner that the fixed price contracts it was signing would be unprofitable. The common law cases underlying U.C.C. § 2-615 and subsequent cases under it cited above[110] quite clearly indicate that under these circumstances a discharge will not be granted and that for reasons of economic efficiency such behavior should not be encouraged by the contract law itself.

Finally, to qualify for excuse, the seller must not by his own actions create the event causing the impracticability of performance. It was argued above that Westinghouse's own behavior in the market had important effects on both the time pattern of prices and the levels to which prices have now risen. More timely contracting on Westinghouse's part would have led to an earlier supply response and ameliorated supply bottlenecks around 1980. By keeping its requirements secret for so long and not "revealing" them to the market by contracting for supplies, Westinghouse was a major contributor to the failure of standard feedback mechanisms to signal the movement into a new expansionary phase for the uranium supply sector. Westinghouse certainly fails to meet this sensible requirement also.

[109] See p. 160 *supra*.

[110] See pp. 161-162 *supra*.

TABLE 15
PROJECTIONS OF FOREIGN INSTALLED NUCLEAR CAPACITY BY 1985
GWe

	August 1973[1]	December 1975[2]	October 1976[3]
France	32	56	31
Germany	38	45	31
Italy	18	26	6
Sweden	16	11	8
U.K.	35	15	11
Canada	15	18	13
Japan	60	49	35
Subtotal Major Countries:	214	220	135
Total—Non-Communist World:	567	479-530	230[4]

Sources:
[1] [Organization of European Community Development] OECD Nuclear Energy Agency, Uranium: Resources, Production and Demand (August 1973).
[2] OECD Nuclear Energy Agency, Uranium: Resources, Production and Demand (December 1975).
[3] OECD, World Energy Outlook (EP (76) 34, rev. draft Oct. 22, 1976).
[4] ERDA Projection, *Nuclear Fuel*, October 11, 1976, at 7.

The economic analysis of U.C.C. § 2-615 concluded that the intent and current interpretations of U.C.C. § 2-615 makes good sense in terms of its ability to promote efficient bilateral exchange, by facilitating the contracting processes and by providing useful guidance around the difficulties of exchange agreements.[111] At least as the law is currently interpreted, Westinghouse appears to fail on all counts to justify a discharge of its contractual obligations under U.C.C. § 2-615. To hold otherwise would mean a major change in the interpretation of the impracticability doctrine, serving to shift business risks ordinarily borne by the sellers of the commodity to the buyers. The long-term effects of such a decision would be to increase uncertainty in contractual relationships involving an associated increase in transactions costs and impairment of efficient market mechanisms. The increase in transactions costs would accompany both the increased uncertainty associated with contracts of this type as well as give disincentives to sellers to use the information available to them to predict the likely course of commodity prices, to insure against price fluctuations by including appropriate price adjustment mechanisms in contracts, and to adopt efficient procurement policies. Buyers can, of course, adapt to such behavior by sellers, but gener-

[111] And Westinghouse certainly doesn't qualify as the small, poorly represented firm that some have suggested U.C.C. § 2-615 was really designed to protect.

ally only through procedures which will increase the costs of exchange.[112] Finally, a decision in favor of Westinghouse would increase the uncertainty associated with U.C.C. § 2-615 itself, leading at least in the short run to a substantial increase in litigation and delays in performance on contracts.

[112] See Richard A. Posner, *supra* note 62, at 42.