Decommissioning Cost Estimate for FMRI, Inc. Site Muskogee, Oklahoma

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Summary of Estimated Reclamation Costs, FMRI Site, Muskogee, Oklahoma

Main Tasks			Cost Estimate ($)	% of Total
1. Ponds 2 & 3		$	3,569,572	4.56%
2. Ponds 5 through 9		$	14,926,589	19.05%
3. Contaminated Soils		$	15,661,933	19.99%
4. Equipment Rental		$	1,358,959	1.73%
5. Labor Costs		$	4,443,832	5.67%
6. Decontamination of Buildings		$	3,830,818	4.89%
7. Site Restoration		$	1,648,340	2.10%
8. Groundwater		$	3,277,140	4.18%
9. Miscellaneous Costs		$	2,217,882	2.83%
10. Contractor Overhead and Profit (10% of Labor Costs)		$	444,383	0.57%
Subtotal		$	51,379,447	65.57%
Planning and Preparation (15%)	15%	$	7,706,917	9.84%
Final Radiation Survey (7%)	7%	$	3,596,561	4.59%
Subtotal with Planning/Prep/Final Rad Survey		$	62,682,926	80.00%
Contingency (25%)	25%	$	15,670,731	20.00%
Total		$	78,353,657	100.00%

Key Assumptions

1) An independent third-party contractor willl perform all of the decomissioning work.

2) The cost estimate adds a contingency factor of 25% to the sum of all estimated costs.

3) Planning and preparation activities include the preparation of a detailed decommissioning plan for approval by NRC, preparing other State and/or local documentation, developing work plans, performing staff training, and procuring special equipment. Planning and preparation costs are assumed to account for ~15% of the total decommissioning costs.

4) The final radiation survey will be performed to ensure that the materials license can be terminated and the premises released for unrestricted use. Final radiation survey costs will include the cost of performing measurements to verify compliance with NRC guidelines on acceptable contamination levels, and the cost for preparing the survey report. The cost for the final radiation survey is assumed to be 7% of the total decommissioning costs based on previous NRC experience.

5) The cost estimate does not include the cost for remediating soils or groundwater, which is outside of NRC's purview. Although some of the contaminated soils removed from the site may contain chemical contamination (e.g., heavy metals, trichloroethylene TCE), and methyl isobutyl ketone (MIBK)), these concerns will be addressed separately by the Oklahoma Department of Environmental Quality (DEQ). The cost estimate also does not include removal or disposal of nonradioactive structures and materials beyond that necessary to terminate the NRC licence. (NUREG-1757, Rev. 1, p. A-22)

6) In 1993, Earth Sciences performed a characterization survey of the site to determine existing conditions. No significant process activities involving ores or Work in Process (WIP) have occurred since completion of the characterization survey.

7) The cost estimate takes no credit for any salvage value that might be realized from the sale of any assets remaining on site.

8) No additional remediation work is needed on the previously released Northwest Property. Buildings in the Northwest Property were remediated to the limits of RG 1.86 that, for U and Th, result in a dose below the 25 mrem/yr limit (NRC's SER, p. 24).

9) Sources of information used in this cost estimate include (1) an independent cost estimate prepared by ICF Consulting in November, 2002; a Staff Evaluation Report prepared by NRC in 2004, and FMRI's "Remediation Costs, Current Decommissioning Plan, Fully Funded, 2015. These, and other information sources, are cited, where appropriate, in this cost estimate.

Inflation-Adjusted Costs

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Base Cost (2014 $)	Total Adjusted for Inflation
1. Ponds 2 & 3	$ 1,433,761	$ 1,002,630	$ 1,002,630	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 3,439,021**	**$ 3,569,572**
2. Ponds 5 through 9	$ 1,804,935	$ 3,509,870	$ 3,509,870	$ 3,509,870	$ 1,729,935	$ -	$ -	$ -	$ -	$ -	**$ 14,064,481**	**$ 14,926,589**
3. Contaminated Soils	$ -	$ -	$ -	$ -	$ 4,635,177	$ 4,635,177	$ 4,635,177	$ -	$ -	$ -	**$ 13,905,530**	**$ 15,661,933**
4. Equipment Rental	$ 130,350	$ 260,700	$ 260,700	$ 144,900	$ 183,750	$ 111,300	$ 111,300	$ 55,650	$ -	$ -	**$ 1,258,650**	**$ 1,358,959**
5. Labor Costs	$ 440,030	$ 633,264	$ 633,264	$ 500,578	$ 626,170	$ 500,578	$ 500,578	$ 249,394	$ -	$ -	**$ 4,083,857**	**$ 4,443,832**
6. Decontamination of Buildings	$ -	$ -	$ -	$ -	$ 1,133,737	$ 1,133,737	$ 1,133,737	$ -	$ -	$ -	**$ 3,401,212**	**$ 3,830,818**
7. Site Restoration	$ -	$ -	$ -	$ 110,000	$ 235,000	$ 125,000	$ 325,000	$ 645,000	$ -	$ -	**$ 1,440,000**	**$ 1,648,340**
8. Groundwater	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	$ 293,421	**$ 2,934,214**	**$ 3,277,140**
9. Miscellaneous Costs	$ 237,000	$ 237,000	$ 237,000	$ 237,000	$ 237,000	$ 237,000	$ 237,000	$ 237,000	$ 59,250	$ 59,250	**$ 2,014,500**	**$ 2,217,882**
10. Contractor Profit (10% of Labor Costs)	$ 44,003	$ 63,326	$ 63,326	$ 50,058	$ 62,617	$ 50,058	$ 50,058	$ 24,939	$ -	$ -	**$ 408,386**	**$ 444,383**
Subtotal	**$ 4,383,500**	**$ 6,000,212**	**$ 6,000,212**	**$ 4,845,828**	**$ 9,136,808**	**$ 7,086,272**	**$ 7,286,272**	**$ 1,505,405**	**$ 352,671**	**$ 352,671**	**$ 46,949,851**	**$ 51,379,447**
Inflation Multiplier	**1.020**	**1.040**	**1.061**	**1.082**	**1.104**	**1.126**	**1.149**	**1.172**	**1.195**	**1.219**		

Notes:

1) Base year costs are shown in 2014 dollars. Costs in years 2015 through 2024 are shown in 2014 dollars and adjusted by the inflation multiplier

2) The total inflation-adjusted cost for each of the major tasks is shown in the column at the far right, "Total Adjusted for Inflation.'

3) Inflation multiplier reflects the average inflation (CPI-U) from 2010 through 2014 2.00 **%**
   2010: 1.6%
   2011: 3.2%
   2012: 2.1%
   2013: 1.5%
   2014: 1.6%

1. Transport & Dispose of Radioactive Work-In-Process (WIP) Material from Ponds 2 & 3

Background Information

Pond 2: Original dimensions were 351' x 151' (1.2 acres) and was ~10' deep. Based on a full volume and 3:1 sloping sides, there are 757,000 ft3 of process waste in Pond 2.
Pond 3: Original dimensions were 400' x 250' (or 2.3 acres) and 25' deep.
Pond 4 and Pond 3 were combined to make the current Pond 3. Areas of Pond 4 not included in Pond 3 were filled from 1975 to 1985.
FMRI completed removal of WIP from Pond 3 in 2010. In 2011, FMRI removed and packaged all remaining Pond 3 material stored in the onsite drying bed. (NRC Trip Report, 5/9/14)
FMRI started removal of WIP from Pond 2 from 8/11 through 12/11 and resumed bagging from 7/12 through 10/12 because storage areas (Chem A and Chem C) were full.
From 2006 - 2009, FMRI shipped WIP to the White Mesa uranium mill site in Utah -- 13,204 tons of WIP in 672 separate shipments. (NRC Trip Report, 5/9/14)
Since 2013, FMRI has shipped 29 intermodals to Utah, each containing 18-20 tons of WIP material. (NRC Trip Report, 5/9/14)
Shipment of intermodals was via truck to Tulsa, rail to Salt Lake City, and truck to the Utah mill. Shipping schedule is limited by available funds. (NRC Trip Report, 5/9/14)

Assumptions

At time of NRC's site visit in May 2014, there were 2,169 bags of WIP in storage: 343 bags in the Thermite building, 714 bags in Chem C, and 1,112 in Chem A.
--> 2,169 bags x (27 ft3/bag x 100 lb/ft3) = 2,169 bags x 2,700 lbs/bag = 2,928 tons of WIP awaiting shipment.
FMRI estimated that it had removed ~3,000 tons of WIP from Pond 2 and that ~5,000 tons remained. (FMRI data cited NRC Trip Report, 5/9/14)
~200 tons of WIP remain in a drying bed near Pond 3. (FMRI Plan for Additional Characterization, submitted to NRC, 2/11/2011)
~16,000 tons of WIP residues (20% moisture content) will be excavated from Ponds 2 and 3 and shipped to a licensed U reclamation facility. (NRC SER, p. 2)

WIP Transportation to Blanding Utah:	**$**	**5,206.00**	**$/load**
Transportation provided by qualified transporters via intermodal containers and rail flat cars.			
Does not include costs for rejected shipments, taxes, or fuel surcharge that may be imposed.			
Source: American Waste Management Services, Inc. price quote for transporting			
WIP material (300 loads), Waste I.D. #35423, May 16, 2014.			

WIP Disposal at White Mase Mill near Blanding, Utah:	**$**	**150.00**	**$/wet ton**
Total quantity to be delivered is from 5,000 to 50,000 wet tons.			
Assumes shipments would be completed by 12/31/2015.			
Assumes that FMRI certifies that the WIP does not contain listed hazardous wastes as defined in RCRA.			
Deliveries to the Mill after 12/31/2013 shall be inflation adjusted by the CPI-U.			
Source: Processing Agreement between White Mesa, Energy Fuels, and FMRI, 8/1/2013.			

Estimated Quantity of WIP Remaining Onsite	**Est. Tons**	
1) Bags of WIP in storage awaiting shipment	2,928	tons
2) Remaining in Pond 2	5,000	tons
3) Material in mound under liner near Pond 3:	210	tons
Total	**8,138**	**tons**

Transportation and Disposal Costs			
Costs per Load	$	5,206	$/load
Tons per Load		20	tons/load
Transportation Cost per Ton	**$**	**260.30**	**$/ton**

WIP Transportation and Disposal

Activity	Quantity	Unit	Cost/Ton ($)	Cost ($)
Transportation of WIP	8,138	tons	$ 260.30	2,118,321
Disposal of WIP	8,138	tons	$ 150.00	1,220,700
Bags for WIP (5,000 @$20 ea)	5,000	ea		100,000
Total for WIP Transportation and Disposal				**$ 3,439,021**

Notes:

WIP estimates used above are from NRC's site visit in May 2014 and NRC/ICF's site visit in March 2015.

Cost of bags for WIP is from FMRI's 2015 cost estimate.

FMRI's current (2015) estimate of WIP remaining onsite is not consistent with FMRI's statements about WIP shipped to White Mesa, UT from 2006-2009 and in 2013.

Allocation of Costs by Year for Transportation and Disposal of WIP from Ponds 2 & 3	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Cost (2014 $)
Ponds 2 & 3 Labor Costs	$ 189,741	$ 132,686	$ 132,686	-	-	-	-	-	-	-	455,112
Transportation and disposal costs are allocated based on labor costs for ponds 2 & 3	**$ 1,433,761**	**$ 1,002,630**	**$ 1,002,630**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$ 3,439,021**

2. Transport & Dispose of Chemical (CaF2) Material from Ponds 5 - 9

Assumptions

~68,800 tons of residue (20% moisture content) of residue will be excavated and disposed from Ponds 5, 6, 7, 8, & 9. *Source: NRC's SER, p. 2.*

CaF2 Transportation			
Price includes liner, fuel surcharge, and a 100-ton per car minimum	$ 10,500.00	gondola car	
Calculated cost/ton (assume 110 tons per load [per FMRI])	**$ 95.45**	**$/ton**	

Source: Email from Jim Smith, American Waste Management Services, Inc. to James Burgess, FMRI, 9/3/2014.

CaF2 Disposal at WCS RCRA Subtitle C Facility, Andrews County, Texas		
Debris	$ 17.50	ft3
Soil or soil-like material	**$ 8.00**	**ft3**

Source: Non-binding disposal cost estimate provided by Waste Control Specialists LLC to James Burgess, FMRI, 9/4/2014.

Estimated Quantity of CaF2 in Ponds 5 through 9				
Estimate from NRC SER and ICF's 2002 cost estimate: 68,000 tons consisting of:				
CaF2	51,500	tons	103,000,000	pounds
Soil below each pond and clay liners	16,500	tons	33,000,000	pounds
Assumes contaminated soils under ponds 6, 7, 8, and 9 are 1-foot thick across the entire footprint (330,000 ft2 x 1 ft thick ' = 330,000 ft3); assume 100 lbs/ft3 for soil				
Total Quantity of CaF2 and Associated Soils	**68,000**	**tons**		

Note: The estimated quantities above assume that contaminated soils under the ponds are included in the 68,000 tons of residue requiring disposal.

Dewatering Costs	
Estimated cost for setup and rental of jet pump system to dewater CaF2 ($75K in year 1, $50K in years 2, 3, and 4.) *Source: FMRI's 2015 Estimated Remediation Costs*	
Total CaF2 Dewatering Costs	**$ 225,000**

Transportation Costs						
Costs per gondola car (includes liner, fuel surcharge, and 100-ton/car minimum)	$ 10,500	$/gondola car				
Tons per gondola car (source: FMRI 2015 estimate)	110	tons/gondola				
Total Transportation Costs	**$ 95.45**	**$/ton**	**68,000**	**tons**	**$**	**6,490,909**

Disposal Costs					
Material	**Est. Tons**	**Lbs**	**Lbs/ft3**	**Total ft3**	**Disposal @ $8/ft3**
CaF2 in Ponds 5, 6, 7, 8, and 9	51,500	103,000,000	175	588,571	$ 4,708,571
Soils under each pond and clay liners	16,500	33,000,000	100	330,000	$ 2,640,000
Total Disposal Costs	**68,000**	**136,000,000**		**918,571**	**$ 7,348,571**

Totals for CaF2	
Dewatering	$ 225,000
Transportation	$ 6,490,909
Disposal	$ 7,348,571
Total for CaF2 Dewatering, Transportation, and Disposal	**$ 14,064,481**

Allocation of Costs by Year for Transportation and Disposal of CaF2 from Ponds 5-9	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Cost (2014 $)
Ponds 5 - 9 Labor Costs	$ 125,592	$ 251,184	$ 251,184	$ 251,184	$ 125,592	$ -	$ -	$ -	$ -		$ 1,004,737
CaF2 dewatering costs	$ 75,000	$ 50,000	$ 50,000	$ 50,000							$ 225,000
Transportation	$ 811,364	$ 1,622,727	$ 1,622,727	$ 1,622,727	$ 811,364						$ 6,490,909
Disposal	$ 918,571	$ 1,837,143	$ 1,837,143	$ 1,837,143	$ 918,571						$ 7,348,571
Transportation and disposal costs are allocated based on labor costs for Ponds 5-9	**$ 1,804,935**	**$ 3,509,870**	**$ 3,509,870**	**$ 3,509,870**	**$ 1,729,935**						**$ 14,064,481**

Background (from ICF's 2002 Cost Estimate)

Pond 5: Original dimensions were 200' x 100' (or 0.5 acres) and 10' deep. Constructed in 1973 with a clay liner.
Residue from this pond was dried and placed in 1,200 1-ton bulker bags (~1 cubic yard), or 1,200 tons total.
Pond 5 was closed by filling in with topsoil. Estimated residue depth of 3'.
Samples revealed elevated gross alpha and gross beta, as well as elevated levels of U and Th. Also high levels of MIBK.
Pond 6: ~200' x 100' (or ~0.5 acres); estimated residue depth of 3'.
Pond 7: ~250' x 150' (or ~0.85 acres) and is <10' deep. Has clay liner. Estimated residue depth of 3'.
Samples revealed elevated gross alpha and gross beta, as well as elevated levels of U and Th. No MIBK.
Pond 8: ~350' x 350' (or 2.8 acres) and is ~25' deep. Has synthetic liner that may be leaking.
Samples revealed elevated gross alpha and gross beta, as well as elevated levels of U and Ra.
MIBK was detected at concentrations well above the 33 mg/kg action limit. Estimated residue depth of 13'.
Pond 9: ~600' x 250' (or 3.4 acres) and is ~25' deep. Constructed in 1985 with a clay and synthetic liner that may be leaking.
In 2002, the pond was full of water and slurry and the CaF2 was seen breaking the surface.
Most samples showed MIBK at levels above the 33 mg/kg action limit. Estimated residue depth of 13'.
Samples revealed elevated gross alpha and gross beta, as well as elevated levels of U and Ra.

Additional Background Information

The CaF2 ponds contain sludges or residues contaminated with organic, inorganic, and radioactive waste.
Primary contaminants of concern are: chromium, MIBK, U-233, U-234, U-235, U-238, Th-230, Th-234, and their decay products.
The presence of hazardous and radioactive contaminants increases the probability that some of the CaF2 material will have to be disposed of as mixed waste.
Pond 2 was constructed in 1960 and included a clay liner and was used to hold process residue until Pond 3 was built in 1979.
In 2002, site personnel said that the pond was capped with a PVC sheet and one polyethylene sheet. Estimates of soil cover thickness are from 6 to 24 inches.
At an unknown date, the residue in Pond 5 was dried and placed in 1,200 one-ton bulker bags (3'x3'x3').

3. Transport & Dispose of Additional Contaminated Soils

Background

1) In a November 2002 independent Decommissisoning Cost Estimate for Fansteel, Inc., ICF reviewed detailed characterization data for the site prepared by Earth Sciences Consultants and confirmed that the surface and subsurface soils at the site have been contaminatec with a number of different isotopes over the years, as well as chemicals.[1] The presence of chemcial and radiological contamination at the site raises the possibility that some of the soil might be considered mixed waste with more limited and more costly disposal options.

Assumptions

2) For cost estimating purposes, ICF's 2002 cost estimate divided the site into seven areas of concern. The Disposal Cost table shows the physical areas of each of the seven site areas and subtracts the pond areas to avoid double counting. For each of the seven areas, ICF assignec a percentage of the area contaminated and a depth of contamination. The current (April 2015) ICF cost estimate focuses on radiological contamination and assumes that at the time of Final Site Surveys, the anticipated area-weighted average thickness of residual radioactivity in surface soils is estimated to be ~0.85 m (0.5 m for 70% of the site; 1 m for 20% of the site, and 3 m for 10% of the site, as documented in Fansteel's January 2003 Decommissioning Plan for the site).[2] [0.85 m = 2.79 ft]

3) As documented in the NRC's SER, site characterization data show that some radioactivity is known to extend down to a depth of several meters. However, because the dose from the residual radioactivity is expected to be primarily from gamma radiation, the dose attributable to radioactivity below a depth of 0.85 meters is expected to be insignificant, which was confirmed through an NRC staff sensitivity analysis (NRC SER, p. 25).

4) The seven areas of the site identified in ICF's 2002 cost estimate as containing radiologically contaminated soils represent an area of 1.6 million ft2 (153,000 m2), as shown in the table below.

5) The amount of soil that ICF estimates needs to be removed constitutes only the radiologically contaminated soils, and not soils contaminated by chemicals that may need to be removed under Oklahoma DEQ requirements. In the absense of data showing an area is clean, ICF assumed it was likely to be contaminated if it was located near areas of known contamination. Although it is possible that some portion of the contamination may need to be disposed of as mixed waste, the estimate below assumes that all of the radiologically contaminated soil could be disposed of as low level radioactive waste at the WCS facility in Andrews, Texas.

Notes:

1) Decommissioning Cost Estimate for Fansteel, Inc, Muskogee, OK. Prepared by ICF Consulting, November 15, 2002.

2) Decommissioning Plan, Fansteel Inc., Muskogee, Oklahoma Site, Volume 2 of 2, Project No. 6473F, January 15, 2003.

Disposal Cost for Radiologically Contaminated Surface and Subsurface Soils

B	C	D	E	F	G	H	I	J	K
Soil Area	**Length (ft)**	**Width (ft)**	**Area with Ponds (ft2)**	**Area Without Ponds (ft2)**	**% of Area Affected (1)**	**Contam. Depth (ft) (1)**	**Modified Contam. Depth (ft) (2, 3)**	**Contam. Soil Volume (ft3) (F*G*I)**	**Disposal Cost @$8/ft3**
1	640	330	211,200	211,200	70%	13	2.79	412,473.60	$ 3,299,789
2	460	460	211,600	158,599	50%	15	2.79	221,245.61	$ 1,769,965
3	550	410	225,500	125,500	50%	10	2.79	175,072.50	$ 1,400,580
4	450	160	72,000	72,000	30%	0.5	0.5	10,800.00	$ 86,400
5	525	150	78,750	78,750	70%	0.5	0.5	27,562.50	$ 220,500
6	650	650	422,500	422,500	10%	0.5	0.5	21,125.00	$ 169,000
7	660	650	429,000	79,000	100%	7	2.79	220,410.00	$ 1,763,280
Totals			**1,650,550**	**1,147,549**				**1,088,689**	**$ 8,709,514**

Notes:

1 m = 3.28084 ft; 1 m2 = 10.7639 ft2

(1) Percent of area affected and contamination depth are from ICF's 2002 cost estimate.

(2) Modified contamination depth reflects the finding in the 1993 Remediation Assessment for the site prepared by Earth Sciences Consultants that soil radioactivity was concentrated in the top 2.5 feet of soil (Earth Sciences Consultants, Inc. Technical Report, Remediation Assessment, Fansteel, Inc. Muskogee, OK, Volume 1 of 4, Project No. 111, December 1993, p. 5-1).

(3) NRC's SER for the site also notes that "…because the dose from the residual radioactivity is expected to be primarily from gamma radiation, the dose attributable to radioactivity below a depth of 0.85 meters [2.79 feet] is expected to be insignificant" (p. 25/57).

Transportation Cost for Radiologically Contaminated Surface and Subsurface Soils

Total to be disposed (assume 100 lbs/ft3 for the 1,088,689 ft3 of contaminated soil in Col. J)		54,434	tons			
Costs per gondola car (includes liner, fuel surcharge, and 100-ton/car minimum)	$	10,500	gondola car			
Tons per gondola car (source: FMRI 2015 estimate)		110	tons			
Total Transportation Costs	**$**	**95.45**	**cost/ton**	**54,434**	**tons**	**$ 5,196,017**

Allocation of Costs by Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total Cost (2014 $)**
Labor Costs				-	$ 251,184	$ 251,184	$ 251,184	-	-	-	$ 753,552
Transportation	-	-	-	-	1,732,006	1,732,006	1,732,006	-	-	-	$ 5,196,017
Disposal	-	-	-	-	2,903,171	2,903,171	2,903,171	-	-	-	$ 8,709,514
Total trans. & disposal	**-**	**-**	**-**	**-**	**$ 4,635,177**	**$ 4,635,177**	**$ 4,635,177**	**-**	**-**	**-**	**$ 13,905,530**

Transportation and disposal costs are allocated based on labor costs for excavating and loading contaminated soils.

4. Equipment Rental Rates

Assumptions

Anticipated months of usage are tied to the Labor Costs tab

Equipment Costs			
Excavator, diesel hydraulic, crawler mounted, 1 CY capacity	**$**	**6,225**	**month**
Front end loader, 1 3/4 to 2 CY, 130 HP	**$**	**3,425**	**month**
Backhoe-loader, 80 HP, 1 1/4 CY capacity	**$**	**2,800**	**month**
	$	**3,050**	**month**

Source of cost information: RS Means, Heavy Construction Cost Data, 2015 Edition (reference section, beginning p. 513)

Anticipated Months of Equipment Usage

Equipment	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Months Needed**	**Total Cost (2014 $)**
Excavator 2-3	6	12	12								30	$ 186,750
Excavator 5-9	6	12	12	12	6						48	$ 298,800
Excavator soils					12	12	12	6			42	$ 261,450
Front end loader 2-3	6	12	12								30	$ 102,750
Front end loader 5-9												
Front end loader soils												
Backhoe-loader 2-3												
Backhoe-loader 5-9	6	12	12	12	6						48	$ 134,400
Backhoe-loader soils												
Dump truck 2-3												$ -
Dump truck 5-9	6	12	12	12	6						48	$ 146,400
Dump truck soils					12	12	12	6			42	$ 128,100
Total Equipment Rental Costs												**$ 1,258,650**

Notes:

2-3 = used for WIP from ponds 2 & 3

5-9 = used for CaF2 from ponds 5-9

soils = used for additional contaminated soils

Equipment Rental Costs by Year

Allocation of Costs by Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total Cost (2014 $)**
Excavator	$ 74,700	$ 149,400	$ 149,400	$ 74,700	$ 112,050	$ 74,700	$ 74,700	$ 37,350	-	-	$ 747,000
Front end loader	$ 20,550	$ 41,100	$ 41,100	$ -	$ -	$ -	$ -	$ -	-	-	$ 102,750
Backhoe-loader	$ 16,800	$ 33,600	$ 33,600	$ 33,600	$ 16,800	$ -	$ -	$ -	-	-	$ 134,400
Dump truck	$ 18,300	$ 36,600	$ 36,600	$ 36,600	$ 54,900	$ 36,600	$ 36,600	$ 18,300	-	-	$ 274,500
Total Equipment Costs	**$ 130,350**	**$ 260,700**	**$ 260,700**	**$ 144,900**	**$ 183,750**	**$ 111,300**	**$ 111,300**	**$ 55,650**	**-**	**-**	**$ 1,258,650**

Occupational Employment and Wage Estimates for Oklahoma, May 2014

Bureau of Labor Statistics Occupation (SOC code)	Equivalent Decommissioning Position (1)	Employment (2)	Annual Mean Wage (3)	Overhead (%) (4)	Annual Salary with Overhead	Hourly Rate with Overhead (%) (5)	% Utilized for Each Year of Activity (6)
General and Operations Managers (111021)	**General Manager**	24560	$98,640	70.0%	$167,688	**$80.62**	20%
Health and Safety Engineers Except Mining Safety Engineers and Inspectors (172111)	**Radiological Safety Officer**	830	$84,910	60.0%	$135,856	**$65.32**	50%
Environmental Engineering Technicians (173025)	**Site Project Manager**	180	$43,080	53.7%	$66,214	**$31.83**	100%
Environmental Scientists and Specialists Including Health (192041)	**Health Physics Specialist**	590	$64,580	53.7%	$99,259	**$47.72**	50%
Environmental Science and Protection Technicians Including Health (194091)	**Quality Control Officer**	630	$41,750	53.7%	$64,170	**$30.85**	50%
Construction Laborers (472061)	**Laborer**	12360	$28,570	141.5%	$68,997	**$33.17**	100%
Operating Engineers and Other Construction Equipment Operators (472073)	**Construction Equipment Operators**	6300	$37,720	141.5%	$91,094	**$43.80**	100%

Source of SOC codes and wages data: Bureau of Labor Statistics, http://www.bls.gov/oes/current/oes_ok.htm. Data extracted on April 1, 201

SOC code: Standard Occupational Classification code -- see http://www.bls.gov/soc/home.htm

Footnotes:

(1) ICF selected the most relevant BLS occupation codes for the equivalent decommissioning positions needed at the site. The positions are described in ICF's 2002 cost estimate for the sit

(2) Estimates do not include self-employed workers.

(3) Annual wages have been calculated by multiplying the hourly mean wage by 2080 hours

(4) Overhead rates are from NUREG/CR-6477, Table A.1, Labor Costs for Decommissioning

(5) Hourly Rate with Overhead (%) includes basic wages and benefits for staff of a third-party contractor performing decommissioning tasks, including overhead, but does not include contractor profi

(6) % Utilized for each position reflects anticipated needs at the site, as well as input from NUREG/CR-6477, p. A.3 for health physics specialist

5. Labor Costs

Assumptions

With the exception of laborers and construction equipment operators, all positions are assumed to work
half-time in 2015 and full-time in 2016 through 2022 (adjusted by percent utilized for each year of activity).
Labor for bagging and loading WIP from ponds 2 & 3, and excavating and loading for ponds 5-9 are from FMRI's 2015 Remediation Cost Estimate.
Labor costs per ton for excavating and loading contaminated soils are assumed to be comparable to the excavating and loading costs per ton for ponds 5-9.

Labor Costs

				HOURS									
Activity	**Labor Category**	**Utilization**	**2014 Hourly Rate**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total Hours**	**Total Cost (2014 $)**
Ponds 2 & 3													
Bagging	Laborer		$ 33.17	3,120								3,120	$ 103,495
Loading	Laborer		$ 33.17	2,600	4,000	4,000						10,600	$ 351,617
Ponds 5 - 9													
Excavating	Constr. Eqpt. Operator		$ 43.80	2,080	4,160	4,160	4,160	2,080				16,640	$ 728,750
Loading	Laborer		$ 33.17	1,040	2,080	2,080	2,080	1,040				8,320	$ 275,986
Contaminated Soils													
Excavating:	Constr. Eqpt. Operator		$ 43.80					4,160	4,160	4,160		12,480	$ 546,563
Loading	Laborer		$ 33.17					2,080	2,080	2,080		6,240	$ 206,990
Management	General Manager	20%	$ 80.62	208	416	416	416	416	416	416	416	3,120	$ 251,532
	Site Project Manager	100%	$ 31.83	1,040	2,080	2,080	2,080	2,080	2,080	2,080	2,080	15,600	$ 496,605
Radiological Safety	Radiological Safety Officer	50%	$ 65.32	520	1,040	1,040	1,040	1,040	1,040	1,040	1,040	7,800	$ 509,460
	Health Physics Specialist	50%	$ 47.72	520	1,040	1,040	1,040	1,040	1,040	1,040	1,040	7,800	$ 372,223
Quality Control	Quality Control Officer	50%	$ 30.85	520	1,040	1,040	1,040	1,040	1,040	1,040	1,040	7,800	$ 240,637
Total Labor Hours & Costs				**11,648**	**15,856**	**15,856**	**11,856**	**14,976**	**11,856**	**11,856**	**5,616**	**99,520**	**$ 4,083,857**

Note:

Labor costs shown in this table reflect those not captured elsewhere in the estimate. For example:

1) Costs do not include contractor overhead and profit of 10% which is added as a separate line item on the Summary page.
2) Labor costs associated with scabbling and cleaning of equipment and buildings are included in the units costs for these activities and captured elsewhere in the cost estimate.
3) Labor costs associated with restoration and groundwater capture and treament are captured in the unit costs for those activities.

Allocation of Labor Costs by Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total Cost (2014 $)**
Ponds 2 & 3	189,741	132,686	132,686	-	-	-	-	-	455,112
Ponds 5 - 9	125,592	251,184	251,184	251,184	125,592	-	-	-	1,004,737
Contaminated Soils	-	-	-	-	251,184	251,184	251,184	-	753,552
Management	49,876	99,752	99,752	99,752	99,752	99,752	99,752	99,752	748,137
Radiological Safety	58,779	117,558	117,558	117,558	117,558	117,558	117,558	117,558	881,683
Quality Control	16,042	32,085	32,085	32,085	32,085	32,085	32,085	32,085	240,637
Total Projected Labor Costs	**$ 440,030**	**$ 633,264**	**$ 633,264**	**$ 500,578**	**$ 626,170**	**$ 500,578**	**$ 500,578**	**$ 249,394**	**$ 4,083,857**

6. Decontamination of Buildings & Equipment

Background

Licensed activities occurred in most of the structures on the south and east portions of the property. The structures in the table below were characterized as "impacted" based on the initial radiological characterization.

Available characterization data for the 15 facility buildings on the FMRI site is limited to a 1993 Remediation Assessment prepared for Fansteel by Earth Sciences Consultants, Inc. (Remediation Assessment, Fansteel, Inc., Muskogee, OK, Kirkpatrick & Lockhart, Pittsburgh, PA, Project No. 111, December 1993). The work included a preliminary scoping survey to identify buildings, portions of buildings, and equipment requiring decontamination. A one-meter square grid was used to identify surveypoints on each building exterior and interior surfaces. A selected portion of these grids was then surveyed for radioactivity. Results, summarized in the table below, show that four of the seven buildings with sampling data had contamination above the limits for total alpha and beta-gamma radiation release limits established in Fansteels, NRC license for Thorium (results are provided in ICF's 2002 Cost Estimate, p. 5). Although the characterization study occurred more than two decades ago, there have been no activities on the site that would significantly alter the distribution of the contamination (NRC's SER, p. 9).

ICF's 2002 cost estimate provides a total cost for chemical cleaning of equipment and chemical cleaning of building surfaces. These costs were developed from unit cost estimates for the chemical cleaning of floors, walls, and ceilings in buildings with a mixture of significant contaminants, as gathered from the *Revised Analyses of Decommissioning Reference Non-Fuel-Cycle Facilities* (NUREG/CR-6477), completed in July 1998. The cost estimate includes the full cost of handling waste generated by its chemical cleaning process (packaging, supercompaction, transportation, and disposal) in addition to manpower and equipment. ICF's 2002 analysis generated a new unit cost per piece of equipment based on a weighted average of the total unit costs for cleaning individual pieces of equipment listed in NUREG/CR-6477 and a weighted average of these items' respective volumes. The weights of each item in the calculation were chosen to reflect that item's expected prevalence in chemically cleaned buildings and are reflected in the cost below for chemical cleaning of equipment.

Decontamination of Buildings and Equipment

Item	Bldg #	Dimensions (ft) (L x W x H)	Description	Comments and Assumptions	Total Grids Sampled	Grids Above Limits	% of Grids Above Limits	Cost ($)[1, 2,3]
Scabbling Cost								
White House	7	45 x 30 x 12	Cinder block and corrugated metal exterior walls on a concrete pad, used as a break room.	The building no longer exists.	80	0	0	
Chemical "C" Building	13	42 x 70 x 34; 48 x 78 x 28	Consists of 2 connected rooms; constructed of corrugated metal with a jointed concrete floor. Currently used to store WIP	Assume 10% of floor area will need to be scabbled and disposed of as LLRW (NRC SER, p. 2); sampling data showed contamination of interior and exterior walls beyond release limits for Thorium	189 27 (Exterior)	47 3 (Exterior)	24.87	$28,357
Chemical "A" Building	16	300 x 70 x 60	Largest building on the site; 1 level with a metal platform above on the south end; north end has a 3rd and 4th floor and partial 5th floor. Constructed of cinder blocks with steel girder supports and a brick exterior. Contains significant amount of piping and vents. Portions are currently used to store WIP.	Assume 10% of floor area will need to be scabbled and disposed of as LLRW (NRC SER, p. 2); sampling data showed contamination of interior and exterior walls beyond release limits for Thorium	2208 59 (Exterior)	104 2 (Exterior)	4.71	$89,093
Thermite Building	9	80 x 40 x 25	1-level, 2-story building constructed of corrugated metal with a concrete slab floor		72	0	0	
Sodium Reduction Building	11	120 x 40 x 30	1-level, 3-story building constructed of corrugated metal with a concrete slab floor. Currently used to store WIP.		91	0	0	
R&D Laboratory Building	15	70 x 100 x 31	Now used as a workshop; consists of two components: a 1-level, 3-story structure constructed of corrugated metal with a concrete floor; and a 2-level office building with a brick exterior.	Sampling data showed contamination of interior walls beyond release limits for Thorium.	519	1	0.19	

Item	Bldg #	Dimensions (ft) (L x W x H)	Description	Comments and Assumptions	Total Grids Sampled	Grids Above Limits	% of Grids Above Limits	Cost ($)[1, 2,3]
Groundwater Treatment Facility	Gunch House	N/A	N/A	The building no longer exists.				
Little Bertha Building	12	44 x 15 x 18	1-room corrugated metal building on a concrete pad.	Sampling data showed contamination of interior walls beyond release limits for Thorium.				
Weir Building	10	20 x 20 x 14	1-room corrugated metal building on a concrete pad. Is used to monitor Outfall 001.					
Ore Storage Pad	N/A	has area of ~10,000 ft2		Assusme 20% of the area will need to be scabbled and disposed of as LLRW.				$84,850
Cleaning Costs								
Chemical Cleaning of Building Surfaces			Total for all contaminated buildings	Assumes chemical cleaning is applied to the percentage of grids on a surface found to be contaminated (e.g., if half the grids on the floor of a building are contaminated, half the floor will be cleaned).[4]				$226,212
Chemical Cleaning of Equipment (incl. packaging, manpower, trans, disposal)			Assumes 1/3 is clean; 1/3 requires disposal as LLW, and 1/3 requires cleaning to be disposed as LLW, per ICF's 2002 cost estimate.	Assumes 1/2 of the equipment present during ICF's 2002 site visit has been removed from the site.[5] Cleaning costs based on assumptions in ICF's 2002 cost estimate.				$2,972,700
Total (2014 $)								**$3,401,212**

Notes:

[1)] Source of scabbling cost of $29.36/ft2 (1998 dollars): Cost Estimate for Decommissioning the Advanced Medical systems Facility in Cleveland, Ohio, prepared for NRC's Office of Nuclear Materials Safety and Safeguards by ICF Incorporated, April 1998.

[2)] Source of chemical cleaning costs: Decommissioning Cost Estimate for Fansteel, Inc., Muskogee, OK, prepared by ICF Consulting, November 15, 2002.

[3)] Costs for scabbling and cleaning have been updated by the CPI-U as of December 2014.

[4)] Source of building contamination data: Decommissioning Cost Estimate for Fansteel, Inc., Muskogee, OK, prepared by ICF Consulting, November 15, 2002.

[5)] According to historical documentation, Fansteel excavated and packaged 371 tons of material during closure activities (NRC SER, p. 4).

Allocation of Costs by Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Cost (2014 $)
Decontamination					**$ 1,133,737**	**$ 1,133,737**	**$ 1,133,737**				**$ 3,401,212**

Note: Assumes decontamination work will be done over a period of 3 years once the Pond work is mostly done and contaminated soils have been removed from the site.

7. Site Restoration (includes equipment, labor, fuel, etc.)

Assumptions

Once WIP, CaF2, and contaminated soils are removed from the site and remaining materials are tested to ensure safety, pond areas will be filled by using available on-site clean soils.
Approximate area of ponds 2 and 3 = 11 acres; approximate area of ponds 5-9 = 15 acreas; total pond area = 25 acres.
Estimated cost of backfilling process ponds = $20,000/acre.
Approximate area of site that will be regraded and restored = 80 acres (source: ICF site visit of 3/17/2015 and review of site maps)
Estimated cost of regrading once ponds have been backfilled = $5,000/acre.
Entire regraded and restored area of the site (80 acres) will be covered with 6 inches of topsoil and revegetated.
Estimated cost of sourcing, scraping, transporting, delivering, and spreading 6" of topsoil on the site = $2,000/acre.
Estimated cost of revegetation at the site, including seeding and mulching = $2,000/acre.
Cost estimates include equipment, operators, fuel, and other associated costs.
Aside from 6" of topsoil, no additional materials from offsite will need to be brought in.

*Source of estimated costs **(bold)** in above assumptions: professional engineering judgment, telephone communication with Jim Kuipers, P.E., April 1, 2015; Kuipers & Associates LLC, jkuipers@kuipersassoc.com , (406) 689-3464. (Mr. Kuipers is a seasoned mining engineer who has completed detailed remediation cost estimates for scores of mining projects for private- and public-sector clients).*

Site Restoration Costs	# of Acres	$/Acre	Total
Backfilling of ponds 2 and 3	11	20,000	$ 220,000
Backfilling of ponds 5, 6, 7, 8, & 9	25	20,000	$ 500,000
Regrading of site	80	5,000	$ 400,000
Placement of topsoil	80	2,000	$ 160,000
Revegetation	80	2,000	$ 160,000
Total			**$ 1,440,000**

Allocation of Costs by Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Cost (2014 $)
Labor Costs											
Ponds 2 & 3	$ 189,741	$ 132,686	$ 132,686	$ -	$ -	-	-	-	-		$ 455,112
Ponds 5 - 9	$ 125,592	$ 251,184	$ 251,184	$ 251,184	$ 125,592	-	-	-	-		$ 1,004,737
Restoration costs are allocated by year based on the anticipated schedule and needs -- not directly tied to labor costs.											
Backfilling of ponds 2 and 3				$ 110,000	$ 110,000						$ 220,000
Backfilling of ponds 5, 6, 7, 8, & 9					$ 125,000	$ 125,000	$ 125,000	$ 125,000			$ 500,000
Regrading of site							$ 200,000	$ 200,000			$ 400,000
Placement of topsoil								$ 160,000			$ 160,000
Revegetation								$ 160,000			$ 160,000
Total restoration costs by year	**-**	**-**	**-**	**$ 110,000**	**$ 235,000**	**$ 125,000**	**$ 325,000**	**$ 645,000**	**-**	**-**	**$ 1,440,000**

8. Groundwater Collection & Treatment

Assumptions

Removal of contaminated soils also removes the potential source materials. Thus, long-term groundwater remediation will not be necessary.
Short-term groundwater remediation will be needed during site remediation and afterwards to allow the site to flush.

Background

Ongoing groundwater collection and treatment at the site consists of a collection trench ("French drain") around the downgradient perimeter of the site. This trench intercepts and collects groundwater and routes it to a treatment facility. Treatment consists of a neutralization/flocculation by the addition of lime in the facility's wastewater treatment system. Groundwater treatment will continue until it is determined that the groundwater meets applicable regulatory standards. No measurable doses to the public from effluents are anticipated from decommissiong activities (NRC SER, p. 39).

The existing wastewater treatment plant will be used to process surface water accumulated in ponds and groundwater encountered in excavations until Pons 6, 7, 8, and 9 are no longer available. The existing plant will then be modified to use sand-drying bed units to filter the water from the solids and remove free liquid from the solids prior to off-site disposal of the recovered solids.

Source: Letter from A. Fred Dohmann, President, FMRI to James Shepherd, NRC Project Manager, December 31, 2003, transmitting a revision to FMRI's Decommissioning Plan regarding License SMB-911, License Condition 40. ML040580238.

Groundwater is considered to be a viable exposure pathway because even under an industrial land use scenario, it is possible that the groundwater at the site could be used to supply drinking water to workers at the site (NRC's SER, p. 22).
Licensee has committed to remediating the groundwater as part of the site decommisssioning.
Residual radioactive concentrations should ensure that exposures will not result in a dose >25 mrem/yr from all relevant pathways.

Costs

FMRI has provided actual and estimated costs of running the groundwater collection and treatment system at $282,000/yr since 2004. In fact, in a March 31, 2012 letter from Robert Compernolle, President, FMRI to James Shepherd, NRC Project Manager, **this amount is cited as the <u>actual cost</u> of groundwater treatment for each year from 2004 through 2011** (assume 2011 dollars).

ICF assumes that groundwater collection, testing, and remediation will continue for 10 years, until 2024.
However, we understand that groundwater collection and treatment may stop once radioactive contaminants reach release limits.

We assume that once the contaminated WIP, soils, and CaF2 materials are removed from the site, the groundwater quality will continue to improve each year as flushing occurs. The cost includes continued treatment for 10 years, until 2024.

Groundwater Collection and Treatment		Cost	Period		Total for 10 Years
Annual Cost (2011 dollars), including collection, treatment, and discharge to the Arkansas River	$	282,000	year	$	2,820,000
Annual Cost (2014 dollars), including collection, treatment, and discharge to the Arkansas River	**$**	**293,421**	**year**	**$**	**2,934,214**

Remediation Assessment

In Feb 1993, Earth Sciences installed 25 monitoring wells in the unconsolidated aquifer ranging in total depth from 13 feet to 34 feet.
Wells were tested for radiological constituents, total and dissolved metals, fuloride, ammonia, nitrate/nitrate, sulfate, VOCs, and semi VOCs.
Results are presented in Earth Sciences Consultant's Remediation Assessment, Fansteel, Inc., Muskogee, OK; Volume 1 of 4, Project 111, December 1993.

Results

1) Results indicate shallow aquifer contamination by a number of different isotopes,as well as metals and an organic compound.
Isotopes include U-233, U-234, U-235, U-238, Th-228, Th-230, and Th-232. Metals were arsenic, barium, chromium, and nickel.
Methyl isobutyl ketone, or MIBK, also was found.

2) 6 wells had elevated concentrations of uranium that exceed the action level of 15 pCi/l, ranging from 37 to 21,000 pCi/l.
In 1996, there was still significant groundwater contamination.

3) In 1993, Earth Sciences also installed 4 monitoring wells in the deeper bedrock aquifer, ranging in total depth from 38 to 70 feet.
Results showed that the bedrock aquifer had *not* been affected by Fansteel's operations.

9. Miscellaneous Costs

Utilities				
Electric	$	40,000		
Natural Gas	$	24,000		
Water	$	8,000		
Total Utilities			**$**	**72,000**
Supplies				
Supplies and Misc.	$	5,000		
Total Supplies			**$**	**5,000**
Professional Fees				
NRC Oversight	$	80,000		
ODEQ Oversight	$	24,000		
Accounting	$	3,400		
Administration	$	7,600		
Other Professional Fees	$	20,000		
Total Professional Fees			**$**	**135,000**
Taxes/Ins./Maint.				
Property Taxes	$	7,000		
Insurance	$	6,000		
General Maintenance	$	12,000		
Total Taxes/Ins./Maint.			**$**	**25,000**
Total Annual Miscellaneous Costs			**$**	**237,000**

Spread of Costs by Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Cost (2014 $)
Misc costs are assumed to remain constant from 2015 - 2022	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 237,000**	**$ 59,250**	**$ 59,250**	**$ 2,014,500**

Source: FMRI's 2015 Remediation Cost Estimate

Assume that miscellaneous costs will be 1/4 of the annual total in the final two years of activities at the site when only groundwater monitoring will take place on site.

Consumer Price Index Data from 1970 to 2015

Excerpted from: http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/

The Consumer Price Index (CPI-U) data is provided by the U.S. Department of Labor Bureau of Labor Statistics.

All Urban Consumers – (CPI-U) 1970-2015

														Percent Change	
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Avg	Dec-Dec	Avg-Avg
1970	37.8	38.0	38.2	38.5	38.6	38.8	39.0	39.0	39.2	39.4	39.6	39.8	38.8	5.6	5.7
1971	39.8	39.9	40.0	40.1	40.3	40.6	40.7	40.8	40.8	40.9	40.9	41.1	40.5	3.3	4.4
1972	41.1	41.3	41.4	41.5	41.6	41.7	41.9	42.0	42.1	42.3	42.4	42.5	41.8	3.4	3.2
1973	42.6	42.9	43.3	43.6	43.9	44.2	44.3	45.1	45.2	45.6	45.9	46.2	44.4	8.7	6.2
1974	46.6	47.2	47.8	48.0	48.6	49.0	49.4	50.0	50.6	51.1	51.5	51.9	49.3	12.3	11
1975	52.1	52.5	52.7	52.9	53.2	53.6	54.2	54.3	54.6	54.9	55.3	55.5	53.8	6.9	9.1
1976	55.6	55.8	55.9	56.1	56.5	56.8	57.1	57.4	57.6	57.9	58.0	58.2	56.9	4.9	5.8
1977	58.5	59.1	59.5	60.0	60.3	60.7	61.0	61.2	61.4	61.6	61.9	62.1	60.6	6.7	6.5
1978	62.5	62.9	63.4	63.9	64.5	65.2	65.7	66.0	66.5	67.1	67.4	67.7	65.2	9	7.6
1979	68.3	69.1	69.8	70.6	71.5	72.3	73.1	73.8	74.6	75.2	75.9	76.7	72.6	13.3	11.3
1980	77.8	78.9	80.1	81.0	81.8	82.7	82.7	83.3	84.0	84.8	85.5	86.3	82.4	12.5	13.5
1981	87.0	87.9	88.5	89.1	89.8	90.6	91.6	92.3	93.2	93.4	93.7	94.0	90.9	8.9	10.3
1982	94.3	94.6	94.5	94.9	95.8	97.0	97.5	97.7	97.9	98.2	98.0	97.6	96.5	3.8	6.2
1983	97.8	97.9	97.9	98.6	99.2	99.5	99.9	100.2	100.7	101.0	101.2	101.3	99.6	3.8	3.2
1984	101.9	102.4	102.6	103.1	103.4	103.7	104.1	104.5	105.0	105.3	105.3	105.3	103.9	3.9	4.3
1985	105.5	106.0	106.4	106.9	107.3	107.6	107.8	108.0	108.3	108.7	109.0	109.3	107.6	3.8	3.6
1986	109.6	109.3	108.8	108.6	108.9	109.5	109.5	109.7	110.2	110.3	110.4	110.5	109.6	1.1	1.9
1987	111.2	111.6	112.1	112.7	113.1	113.5	113.8	114.4	115.0	115.3	115.4	115.4	113.6	4.4	3.6
1988	115.7	116.0	116.5	117.1	117.5	118.0	118.5	119.0	119.8	120.2	120.3	120.5	118.3	4.4	4.1
1989	121.1	121.6	122.3	123.1	123.8	124.1	124.4	124.6	125.0	125.6	125.9	126.1	124.0	4.6	4.8
1990	127.4	128.0	128.7	128.9	129.2	129.9	130.4	131.6	132.7	133.5	133.8	133.8	130.7	6.1	5.4
1991	134.6	134.8	135.0	135.2	135.6	136.0	136.2	136.6	137.2	137.4	137.8	137.9	136.2	3.1	4.2
1992	138.1	138.6	139.3	139.5	139.7	140.2	140.5	140.9	141.3	141.8	142.0	141.9	140.3	2.9	3
1993	142.6	143.1	143.6	144.0	144.2	144.4	144.4	144.8	145.1	145.7	145.8	145.8	144.5	2.7	3
1994	146.2	146.7	147.2	147.4	147.5	148.0	148.4	149.0	149.4	149.5	149.7	149.7	148.2	2.7	2.6
1995	150.3	150.9	151.4	151.9	152.2	152.5	152.5	152.9	153.2	153.7	153.6	153.5	152.4	2.5	2.8
1996	154.4	154.9	155.7	156.3	156.6	156.7	157.0	157.3	157.8	158.3	158.6	158.6	156.9	3.3	3
1997	159.1	159.6	160.0	160.2	160.1	160.3	160.5	160.8	161.2	161.6	161.5	161.3	160.5	1.7	2.3
1998	161.6	161.9	162.2	162.5	162.8	163.0	163.2	163.4	163.6	164.0	164.0	163.9	163.0	1.6	1.6

														Percent Change	
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Avg	Dec-Dec	Avg-Avg
1999	164.3	164.5	165.0	166.2	166.2	166.2	166.7	167.1	167.9	168.2	168.3	168.3	166.6	2.7	2.2
2000	168.8	169.8	171.2	171.3	171.5	172.4	172.8	172.8	173.7	174.0	174.1	174.0	172.2	3.4	3.4
2001	175.1	175.8	176.2	176.9	177.7	178.0	177.5	177.5	178.3	177.7	177.4	176.7	177.1	1.6	2.8
2002	177.1	177.8	178.8	179.8	179.8	179.9	180.1	180.7	181.0	181.3	181.3	180.9	179.9	2.4	1.6
2003	181.7	183.1	184.2	183.8	183.5	183.7	183.9	184.6	185.2	185.0	184.5	184.3	184.0	1.9	2.3
2004	185.2	186.2	187.4	188.0	189.1	189.7	189.4	189.5	189.9	190.9	191.0	190.3	188.9	3.3	2.7
2005	190.7	191.8	193.3	194.6	194.4	194.5	195.4	196.4	198.8	199.2	197.6	196.8	195.3	3.4	3.4
2006	198.3	198.7	199.8	201.5	202.5	202.9	203.5	203.9	202.9	201.8	201.5	201.8	201.6	2.5	3.2
2007	202.4	203.5	205.4	206.7	207.9	208.4	208.3	207.9	208.5	208.9	210.2	210.0	207.3	4.1	2.8
2008	211.1	211.7	213.5	214.8	216.6	218.8	220.0	219.1	218.8	216.6	212.4	210.2	215.3	0.1	3.8
2009	211.1	212.2	212.7	213.2	213.9	215.7	215.4	215.8	216.0	216.2	216.3	215.9	214.5	2.7	-0.4
2010	216.7	216.7	217.6	218.0	218.2	218.0	218.0	218.3	218.4	218.7	218.8	219.2	218.1	1.5	1.6
2011	220.2	221.3	223.5	224.9	226.0	225.7	225.9	226.5	226.9	226.4	226.2	225.7	224.9	3	3.2
2012	226.7	227.7	229.4	230.1	229.8	229.5	229.1	230.4	231.4	231.3	230.2	229.6	229.6	1.7	2.1
2013	230.3	232.2	232.8	232.5	232.9	233.5	233.6	233.9	234.1	233.5	233.1	233.0	233.0	1.5	1.5
2014	233.9	234.8	236.3	237.1	237.9	238.3	238.3	237.9	238.0	237.4	236.2	234.8	236.7	0.8	1.6
2015	233.7	234.7													