Reference

Quest: Should a copy of this be scanned and added to the surety file?

RRD INTERNATIONAL CORP

Geotechnical & Environmental Consulting for Mining & Mineral Processing

DRC-2014-008801

18 April 2014 (revision 1.1, 29 April)

Ms. Celene Hawkins
Associate General Council
Ute Mountain Ute Tribe
PO Box 128
Towaoc, CO 81334

Re: *White Mesa Uranium Mill, Updated Closure Cost Analysis for Reclamation Plan Rev. 3.2 Cost Estimate Rev. 4 14*

Inconsistent

Dear Celene,

This letter summarizes my recent review of the surety cost estimate (Rev 4.14) submitted to the Utah DEQ by Energy Fuels (EFRI) for the White Mesa Mill (WMM). This revised letter contains the following changes from the original letter issued on 18 April:

- Formatting;
- Correction to a math error in the labor adjustment;
- Discussion of 25% contingency; and,
- Revised the benchmark analysis to additionally consider the costs without Title I sites.

1. Review of the EFRI closure plan

The focus herein is on the capping systems and how they compare to the Monticello cap. Monticello is an important reference project because it is nearby and in a similar climate, geologic and social-~~economic~~ settings. Monticello was also closed by a government agency and thus presents the methods (and costs) that would most likely be applied to White Mesa in the event of an owner walk-away. Table 1 compares the components of the two projects' tailings cell caps.

fed funds @ Monticello, none @ WMM

Table 1: Comparison of capping systems at Monticello and White Mesa

Cap Component	Monticello Thickness	White Mesa ~~Thickness~~ Rec Plan 4
Vegetation	a few inches	none
Erosion control	0.67 ft	0.25 ft
Water storage/frost protection	4.83 ft	2.0 ft
Biotic intrusion (gravel)	1.00	none
Geotextile	~100 mil	none
Capillary break (sand)	1.17 ft	none
HDPE geomembrane liner	60 mil	none
Radon barrier (compacted clay)	2.00 ft	1.0 ft
Radom Fill (foundation)	none	3.0 ft
TOTAL	9.67 ft	6.0 ft

The White Mesa cap omits several important components used at Monticello, listed and discussed below. All of these missing components should be included in the White Mesa caps

- Vegetative cover: Vegetation is the only truly sustainable cover, but rather than provide any vegetation White Mesa has proposed a 3-inch think layer of gravel. Further and equally important, vegetation reduces the net infiltration of rainwater, and thereby the net discharge of leachate, through two important mechanisms: hold-up of water in the root zone, and evapotranspiration (evaporation and loss through the leaves of the vegetation). Without a vegetative layer the leachate loss into the environment will increase; not necessarily – attractant for prairie dog & badger populations

- Biotic intrusion layer: this is both standard practice on closure caps and needed to prevent deep burrowing animals from penetrating the cap;
- Geotextile & capillary break. for a +200 year closure design, as required by law and industry practice, a water storage layer must be isolated from the balance of the system with a capillary break. Without said break, the water stored in the upper layer will be drawn into the radon barriers through the capillary action of the soils. Clayey soils can develop capillary suctions approaching 1 atmosphere and 15-foot draws are commonly seen in the field; and,
- HDPE geomembrane: without this barrier, any seepage that penetrates the water storage layer will be available to mobilize contaminates from the waste and affect the radon barrier. The standard of care for uranium mill tailings caps is to include both a water balance cap and a low permeability caps. There is ample research showing that compacted soil barriers fail to meet design standards in the majority of cases, and they do so by a wide margin, producing field permeability several orders of magnitude higher than predicted (Benson, 2007), as shown in Figure 1.

need citation mandating these elements

get

General note: Current cover design meets or exceeds requirements. ET cover is under development. Current analysis by commenter fails to establish necessity for the items listed.

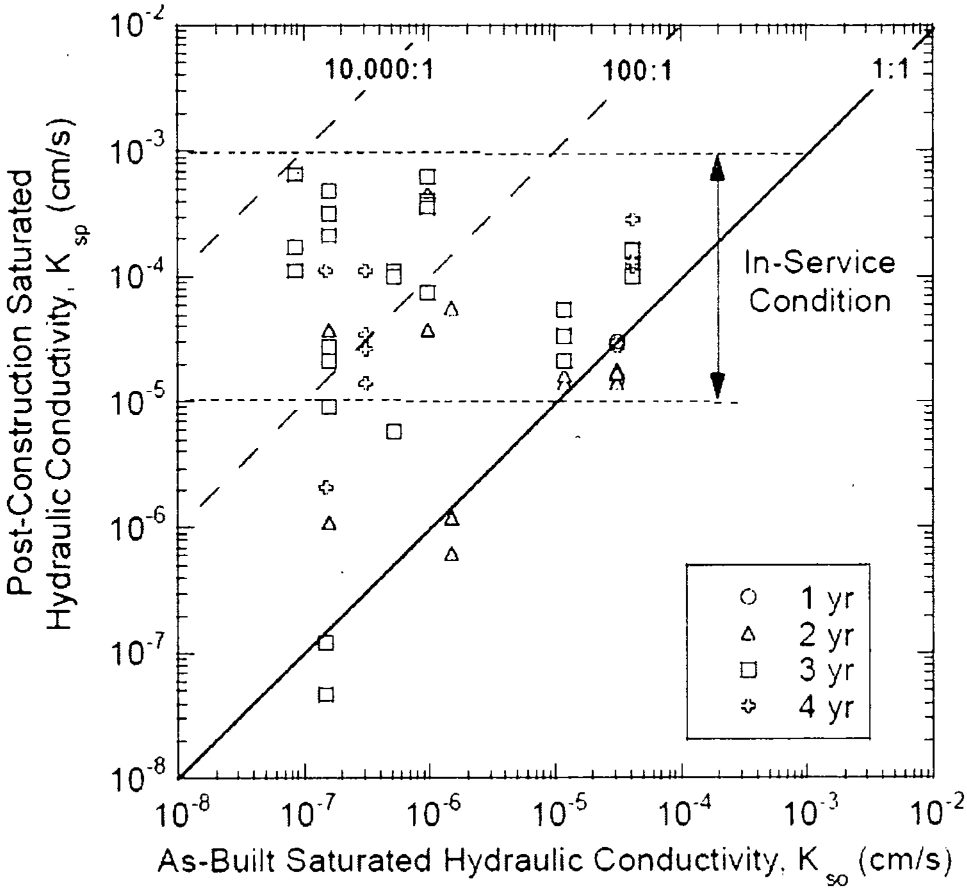

Figure 1: Long-term cap performance v. as-built permeability (Benson, 2007)

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2. Review of the White Mesa closure cost estimate

2.1 A review of cost estimating methods

Cost estimating can be divided into three broad categories, each commonly used in the industry and each having an important role. These are:

- Benchmarking: costs from other sites are adapted to the target site to give guidance on total costs. The more sites studied and the more directly applicable those sites, the more accurate a benchmarking estimate can be. With a modest level of effort a cost estimate of +/-50% accuracy can be developed, and the author has had success with developing better than +/-15% estimates from robust benchmarking efforts (IPA, 2004). The benchmarked costs for uranium mill closures referenced herein represent over two-thirds of the total world uranium production capacity;
- Contractor, EPCM or CM bids: this is a process where the detailed design is put out to bids where firm pricing is obtained for either the entire package or logical work areas These estimates are generally very accurate (+/-10%) to the extent they include all required closure actions. Bid-supported estimates are generally only applicable when a detailed design has been completed and the project is within a year or two of construction; and,
- Built-up estimates: these cost estimates are developed by "building up" the costs from line-items, following the engineered design to the extent it is complete. This is the most common method and this is what EFRI has submitted as its closure cost estimate. A built-up estimate can be done at a wide-range of accuracies, typically ranging from +/-10% for a very detailed design supported by contractor bids for the major cost items, to +/-50% for a conceptual design or a more advanced design for a distant future installation (Lazenby, 2010). These accuracies apply only to the considered closure actions; for example, if groundwater remediation is not considered in the design the accuracy would be before adding possible groundwater remediation costs

Most built-up costs will have four basic inputs:

- Direct costs (labor, equipment and materials to perform the construction including mobilization and demobilization);
- Indirect costs (project and company overhead, insurance, bonds, profit, etc) which commonly run 15% to 35% of direct costs for non public works construction, and higher for public works;
- Owner's or Agency's costs (the cost of the owner's or agency's team to administer the project, including bidding and awarding the construction contracts, hiring a project management or construction management team, performing design changes during construction, and so forth). Owner's or Agency's costs generally run 10% to 25% of the direct costs; and — currently set at 4%. We are evaluating.
- Contingency, which is reflective of the level of design and the risk of unknowns. The most common contingency used in the mining industry is 15 to 20% of the direct costs (and, as discussed below, this is almost always inadequate). Larger contingencies are appropriate when either the design is conceptual (as in the case of most, including the Whit Mesa, closure plans) or the site is subject to significant uncertainties (such as the extent of contamination in need of remediation). Contingencies are sometimes applied at different rates by either line item or work area subtotal. For example, the contingency for dismantling the mill could be lower than the contingency for remediating groundwater contamination. We are at 25%.

ASTM: If you can name it, set a budget allowance. Contingency is for the unforeseen and the unforeseeable.

Most cost estimates do not recognize inflation or cost escalation and as such should be cited in terms of the year the estimate was based (e.g., 2014 dollars). The estimate must then be escalated to the time period in which the work will be completed, using forward-looking inflation factors appropriate for the region. Common escalation factors are 3.0 to 5.0% per year (Zuzulokc, 2004). The failure to recognize inflation in cost estimates looking out 10 to 15 years in the future creates a strong built-in bias to underestimate costs; all other factors being correct, the actual cost will be 151% to 198% of the estimate. This is commonly included in the bonded amount because the cost will escalate regardless of

We update annually but need to escalate to cover pre-bid period and to cover escalation during decommissioning.

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the operator's ability to obtain larger bonds in the future. That is, the liability for the escalated future cost of closure is created in the year the impacts are created and the bond should reflect that.

Even detailed built-up cost estimates, supported by detailed engineering and claimed to contain high levels of accuracy, are generally too low. A study issued by the well-respected engineering and project management firm Pincock, Allan and Holt in 2000 made the following disturbing observations (PAH, 2000).

- "*It is rare, not the norm, for the actual project capital cost to be within 10 percent of the feasibility study capital estimate* [including contingency];"
- "*Within the 21 projects, only three [14%] came in under the feasibility study cost estimate;*"
- "*Site earthworks are often underestimated*" [closure costs are principally earthworks];
- After escalating the estimates for the time between the estimate and actual construction at 3.5% annually, 52% of projects considered came in at 118% of the estimated cost (and those estimates included contingencies), 14% came in at 137%. The projects in North America averaged 124% of estimate. The cost overruns would be much larger if original cost estimates were not escalated;
- Smaller projects (i.e., under about $200 million) performed by smaller mining companies are most likely to have higher cost over-runs [i.e., higher than 124%]; and,
- Other important areas that are either omitted or underestimated include owner's (or agency's) costs, working capital, freight, environmental, duties and taxes.

In another study of cost overruns, those researchers analyzed 63 mining projects and found that the mean actual cost was 125% of the estimate (including contingency) and that the maximum cost was 214% of the estimate (including contingency). Nearly 70% (44) of the 63 projects underestimated the cost (Bertisen, 2007).

Several other studies, summarized in a mining industry blog (Caldwell, 2007), reached two important conclusions:

- The average actual closure cost in Australian mining (not uranium specific) is 6.8 times the average estimate; and
- Total US mining closure liability is up to $12 billion more than the bonded total.

It's one thing for a mining company to underestimate its liabilities if it has the resources to cover the higher costs; such liability is the cost of doing business. However, transferring this risk to the public is generally considered bad public policy and clearly not the intent of state and federal closure regulations Thus, when a mining estimate is prepared for public purposes a much more robust estimating method is needed to avoid transferring liabilities to the public sector. Such robustness should include:

- Higher unit rates to recognize the inherently more expensive delivery method;
- Full recognition of indirect and agency costs; and
- Significantly larger contingencies than traditionally used in mining.

2.2 Cost benchmarking

In 2010 the author completed a broad mining cost benchmarking study focusing on liner and capping systems. The liner costs were determined for 37 phases of recent projects either constructed or in advanced stages of design with detailed engineers' cost estimates. The closure cost was developed as a "typical" for tailings and mine waste in semi-arid sites, using data from a dozen sites and several parallel studies. These systems were nominally 1.0 m thick, from base of bottom-most component to top of the drainage gravel and protective layer (for the liner systems) or top of the vegetative layer (for the caps). Factoring these costs for the requirements of UMT caps and escalating the costs to 2014, produces $410,000/ac or $102/m2 (Smith 2010, Smith & Athanassopoulos 2013).

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Two authoritative sources for mine closure costs (non UMT) are AFCEE (mid 1990s) and Dwyer (1998). In a broad survey of industry practices they found the following range of capping costs for tailings and waste dumps (but not considering the more robust requirements of uranium mill tailings).

- AFCEE: \$36 to \$97/m2 or \$145,828 to \$392,926/ac (ET and capillary barriers, plus synthetic liners at the upper end, mid-1990s dollars);
- Dwyer: \$72 to \$96/m2 or \$291,657 to \$388,876/ac (ET and capillary barriers only, 1998 dollars); and,
- Averaging those two sources and escalating the costs to 2014 produces \$472,000/ac or \$118/m2. This compares well to the Smith and Smith & Athanassopoulos studies (\$102/m2).

A German study of the 14 major uranium-producing countries and the associated closure costs was completed over a decade ago. That study considered mines producing a total of 63% of the world's uranium and as such should be considered statistically relevant. Part of the findings of that study include: "*The accumulated and estimated costs for the decommissioning and rehabilitation of the uranium-producing plants referred to in this study amount to about US \$3.7 billion* [cost basis: 1993] *The resulting specific rehabilitation costs are US \$1 25 per lb of U3O8 and US \$2 20 per tonne of tailings. Omitting plants which produce/produced uranium as by-product of gold and copper production, the specific cost per tonne of milling doubles to nearly US \$4 00*" (Germany, 2002). Escalating that to 2014 dollars, the average closure cost is \$7.44 per metric tonne of tailings. For an average depth of tailings producing 10 to 15 tonnes per square meter (typical values for the industry), that equates to \$75 to \$112/m2 or a mid-range value of \$93/m2. This compares well with the studies by Smith, Dwyer and AFCEE (\$102 to \$118/m2).

Table 2: Uranium Mill Closures in the USA (U.S. DOE, 1995 & Robinson, 2004)

Facility (Title I & II Sites)	Permitted Site Area (ac)	2014 Dollars	
		Total Cost, \$	\$/acre
Sites with Costs >\$100M			
Grand Junction, Co	56	1,072,000,000	19,000,000
Moab, Ut	439	810,000,000	1,800,000
Monticello, Ut	380	585,000,000	1,600,000
Old & New Rifle, Co	55	251,000,000	4,500,000
Salt Lake, Ut	128	199,000,000	1,600,000
Naturita, Co	63	182,000,000	2,900,000
Durango, Co	120	146,000,000	1,200,000
Maybell, Co	316	137,000,000	440,000
Gunnison, Co	90	125,000,000	1,300,000
Falls City, Tx	593	122,000,000	200,000
Mexican Hat, Ut	235	118,000,000	500,000
Ave of Sites >\$100M	225	341,600,000	1,510,000
Average of All 43 Sites	180	120,300,000	670,000
Average Title II Sites Only	174	31,200,000	179,000

During the heyday of US uranium mining, there were over 50 operating conventional mills. All but one of those is now closed, with varying degrees of attention to closure. The US DOE has published reports (DOE, 1995 & Robinson, 2004) on 43 of those sites, including both Title I and II sites (10 C.F.R. Part 40), detailing the closure costs, surety levels and other issues. Most of the closure liability comes from securing the tailings storage facilities and addressing control of radon emissions and contamination to groundwater, surface water, and land (principally dust). In some cases, tailings have been completely relocated, such as at Monticello, Utah. at a cost! In others, the tailings were secured on site. About a third of these 43 sites are still the subject of on-going active controls and, to some extent, dispute about whether the sites are secured (Smith 2010, Smith & Athanassopoulos 2013). Table 2 summarizes the costs at

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those 43 US sites Key lessons from these studies are average closure costs per permitted acre of $179,000 for Title II sites and $670,000 for all US UMT sites (in 2014 dollars).

To summarize, the references reviewed considered a total of at least 110 sites and about 80% of global uranium production. These are summarized in Tables 3a and 3b. One conclusion that must be drawn is that a closure cost estimate significantly lower than $356,000 per acre of tailings must be viewed with suspicion. EFRI's latest estimate is $93,098 per acre of tailings, which is less than 15% of the average of all US UMT closures and 6% of the cost for Monticello (Table 2).

Portions already in process of decommissioning so money has been spent - these funds do not appear in the surety.

Table 3a: Benchmarking data on closure costs (including Title I & II sites, 2014 dollars)

Source	Number of Sites Considered	Closure & Remediation Costs, $/ac	Comments
US DOE 1995, Title I & II Sites	43 sites	$670,000	Per "permitted acre", 80% of all US UMT sites
Germany, 2002	14 countries	$380,000	**Sites total 63% of world uranium production**, all UMT sites
AFCEE & Dwyer mid 1990s & 1998	>10 sites	$472,000	Non UMT sites
Smith 2010, 2013, factored	40 sites	$410,000	Non UMT sites, factored to 3.0m thick capping system
Average All Studies	>110 sites	$511,000	**Representing 80% of global uranium production**

Table 3b: Benchmarked data on closure costs (excluding Title I sites, 2014 dollars)

Source	Number of Sites Considered	Closure & Remediation Costs, $/ac	Comments
US DOE 1995, Title II Sites Only	21 sites	$179,000	Per "permitted acre", excluding Title I sites
Germany, 2002	14 countries	$380,000	**Sites total 63% of world uranium production**, all UMT sites
AFCEE & Dwyer mid 1990s & 1998	>10 sites	$472,000	Non UMT sites
Smith 2010, 2013, factored	40 sites	$410,000	Non UMT sites, factored to 3.0m thick capping system
Average All Studies	>88 sites	$356,000	

2.3 Built-up estimates for closure bonding

The regulatory purpose of a closure cost estimate is to ensure that sufficient funds exist to properly close and secure the site in the event that the owner defaults. In an industry-supported initiative to standardize closure guarantees, a model agreement has been prepared and includes this language: "(a) *The mine closure guarantee shall be in an amount calculated to be necessary to implement the Closure Plan should the Company fail to implement the Closure Plan ...*"(MMDA, 2011). Given this, the method of preparing the cost estimate must assume that ~~the project will be~~ under government management, for which government-contracting rules ~~apply~~. This means that:

but not Davis-Bacon unless federal funds are attached.

- The cost efficiencies available to the mining company cannot be recognized;
- An engineering, procurement and construction management (EPCM) firm with governmental experience and a high bonding capacity will be used;

Maybe

- Prevailing wage (Davis-Bacon Act) rules will not apply;
- All work will be contracted to public-works qualified construction companies with applicable overhead and other indirect cost factors;

Not necessarily, this is not piping and paving.

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 contingency

- The cost estimate must have reasonable consideration for unforeseeable circumstances, including unexpected contamination; — working through this issue
- Agency required insurance, bonding, health and safety, independent inspection, and other rules will apply; and,
- Agency oversight costs must be recognized and reasonable. need to be more robust,

2.4 White Mesa mill reclamation cost estimate, Rev. 4.14

The White Mesa estimate fails to meet the criteria set forth in the preceding section, prevailing industry standards, and legal requirements on a variety of grounds, as summarized below. we are refining scheduling issues

not true

Equivalent earthworks unit cost: The Rev. 4.14 estimate as provided by DEQ includes no back up information; no earthworks quantities, no equipment cycle times, etc. This makes it impossible to review or verify the accuracy of the ERFI estimate. Using the Rev. 5 estimate, which had supporting detail, the direct cost for earthmoving was equivalent to \$3.39 per cubic yard moved. Prorating that for the increased total cost of the latest White Mesa estimate (Rev. 4.14), the cost would be \$4.03/cu.yd. Anyone familiar with public works construction will recognize this as unrealistically low. This is also below the average costs for private works construction on mine sites. The author is the peer reviewer for a major tailings dam in Peru and the lowest unit rate (direct costs only) on that job, in low-cost Peru, was US \$5.00 per cubic yard, in 2011 dollars and for mass grading of a multi-million cubic yard fill and thus getting considerable cost advantage due to economies of scale. In 2014 dollars this project would cost \$5.46/cu.yd, or 35% more than the White Mesa estimate. White Mesa is small, complex, and with significant regulatory oversight, all of which increase unit costs. A more likely real cost would be at least \$10.00/cu.yd.

Labor hourly rates: White Mesa apparently obtained 3 quotes for labor (those were not provided and thus not reviewed). However, according to federal law, the minimum wage and fringe benefits packages are set based on "prevailing wage" determinations. These come in the form of regional and project-specific "Wage Decisions." There are two Wage Decisions for the San Juan County, issued in 2011 and 2014 for specific labor categories. The labor rates used by White Mesa are much lower than these Wage Determinations. Further, White Mesa failed to include the employer's share of the taxes and insurance, as required by law. These rates depend in part on the total compensation of the employee during the calendar year, and a commonly used typical value is 10% of the base wage rate for FICA and unemployment insurance, and 8% for workers compensation insurance. A sampling of rates used in the White Mesa closure cost estimate (Rev. 4.14), along with the applicable regulatory rates, are presented in Table 4. The White Mesa rates average 44.5% of the all-in Wage Determinations. However, direct labor cost is what a contractor uses to estimate his expenses, but the bid price includes direct costs, utilization rate (that percentage of an employee's time that is actually productive), administration and overhead. I spoke with two contractors as part of this review and both advised me that they use 2 times the base wage rate to estimate the "all in" labor costs, include fringe, taxes and overhead That adds another \$9.36/hr to the labor costs, decreasing the White Mesa labor rate to just 36.5% of what a contractor would quote. Using Cell 3 as a proxy for the balance of the project, labor is 19.1% of the total costs.

this is one of the three used by EFRI.

check

check

check

There is another important error in the labor estimate, the lack of a number of categories of workers that will be required to execute the project. Supervisor, foremen, engineer, laborers (provided in some but not all areas of work), assistants and similar personnel are missing from the estimate but required to compete the work. At a minimum, there would be one supervisor (other than the "Manager" included in the estimate) and two foreman, at a total loaded cost of about \$26,500 per month. Again using the Cell 3 details as a proxy for the entire cost estimate, this additional labor adds the following: 6.15 months of construction x \$26,500 = \$162,975, or 7.9% to the total cost of Cell 3. That percentage is consistent with what the author has seen on other projects of similar complexity, which tend to range from 5 to 15%.

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Table 4: Labor rates from Rev 4.14 and corrected for prevailing wage & taxes

Labor Category	White Mesa Rate (total, $/hr)	Prevailing Wage Rate direct + fringe				
		Base Wage ($/hr)	Fringe Benefits ($/hr)	FICA, Unemployment, Workers' Comp ($/hr)	Total ($/hr)	Escalated since last labor ruling (note 3)
Laborer (notes 1, 4)	$12.51	$17.61	$4.94	$3.17	$25.72	$26.65
Mechanic (note 1)	$20.13	$35.10	$12.49	$6.32	$53.91	$55.85
Equipment operator (note 2)	$21.51 to $27.26	$25.37	$15.65	$4.57	$45.59	$45.59

Notes:
1. Prevailing wage according to General Decision Number: UT100073 09/30/2011 UT73 for San Juan County, Utah, adopted 9/30/2011.
2. Prevailing wage according to UT140043 adopted 01/03/2014 for San Juan County.
3. Laborer & Mechanic rates have not been reviewed since the 9/30/2011 ruling; a new ruling would be issued before any public works takes place, and it is likely the rates would increase by the same amount as Equipment Operator, or 3.6%.
4. There are no Laborers in the Rev. 4.14 cost estimate, but this is unrealistic. Thus, the rate for this category has been taken from the Rev. 5.0 estimate.

Equipment hourly rates: No details for the Rev. 4.14 were provided, and thus this section discusses the Rev 5 cost estimate. A local leasing company provided equipment rates. The rates include a nominal 50% discount for hours after 40 per week, and the assumption has been that a 50-hour workweek is average, producing an average rate less than the straight rental rate. However, the corresponding labor rates do not reflect any overtime multiplier as required by prevailing wage rules. This means that either (i) the equipment rates are too low or (ii) the labor rates need to be adjusted for overtime. Public works projects tend to limit overtime because of the high hourly rate penalty and thus the safe assumption is no overtime. This increases equipment rates by 11%. The price used in the equipment cost calculations is $2.332 per gallon, representing the 12-month "off-road use" cost for 2010. The commercial price in Sept. 2011 for off-road use was $2.97/gallon. Thus, the rate used is about $0.65/gal lower than the current market price, or 27.9%. Based on the built-up equipment unit rates, fuel is 10.6% of the total hourly rate and thus the hourly rates should be increased by 27.9% x 10.6% = 3.0%. Combining the equipment overtime and fuel adjustments, the equipment hourly rates should be increased by 11% + 3% = 14%. Using the Cell 3 cost details as representative of the entire project as an approximation, equipment costs are 78.8% of the total closure costs, and thus they should be increased by 11.0%. The Rev. 4 14 equipment costs also exclude any provisions for maintenance parts. The estimate uses rental rates and those generally include normal wear and tear, but exclude routine maintenance while on the job (oil, lube, filters, etc) or damage beyond normal wear and tear (tires, wear steel, glass). Taking typical allowances for light construction equipment, trucks would cost $3.22/hr for oil, lube, tires and misc wear parts while track equipment would be $5.67 (www.fao.org/docrep/t0579e/t0579e05.htm). Taking the average and applying it to the equipment rate used by White Mesa, the hourly equipment cost increases by 3.7%. Thus, the combined uplifted needed for the equipment rates is 11.0% + 3.7% = 14.7%.

Bids received

Quantities (labor and equipment hours): No details on quantities were provided for Rev. 4.14, and thus this section referees to Rev. 5. The benchmarked costs are vastly higher than the costs produced from Energy Fuel's quantity estimates, suggesting the quantities are unrealistically low. The quantity estimates were prepared by EFRI, by neither an independent party nor a registered engineer. The basis for the quantity estimates is provided in the hand-written notes following the cost tables, these suggest a traditional mining view on economies of scale, which are not available to a public works project. Without having a full peer review of the quantity estimates it is not possible to estimate an adjustment.

refining schedule

Specialized Professional Services: The cost estimate includes three highly specialized labor categories: Survey crew, environmental sample crew, and quality control contractor. The hourly rates used for these are: $14.46, $14.46 and $62.00 per hour. These are all far below industry norms.

check

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Survey crews include the licensed surveyor and his or her support team ("chainman," "rod man," and so forth). The most common way to price surveying is an all-in hourly rate; this includes the 2-person crew plus equipment and software. I have requested informal quotes from two Utah-based survey firms for providing construction survey control, and their rates average $125 for a 2-person crew with equipment and truck (excluding travel to and from the site, for which they charge labor and truck mileage). This rate is also identical to that cited by the USFS Northern Region for a two-person field crew (USFS, 2011). This is 865% of the rate used in the cost estimate by EFRI. This adds about $32,895 to the total costs.

Environmental sample crew. This is most likely 1 person with the required equipment (sampling, health and safety). I obtained an estimate from a Colorado-based firm that specializes in both environmental and construction quality control testing. Their environmental techs charge $95.00 per hour, plus $5.00 for equipment and $320/week for a truck (or $8.00 per hour on a 40-hr week). That truck can be shared between this position and the quality control position and thus is included herein with the QC technician only. Thus, the "all in" rate for the environmental sampling technician is $100.00/hr, or 692% of the rate used by EFRI. EFRI estimated 6,083 hours for this labor category, which seems high. I reduced this by 50% and adjusted the rate to the prevailing commercial rate. Thus, the total cost should be adjusted from $87,960 to $304,150, adding $216,190 to the total costs.

Quality control. The same firm gave me a price for a QC technician, including field testing equipment. That rate is $85.00 per hour for a "Technician II," their mid-priced technician. In addition, they charge $5.00 per hour for the field equipment and $320/week (or $8.00/hr for a 40-hour week) for a vehicle. Thus, the total for the technician and the field package is $98.00/hr, or 158% of the rate used by EFRI. Further, any geotechnical firm is going to require oversight of the field technical by a registered engineer, and the rates for that position range from $150.00 to $210.00 per hours. No time for this position has been included in the estimate. There is also nothing in the budget for geotechnical laboratory testing to support the quality control program, but testing would be required (Proctor compaction curves, soil classification tests, permeability for the clay, etc).

Table 5: Summary of Rates for Survey, Environmental and Quality Control

Item Description	Rate Used by EFRI, $/hr	Industry Rate, $/hr (including equipment)	Difference, %
Survey Crew	$14.46	$125.00	764%
Environmental Sampler	$14.46	$100.00	592%
Quality Control	$62.00	$98.00	58%
Professional Engineer (oversight & review)	Not included	$150 to $210	na

Management & Support. At the end of the cost estimate EFRI has included a category for "Management/Support." The rates range from $8.96/hr for security to $64.81/hr for health physics. No salary loading or employer's share of taxes have been included and thus these rates are understated A similar approach as used for the prevailing wage analysis would be appropriate here, and would produce a similar adjustment, increasing the total labor costs by $996,931, or 4.7% of the total cost. check

Revisiting

Cell dewatering costs: A unit rate of $0.48/hour ($11.52/day) has been used with no basis. Given the electrical power rates in Utah, this equates to the electrical cost for one 4 hp motor, which might be a reasonable total power demand but excludes labor, supervision, reporting, purchase or rental of the pumps and motors, and costs for installation and maintenance. The same quantity of hours is used for each cell, though they vary in size, retained water and efficiency of the dewatering system Dewatering has two stages for cost-estimating purposes: that performed during the active operating life of the mine and that performed afterwards. An approach based on a nominal cost per hour or cost per gallon may be logical during the operating life, since there is a core staff already on site along with the equipment, infrastructure and administration systems. However, once operations have ceased there will be no support and the dewatering program will be operated by a contractor and a significantly higher unit cost. If operator time required just 1 hour a day that would increase the total closure cost by 5.67%.

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Supporting quotes: The Rev. 5 estimate included supporting price information for some of the relatively minor costs (e.g., road haulage of rip rap from the borrow source 7 miles from the site, rental rates for a gravel screen, and so forth). None of these "quotes" (some are as informal as telephone notes) suggest that the vendor understands ~~that he or she is quoting a public works project with~~ the applicable contracting, insurance and prevailing wage criteria. ? I think this might be overstating the case.

Remediation costs: There is no provision for any currently unknown contamination. It is unlikely that the extent of surface or groundwater contamination is currently fully known and providing no such provision is irresponsible. true

Indirect costs:

- Contingency: 20% is allowed and is too low for the level of design and the lack of supporting fixed price bids. Considering the findings of the prior section on industry experience with cost estimates versus actual costs, a contingency of 25% to 30% is recommended and the DRC has advised that they will require 25% for future cost estimates. For the purposes of this analysis, the contingency has been left at 20% of the direct cots and updated as the direct costs have been adjusted; Currently 25%
- License & bonding: 2.0% is reasonable for a private-works project but is much lower than seen on public works projects; ?
- UDEQ contract administration: 4.0% is allowed. This item is equivalent to "owner's costs" for conventional cost estimating, which run from 10% to 25%, with 12% to 15% being typical; Revisiting
- Detailed engineering, procurement and construction management (EPCM) has been omitted and typically runs about 12%; and, no! Currently 2.25%
- Estimate provides 2.25% for "Engineering design review." This suggests that the design will be prepared by EFRI then reviewed and stamped by an external PE. Not only is this inappropriate for a project which has been taken over by the State, it is in violation of the Professional Engineers and Professional Land Surveyors Licensing Act.

Long-term care fund: At current deposit interest rates a fund of $847,862 provides an annual cash flow of about $12,000. This provides for no on-site care and is unlikely to provide for the mandatory report filings. A more reasonable provision is $100,000 per year, at least for the decades immediately following closure, increasing the long-term care fund requirements to $7,485,471. Will revisit when front-end is shored up.

Cost escalation: The EFRI costs have been estimated using a range of base dollars from 2007 to 2013. None have been escalated to the date of closure. — check

3. More probable closure cost

A reasonable range of closure costs can be estimated by approaching the costs from two directions: adjusting the EFRI cost estimate for the line-item corrections discussed in the prior section, and applying the benchmarked costs to the White Mesa closure areas. Tables 6 and 7 summarize the results of those two approaches. The benchmarked costs range from $76.5M to $144.0M, with an average of $110.1M. This compares well with the benchmarking case including all documented closures (Table 3a) of $109.9M and with the adjusted WMM cost of $96.8M.

A key purpose of benchmarking costs is to check the validity of a built-up cost estimate. The benchmarked average estimate is within 9% of the average for all 43 of the documented US uranium mill closures and thus checks well with industry experience. The author has used benchmarking to verify built-up costs on over 100 sites; this has produced variances generally within 15% to 25% of actual or the detailed estimate. In the current case, the benchmarked cost is 5.2 times higher than the unadjusted EFRI estimate, but within 13% of the EFRI estimate after adjustments for errors and omissions. This strongly suggests that the correct estimate is between $96 million and $110 million, with reasonable allowance for remediation and cost escalation.

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Table 6: Adjusted closure cost estimated (using EFRI estimate as basis)

Total direct costs (from EFRI): (Rev. 4.14)	**$21,126,000**
Adjustments:	
Labor rates	$8,682,000
Equipment unit	$3,106,000
Survey Crew, Environmental Sampling, Quality Control	$1,009,000
Management & Support	$997,000
Cell dewatering, adjusted for 1 hour per day oversight	1,204,000
Adjusted direct costs:	**$36,125,000**
Indirect Costs:	
Contingency, 20% of adjusted direct costs (to be increased so 25% in 2014)	$5,332,000
UDEQ contract administration, 15% vs 4% in estimate	$3,974,000
EPCM, 12% (no provision in estimate)	$4,335,000
Long-term care fund (based on annual cost of $100,000 and 1.2% deposit rate)	$7,485,000
TOTAL before remediation costs	**$57,251,000**
Probably remediation costs:	
Upgrade cap to Monticello system	$19,900,000
Escalation to end of closure (5 years x 3.0%/yr)	$3,165,000
Off-site soil remediation (50 acres x 6" deep)	$480,000
Groundwater remediation (perpetual treatment at $20,000/mo)	$16,000,000
TOTAL including remediation costs	**$96,796,000**
Notes: 1. Quantities unverified.	

Table 7a: Closure cost from benchmarking data with escalation (using Table 3a costs)

Cell	Area (acres)	Capping Costs (2014)	Comments
Cell 1	55 (exclude)	-0-	To be removed
Cell 2	65	$33,215,000	
Cell 3	70	$35,770,000	
Cell 4A	40	$20,440,000	
Cell 4B	40	$20,440,000	
Demolition debris	12 (exclude)	-0-	Costs included in per-acre tailings costs
TOTAL	215	$109,865,000	91% of the average cost for 43 UMT sites
Note: Capping rate of $511,000 per acre used from benchmarking data.			

Table 7b: Sensitivity analysis based on benchmarking cases

Source	White Mesa Area (ac)	Cost per Acre ($/ac)	Total as Applied to WMM ($)
Title I & II Sites	215	670,000	144,050,000
Benchmarked Costs, Table 3a (includes Title I & II)		511,000	109,865,000
Benchmarked Costs, Table 3b (excludes Title I)		356,000	76,540,000

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Respectfully submitted,
RRD INTERNATIONAL

REGISTERED PROFESSIONAL ENGINEER
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State of Utah

Mark E. Smith, PE
Civil, Geotechnical & Structural Engineer

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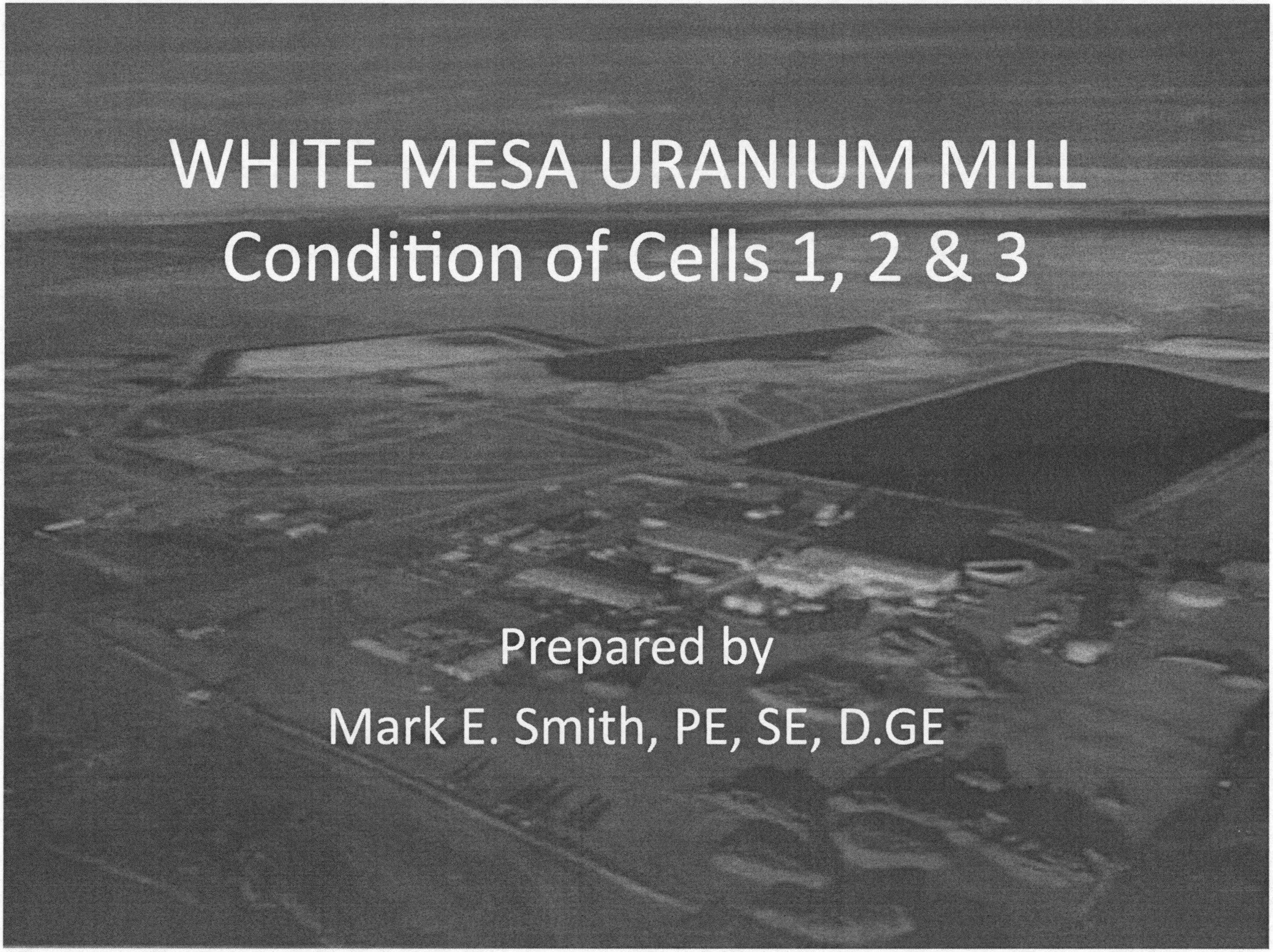

WHITE MESA URANIUM MILL
Condition of Cells 1, 2 & 3
Prepared by
Mark E. Smith, PE, SE, D.GE

Likely State of Tailings Cells 1, 2 & 3

- Industry standards
- Compatibility with tailings chemistry
- Compatibility with alternative feed chemistry
- Design life
- Likely leakage rates

Industry Standards

- Liner did not meet industry standards in 1979:
  - Less dangerous mine wastes were using more robust liner systems (36 mil CSPE, 40 to 60 mil HDPE)
  - US EPA began drafting municipal solid waste standards in 1979, required 60 mil liner + clay (for lower risk waste)
  - There are no other contemporaneous examples of PVC-lined impoundments for acidic tailings
  - No manufacturer in 1979 offered a warrantee for over 20 years, or for any period exposed to low pH / organic solvents
- State of practice in 1979 was inadequate to protect the environment:
  - Every pre-1985 geomembrane-lined tailings facility in North American has been replaced or decommissioned. Except White Mesa.

PVC: not Compatible with Acids

- Both the base resin and the plasticizing agents are subject to attack in low pH environments.
- "Long-term compatibility of [PVC] liner material with the acidic tailings is unknown" (White Mesa consultants MWH, 2007)
- PVC seams and thin sheets are much more vulnerable than most other geomembranes

Immersion Time in H2SO4	Loss of Elongation of Base Sheet	Loss of Elongation of Seams
30 days	58%	90%
60 days	71%	94%

PVC Compatibility Ratings

Chemical	Harmsco	Spilltech	Cole-Palmer
Benzene	NC	B (for <1%)	C
Carbon Tetrachloride	C	C	D
Chloroform	NC	X	D
Methylene Chloride	NC	not rated	D
Naphthalene	NC	X	D
Ranking Keys:	C=compatible NC=not compatible	B=Minor to moderate effect C=severe effect X=no test date, likely severe effect	C=fair D=severe effect

Notes: For PVC basin resin without plasticizers or other additives. Plasticizers are usually more aggressively degraded than the resin.

PVC: not Compatible with Alt Feed

- Alt Feed contains organic solvents: benzene, carbon tetrachloride, chloroform, methylene chloride, naphthalene
- Every manufacturer and rating agency says that PVC is not compatible with those solvents. Both the PVC resin and plasticizers are aggressively attacked.
- Vinyl chlorides are then mobilized into the environment, creating another constituent of concern.
- Changing chemistry is a key cause of failure of containment systems.
- Regardless of which cell the Alt Feed material is discharged to, the entire process circuit and thus all cells will be contaminated.
- Cells 4a & 4b used thick HDPE for these reasons.

Design Life is Integral to Design

"Of critical importance to the long-term performance of a liner system is the service life of the GM component of the system…… Perhaps the most important factor governing the service life of the GMs is the polymer type….." (**EPA/600/R-02/099** *"Assessment and Recommendations for Improving the Performance of Waste Containment Systems,"* Bonaparte, Danidi & Koerner, Dec 2002)

Service Life as Design Criteria

- Design life = 15 yrs in 1979, but only 5 yr per cell
- The engineer selects components, load and chemical ratings with the expected service life to achieve the intended Factor of Safety or Risk of Failure, based on both rational analysis, industry experience & US EPA guidelines.
- That this is critical is manifest in the closure rules which specify a service life of the capping system of 200 to 1,000 years.
- Exceeding the design life decreases the factor of safety and increases the risk of failure.

PVC Service Life is Under 34 yrs

- There are neither data nor case histories supporting a service life of 34+ yrs for PVC in low pH
- For a given plastic, thinner material has shorter life
- Koerner (2011) estimated service life of PVC at 18 to 32 yrs for <u>non-aggressive chemical</u> environments
- Stark (2005) measured plasticizer loss at 10 sites over 22 yrs and found that all reached 50% loss in <20 yrs
- Alt Feed further shortens service life by introducing organic solvents, not considered by original design and broadly banned from PVC-lined containments. Solvents will mobilize vinyl chlorides, another regulated contaminate

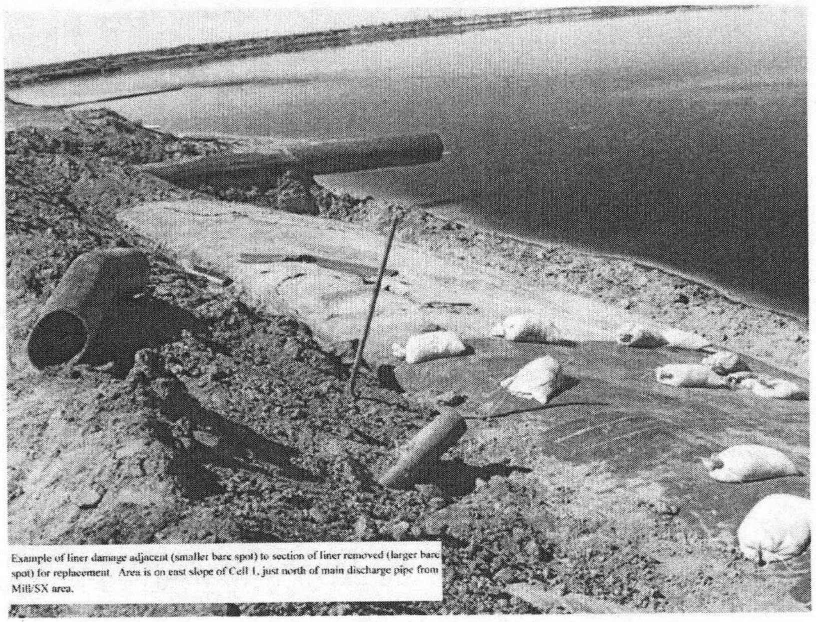
PVC Service Life is Under 34 yrs

- Absence of elevated contaminates is not evidence of no leakage, but of a dysfunctional monitoring system (EPA *Liner and Leak Detection Rule*, 1987). HGC (2007) estimated time for first intercept at 290 yrs
- The monitoring system should have been modernized when (i) extended service life, (ii) allowing Alt Feed, (iii) converted Cell 1 to surface impoundment
- EPA (2002) surveyed 26 modern double-lined Subtitle D-compliant landfills:
  - Thick liners, leachate collection, installed within last 20 yrs
  - Top Liner Leakage = 45 to 29,000 gal/ac/day
  - Average Leakage = 3,250 gal/ac/day
  - Applying that rate to Cells 1, 2, 3 = **225 million gals/yr**

PVC Service vs Leakage

- If liners are leaking excessively, system has exceeded service life
- Lack of leakage is not evidence of good performance:
  - Centuries for leakage to intercept monitoring wells (HGC 2007)
  - Require sufficient remaining service life for planned operations (~10 yrs) and completing closure (>5 yrs)
- Any extension to service life should be supported by rational analysis including:
  - Comprehensive determination of the actual condition of the geomembranes
  - Chemical and physical environment through closure
  - Prediction of remaining useful life of geomembranes

White Mesa Cell #1


Example of liner damage adjacent (smaller bare spot) to section of liner removed (larger bare spot) for replacement. Area is on east slope of Cell 1, just north of main discharge pipe from Mill/SX area.

This is a Failed Liner System!

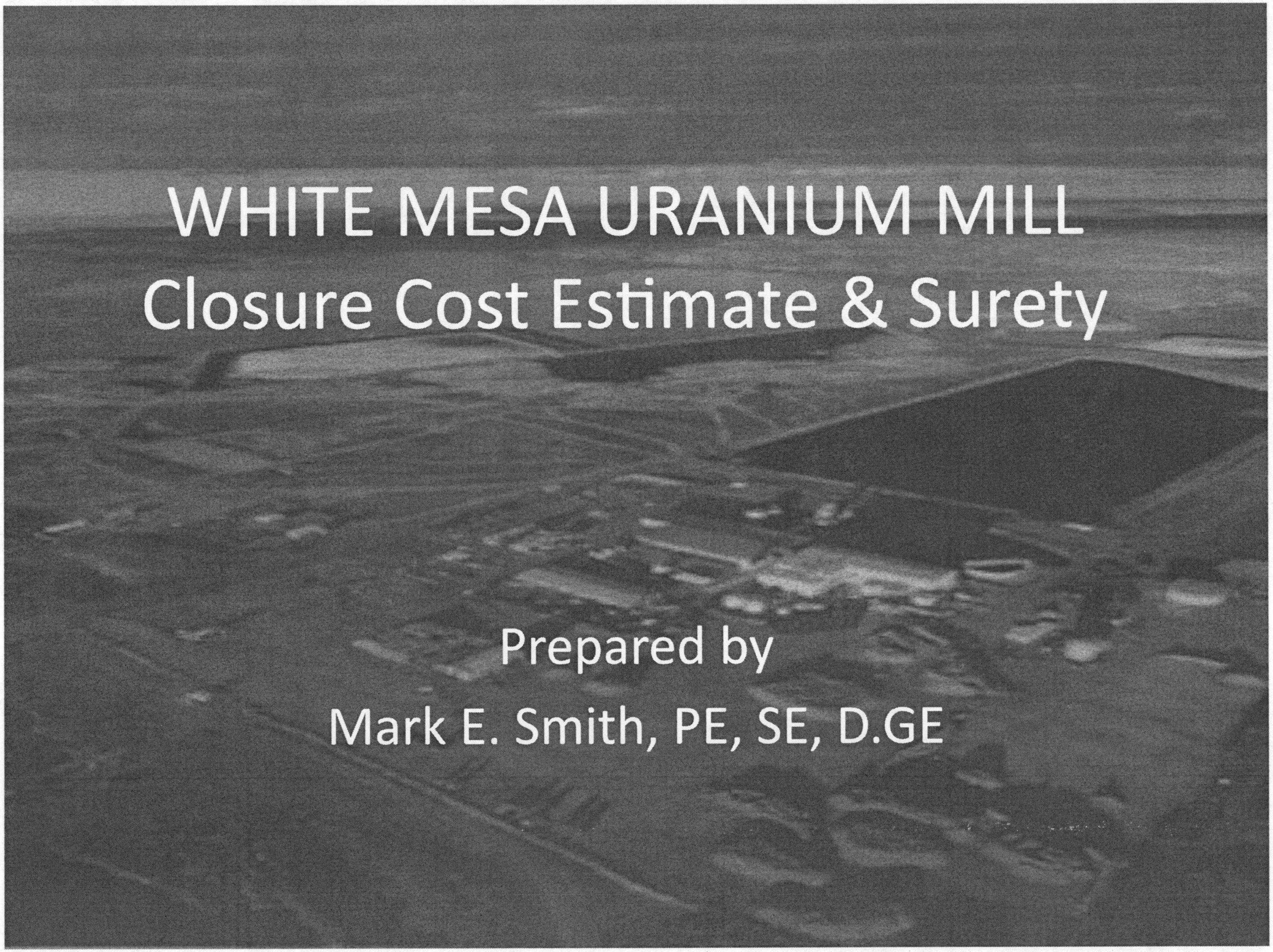
Observations from DMT Q2 2012 EFR Report:

- Degraded liner
- Small holes, cracks, tears
- Liner looks aged, very brittle, lots of cracking, breaks when pressure applied
- Several areas of **missing liner**
- Sun damage (should not apply where properly buried)
- **A total of 6,618 ft of PVC required repair or replacement**; 79 ft caused by repair crew, 210 ft sun damaged

Evidence of Failure or Incipient Failure	Evidence of Satisfactory Performance
-Chloride & Nitrate plumes co-located -UGW12-03 decreasing pH, increasing trends in indicator parameters -MW-22 increasing trends -Fluoride spike while processing high fluoride Alt Feed material -Uranium seep across from mill -Design Life was <u>only 5 yrs per cell</u> -Research on useful life of PVC -Industry experience with PVC -Industry experience with all geomembranes installed before 1985 -Alt Feed's aggressive chemistry -Manufacturers' warrantees: none apply to WMM chemistry -2012 EFRI's inspection of upper section of Cell 1 liner; ~6,600 ft of failed liner	-Controversy around source of plumes (but HGC predicted 290 yrs for first intercept) -University of Utah study (report is 7 years old, admits leakage likely, recommends more work, data discounted by MWH 2010)

Cells 1, 2 & 3

- Heightened risk of catastrophic release
- Cell liners:
  - Not BAT compliant
  - Not designed for 30+ yr service life
  - Original design life was 15 yrs
  - Original environmental analysis contemplated concurrent closure
  - No functional leak detection systems
  - Liners are leaking
  - Liners have never been tested for continuity


WHITE MESA URANIUM MILL
Closure Cost Estimate & Surety
Prepared by
Mark E. Smith, PE, SE, D.GE

Closure & Financial Surety

- The proposed capping system is inadequate to meet regulatory intent or industry standards
- The cost estimate excludes key technical and legal requirements
- The estimated cost makes White Mesa the 4th cheapest uranium mill closure in US history, though it is the largest, longest operating and faces the strictest closure rules

Capping System is Inadequate

- State and federal law require that the cap:
  - Minimize infiltration into/out of the tailings cells
  - Provide a service life of up to 1,000 years and at least 200 years
- MWH (2011) estimated average infiltration at 13 million gallons during the first 200 years after decommissioning mill
- That estimate is very optimistic given the actual performance of other ET Cover systems

ACAP Study of Capping Systems

- Alternative Cover Assessment Program conducted by the US EPA, which sets the benchmark standards for modern caps
- Goal: determine actual performance of a range of cover types and climates to help guide design of new covers for landfills
- Study included 12 sites throughout the US

Comparison of ACAP Sites to White Mesa

- Two sites with similar rainfall and similar caps:
  - Altamont, CA
    - 358 mm/yr precipitation
    - 44.8 mm/yr infiltration
    - 100 times higher than White Mesa prediction
  - Sacramento, CA
    - 422 mm/yr precipitation
    - 2.7 mm/yr infiltration
    - 6 times higher than White Mesa prediction

Monticello Uranium Mill

- Essentially identical climate conditions as White Mesa
- More robust capping system:
  - Thicker cap, capillary barrier & geotextile
  - Excluded geomembrane from test cap
- Measured infiltration = 0.7 mm/yr, or 1.6 times higher than White Mesa's estimate
- The <u>only sites</u> with 0.45mm/yr or less had geomembrane and clay in the cap, as did the actual cap at Monticello

Adjusting White Mesa Leakage to Match US EPA Study

- Sacramento & Altamont are close analogies
  - Infiltration = 2.7 & 44.8 mm/yr
  - In first 200 yrs: **70 million & 1.3 billion gallons**
- The only way to get leakage down to White Mesa's estimate & meet regulatory mandate is to upgrade cover to Monticello's installed cap standards

Closure Cost Estimate

- Approved Closure Plan is version 3.2.
  - Deemed “obsolete” by State
  - Cost estimate is not for Plan 3.2
- Cost Est 4.14 appears to be for Plan 4
  - No supporting documents were provided by DEQ
  - Relied on both Plan 4 and 5 for my review
- White Mesa’s estimate is defective:
  - Unit costs are too low
    - Fails to meet industry adopted Model Agreement
    - Fails to meet standards used in adjacent states and by DOE
    - Fails to meet legal requirements
  - Not independently prepared
  - Missing major items
  - Estimate is less than 20% of the actual closure cost of similar sized uranium mills

Industry Benchmarking

- Benchmarking is a near-universal way of validating estimates (IPA, 2004)
- Deviations from benchmarked costs should be justified or revised (IPA, 2004)
- Broadly used by lenders, insurers, peer reviewers, regulators, forensic analysis, US BLM, US FS, US EPA, US DOE

Industry Benchmarking

Source	# of Sites	Cost $1,000/acre	Comments
US DOE 1995, Title I & II Sites	43	$670	80% of all US UMT sites
Germany 2002	14	$380	63% of global U production
AFCEE & Dwyer 1998	>10	$472	non-UMT
Smith 2010, 2013	40	$410	non-UMT
Average All US UMT Sites	43	$670	Range of reasonable estimates
Average All Sites Including Title I	>110	$511	
Average All Sites Excluding Title I	>88	$356	
White Mesa	1	**$ 98**	19% of average cost for 110 sites/~80% of global U3O8 production
Notes: Costs are in 2014 dollars per acre of tailings.			

Adjustments to EFRI Estimate

Item	Comments	Adjusted Estimate ($1,000)
Direct Costs:		
Labor	Prevailing wage rate, fringe benefits, employer's taxes	$8,682
Equipment	Overtime, wear parts, fuel price	$3,106
Survey Crew, Environmental, Quality Control	Survey & Env rate of $14.46/hr is unrealistic, QC rate of $62 is below commercial, excludes PE oversight	$1,009
Management & Support	Rates used are less than prevailing wage, less than commercial	$997
Cell Dewatering	Estimate excludes labor, pumps, maintenance (i.e., funds only electricity)	$1,204
Adjustments to Direct Costs		**$14,999**

Adjustments to EFRI Estimate

Item	Comments	Adjusted Estimate ($1,000s)
Indirect Costs:		
Contingency	Held rate at 20%, adjusted for increased direct costs (should be at least 25%)	$5,332
UDEQ Costs	4% is much lower than industry experience. 15% would be typical for a private owner, likely more for public	$3,974
EPCM	Excluded from cost estimate; 12% is low end of industry standard	$4,335
Long-term Care Fund	$1,000/mo allowed. More realistic would be $8,300/mo	$7,485
Adjustments to Indirect Costs		**$21,126**

Adjustments to EFRI Estimate

Item	Comments	Adjusted Estimate ($1,000s)
Excluded Costs		
Upgrade Cap to Montecello System	Add biotic intrusion, vegetative cover, geomembrane, geotextile, increase thickness from 6.0 to 9.67 ft	$19,900
Escalation to End of Closure	Escalated by 3.0% per year x 5 years required to complete closure	$3,165
Off-site Soil Remediation	Assumes 50 acres x 6" deep, plus revegetation	$480
Groundwater Remediation	Provide fund for treatment in perpetuity to pay $20,000/mo (labor, energy, treatment, testing, oversight)	$16,000
Contingency	Not considered, but should be included	-0-
Total Excluded Costs		**$39,545**

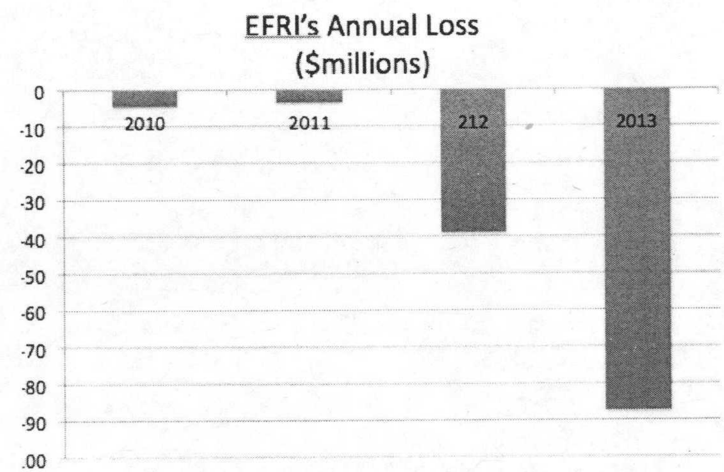
Adjustments to EFRI Estimate

Item	Adjusted Estimate ($1,000)
EFRI Estimate	$21,126
Adj Direct Costs	$14,999
Adj Indirect Costs	$21,126
Subtotal	**$57,251**
Excluded Items	39,545
Total Adjusted Cost	**$96,796**
Benchmarked Cost	**$109,865**

Why is this Important?

- Only 3 of 44 US mills were closed within WMM surety
- EFRI has inadequate cash flow and net worth to fund closure: cash = $6.6M, down from $43M in 2012

- Taxpayers will inherent $80M in un-funded costs
- Closure will be delayed by decades, increasing threat to Tribal water supply



Points of Agreement?

- Closure plan & surety estimate exclude groundwater remediation, off-site soil remediation, Monticello cap
- Surety estimate does not fully contemplate government contracting (i.e., prevailing wage)
- Surety estimate does not include cost escalation to time of closure

Concurrent Closure

- Concurrent closure was contemplated in original environmental study and project design; approved plan excludes it
- Would reduce the risk of:
  - Irreversible or long-term GW contamination
  - Exceeding Radon-222 emissions standard
  - Violations of NESHAPS work practice standard
  - Risk of default by EFRI
- Reduced financial liability assumed by State of Utah in event of EFRI default
- Allows verification of closure technologies
- Industry standard and regulatory standard in most jurisdictions, even for low risk sites


WHITE MESA URANIUM MILL
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Extra Slides

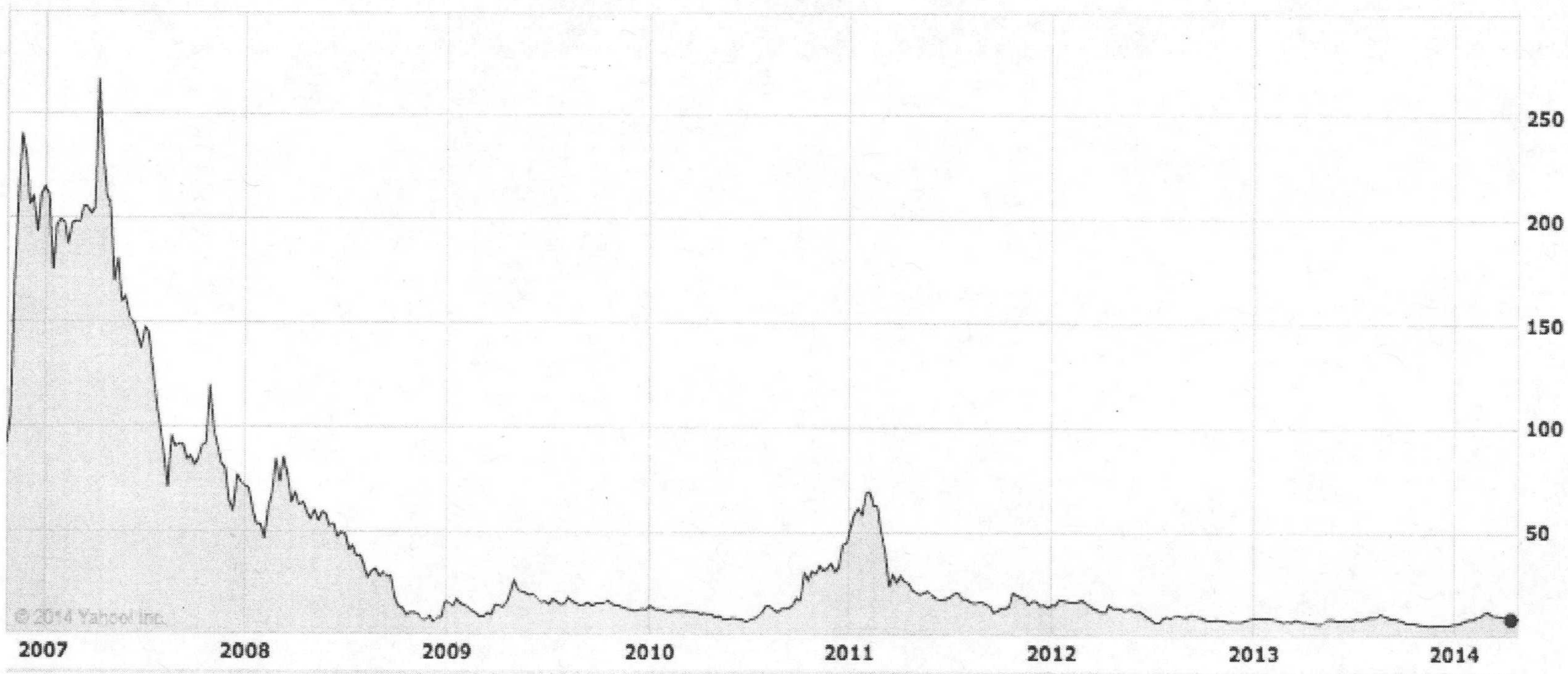
Temporary or Interim Covers are Inadequate

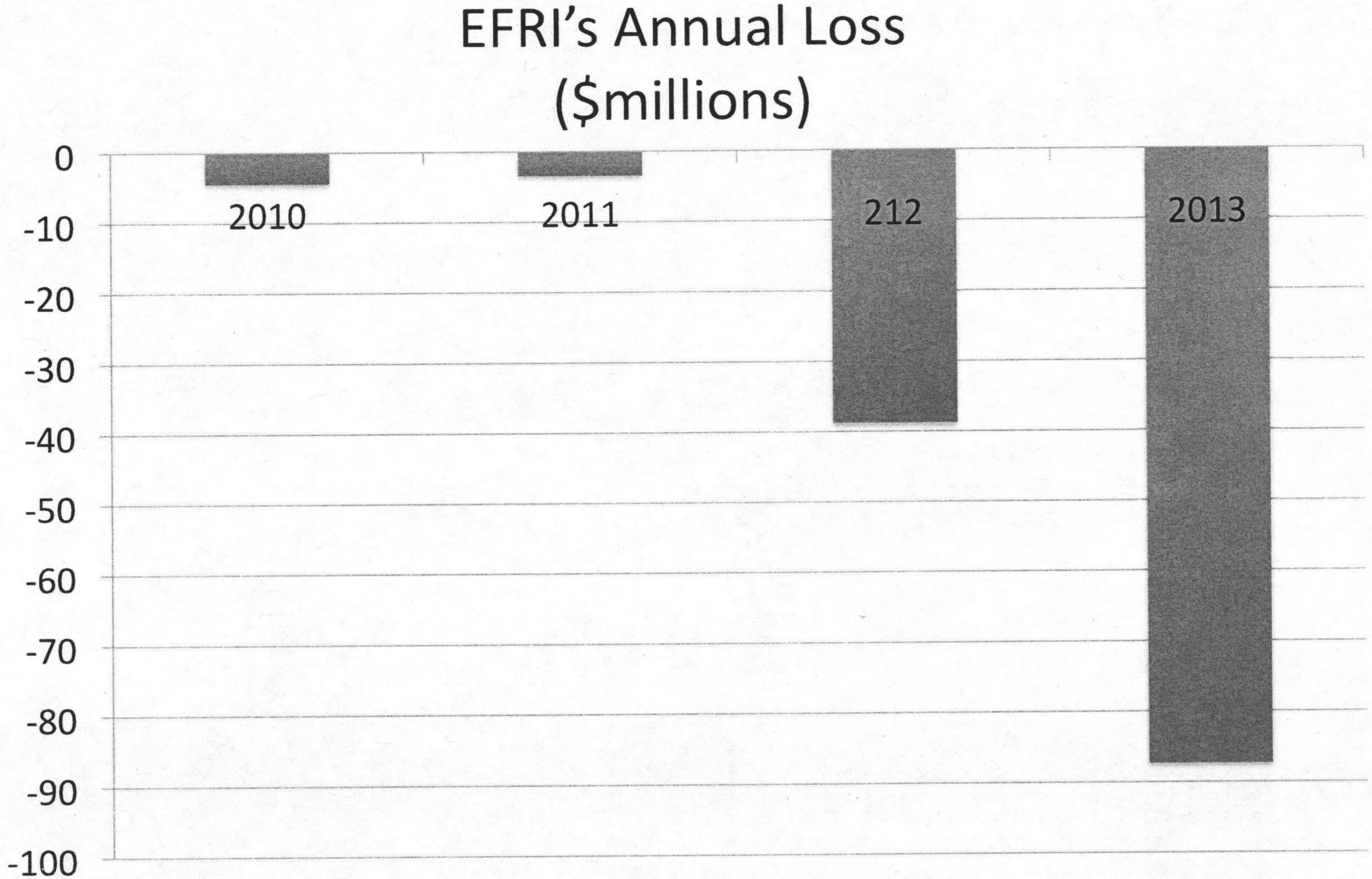
- NESHAPS does not contemplate interim covers as part of final closure process.
- Waste cells are intended to be decommissioned, dewatered, fully capped by end of PVC's service life.
- Thin, temporary caps will continue to allow excess infiltration into the tailings (and thereby into the groundwater) and radon emissions into the air.
- There is no good technical or regulatory reason to defer final capping.
- Concurrent closure is the standard of practice, both in the US and internationally.
- EFRI is financially unable to fund end-of-life closure, or to obtain a bond appropriate to the likely all-in costs

Concurrent Closure

- Reduces the environmental footprint annually
- Reduces the risk of contamination annually
- Reduces the liability that will be transferred to taxpayers at abandonment
- Allows full-scale verification & optimization of the selected closure technologies
- Provides better cash-flow management for both the owner and agency
- Reduced likelihood that owner will abandon facility

EFRI Stock Price History




EFRI's Annual Loss
($millions)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
2010
2011
212
2013