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## A Lot of Confusion over Tails

In recent weeks, we have been inundated with requests to react to a certain "analysis" on the impact of changing tails assay on uranium demand. Last week, we participated in an investor conference in Toronto, and the subject of tails assay came up time and time again. For these reasons and the likelihood that the impact of possible changes in enrichment tails assay on uranium demand is not perfectly understood in this industry, we will focus on this subject here.

While there is clearly some substitution of enrichment for uranium that is taking place in the current market environment, the question is how much change is actually occurring. The investment community, as well as some in this industry, tend to focus on changes in the optimal transaction tails, which is simply the tails assay that minimizes fuel cost given published uranium and enrichment prices. Several years ago this optimal tails was 0.35w/o but now is around 0.25w/o. This has led some to conclude that uranium demand will decline by 15% (we have also heard numbers as high as 40 million lbs U3O8).

and whether they have any excess capacity to sustain operations at lower tails. The optimal operating tails depends on such things as how the plant is configured and the marginal cost of electricity - the relative importance of these factors depends on the technology deployed - but suffice it to say that the optimal operating tails for enrichers is derived on a different basis than the optimal transaction tails assay for utilities.

Over time, enrichers can react in another way - to limit the tails flexibilities they offer in new contracts. Allowing utilities the flexibility to lower tails assays substantially has a high cost to an enricher since the enricher has to build capacity to meet this potential need (or be prepared to buy uranium to overfeed). These limitations will restrict the ability of utilities to transact below certain tails assays. This brings up the possibility that the optimal transactions tails assay may fall to 0.20w/o, but transaction tails choices may become limited so that a utility cannot select a tails assay below 0.25w/o, for example. Thus, the downward adjustment of tails is limited both by physical enrichment

There are also some second and third order effects at play here as well. As demand shifts from uranium to enrichment, SWU prices rise. We are seeing this to some extent now, but this will likely intensify in the future. As enrichment prices rise, the optimal tails will tend to increase for any given level of uranium price. In this respect, static representations of tails assay choices do not reflect the dynamic interaction of enrichment prices with uranium prices.

Uranium supply potentially decreases in another way: historically, uranium supply has been increased by enrichers re-enriching tails material. As this material is depleted and as new tails material comes out at lower assays, there will be a reduction in this source of supply to the market. Moreover, as tails assays decline, the amount of enrichment work needed to generate a given amount of uranium from tails increases, increasing the cost of such uranium and reducing the supply of enrichment available for normal enrichment activities. Simply put, these dynamic factors mean that a

There are a number of problems with this approach to deriving the impact of changing tails. First, one needs to distinguish between the transaction tails in utility contracting and the operating tails actually employed by enrichers. In the past when uranium prices were much lower and the optimal tails was much higher, enrichers with low marginal costs were actually operating at a lower tails assay than the average transaction tails assay. This meant more uranium was being delivered to enrichers than they were actually enriching, in which case they simply turned around and sold the excess uranium. (USEC was an example of this.) So when transaction tails assays declined in response to higher uranium prices, utility uranium demand went down, but so did supply due to uranium sales by enrichers.

As transaction tails fall, enrichers have two choices - lower their operating tails or go into the market and buy uranium to overfeed their plants. Their decision on whether or not to lower their operating tails depends on the best way that they can optimize their own costs

capacity and the terms and conditions in enrichment contracts. (Of course, here we are assuming that an enricher would not want to operate at a tails lower than the lower limit of tails flexibility stated in the contract.)

This relationship between transaction and operating tails is diagrammed in the chart to the left. This chart shows a wide range of transaction tails but a much more narrow range of operating tails. Actions taken by utilities are represented on the left side of the column, and actions by enrichers on the right side. The substitution of SWU for uranium relates to the height of the box labeled operating tails, not the height of the column that represents the range of transaction tails assay. The operating tails box may be taller than what is shown, but as long as it is not as extensive as the range of transaction tails assays, then the substitution of SWU for uranium will be less than that indicated by the transaction tails assay range.

declining optimal transaction tails assay may have far less effect on the actual uranium supply/demand balance than many seem to expect. Enrichment capacity will be shifted from tails stripping and underfeeding to utility contracts, reducing the supply of secondary market uranium by some proportion to the amount of reduction in primary utility demand for uranium and increasing prices for enrichment.

Finally, while reactor requirements are falling because of the move to lower tails, in reality overall utility requirements are not falling very much. What is happening in many cases is that utilities are nominating lower tails, but are continuing to buy the same amount of uranium (especially if this supply is from older, lower-price contracts). This can be observed in utility behavior, and can be inferred by the fact that uranium prices have continued to rise.

From this standpoint, utility inventory demand is increasing, and this demand is not reflected in the WNA or other reactor requirements forecasts. (Note that in addition to utility inventory demand, there is also inventory demand on the part of investor/hedge funds as well as producers, and this demand is not reflected in demand forecasts.) This inventory demand is not necessarily trivial. For instance, if utilities collectively want to add six months of inventory supply (about 90 million pounds), this would be equivalent to



buying 10 million pounds a year for nine years, hardly an insignificant amount.

**Additional information** on the effects of tails assays was covered in a paper presented by Dr. Tom Neff on October 13, 2003. Both the paper and presentation slides are available online.

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