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UF_6 Conversion Supply Post 2006

Scott Melbye

I am delighted to be here with you today to present a look at UF_6 conversion supply in the post 2006 time frame.

Post 2006 is a critical time period in the conversion market due to the fact that there is an anticipated decrease in known supply while at the same time there is an expected increase in demand.

This presentation looks at some of the factors behind this situation and highlights some of the risks and issues that will be faced going forward.

Finally, by way of introduction, I want to let you know that most of the data presented here is drawn from the WNA 2003 Market Report.

Here are the topics we will discuss today:

- First we will start with an overview of conversion;
- Then we will examine some of the events impacting UF_6 supply;
- Next we'll have a look at current supply and demand and compare it to supply and demand in 2009;
- Finally we will touch upon possible supply sources and how they might contribute to filling the gap.

To set the stage for discussing post 2006 conversion supply, let's begin with an overview of conversion.

UF_6 conversion is one of the front-end steps in the process of producing reactor fuel for light water reactors and involves taking natural uranium ore concentrates and converting them into natural UF_6. Natural UF_6 is the form needed for the next step in the fuel cycle: enrichment of the natural UF_6 at 0.7% U-235 to 4% or 5% U-235 so that it can be burned in a light water reactor.

Each step identified here is vital in the production of nuclear fuel, meaning you can't make light water reactor fuel if one of the steps, such as conversion, is missing.

It is important to note that one must not only provide the conversion service, but also deliver the UF_6 to the enricher, the next step in the cycle. This means that the location of converters relative to enrichers is a factor when it comes to transporting the finished product, and we'll look at this later in the presentation.

If we look at conversion from the point of view of its value relative to the rest of the fuel components in a typical 1100 MWe PWR reload, we find that conversion represents only 6% of the fuel cost. *(Assuming US$18.50/lb U_3O_8, US$8.50/kgU conversion, US$100/kg SWU and US$200/kgU for fabrication).* If we take it one step further and assume fuel costs represent about 30% of electricity costs, not including backend costs, then conversion would only represent about 2% of the cost of electricity production.

So here we have a step that appears relatively unimportant from a cost perspective. However, since fuel can't be produced without conversion, and electricity can't be produced without fuel, conversion affects the ability to produce a final product that costs 50 times as much and sells for even more.

Nuclear utilities have a huge investment in their fuel and, if conversion is not available when needed, the whole fuel cycle can be held hostage.

Today there are four converters which together have a total nameplate capacity of 46 500 tonnes U, representing about 80% of today's Western world demand for UF_6 conversion services. They are:

- Cameco at 12 500 tonnes U or 22% of Western demand;
- BNFL at 6000 tonnes U or 10% of Western demand;
- ConverDyn (who markets the production from the Honeywell facility), with assumed nameplate capacity of 14 000 tonnes U or 24% of Western demand; and
- Comurhex, at 14 000 tonnes U or 24% of Western demand.

I would like to point out that although BNFL's nameplate capacity is 6000 tonnes U, we have assumed an operating level of 3500 tonnes U per year. And, while we have shown ConverDyn with a nameplate capacity of 14 000 tonnes U, we know they are in the process of ramping up production since last year's production interruption, so actual output is likely less.

The other 20% of Western world supply comes from secondary sources and the natural feed component of HEU, which we will address in a moment.

Now let's jump ahead to 2007.

In 2001, BNFL announced that its conversion facility would be closed in the first quarter of 2006. Thus, in 2007 there will be three UF_6 conversion facilities in the Western world, rather than four, and capacity will decrease to 40 500 tonnes U.

This represents a capacity loss of 6000 tonnes, which is equivalent to about 10% of western world requirements at that time.

Importantly, since BNFL is located in Europe, loss of this capacity affects the regional distribution of conversion relative to enrichment, and, as a consequence, impacts the volume of UF_6 to be transported between North America and Europe.

Let's have a look at what we mean by a regional imbalance.

First, uranium from all over the world, including Canada, Australia, Africa, Central Asia and the US, is shipped to one of the four converters previously discussed.

As you can see, two primary converters are located in North America representing 57% of total current nameplate conversion capacity, and two are located in Europe representing the other 43% of total nameplate capacity.

Now let's look at the continental distribution of economic enrichment capacity, the next step in the fuel cycle, to see how these two pieces fit together.

There are three western world suppliers of enrichment, one in North America and two in Europe.

In this case, the distribution of current economic enrichment capacity is almost opposite to that of conversion, with 26% of capacity located in North America and the other 74% in Europe. *(Assuming USEC capacity is 5.0 million SWU, Urenco is 6.55 million SWU, and Eurodif is 8.0 million SWU, all at 4% enrichment and 0.3 tails).*

It is much easier to ship UF_6 on the same continent than it is to ship it overseas. Shipping overseas adds costs and, importantly, requires additional time. Therefore, an increase in the amount of material shipped to Europe means an increase in the amount of material required in the pipeline, which would cause a one-time increase in demand.

We'll talk a bit more about this concept of "priming the in-process inventory pump" a bit later in the presentation.

If we look at the situation in 2007, after BNFL has closed its conversion facility in Europe, the disparity between nameplate conversion supply and economic enrichment capacity increases further (nameplate capacity located in Europe declines from 43% to 35%), which means there is a requirement for yet more UF_6 transport to Europe.

Now, let's have a look at a snapshot of UF_6 supply and demand today.

Western world demand is calculated from the 2003 WNA Market Report, and includes all demand except Russia, Armenia, Bulgaria, Ukraine and China.

Secondary supplies include supplies to the West from Russian HEU, re-enriched tails, Russian exports of LEU, reprocessed uranium, the midpoint of the MOX supply scenarios, and enough inventory to fill the space between supply and demand.

Primary supply assumes that BNFL is producing at 3500 tonnes and the other three converters produce at 90% of their nameplate capacities, amounting to a total of 39 950 tonnes. This is a conservative assumption due to the ramp-up to full production that is currently occurring at ConverDyn.

Since we assume current actual production is less due to ConverDyn's ramp-up, we conclude that available inventories must be decreasing and/or the liability to make good on deferred deliveries is increasing.

Now I'll summarize several market events that have or will have an impact on UF_6 supplies.

We've already mentioned the ramp-up at ConverDyn. Here we assume a net loss to the market of about 4500 tonnes U per year of supply, to allow depleted inventories to be replenished.

Looking out further in time, events that will affect the market include:

- the BNFL closure, where supply lost to the market will amount to about 3500 tonnes U per year (about 6% of annual western world requirements); and
- the Tenex announcement, whereby Tenex indicated that it will return its share of HEU feed component to Russia beginning in 2008, which means a further reduction in supply of up to 3000 tonnes U per year or 16 000 tonnes through 2013 (up to 5% of annual Western world demand).

In isolation, these events are manageable, but taken together, in an environment where the system has already been stretched, and future replacement supply has not been clearly identified, these events become significant, amounting to some 52 000 tonnes U of conversion being removed from the Western world market through 2013.

There is one more factor that impacts UF_6 supply. This is foreign exchange.

The relationship between the US dollar and the currencies of other primary conversion suppliers is also a factor that may influence future UF_6 primary production.

For example, since the beginning of 2002, the average of the North American and European spot conversion price has increased by over 50% in US dollar terms. However, from the perspective of primary suppliers in Canada and Europe, the price increase in the local currency has been significantly less (28% for Canada and 9% for the Euro at 31 July 2004).

This means that while the market has begun to send price signals to primary suppliers, not all primary producers have received price signals of the same magnitude in support of potential future investment.

Investment in new primary conversion capacity requires sustained prices in producer currencies that are sufficient to amortize a new investment over a reasonable period of time and provide a return to shareholders.

Now let’s look at a snapshot of 2009 Western world supply and demand.

Changes from the current year include the removal of BNFL conversion from primary supply, the updating of secondary supplies – again as per the WNA Market Report at that time, and a decrease in HEU feed supplied to the West to reflect the return of this material to Russia for use as blendstock.

Supplies have decreased and expected demand has increased, resulting in a gap.

We have all seen this gap before and we know that sources of supply today will change in order to meet demand in the future.

The question is: what will change and where will this supply come from?

Before we consider this question let’s revisit the regional imbalance raised earlier and add its effect to the ‘gap’.

Here we focus on the European perspective, since Europe is most impacted.

Because European enrichment facilities require more UF_6 than European converters can produce, it’s necessary for UF_6 to be shipped into Europe, with a good portion of it coming from North America.

Notice that in 2004, about 5900 tonnes U will have to be brought into Europe. Exactly how much is actually transported from North America and how much comes from elsewhere or from inventories is not known - what is important, however, is the trend of the imbalance as time goes on.

For example, the imbalance increases to 10 700 tonnes U when BNFL exits the business and Urenco capacity is assumed to increase to 7.5 million SWU.

On top of this, one must also consider that a portion of the UF_6 feed derived from Russian HEU equal to as much as 3000 tonnes U per annum will need to be transported from North America to Russia beginning in 2008 – adding to the volume requiring transport.

As mentioned earlier, cross-ocean transport takes longer, and requires more pipeline inventory. Therefore, there may be a requirement for additional UF_6, over and above identified annual demand, to prime the ‘in-process’ inventory pump. Such additional demand will likely occur at a time when known supply is already less than demand.

So now let’s talk about how the supply gap might be filled.

Here are some possibilities:

In the longer term, new primary production is possible, but not until conversion prices justify new plant investment. Additionally, assuming the right market conditions do come into existence, there will be years of approvals and construction before output becomes available as the plant gradually ramps up to full production.

Expansion of existing facilities is possible, but such expansion is typically incremental in nature, and constrained by regulatory limits placed on these older facilities.

More secondary supply is possible, including Russian LEU exports, rep-U, MOX, and re-enriched tails, but the rate these supplies can access the market is also constrained by regulations, restrictions, and technical considerations. Similarly, additional HEU feed during this period is possible, but unlikely, given the complex political/commercial agreements underpinning this material.

Inventory drawdown is possible, but only if there is inventory available. Given recent production interruptions that have drawn down inventory, and the reductions in supply discussed here, it may not be prudent to rely on the existence of abundant future inventories.

Finally, it is possible to reduce demand by decreasing tails assays, but this may be a zero sum game, since enrichers already take advantage of operational tails assays that are below transactional tails assays.

Having systematically ruled out sources of future conversion supply paints a rather negative picture, but this is not the intent. We believe there will be a solution, and it will probably be some combination of the previously mentioned sources, or some yet to be identified source.

Unfortunately (or fortunately), recognition of our future vulnerability is precisely what is required to bring about positive change, that is, as long as we heed the signs and begin to take action.

So, in conclusion, allow me to summarize the main points:

- conversion is a vital link;
- known conversion sources are set to decrease;
- a growing regional imbalance will increase the amount of overseas transport and will require an increase in pipeline inventory;
- new supply sources needed to fill the gap are yet to be clearly identified; and
- recognizing today the vulnerability of tomorrow can and will lead to a solution.

Thank you for your attention.