ONTARIO POWER GENERATION

URANIUM PROCUREMENT PROGRAM ASSESSMENT

Prepared for: Ontario Power Generation

By Ron Witzel and James Malone

Longenecker & Associates
5052 Pensier Street
Las Vegas, NV 89135

Engineering and Management Consultants
Woman Owned and Operated

Bonnie Longenecker - Chief Executive Officer
John R. Longenecker - President
Telephone: 702-493-5363
Facsimile: 702-543-2382
E-Mail: info@longenecker-associates.com

DUNS Number: 07-208-1990

April, 2012

NOTICE

This report is the property of OPG and can be used as OPG requires.

Longenecker & Associates believes that the information in this report is accurate. However, neither Longenecker & Associates nor any of its subcontractors make any warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained herein, nor for any consequent loss or damage of any nature arising from any use of this information.

CONTENTS

1. Executive Summary

The Ontario Energy Board (OEB) directed Ontario Power Generation Inc. (OPG) to file an external review of OPG's uranium procurement program as part of its next rate application "to determine whether the company is optimizing its contracting, in order to minimize costs to ratepayers."

In response to this direction, Longenecker & Associates (L&A) was retained by OPG through a competitive procurement process.

In preparation of this Report, L&A has undertaken an extensive assessment of OPG's uranium procurement activities, including reviewing purchasing strategies, contracts, risk limit methodology, and inventory policy.

1.1. Summary Assessment and Recommendation

Longenecker & Associates' summary conclusion and recommendation is as follows:

- We find OPG's procurement program appropriate and fully inclusive of the various factors involved in other utility uranium procurement programs, as further described below.

A complete list of our conclusions and recommendations is found at the end of this assessment.

1.2. OPG's Uranium Procurements

- OPG's uranium procurements have been undertaken in a professional manner, using evaluation criteria that give appropriate consideration to diversity of supply, relative capabilities and risk of performance of suppliers, and an appropriate mix of contracts (spot versus long-term, fixed price versus market-related, etc).
- We find OPG's uranium purchasing activities consistent with those of other utilities surveyed.
- We find OPG's forward uranium contract coverage consistent with the aggregated contract coverage of US utilities, as published by the US Energy Information Administration (EIA).
- We find OPG's target inventory policy consistent with other utilities' inventory policies.
- We recommend that OPG maintain, consistent with the physical coverage limits, a continuing presence in the uranium market by frequent market contracting in order to maximize opportunities to achieve attractive contract terms and encourage potential suppliers to solicit OPG's business**.**

- We recommend revisiting the Physical and Financial Risk Limits on a more regular basis than has been done, given the dynamics in the market.
- We recommend that OPG ensure that its Financial Coverage Limits continue to enable effective monitoring of the degree of price certainty, as new pricing determinants emerge.
- We recommend that OPG evaluate its inventory levels on an ongoing basis based on an assessment of potential supply risks.
- We recommend that OPG explore "off-market" negotiated transactions that may provide value by lowering its costs and providing terms and conditions that are not offered in open market transactions.

1.3. Structure of Report

This Report is structured to provide (1) a description of the Scope of Work requested by OPG, (2) an overview of the uranium market, L&A's methodology, and the documents and information sources reviewed by L&A, (3) comparisons with other utilities' uranium procurement programs, and inventory policies, and with publically available information from the US and Europe, and (4) Longenecker & Associates Assessments and Recommendations for OPG's future review of inventory levels and uranium procurement activities.

2. OPG's Requested Scope of Work

OPG requested that L&A conduct an independent third party review of OPG's uranium procurement program including reviewing OPG's current uranium procurement portfolio, plans and strategies relative to the program's objectives, and provide recommendations for improvement. The specific scope of work that OPG requested included the following:

2.1. Review of Risk Limits

- Review and assess the appropriateness of OPG's Physical and Financial Coverage Limits for uranium procurement.
- Provide recommendations on alternatives or adjustments to OPG's Physical and Financial Coverage Limits.

2.2. Review supply risk and supply risk mitigation strategies by reference to recent uranium concentrates (U308) supply contracts

- Review and assess items such as the evaluation criteria, proposal evaluations, standard contract terms and conditions, and supplier diversity.
- Assess level of supply risk from OPG's existing contract portfolio versus OPG's risk limits, and versus other utilities.

- Provide recommendations on contract improvements for future uranium procurement.

2.3. Review price risk and price risk mitigation strategies by reference to recent uranium concentrates (U308) supply contracts

- Review and assess factors such as market timing, use of market forecasts, pricing mechanisms.
- Assess level of price risk of existing contract portfolio versus OPG's risk limits and versus other utilities.
- Provide recommendations on price risk and risk mitigation strategies for future uranium procurement.

2.4. Review of current minimum inventory targets

- Review and assess OPG's inventory targets versus other utilities.
- Provide any recommendations on alternative inventory targets.

2.5. Provide an overall assessment of OPG's uranium procurement program

- Assess its ability to achieve low cost while meeting OPG's supply and inventory objectives.
- Include comparisons to other utilities.
- Provide any recommendations for improvement.

3. Overview of Uranium Market

The Uranium Market involves transactions with deliveries categorized in three different time frames, spot contracts call for deliveries within 12 months, mid-term contracts generally involve deliveries beyond 12 months and completed within the next 3 years, and long-term contracts involve deliveries extending longer than 3 years. Long-term contract terms range as long as 10 years, but typically run 3 to 5 years, with the first delivery usually occurring within 24 months of contract award.

Reporting of transactions in the uranium industry continues to be somewhat imprecise and difficult to validate, and has grown more so, given the increased activity of financial entities in the market.

In their December, 2011 ***TradeTech's Nuclear Market Review*** issued in January 2012, reported that in 2011, there were *313* "near-term" transactions representing *45.77* million pounds U3O8 equivalent.

In their January 23, 2012 edition, ***UxC's UxWeekly*** reported 2011 Spot Market volume as *55.4* million lbs U3O8e based on *365* transactions, with the number of small transactions, those below 100,000 pounds, having increased greatly in 2011.

UxC reported "actual" demand, essentially purchases by utility end-users that will enter the pipeline inventory, (versus "discretionary" demand), amounted to 16.2 million pounds U3O8e or only 30% of the overall volume of transactions in 2011.

Spot Market--As indicated, spot transactions, those involving immediate or near term deliveries represent a relatively small portion of the total amount of uranium traded annually, and much of the volume traded in spot transactions does not involve utility end-users.

Mid-Term Market--The "mid-term" market is a relatively recent delineation in uranium transaction reporting. TradeTech initiated monthly postings of a Mid-Term U3O8 Price indicator beginning in mid-2009. Mid-term market transactions often involve arbitrage transactions by brokers and financial entities with access to financing at lower costs than utility end-users. Mid-term prices are driven by the comparative levels of spot prices versus long-term prices and the cost and availability of financing.

Mid-term market transactions are often structured on a back-to-back basis with aggregated purchases on the spot market being resold to utility end-users. Therefore on an annual basis, mid-term market transactions may involve double reporting of volumes previously sold in spot transactions.

Long Term Market--Deliveries under long-term contracts represent the vast majority of contracted supplies. Total uranium consumed worldwide in 2010 was about 174 million lbs U3O8, and about 177 million lbs U3O8 in 2011. It was estimated that 87% of uranium delivered worldwide in 2010 was sold under long-term, multi-year contracts.

Historically, long-term contracts have been priced using an escalated base price or tied to the spot market price at time of delivery. Recently a significant volume of long-term contracts contain what is termed "hybrid pricing" or pricing based on a combination of spot market at time of delivery and an escalated base price, generally with escalating floor and ceiling prices. TradeTech estimates that 85% of long-term contracts awarded in the last 18 months involved "hybrid pricing". Obviously, the level of floor and ceiling prices vary with market conditions and a discount from the future spot market also may be achievable depending upon market conditions.

TradeTech reported that there were 16 new sales agreements under term contracts in 2011 covering 19.27 million lbs U3O8e, down significantly from 19 contracts covering 74.4 million

lbs U3O8e in 2010, when the Chinese were more active in the long term market. TradeTech data also shows that prior to 2007 Long Term Prices and Spot Prices tended to track closely , but since then there has been a divergence between Spot and Long Term Prices, with a more gradual change in the trend of Long Term Prices. Since 2008, Long Term Prices have been an average of 35% higher than Spot Prices.

4. Methodology

4.1. Process for Assessing OPG's Uranium Procurement Strategy

L&A initiated its assessment by reviewing OPG's recent procurement activities in a chronological manner, and surveyed other utilities regarding their uranium procurement programs. Additional information was gathered from the US Department of Energy, Energy Information Administration (EIA) on US utility inventory and procurement patterns, and from the World Nuclear Association (WNA) and European Atomic Energy Community (EURATOM) on inventory levels.

Conference calls involving discussions with various OPG Fuel Working Group personnel, in addition to an in-person meeting with OPG's fuel specialists, were undertaken as L&A assessed OPG's uranium procurement program and its risk limits methodology. L&A also evaluated the prices OPG paid to uranium suppliers on an annual basis.

L&A's conclusions and recommendations about OPG's uranium procurement program were based on its review and discussions, and on the authors' extensive personal utility experience in uranium markets and their understanding of other utility uranium procurement programs.

4.2. OPG's Filing with the OEB

L&A reviewed OPG's May 26, 2010 Nuclear Fuel Cost filing with the OEB, (EB-2010-0008 Exhibit F2, Tab 5, Schedule 1).

4.3. Review of OPG's Objectives and Methods

L&A reviewed the stated objectives and methods of OPG's Uranium Procurement Program. OPG's objectives are as follows:

- Ensure adequate supplies of uranium are available to meet the operational requirements of OPG's nuclear units, a combined 6,600 MW of generating capability at the Pickering and Darlington Nuclear Power Stations.
- Manage the risks, particularly the price, market and credit risks, associated with the supply of uranium.
- Minimize cost consistent with the other objectives.

OPG identified that these objectives are met through the following methods:

- Purchase within physical limits:
  - Forces regular entry into markets, which reduces significant fluctuations in the average price paid by OPG;
  - Encourages diversity of supply, which reduces the impact of individual supply disruptions.
- Purchase within financial limits (relating to that portion of supply under "fixed" price arrangements):
  - Mitigates near term market uncertainty;
  - Encourages diversity of price mechanisms.
- Operate within credit limits:
  - Mitigates exposure to the financial impact of default risk;
  - Encourages diversity of supply.
- Maintain a strategic inventory of uranium:
  - Mitigates the impact of supply disruptions and ensures continuous reactor operations.
- Employ competitive and fair procurement practices:
  - Provides the opportunity to achieve the best value for money.

4.4. Review of OPG's Risk Limits

Risk management is a widely used quantitative technique applied in many areas of business to evaluate comparative risks of various outcomes. Beginning in 2008, OPG began utilizing a risk management methodology to provide quantitative, long-term guidelines for Physical Coverage Limits from inventories, spot purchases and forward contracting, and for financial coverage limits for the appropriate fixed priced portion of OPG's uranium supply going forward.

L&A reviewed OPG's Uranium Limits Overview document describing the derivation of and motivation for OPG's minimum and maximum limits for both physical and financial coverage. These limits are used to optimize the operating range of uranium inventories and reduce both the physical and financial risks in uranium procurement. Discussions also were undertaken with staff from OPG's Corporate Risk Management Department. OPG staff indicated that the limits are applied in a pragmatic fashion. Senior management can approve exceptions to these limits and did so during 2011.

4.5. Review of OPG's Recent Uranium Procurements

Longenecker & Associates assessment of OPG's uranium procurement involved a review of OPG's recent supply strategies and procurement plans, and OPG's uranium contracting.

These included:

- The 2006 Uranium Supply Strategy upon which the March 20, 2006 Request For Proposals was initiated and the Memorandum of Purchase Approval dated May 2, 2006 covering three contracts – one for the supply of 3 million pounds U3O8 over 2008-2013, the second for 3 million pounds U3O8 over 2010-2015, and the third for the supply of 1 million pounds U3O8 over 2011-2015.
- The Amendment to the Memorandum of Purchase Approval: Uranium Supply Contracts dated May 30, 2006 covering an additional 300,000 lbs in 2007 and 500,000 lbs U3O8 in 2008 for a total of 3.8 million lbs U3O8 over the 2007-2013 period.
- The 2007 Uranium Procurement Plan upon which the June 14, 2007 Request For Proposals was based, resulting in a term contract dated November 15, 2007 for 500,000 lbs U3O8 per year over the period 2009-2011, and 250,000 lbs U3O8 per year from 2012-2017.
- The 2009 Uranium Procurement Plan, authorizing the purchase of 3 million lbs U3O8 (500,000 lbs of Spot Purchases in 2009, 750,000 lbs to be delivered under a term contract between 2010 and 2012, and 1.750 million lbs under a term contract between 2012 and 2018). Based on this Plan, the April 27, 2009 Request For Proposals for 200,000 lbs U3O8 for spot delivery was issued and resulted in two spot contract purchases of 200,000 lbs U3O8 each for delivery in June and July 2009 respectively.
- The March 15, 2010 review of the 2009 Uranium Procurement Plan, which recommended continuation of the long term portion of this Plan and upon which the April 21, 2010 Request For Proposals was based, resulting in two term contracts – one for 250,000-275,000 lbs U3O8 per year over 2012-2014, and a contract for 250,000 lbs U3O8 per year from 2015-2020.
- The May 2011 Uranium Procurement Plan upon which the August 3, 2011 Request For Proposals was based resulting in a spot purchase of 200,000 lbs U3O8 for delivery in September 2011. A November 2011 Request for Proposals was also based on the May 2011 Uranium Procurement Plan and resulted in a spot purchase of 275,000 lbs U3O8 for delivery in the December 2011.
- The June 15, 2011 Information Briefing – Uranium Supply Contracts recommending executing the two term uranium supply contracts (for 2012-

2014 and 2015-2020), which had resulted from the April 21, 2010 Request for Proposals discussed above.

4.6. Review of OPG's Uranium Supply Contracts

L&A reviewed summary information on all of OPG's existing uranium supply contracts as well as requests for proposals, contract templates and contract terms and conditions. Examples of specific uranium contracting documents provided by OPG include:

- The October 6, 2006 Term Contract for total delivery of 3.8 million lbs U3O8 over the 2007-2013 period, which was one of the three contracts resulting from the March 20, 2006 Request For Proposals, and referred to in the May 30 Amendment to the Memorandum of Purchase Approval;
- The January 15, 2007 Term Contract for 200,000 lbs U3O8 per year over the 2011-2015 delivery period with a total delivery of 1 million lbs U308, which was one of the three contracts resulting from the March 20, 2006 Request For Proposals;
- The November 15, 2007 Term Contract for 500,000 lbs U3O8 per year over the period 2009-2011, and 250,000 lbs U3O8 from 2012-2017;
- The April 14, 2010 Draft Agreement sent by OPG with the April 21, 2010 Request for Proposals; and
- The July 8, 2011 Term Contract for 275,000 lbs U3O8 per year over the 2012-2014 period resulting from the April 21, 2010 Request for Proposals.

4.7. Other Information Sources

To compare OPG's procurement program with other utilities, in October, 2011, L&A surveyed fuel managers from 10 US utilities in order to ascertain specific relative comparative parameters, such as annual volumes of uranium required, procurement strategies such as spot versus long term contracting, inventory status, existence of formal protocols or policies for risk management, and inventory levels. Individual company information in these areas generally is held confidential and not available on a published basis, but L&A was able to obtain a reasonable overview, based upon relationships with these fuel managers.

Additional information published by the US Energy Information Agency regarding US utilities' uranium aggregated purchases and inventories held as of 2010 was compared with OPG's inventory position.

Information on European utilities uranium contracting inventory levels published by the EURATOM agency was also compared with OPG.

5. OPG's Risk Limits

The Uranium Limits Overview document describes the inputs for the uranium risk model developed by OPG's Corporate Risk Management Department as including GDP, CPI, reactor efficiency, conversion factors, forward price curves, forced outage rates, planned outage days, fuel inventory levels, and contract information, which are updated regularly to reflect current market and operating conditions.

Financial Coverage Limits

The Financial Coverage Limits provide a formal guideline representing the optimal mix of fixed and variable priced uranium supply contracts.

When OPG buys uranium under fixed or base-escalated priced supply contracts, they are protected against increases in future market prices above the fixed or escalating base pricing, but are subject to the risk that market prices may decline or stabilize at a level below the escalating base price.

In contrast, when OPG buys under market-priced contracts they are subject to potentially dramatic market price swings for that portion of their uranium contract portfolio.

OPG's objective is to maintain an appropriate balance between fixed and variable priced contracts avoiding undue exposure to future uranium prices.

OPG's guidelines provide that the optimal financial coverage limit for the current year is to hold approximately 60% of its overall uranium requirements as fixed-priced or base-escalated contracts, with coverage decreasing progressively in future years, leading to the Financial Coverage Limits expressed as a percentage of overall uranium requirements shown in Table 1.

Table 1 – OPG's Financial Coverage Limits

	Minimum Financial Coverage Limit	Maximum Financial Coverage Limit
Current Year	60%	110%
Year +1	50%	100%
Year +2	40%	90%
Year +3	30%	80%
Year +4	20%	70%
Year +5	15%	60%
Year +6	10%	50%
Year +7	5%	40%
Year +8	0%	30%
Year +9	0%	20%

OPG has indicated that the Financial Coverage Limits are higher in the near term because near term price risk is lower and OPG's objective is to avoid locking in large quantities at fixed prices given the greater uncertainty in future prices. The later years are also impacted by variables such as the level of future plant generation, economic variables, and potential disruption in uranium mine operations. OPG uses these limits in procurement planning to determine how much uranium to purchase under fixed price or base-escalated supply contracts in various future years.

These limits are displayed graphically in the following Figure 1, which shows OPG's current financial coverage from 2011 through 2020, versus the Financial Coverage Limits, and OPG's overall uranium requirements.

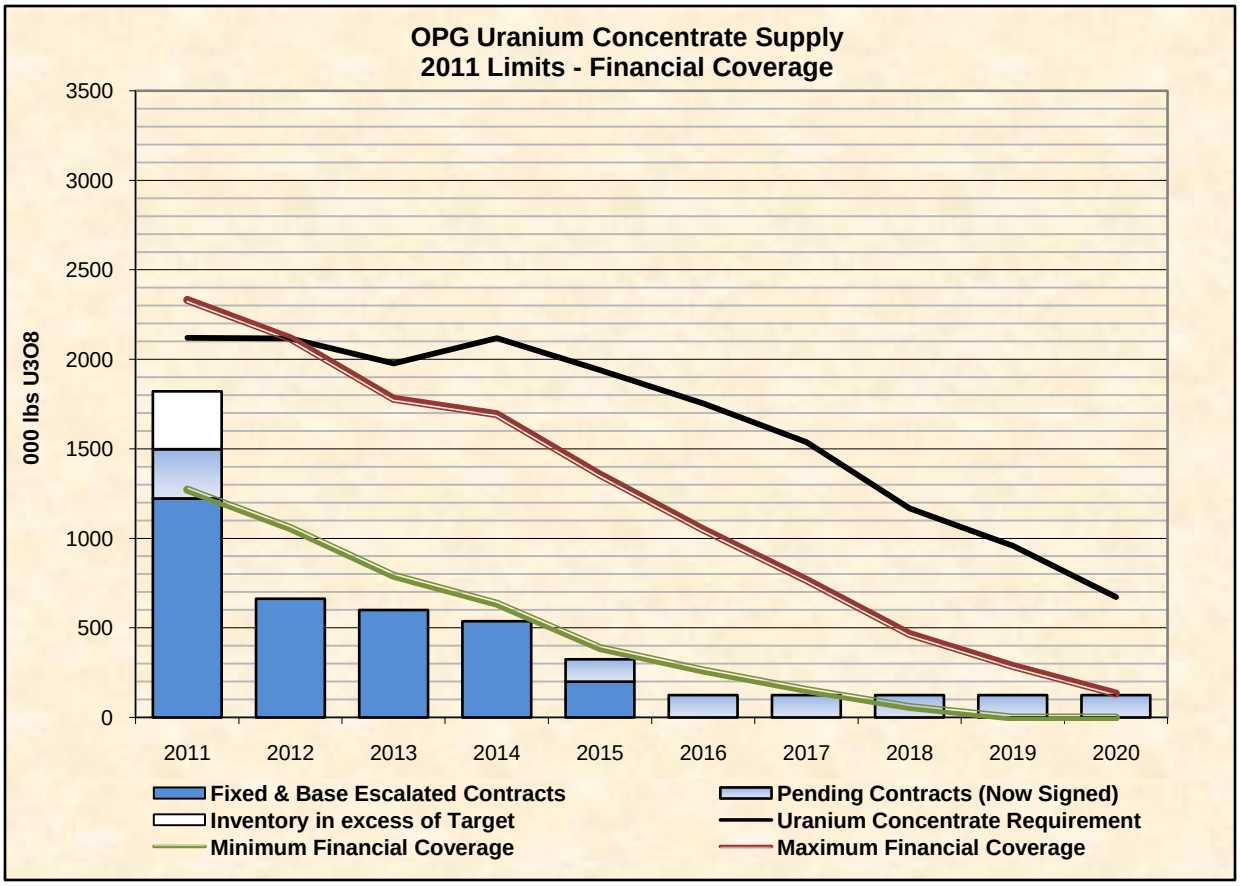


Figure 1 – OPG's Financial Coverage 2011-2020

The graph indicates that as of 2011, forward contracting of uranium supplies under fixed price or base escalated contracts and the associated deliveries in out years, was below the recommended Minimum Financial Coverage limit, suggesting additional contracting utilizing these determinable price mechanisms is warranted. OPG has advised that it has deferred

additional contracting while awaiting the outcome of this Uranium Procurement Program Assessment.

In addition, OPG's anticipated Uranium Concentrate Requirements for the out years are significantly higher than the Maximum Financial Coverage limit, indicating that uranium contracts based on future market prices will also be a component of OPG's uranium costs in those years.

Physical Coverage Limits

The Physical Coverage Limits provide guidelines for the total quantity of committed uranium supply under all contracting types (fixed price, market priced, and contract options), including inventory in excess of OPG's minimum inventory targets, expressed as a percentage of the overall requirements.

The physical coverage limits progressively decline for the next ten years as shown in Table 2 below.

Table 2 – OPG's Physical Coverage Limits

	Minimum Physical Coverage Limit	Maximum Physical Coverage Limit
Current Year	100%	160%
Year +1	100%	130%
Year +2	80%	110%
Year +3	70%	100%
Year +4	60%	90%
Year +5	50%	80%
Year +6	40%	70%
Year +7	30%	60%
Year +8	20%	50%
Year +9	10%	40%

These limits are displayed graphically in the following Figure 2, which also shows OPG's actual physical coverage, from 2011 through 2020, versus the Physical Coverage Limits and OPG's overall uranium requirements:

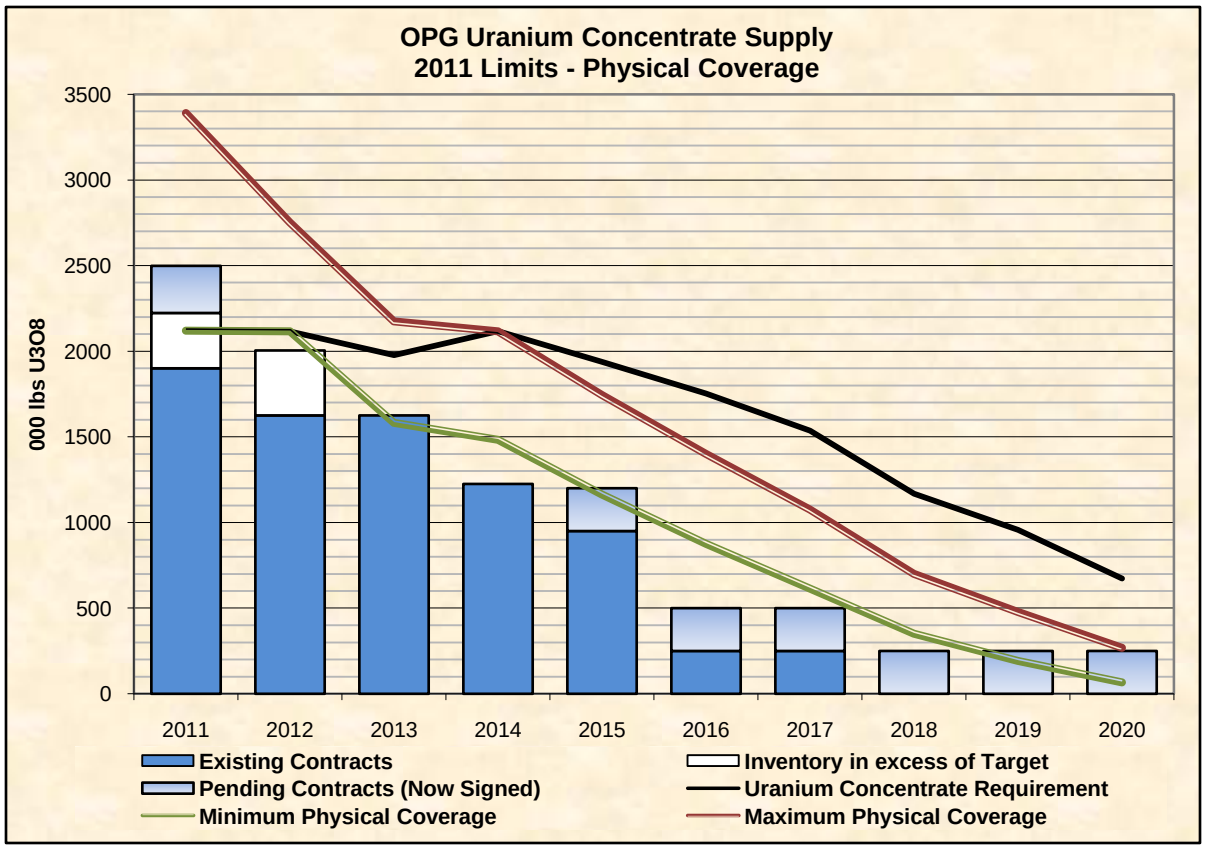


Figure 2 – OPG's Physical Coverage 2011-2020

The graph indicates that as of last year, OPG had aggregate supplies in excess of the actual Uranium Concentrate Requirement for 2011, but substantial uncovered forward requirements in the out years, especially in 2013 and beyond. Uranium Concentrate Supplies were in all years below the projected Maximum Physical Coverage Limit and in several years below the Minimum Physical Coverage Limit. OPG has advised that it has deferred additional contracting while awaiting the outcome of this Uranium Procurement Program Assessment.

OPG uses these guidelines in procurement planning, developing specific uranium procurement strategies, or procurement plans, to determine how much uranium to purchase in various future years.

OPG's procurement plans describe individual contracting actions consistent with the Physical and Financial Coverage Limits, while addressing the current outlook on uranium supply/demand, pricing trends, and other information driving market perceptions.

6. OPG's Uranium Procurement Strategy

OPG's forecast of future uranium requirements, as of September 2011, is as shown in Table 3 below.

Table 3 – OPG's Uranium Requirements

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2119	2116	1976	2117	1938	1752	1536	1167	957	672

(000 lbs U3O8)

6.1. OPG's Contracted Uranium Supplies

OPG's contracted future uranium deliveries, as of December 2011, including Spot purchases, are as shown in Table 4 below.

Table 4 – OPG's Contracted Uranium Deliveries

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2175	1625	1625	1225	1200	500	500	250	250	250

(000 lbs U3O8)

6.2. OPG's Projected Uranium Inventories

In the 2011 Uranium Procurement Plan, OPG's Target Inventory Policy is stated as maintaining a minimum strategic and working inventory of 1 million lbs U3O8.

As of December 2011, absent any further procurement actions, OPG's projected year-end uranium inventories are as shown in Table 5 below.

Table 5 – OPG's Projected Year-end Inventories

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1379	888	537	-355	-1093	-2345	-3381	-4298	-5005	-5427

(000 lbs U3O8)

In addition, OPG maintains individual inventories at each stage of the nuclear fuel supply chain.

- An inventory of finished fuel bundles equivalent to 12 months expected forward usage to allow continued fueling.
- A working inventory of UO2 to feed the manufacturing process, described generally as a 2-3 month UO2 supply.
- The uranium conversion supplier is also contractually required to maintain an inventory of UO2 for OPG's use in the event of a supply interruption.

7. Evaluation of Utility Uranium Procurement Policies

7.1. Utility Procurement Patterns

Uranium procurement patterns vary greatly from utility to utility. L&A surveyed ten utilities to determine their current uranium strategies. Table 6 below reflects the results of an October 2011 survey (Utilities A to J).

- The fuel managers were interviewed regarding their uranium procurement strategies including Spot versus Term buying decisions, extent of contract coverage, the utilization of supply risk assessment protocols, and any uranium inventory guidelines.
- The companies surveyed represent both large and small utilities, and reflect diverse uranium procurement strategies that appear to be independent of the size of the utility or volume of annual uranium consumption. In total, these companies account for approximately 60% of annual uranium purchases by US utilities.
- The regulatory structures of US nuclear utilities vary greatly; many are diversified utilities with unregulated or merchant generating operations, combined with regulated distribution subsidiaries. It can be concluded from the survey data described below that various nuclear fuel procurement organizations operate under widely differing philosophies, with a broad mix of reliance on spot and term contracting.
- There have been two large US utilities that managed to successfully minimize costs for a number of years, with almost total reliance on uranium purchases on the spot market, and just-in-time deliveries to meet fuel processing requirements.
- However, this very aggressive, cost-minimizing strategy exposed the utilities to supply risks once the spot market price began to rise dramatically. Sellers held material off the market, financial entities moved to manipulate market prices by buying small quantities at ever-increasing prices, while the availability of substantial quantities of uranium evaporated in the face of the fly-up in pricing.
- As a result, these utilities were hard pressed to secure uranium requirements for a period of time. And, while they experienced no operational constraints, their experience illustrates the risk of over-reliance on the spot market.

Table 6 – U.S. Utility Information with OPG Comparative Information

Utility	Size[1]	Regulatory Status	Single/ Multi Unit	Annual U3O8 Consumption	Procurement Strategy and Risk Management	Inventory Status	Spot Market Approach
OPG	Large	Regulated	Multi	2 million lbs	Ensure adequate uranium supplies to meet the operational requirements for a combined 6,600 MW of generation. Manage price, market and credit risks using Physical and Financial Coverage Limits and credit risk assessment. Minimize cost consistent with the other objectives.	Minimum 1 million lbs. U3O8 inventory. Can be higher, subject to Physical Coverage Limits, if market conditions warrant ("buy and hold").	Use to cover a disruption in supply. Always evaluate "buy and hold" spot purchases vs. contract for future delivery.
A	Large	Deregulated	Multi	3.5 Million lbs	Try to layer term contracts with not more than 20% from each supplier. No risk assessment protocol other than credit risk for counterparties. Credit risk assessment has never resulted in stopping a deal. Monitors credit ratings of intermediaries involved in each transaction.	Working inventories down to a 6 month level from levels built up during the 2007 price rise.	Utilize spot when market conditions attractive.
B	Mid-Size	Deregulated	Multi	1.1 - 1.3 million lbs	Moving more to spot and mid-term contracting, evaluating "buy and hold" as internal cost of capital seems less expensive than	"No inventories to speak of"	Consider spot when relatively attractive

[1] "Size" relates to the amount of nuclear generation. "Small" includes companies with a single plant site. "Mid-size" includes companies in the range of 3,000-4,000 MWe of nuclear generation. "Large" includes companies with greater than 4,000 MWe of nuclear generation.

Utility	Size[1]	Regulatory Status	Single/ Multi Unit	Annual U3O8 Consumption	Procurement Strategy and Risk Management	Inventory Status	Spot Market Approach
					mid-term prices. Rejected offers using the long-term price indicator as a price determinant in long-term contracts. No risk assessment protocol other than credit risk for contracting counterparties.		
C	Mid-Size	Deregulated	Multi	2.5 - 3 million lbs	70% coverage with long-term contracts through 2016.	No information provided	Fuel budget constrained, can't buy spot uranium right now. Internal short-term cost of capital approximately 2.5% versus 5% for longer term financing.
D	Small	Regulated (Municipal)	Single (Unit Currently Shut-down)	.2 million lbs	Currently have 3 long-term contracts, pricing based on discount from 1) spot at time of delivery, 2) long-term price, and 3) base escalated.	Inventory policy is to hold 1 year of fuel reload as UF6. Approval of inventory investment took 2 years	Potential for small spot purchases due to flexibility in delivery quantities, once reactor re-starts operation in 2012.
E	Mid-size	Deregulated	Single (Multiple Owners)	2.5 million lbs	Currently have 100% coverage with long- term contracts through 2020 with declining coverage through 2025. Seven utility owners want predetermined future pricing, even if the cost is higher. Use base escalated or fixed prices, with price re-openers	No information provided	Believe that financial players are manipulating the spot market prices.

Utility	Size[1]	Regulatory Status	Single/ Multi Unit	Annual U3O8 Consumption	Procurement Strategy and Risk Management	Inventory Status	Spot Market Approach
					every 3-5 years. Don't like the long-term price Indicator as a price determinant, as there are not many data points for each posting. Hoping to narrow gap between floors and ceilings in next contract.		
F	Large	Deregulated	Multiple Units (Some Merchant Plants)	9-10 million lbs	Layered long-term contracts typically 3-5 years, spot price related, some incorporate long - term price indicator as the price determinant. Staggered contract expiration dates keep them in the long-term market. 100% physical coverage through 2014, declining thereafter.	Target strategic inventory level of about 3 million pounds. Inventory level derived from a risk assessment based on physical upset on supply side. Assessment accounted for inventory in process at the time of market upset.	Anticipate regular purchases on the spot market.
G	Large	Regulated	Multiple Units	3.5 - 4 million lbs	No formal procurement plan or strategic protocol, other than to "Stay in the spot market all the time" and evaluate the price variation (spot vs. long term). Base escalated, fixed price, spot related, with price reopeners every 3-4 years. Diversity of supply, political	No information provided	Constant presence in the spot market

Utility	Size[1]	Regulatory Status	Single/ Multi Unit	Annual U3O8 Consumption	Procurement Strategy and Risk Management	Inventory Status	Spot Market Approach
					risks, geographical diversity, determinants of when to re-enter long-term market. 100% physical coverage through 2015, less thereafter.		
H	Small	Deregulated	Single Site (2 Units) w/shared ownership	1 million lbs.	Long-term contracting extending to end of plant license in 2022, contracted on the "back side" of the 2007 price spike. 100% physical coverage. Management wants to know future costs.] Pricing based on spot indicators, long-term indicators, and base escalated. No price re-openers in their long-term contracts.	No information provided	Spot market purchasing is not part of procurement strategy
I	Large	Deregulated	Multiple Units	3+ million lbs.	Currently have layered long-term contracts, prefer hybrid price indicators (base escalated, combined with discount from spot), prefer not to use long-term price indicator as price determinant. No formal procurement strategy. No risk assessment protocol.	No information provided	Haven't been in spot market lately, concerned about spot market Indicators.
J	Mid-size	Deregulated	Single Site (2 Units)	1 million lbs.	Uses long-term contracts with escalating fixed	No information provided	

Utility	Size[1]	Regulatory Status	Single/ Multi Unit	Annual U3O8 Consumption	Procurement Strategy and Risk Management	Inventory Status	Spot Market Approach
					price based on spot with re-openers every 5 years. If price exceeds a given percentage above market then open renegotiations. If no agreement, then contract terminates after following year's deliveries. Current physical coverage is 100% through 2016.		

7.2. Utility Goals in Fuel Procurement

First and foremost, utilities seek to assure ongoing availability of nuclear generating capacity and scheduled operation of reactors. Thus, assured fuel supply has a higher priority than minimized costs. Replacement power for unavailable nuclear generating capacity is costly, on the order of $1 million per day for a 1000 MWe reactor.

The majority of US utilities hold a goal of "minimizing costs", consistent with achieving uninterrupted electrical generation, either to benefit ratepayers by avoiding unnecessary expenses or to maximize profits for stockholders.

However, given individual supply uncertainties and speculative market influences, the goal of "minimizing costs" is elusive, and can only be evaluated after the fact. At any point in time, a utility may find that it has not achieved the minimum possible costs, but may have taken a series of progressive actions which were reasonable at the time each decision was made.

As an example, a new supplier just entering the market may offer very attractive, below-market pricing, however, if they are unable to deliver, neither supply assurance nor cost minimization goals have been met. If minimizing costs is the sole goal, then the buyer is likely to take the risks associated with the offer and commit to a substantial quantity. A balanced goal related to supply assurance and minimizing cost would not rule out the supplier entirely, but it would most likely

result in a contract for a lower quantity as an initial step to prove the supplier's reliability.

In addition, there are utilities or utility-owner groups that believe that having predictable future costs is a higher goal than "minimizing costs", as an example, the priorities related by surveyed utilities E and H.

7.3. OPG Procurement in Comparison Utilities Surveyed

The utilities surveyed represent a reasonable population of US utilities, with varying annual uranium requirements and a wide spectrum of procurement philosophies, and not directly corresponding to whether the utility's rate structure is regulated or deregulated. While not every fuel manager was willing to respond to every question, the survey information does provide evidence of the diversity of procurement philosophies.

As discussed further in the next section, like OPG, most utilities contract to cover a declining percentage of their needs in the later years. However, the two utilities mentioned earlier, utility E and utility H, involve owner groups that require 100% forward uranium contract coverage for the term of their reactor operating licenses, to assure supplies and predictable pricing.

Given the wide divergence of procurement approaches shown among the utilities above, it is not surprising that OPG's procurement activities are similar to some utilities surveyed and with variations from others.

In terms of its actions during the 2007 price spike, however, OPG was not alone in seeking assured supplies as market price increased. Several utilities, including some of the utilities surveyed were also active purchasers during this period and experienced the rapid fly-up and decline in the spot market, with TradeTech's Exchange Value at $135 / lb U3O8 on June 30, 2007, declining to $123 on July 31, 2007, $85 on August 31, 2007, and $75 on September 30, 2007.

In comparison, TradeTech's Long Term Price Indicator was at $95 / lb U3O8 on June 30, 2007, and remained unchanged at the end of July, August, and September.

TradeTech reported five relatively small Spot sales in July, 2007, all involving an Intermediary and no Long Term Contracts.

In August 2007, TradeTech reported a Long-Term Contract "*with a non-US utility selecting a preferred supplier for delivery of a total of 3 million pounds U3O8 over*

the period 2009-2017, assumed referencing the subject OPG procurement. At month end, nine utilities remained in the market seeking 23 million pounds U3O8 equivalent for delivery between 2007 and 2017. One US utility was evaluating offers for 5 million pounds U3O8 to be delivered over a ten-year period. Another US utility was evaluating offers for 1.7 million pounds U3O8 equivalent. A third US utility was seeking 2 million pounds U3O8 with delivery beginning in 2009. One other US utility was seeking just over 2.4 million pounds U3O8 for delivery between 2010 and 2013.

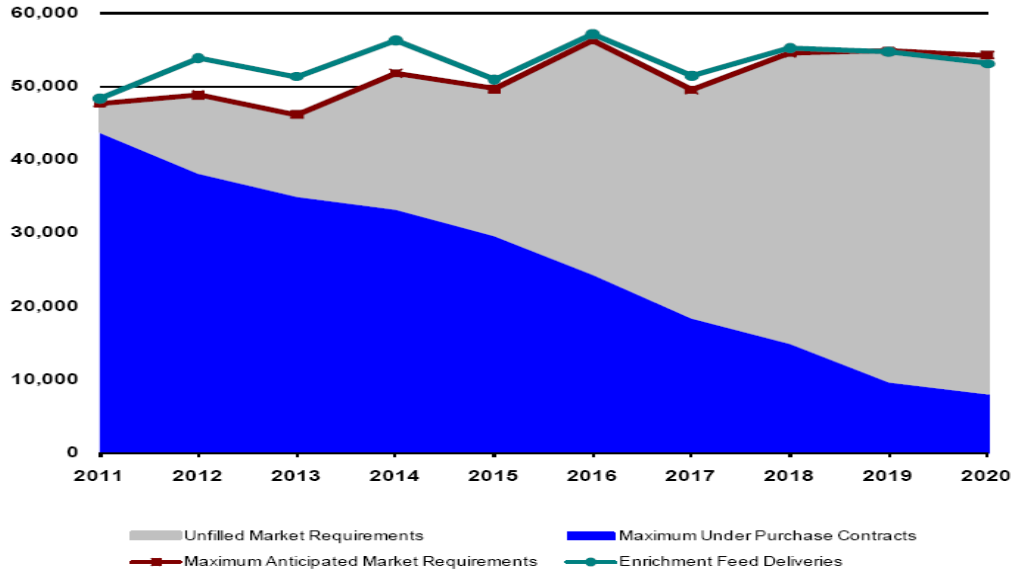
In September 2007, TradeTech reported a US utility seeking 4.4 million pounds for delivery between 2011 and 2020 had selected preferred suppliers, and eight utilities remained in the market seeking 18 million lbs U3O8 for delivery between 2007 and 2017.

TradeTech's observations that month on continuing the $95/lb U3O8 Long-Term Price were that "*the price was representative for delivery in the near term but prices were softer for delivery in much later years when offers include more speculative production. In the wake of the steep decline in the spot uranium price, buyers are showing strong resistance to higher long-term prices, especially floor and base-escalated prices for deliveries beyond 2010.*"

7.4. US DOE Energy Information Administration (EIA) Data

EIA's Report on Uranium Contract Coverage by US Utilities.

- The US EIA publishes data (Figure 3) regarding committed and unfilled uranium for US utilities as shown below with data reported as of 2010 (Thousands of Lbs U3O8 equivalent, referred to as "U3O8e").
- The data in Figure 3 shows a declining level of committed contract coverage for US utilities, and presents results consistent with those of OPG's coverage limits analysis, with the EIA data reflecting a level of 20% of Maximum Anticipated Market Requirements covered 10 years out, for the year 2020.



Source: U.S. Energy Information Administration: Form EIA-858, "Uranium Marketing Annual Survey" (2010).

Figure 3 - Committed and Unfilled Uranium Requirements for US Utilities (000 lbs U3O8e)

Figure 3 reflects the relatively short term commitments generally followed by US utility nuclear fuel managers. For example, the line graph titled Maximum Anticipated Market Requirements shows that uranium requirements for US reactors five years forward, in 2015, were forecast to be approximately 50 Million Lbs U3O8. The blue-shaded area, titled Maximum Under Purchase Contrasts, indicates that these requirements were approximately 60% covered, approximately 30 Million Lbs U3O8, when the survey data was reported to EIA in 2010.

In comparison, OPG's Physical Coverage Ratios for 2015 and 2016 are 60 to 90 percent and 50 to 80 percent, at ranges consistent with the aggregate data reported above.

8. Inventory Levels

8.1. EIA Information on US Inventory Levels

The US EIA annually reports on aggregate inventories held by Owners and Operators of US civilian nuclear power reactors in a document entitled Uranium Marketing Annual Report. Their most recent report, dated May 31, 2011, indicates the following inventories (Table 7).

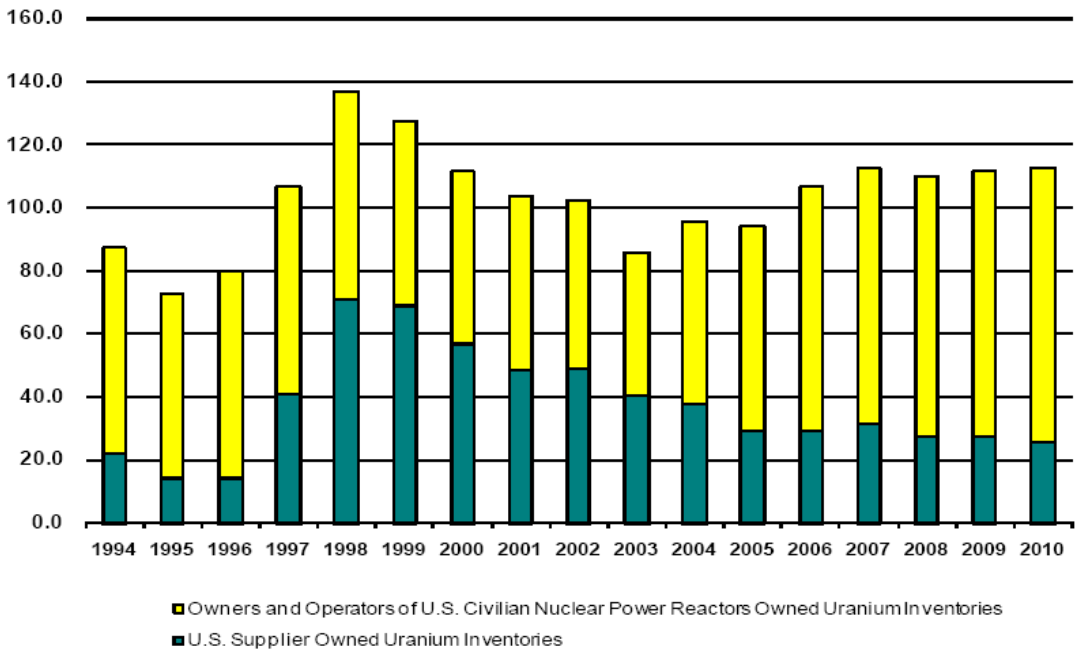
Table 7 – EIA Aggregate Inventories

Owner of Uranium Inventory	2006	2007	2008	2009	2010
Owners and Operators of US Civilian Nuclear Power Reactors	77,484	81,227	82,972	84,757	86,528

(000 lbs U3O8e)

The data reflects a growing level of inventories held by US utilities, likely a result of increased contracting after the 2007 price run-up and more recent expectations of continued high volume of contracting by China.

The US EIA also reports aggregated information on uranium inventories held by nuclear plant owners/operators and by US suppliers. This information is shown below in Figure 4.



Source: U.S. Energy Information Administration: 1994-2002-Uranium Industry Annual reports. 2003-2010-Form EIA-858, "Uranium Marketing Annual Survey".

Figure 4 - US Uranium Inventories (Millions lbs U3O8)

The data for inventories held by utilities combined with those held by suppliers reflects a trend of relatively stable aggregate inventory levels for the last four or five years.

8.2. World Nuclear Association (WNA) Data

The WNA report *The Global Nuclear Fuel Market: Supply and Demand 2011-2030* includes data on worldwide uranium inventories. As of 2010, about 145,000 MtU

(377 Million lbs. U3O8e) is held in commercial inventories worldwide. Utilities held about 120,000 MtU (312 Million lbs. U3O8e) of these inventories, up from 119,000 MtU (309 Million lbs. U3O8e) in 2008. Of the 120,000 MtU, only 32,000 MtU (83 Million lbs. U3O8e) was considered "non-strategic" and required to satisfy reactor requirements in the next several years.

China imported 4,333 MtU (11.26 Million lbs. U3O8e) in 2009 and 14,806 MtU (38.5 Million lbs. U3O8e) in 2010, which likely induced utilities elsewhere to hold onto existing inventories or increase them during this period.

8.3. European Utility Information

Inventory data reported annually by the EURATOM Supply Agency:

- The average annual inventory held by European utilities for the 143 operating reactors and 6 reactors under construction grew at a rate of 3% from 2006 to 2010, before declining slightly in 2010, to a level of approximately 45,272 MtUe, or approximately 117.7 Million Lbs U3O8e. This historical build-up and the current declining trend are due to contracting during the rapid run-up in market prices which culminated in mid-2007. Inventory build-up will accrue as previously contracted deliveries are made.
- This is consistent with the WNA data and with comments from US utilities that they are currently working off inventories built up during the price run-up.

8.4. OPG Inventory Levels in Comparison to Other Utilities

OPG's inventory policy is to maintain a minimum inventory of 1 million lbs. U3O8. Inventory can be higher, subject to Physical Coverage Limits, if market conditions warrant. In contrast, Several US utilities surveyed indicated they maintain a minimal inventory level, or were moving toward reducing uranium inventories built up during the 2007 rapid run-up in prices.

Comparison of OPG inventories to those held by other generators should be made on the basis of percent of requirements represented by the inventory. OPG's annual uranium requirements, as shown in Table 3 are about 2 million pounds per year. Therefore, a one million pound inventory is about 50% of annual requirements. There is, however, additional inventory in the form of finished fuel which contains approximately 2 million pounds. No US utility carries finished fuel as inventory except for the very short time between when it is delivered and when it is placed into the reactor. OPG is carrying about 1.5 years of inventory, including finished fuel, or 150% of annual requirements. Further discussion of OPG's inventories is included in Section 12.

This can be compared to a large generator in the US with annual requirements of nine to ten million pounds per year. This utility carries an inventory of about 3 million pounds or between 30 and 35% of requirements. This utility does not maintain an inventory of finished fuel but due to its number of reactors always has uranium in process for the production of new fuel assemblies.

8.5. Risk Assessment Methodology

Several utilities employ a risk management-based method to determine their desired inventory levels. The method begins by establishing the utility's physical supply risk by reviewing all supply contracts in the context of assurance of supply. For example, a uranium supply contract may have an attractive price but the source is located in an area of political instability. Another concern might be related to the physical conditions at the mine, such as those mines in the Athabasca Basin that have flooded. Each contract must be examined to ascertain its risks.

Once the risks have been identified, they must be quantified. The utility must assign a probability to the event(s) and determine the consequences if the event occurs. Determining the consequences requires the fuel analyst to estimate the duration of the interruption, since it is assumed that there is a temporal component to the event (a flooded mine can be pumped dry and recovered but it takes time; other types of interruptions may be seasonal in nature and last only for 2 or 3 months and have little impact on the overall risk profile). The risk is determined by multiplying the probability by the consequences.

The identified risks must be placed in the context of the utility's contract portfolio. For example, the consequence of a supply disruption will be greater for a utility with a small number of contracts than for a utility with a large number of diversified supply contracts. The context is determined by utilizing some of the information already in place.

The real questions to be answered are: "What are the physical risks"? and "How long can the utility continue to fuel its reactors if there is a supply disruption"? Getting to answers is achieved by looking at material already in process and future deliveries from other sources. The result of the analysis will express forward uninterrupted coverage in months. Once that is known the utility can determine inventory levels and inventory forms that will protect it from a supply disruption.

This method of determining appropriate inventory levels arrives at a specific quantity and form of inventory based on the utility's risk perception. The method

is specific to a point in time and the underlying analysis must be repeated as circumstances change. The results should also be periodically reviewed to assure that they are still relevant.

Once the physical risk situation has been assessed, many utilities move on to add Financial Risk to the inventory form and level determination. The process is similar, however, this time it is focused primarily on price risk. The analysis is contextually the same, but the cost of offsetting the Financial Risk come into play. Therefore the utility must factor the capital and carrying costs into the analysis.

If the result of the Financial Risk assessment concludes that the inventory should be larger than the inventory levels derived from the Physical Risk assessment, higher inventory levels can be justified. Our observation is that the duration of price spikes tends to be relatively short and quite often the inventory being held for protection from supply interruption is sufficient to cover a period of price spike.

9. Uranium Prices, Markets and Transactions

9.1. EIA Market Price Information

In the US, the EIA reported that in 2010, 82% of deliveries to US utilities, or about 38.5 million lbs U3O8 were under term contracts at an average price of $50.43 / lb U3O8. The remaining 18% or 8.5 million lbs U3O8 were under spot sales and had an average price of $46.45 / lb U3O8.

The chart below (Figure 5, **Uranium Prices**), reflects the annual average prices paid by OPG compared with US EIA's weighted average price of uranium purchased by owners and operators of US reactors, together with UxC's published indicators for the spot market (Ux U3O8 Price) and prices reported for new long term contracts, the long-term market price (Ux LT U3O8 Price).

The US EIA and OPG ranges were calculated using the US EIA-developed methodology to minimize over-emphasis of outlier data points. The high ends of the US EIA and of the OPG ranges reflect the average price for the highest $1/8^{th}$ of the total volume purchased. The low ends of the ranges reflect the average price for the lowest $1/8^{th}$ of the total volume purchased. Therefore, actual prices for the very highest and very lowest priced deliveries will be outside of the identified range shown in the chart below.

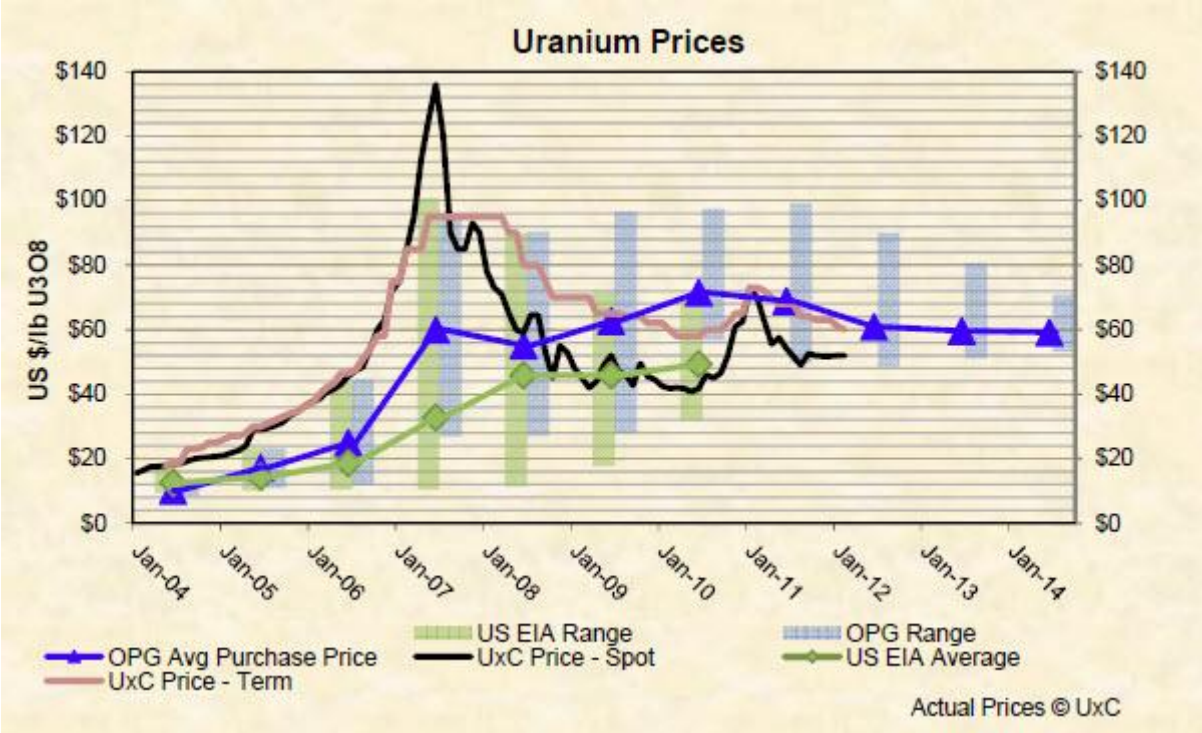


Figure 5 – Uranium Prices

The divergence of the OPG Average Purchase Price with the US EIA data for US utilities reflects the impact of legacy long-term fixed price and base escalated contracts in the US EIA Average prices.

As noted previously, if utilities buy uranium under such contracts, they are protected against fluctuations in the market price, but pay a premium if market prices are subsequently lower at the time of delivery. Conversely, if market prices are above the fixed price at the time of delivery, the utility benefits. The divergence may also reflect reduced buying activity in the spot market by US utilities as prices rose. As discussed, in the 2007 ramp-up of prices there was heavy speculative trading activity in the spot market by financial entities in an effort to extend the price ramp-up. The prices involved in these trading activities by financial entities, are not reflected in the US EIA data in Figure 5.

Another factor to be considered is that utilities with Light Water Reactors (LWRs), in the process of enriching the U235 isotope for their LWR fuel, are able to optimize their input of UF6 feed versus the amount of enrichment required or Separative Work Units (SWU) utilized. For a given enrichment assay required for their fuel design, utilities have a degree of flexibility with their uranium enricher, which depending on their contract terms potentially allows them to reduce uranium requirements by as much as 20% and correspondingly increase SWU

purchased. In times of high uranium prices they increase the quantity of SWU purchased and utilize marginally less uranium, as many utilities did as prices rose in 2007. OPG's CANDU reactors do not use enriched uranium and cannot, therefore, make this tradeoff.

9.2. Comparison of Uranium Pricing with Other Markets

In the uranium market, there is no central clearinghouse for transactions, and as recently, there are weeks when relatively few transactions occur. Price reporters such as TradeTech and UxWeekly must make frequent phone or e-mail inquiries of market participants in order to gather transaction information. They are subject to receiving misleading trading information, and many transactions occur "off-market" and are only revealed to the price reporters much later, if at all.

There are a small number of brokers publishing bid and ask quotations for relatively small quantities of uranium. The Uranium Spot Market is not equivalent to the London Metals Exchange. There is no central market location, no "open outcry" of bid and ask by individuals in a trading pit. There is no mandatory reporting of transactions or verification of prices paid as in the London Metals Exchange.

9.3. Contracting Parties Active in the Uranium Market

Over the last several years there have been numerous efforts to improve the transparency of the uranium market by establishing a formal market to trade uranium. The London Metal Exchange investigated the possibility with an international group of producers and utility consumers. After more than a year of trying to establish a trading floor for uranium, the attempt was abandoned. The London Metal Exchange reviewed the business case and concluded that the volume of transactions was too small to allow the Exchange to operate a profitable business.

A subsequent effort was undertaken using the model established by buyers and sellers of steam coal. The WNA established a task force to investigate emulating the steam coal program. Once again, the forecasted volume of uranium trades was determined to be too small to support the overhead related to operating a formal exchange. The relatively small size of the uranium market can be seen by comparison to the natural gas market. The gas market can involve hundreds of thousands of trades per day whereas the uranium market may see only a few hundred transactions in a year.

The lack of a formal exchange for uranium limits the degree of price transparency when compared to that found in formal commodity markets. As a result of the impracticality of establishing a formal exchange for uranium, transactions in the uranium market generally involve direct contact between buyers and sellers. The fact that there is no formal exchange also means that there is not a standard contract, but rather a wide range of contract terms and conditions that are negotiated for each contract.

Spot market contracts are relatively straightforward. The price is tied to the price as published by Ux or Trade Tech for the month of delivery. There may be a small discount offered if there is a buyer's market, but there is no guarantee that that will be the case.

Long-term or term contracts are more complex with several parameters to be negotiated. The price can be a base escalated, often with step-wise increases in various out years, referred to as a fixed price. The price escalation can be based on changes in economic indices published by government entities such as the United States Bureau of Labor Statistics, or it can be tied to a combination of the spot price and the long- term price, (although use of this indicator is no longer in favor). Items such as the date at which the escalation begins (Base Date) and how much of the price is escalated (percentage escalated) are important parameters in a term contract.

Since the term of the contract can be as long as 10 years or more, it is important to have price reopeners in the contract to protect both the buyer and the seller. Another feature of term contracts that can protect both sides is floor and ceiling price limits. These limits constrain the impact of market volatility on the contract price.

In 2011, the ratio of term to spot contracting was about 2 to 1. More than 100 million pounds were sold under term contracts while the spot contract volume was 45-55 million pounds.

There were well over 300 transactions in the spot market versus about 25 in the term market. This is consistent with the split in prior years.

When markets are moving there are predictable behaviors on either side of transactions. Essentially, sellers want to maximize their profit and buyers want to minimize their costs. If prices are moving up, sellers will be reluctant to offer price ceilings that will protect buyers. Conversely, when prices appear to be falling, buyers will be reluctant to accept floor prices that will protect sellers. If prices are

falling, utilities may find themselves competing in the market against seller's taking advantage of low spot prices to acquire uranium below their cost of production.

Market prices can also be influenced to some extent by the activities of brokers and traders who may try to move the market to their own advantage. Producers also may buy spot quantities near the end of the year in an effort to increase spot prices, improving revenue generated from their market-priced contract portfolios, a significant portion of which may have year-end deliveries.

Other considerations, aside from floor and ceiling prices, also influence the negotiation of term contracts. These include the proportion of the price to be escalated, the base escalation date, and the index or indices selected for the escalation calculation.

Although sellers' prefer that the entire price be escalated, the reality is that not all of the cost components actually escalate over time. Some components, such as the capital cost of a mine are largely fixed and do not vary with production. As a result, it is appropriate for the Buyer to negotiate a position that escalates only a portion of the price. A fixed component should be based on an analysis of the mine costs for the source of the material. If there is no specific mine identified then the analysis may include reviewing the cost of production at all of the facilities owned by the seller. It is not unreasonable to find that 20% of the costs are fixed which would result in a coefficient such as 0.80 being inserted into the escalation equation, which effectively eliminates the fixed costs from escalating.

In a seller's market, the seller will want to have the escalation begin as early as possible. In this circumstance, it is not unusual for sellers to ask that the price escalation begin at the time of contract signing, as opposed to the timing of the first delivery under the contract. The buyer, naturally, will want the escalation to begin as close to the first delivery date as possible. This difference is usually negotiated to a compromise that balances the interests of both sides.

Uranium producers and utility end-users predominate as buyers and sellers in the long term market. However, pure traders, entities that neither produce nor consume uranium, also are active in the uranium market and acquire positions in uranium. Uranium producers may also act like traders purchasing uranium to meet contract deliveries, or to leverage market prices for their contract portfolio.

Brokers also participate in the uranium market, typically negotiating deals for a small number of counterparties, often financial entities, and generally involving

small volume transactions. Their activities impact uranium prices to a greater degree than their size would justify.

Financial entities with a particular price risk exposure seek to influence the price direction especially at month end, in an effort to push prices in a direction that will be beneficial to them.

The lack of a formal exchange to facilitate buying and selling uranium is likely to continue, since the number of participants and transactions is not expected to increase sufficiently to support a formal exchange.

Given this lack of an exchange, the traditional market price risk mitigation mechanisms are not widely utilized for uranium. Uranium futures are not traded in sufficient volume to provide an adequate hedging mechanism for utilities' uranium price exposure. Instead, utility fuel buyers structure their supply portfolios to include contractual pricing terms which protect against market price risk. They achieve this protection by maintaining a portion of their supply arrangements with fixed or base-escalated pricing.

9.4. Alternative Transactions - Off Market Solicitations

A significant number of US utilities initiate "off market" solicitations (i.e. solicitations that are not initiated through a formal Request for Proposals), essentially negotiating with a limited number of suppliers, and "off market" transactions have become the predominant procurement method for private US utilities.

In recent years, nearly 90% of current spot market activity has been classified as "off-market." Utilities either solicit offers or are presented with offers by incumbent suppliers seeking to add-on additional coverage to existing contracts. US utilities also will initiate counter-offers, negotiate simultaneously with multiple suppliers and offer add-on delivery commitments in these negotiations.

Pricing mechanisms are not the only parameters that may be negotiated in an off-market deal. Payment terms and timing are often more favorable in off-market transactions. The terms available can include discounts for a short payment period or changes to the date at which escalation is begun. For example, in a seller's market the escalation may begin at the contract signing date, however, in an off-market transaction the date may be moved closer to the initial delivery date.

Off-market transactions are generally viewed as beneficial to both buyers and sellers since they offer the opportunity to conclude arrangements privately that

would have an impact on the market if the transaction or the terms and conditions were made public. All of the terms and conditions of the transaction, not just pricing, can be maintained as confidential by both parties. Sellers are able to offer terms to close the deal in a buyer's market, without the negative impact on published prices that would result if the transaction details were publicly known. Conversely, in a seller's market the confidential nature of the transaction can benefit the buyer.

9.5. Spot Market

Utilities also undertake intermittent opportunistic activity on the spot market. They take advantage of potential opportunities to acquire supplies at spot prices, sometimes reducing existing commitments using flexibility in their existing supply contracts, while continuing reliance on the long-term contracts for assurance of supply in out years.

10. Supply – Demand Overview

Most industry participants rely on the World Nuclear Association's biennial report for projections of uranium supply and demand. The most recent edition, *The Global Nuclear Fuel Market: Supply and Demand 2011-2030,* was released in September, 2011.

Conditions can vary dramatically in a dynamic market such as the uranium market, with situations such as the flooding of Cameco's Cigar Lake mine, and ongoing reaction to the Fukushima accident, impacting the market. Having the ability to recognize attractive timing for entry into the market, albeit within the constraints of mitigating physical supply risks, can have a significant effect on the overall costs incurred by a utility.

10.1. Role of Financial Intermediaries in the 2007 Uranium Price Spike

An important, but challenging aspect of a successful procurement program is the ability to recognize the reasons for price spikes. The spike that occurred in 2007 was initiated by a number of supply disruptions and was amplified by financial intermediaries who seized upon the belief that there would be a shortage of uranium due to the forecasted construction of new power plants and the planned end of the Russian nuclear weapons downblending known as the Megatons-to-Megawatts program.[2] While both were legitimate concerns at the time, the price overshot the level needed to support exploration and development of new mines. It is evident given increased mine development

[2] The results are very similar to the spike in the palladium market that occurred in the late 1990s. The same phenomena occurred there, i.e., a rapid price rise to an irrational level followed by a rapid drop in price to a more appropriate level related to the underlying market fundamentals.

since 2007, that new uranium mines need a long-term price of at least $65/ lb U3O8 in today's dollars, to support the forward production cost of the marginal mine needed to deliver the last pound required to the market. This price does not include the capital cost of exploration and mine development. Adding the capital cost component will likely drive the price into the range of $80 - $85 per pound. The decision on the part of a mining company to proceed with mine development also hinges on their analysis of demand for uranium going forward. The miners want to be sure that demand for their product will be there and utilities want to be sure that uranium supply will be there when they need it.

Examination of the trades being made at the time found that the price was pushed to an irrational peak mainly by trades made between intermediaries, and not by the activities of uranium producers and utilities.

The 2007 price spike was very different from the price spike in the early to mid-1970s. In the 1970s there was a "false" demand created by the US Government's requirements for "Early Feed" deliveries under the DOE's uranium enrichment contracts. This apparent demand, however, was not supported by reality because many of the planned nuclear plants that drove it were cancelled even before the events at Three Mile Island Unit 2.

Keeping a very close eye on the fundamentals of the uranium market is a necessary step to take in order to minimize purchases in an overheated market.

10.2. Current Market Situation

The current uranium market as of early 2012 is relatively in balance; essentially supply and demand are in equilibrium, with spot prices holding around the low $50s. Utility end-user demand is essentially satisfied for the next few years. Few spot transactions are being reported, as financial entities and traders are not active in the market.

Worldwide inventories are building due to reduced utilization of uranium in the aftermath of the Fukushima accident, the shutdown of 8 reactors in Germany with the remainder scheduled for closing by 2022, and 52 of the 54 Japanese reactors currently shut down for annual inspection, with growing public opposition leading to indeterminate delays in restarting the reactors, as well as generally delayed construction schedules for new reactors in China and elsewhere.

There have been expectations in the market that uranium producers with sales contracts with Japanese utilities may now seek alternate consumers, although on February 24, 2012 Kazatomprom stated that their Japanese utility customers would accept contracted deliveries scheduled to begin this year. Japanese trading companies are actively seeking to place excess inventories held by the Japanese utilities with other buyers, while not disturbing the current market price levels.

Although there are no widespread reports of cutbacks in investment, uranium producers see uncertainty in the current uranium market, related to the situations in Japan, Germany, and elsewhere.

10.3. Outlook for the Future

This situation with excess inventories and uncertain demand is anticipated to extend for the next 18-24 months. There are also some expectations that uranium market prices may be soft and even slightly decline over this period as the Japanese plants remain off line and construction of new plants in China gradually resumes.

In spite of the impacts from Fukushima and other factors described above, the longer-term outlook still remains strong for future uranium demand. Last year, TradeTech estimated that the impact of Fukushima would result in a 2-3 year delay in demand and a reduction in uranium requirements of about 9%, or about 263 million lb U3O8, for the period between 2011 and 2025. Given ongoing delays in resumed operation of reactors in Japan and new construction in China, TradeTech is currently updating this outlook.

There is also uncertainty surrounding the 2013 ending of the 24 million lbs U3O8e supplied annually from the Megatons-to-Megawatts program. Some in the uranium industry and the investment community postulate that a supply deficit could occur if new mine capacity, such as Cameco's Cigar Lake, is unable to smoothly ramp up production. Prices may even rise precipitously, leveraged by speculative buying by financial entities and traders active in the market.

The WNA took the accident at Fukushima into account with respect to its mid-2011 forecast of uranium demand in its Market Report dated September 2011. The impact of the accident was reflected in the reactor requirements for Japan and Germany with respect to the number of operating reactors, at that time. The report also reduced projected uranium demand from Switzerland, Belgium and prospective countries such as Italy. While the adjustments are an important

reflection of the negative impact of Fukushima, demand from the number of new reactors moving forward overcomes the negative impact. Overall, near-term demand is suppressed, but it is expected that in the longer term that demand will rebound by about 2020.

Financing for new uranium projects will become increasingly difficult in the post-Fukushima environment, making it even more important that utilities contract long term in order to assure supplies.

11. L&A's Assessment of OPG's Uranium Procurement Strategy

11.1. OPG's Procurement Objectives

- Ensure adequate supplies of uranium are available to meet the operational requirements of OPG's nuclear units, a combined 6,600 MWe of generating capability at the Pickering and Darlington Nuclear Power Stations.
  Assessment: OPG has successfully ensured that adequate supplies of uranium have been available to meet reactor operating requirements through forward contracting.

  We find OPG's uranium contract coverage consistent with the aggregated contract coverage of US utilities as published by the US EIA.

- Manage the risks, particularly the price, market and credit risks, associated with the supply of uranium, and
- Minimize costs consistent with the other objectives.
  Assessment: OPG has successfully managed market and credit risks associated with uranium supplies by diversifying its supply portfolio and continued evaluation of the credit risks of individual suppliers.

  In 2007, in the face of dynamic market conditions with rapidly rising prices and predicted supply shortages, OPG experienced some contract portfolio exposure to high uranium prices, as did a number of other utilities. OPG continues to review uranium purchase strategies and inventory holding costs consistent with other objectives.

OPG's procurement objectives are met through the following methods:

- Purchase within physical limits
  - Forces regular entry into markets, which reduces significant fluctuations in the average price paid by OPG

    Assessment: OPG's Physical Coverage Limits provides a band of procurement volumes for each of the next ten years, introducing market opportunities on a regular basis and provide flexibility to manage the timing of procurements if the market is perceived as subject to a short term price spike.

    Recommendation: We recommend that OPG maintain, consistent with the physical coverage limits, a continuing presence in the uranium market by frequent market contracting in order to maximize opportunities to achieve attractive contract terms and encourage potential suppliers to solicit OPG's business.

  - Encourages diversity of supply, which reduces the impact of individual supply disruptions

    Assessment: OPG's current supply portfolio is diverse and its procurement plans and evaluation criteria continue strategies that diversify supply sources, minimizing the risk of delivery default by an individual supplier.

- Purchase within financial limits (portion of supply under "fixed" price arrangements)
  - Mitigates near term market uncertainty

    Assessment: OPG's Financial Coverage Limits provide a band of procurements of fixed price or base escalated contracts, declining in out years, in an effort to mitigate the impact of price fluctuations.

  - Encourages diversity of price mechanisms

    Assessment: OPG's Financial Coverage Limits encourage a balanced procurement of fixed price and base escalated pricing mechanisms, together with market-related pricing mechanisms and spot market purchases.

- Operate within credit limits
  - Mitigates exposure to the financial impact of default risk

    Assessment: OPG's counterparty credit limit constraints limit exposure to potential default by uranium suppliers.

- Encourages diversity of supply

  Assessment: OPG's strategy of operating within counterparty credit limits also encourages diversity of supply by limiting the volume of commitments to any one supplier.

- Maintain a strategic inventory of uranium
  - Mitigates the impact of supply disruptions and ensures continuous reactor operations

    Assessment: OPG's strategic inventory of uranium provides a supply cushion to assure continued reactor operations in the event of specific supplier or industry-wide disruptions in supply. The level of strategic inventory has not been re-assessed at OPG in a number of years.

    Recommendation: Risk evaluations as to the appropriate level of strategic inventory should be undertaken on a more frequent basis and consider significant industry issues such as AREVA's financial retrenchment, Cameco's ability to ramp up Cigar Lake production, the impact of Fukushima on uranium demand and mining expansions, and the ending of Megatons-to-Megawatts program. These developments warrant keeping a close watch on mine development activities. Being aware of progress related to mine development is an appropriate way to strengthen OPG's ability to foresee changes in market conditions before they become generally known.

- Employ competitive and fair procurement practices
  - Provides the opportunity to achieve the best value for money

    Assessment: OPG's procurement practices encourage competition among suppliers.

- Objectives should guide procurement decisions and be reflective of the current operating situation and regulatory environment.

  Assessment: We find OPG's Procurement Objectives appropriate and fully inclusive of the factors which should be considered in a uranium procurement program.

11.2. Supply Risks and Mitigation

Were OPG's contracting decisions appropriate regarding timing, quantity, and supply diversity?

It is our perspective that OPG's uranium procurement activities have been effective and appropriate, with qualified suppliers and geographic diversity, and

reasonable prices have been achieved based on the market conditions at the time of each uranium procurement.

In our review of OPG's Uranium Procurement Plans and bid evaluations, we found due consideration was given by OPG as to timing of market entry, quantities sought, description of procurement alternatives, assessment of supplier capabilities, risk of performance, and geographical diversity. OPG has achieved a mix of contracts (spot, short term versus long-term, fixed price versus market-related, etc.) that balance the risks related to security of supply and price. The balance achieved is similar to that of other large uranium consumers. The procurement decisions must balance the physical and price risks rather than focus solely on one or the other and OPG's approach achieves this goal

Assessment: In our view OPG's uranium procurements have been undertaken in a professional manner, with consideration for timing of market entry, quantities purchased, diversity of supply, relative capabilities and risk of performance of suppliers, and an appropriate mix of contracts (e.g., spot, short term versus long-term and fixed price versus market-related). We believe that OPG has optimized its contract portfolio with respect to protecting itself from both supply and market price disruptions.

11.3. Price Risks and Mitigation

In the specific instance in the 2007 Procurement, OPG was faced with a very difficult market during the 2007 price run-up. The long term contract entered into in that procurement was concluded during a period of very high prices in the market associated with a growing perception of potentially insufficient supplies in the future and competition from new build reactor demand. It was a period with strong competition from other buyers and financial intermediaries resulting in a strong sellers' market. We evaluated the pros and cons of the contract as follows:

- Deliveries from the November 15, 2007 contract of 500,000 lbs per year from 2009-2011 and 250,000 lbs U3O8 per year from 2012-2017 do not represent an overly large portion of OPG's future requirements. They also provide security of supply out through 2017, an ongoing period of supply uncertainty regarding new mine development, especially in the post-Fukushima environment.
- This contract's escalated Base Price is high compared to current price levels, but consistent with the market at the time the contract was awarded.

- Over the life of this contract the price provisions are attractive in that they provide a gradual transition to a discount off the spot market price over the 2012-2014 period from the escalating base price in 2009-2011. During the final three years of the contract, 2015-2017, the discount off spot market price is in effect and will be more attractive than reliance on spot market purchases over that period.
- L&A's initial view was that this agreement might present an opportunity for OPG to negotiate near term price concessions with the supplier in exchange for offering to commit additional contract supply coverage. OPG related that it has explored such options and found them to be not economically competitive with alternative supplies.

Assessment: We find that OPG made appropriate uranium contracting decisions regarding price risk in a period of dynamic price volatility and growing uncertainty. We believe that the 2007 long-term contract provides OPG with assurance of supply over a future period of uncertainty, although with a significant price premium for the 2009-2011 deliveries.

11.4. Recommendation on Contract Improvements for Future Uranium Procurement.

Dynamics in the term uranium market can provide or remove attractive terms and conditions. Such terms as contract quantity flexibility, pricing based on a nominal percentage discount from the spot market price at time of delivery, no-cost options for additional quantities, extended payment terms, short notice periods, price re-openers on long-term contracts, and dedicated inventories held by suppliers can often prove very attractive for the buyer.

The reality of the uranium market is that when prices are trending upward and there are fewer suppliers competing, attractive contract terms may no longer be achievable. It is therefore incumbent upon a utility to maintain a presence in the market to determine the currently offered terms and conditions. Aggressive fuel managers will explore these attractive terms in negotiations with a "short list" of potential successful bidders in term contract procurements, or in "off-market" negotiations. By continuing to have an ongoing presence in the uranium market, OPG will recognize opportunities to achieve attractive contract terms.

Recommendation: Exploring "off-market" negotiated transactions may provide value to OPG in terms of lowering costs and providing terms and conditions that are not offered in open market transactions.

11.5. OPG's Risk Limits

11.5.1.1. Physical Risk Limits

OPG's Physical Coverage Limits provide a valuable tool to assess forward commitments and the utilization of inventories. Applying the methodology incorporates critical thinking into the process and establishes parameters for evaluation of various procurement alternatives such as purchasing spot, mid-term, long-term contracting, or buy-and-hold strategies, etc. Looking out into the future to determine an appropriate level of physical coverage is difficult unless parameters are considered on a consistent basis.

OPG's Physical Coverage Limits provide a quantitative range of acceptable uranium supply arrangements, a situation that is generally approached in a less structured manner by other fuel management groups. The range allows for uncertainties in requirements and market conditions and allows for some pragmatism in planning uranium purchases. The procurement strategy also has controls related to the risk limits that ensure the targets are not exceeded without review and approval.

Having the Physical Coverage Limit range also provides a basis for evaluating procurement alternatives or adverse scenarios in light of real supply and demand situations. For example, "what happens to our program if our Supplier A has a mine flooding and declares *Force Majeure* on its commitments?" Firstly, one would expect the supplier to make every effort to secure alternative uranium supplies from other operations or purchase them in the market, as one supplier has done recently. But if OPG's contract delivery price is lower than the current market price that may not be a realistic expectation.

Risk limits methodology can be a valuable tool if it is frequently assessed against current market perspectives, such as changing uranium market dynamics, the impact of financial players in the uranium market, changes in uranium demand and uranium mining developments.

Absent frequent calibration, the potential exists to perpetuate a band of physical coverage, which could understate or overstate the optimal level of forward commitments and inventory utilization. OPG frequently reviews their purchasing plan in light of market conditions and their strategy. They then adjust the plan based on the findings of the review.

This is a good practice. OPG's procedures require a review of the limits at least every 2 years. Their procedures also allow for more frequent reviews. However, OPG's risk limits (Physical and Financial Coverage Limits) were last approved by OPG's Enterprise Risk Committee in August 2008. We agree with the need to review and adjust limits on a regular basis due to changes in the future supply/demand outlook for uranium. Given the current uncertainty in the uranium markets, we encourage OPG to undertake such a review.

We recommend that OPG revisit the Physical and Financial Coverage Limits on a more regular basis.

11.5.1.2. Financial Risk Limits

L&A approached the assessment of OPG's Financial Coverage Limits by evaluating the purpose intended. OPG stated that the purpose of their Financial Coverage Limits methodology was to establish a formal guideline that represents the optimal mix between fixed and variable price supply.

This guideline is used to define the optimal trade-off between fuel cost risk and the forgone opportunity cost. If OPG buys under a fixed price contract, it is protected against fluctuations in the market price, but is potentially subject to paying a premium, if the ultimate delivery price is higher than the spot market price at the time of delivery. Conversely, if the delivery price is lower than the spot price at the time of delivery there would be a discount to market. The point here is that the limits are in place to define a range of acceptable price trade-offs.

When purchasing under a market index priced contract, for example one based on the spot market price at time of delivery, OPG is subject to price risk and uncertainty as to the cost of the forgone opportunity to buy later at a fixed price that may be lower.

It is important to OPG to maintain the appropriate portfolio balance as guided by its Financial Coverage Limits. A Balanced portfolio of contracts in a well managed procurement process eliminates speculative behavior.

Maintaining a balanced mix of fixed price contracts and market-related contracts has proven desirable to both uranium buyers and suppliers. As mentioned previously in this report, this factor has resulted in the growing use of "hybrid pricing" in long term contracts.

OPG's Financial Coverage Limits analysis only applies to fixed price contracts, therefore the large portion of future supply contracts based on market price mechanisms, and any future spot market purchases are not included in the Financial Coverage Limits evaluation.

We anticipate that over time price determinants in long term contracting will continue to evolve. As an example, the nascent effort by some suppliers in marketing multi-year contracts to apply the Long Term Price Indicator to determine the Delivery Price in contracts has been rejected by market participants. Contracting formats can be expected to continue to evolve.

The objective of OPG's Financial Coverage Limits is to provide a degree of price certainty for future deliveries under current Long-term contracts rather than to control the absolute level of price paid.

Recommendation: We recommend that OPG ensure that its Financial Coverage Limits continue to enable effective monitoring of the degree of price certainty as new pricing determinants emerge.

Financial limits should also be reviewed on a periodic basis. Items such as OPG's current weighted average cost of capital should be monitored to assure that the cost to carry inventory is accurately forecast. This may present opportunities to buy and hold if market prices are attractive. This information is important to have readily available when presented with unsolicited offers. Being able to quickly assess and execute offers will give OPG an advantage over most other potential buyers.

Assessment: We find that OPG's Risk Limits provide an appropriate methodology to optimize contracting with regard to forward commitments and the balance of fixed price and market priced contracts.

12. Inventory Levels

12.1. OPG's Strategic Inventories

OPG has a uranium concentrate target inventory level of 1 million lbs U3O8 on hand. The Physical Coverage Limits also allow OPG to increase the level of U3O8 inventories if market conditions make it prudent to purchase more than is required, to be held for future use.

In addition, OPG maintains individual inventories at each stage of the nuclear fuel supply chain.

- An inventory of finished fuel bundles equivalent to 12 months expected forward usage to allow continued fueling.
- A working inventory of UO2 to feed the manufacturing process, described generally as a 2-3 month UO2 working inventory,
- and the UO2 conversion supplier is also contractually required to maintain and inventory of UO2 for OPG's use in the event of a supply interruption.

With 10 units between Pickering and Darlington, OPG may be able to reduce inventories. The steady stream of incoming uranium under contract, combined with material in process, either at the conversion or fabrication stage, is a significant hedge in itself.

L&A estimates the value of the uranium contained in inventories carried by OPG to be on the order of $170 million based on the following:

- $50 million for the Target Inventory (1 million Lbs U3O8 @ $50/lb U3O8)
- $100 million for U3O8 contained in 12 months of Finished Fuel Bundles (2 million Lbs U3O8@ $50/ lb U3O8)
- $20 million for the 2-3 months of UO2 working inventory (400 thousand Lbs U3O8 @ $50/lb U3O8)

It is our view is that these multiple inventories provide an opportunity for reduced investment by OPG, potentially reducing annual inventory carrying costs, which we estimate as approximately $12 million per year ($170 million @ 7% per year). There appears to be significant potential to "optimize" the existing multiple inventories.

- The quantity of material to be held as "strategic inventory", as OPG's Target Inventory is considered, should be based on a risk assessment that is specific to CANDU reactor operational needs and the OPG fuel supply portfolio. We assume that the one million pound quantity was arrived at earlier based on a "comfortable round number", rather than a quantity which is analytically derived.
- Regarding the existing Finished Fuel Inventory of 12 months refueling requirements, these inventory levels are justifiable due to different fuel designs at Darlington and Pickering. Therefore, we believe that these finished fuel inventories should be viewed as OPG's primary hedge for supply assurance, or "strategic inventory".

- The volume of the UO2 Supplier Contractual Inventory, should provide sufficient in-process inventory to assure continued fuel deliveries in the event of a supply interruption.
- Utilities generally plan for a maximum of one year interruption of deliveries from any one supplier. A determination should be made as to the most significant future supply risk by any of OPG's uranium suppliers. Assessment of each uranium supplier's risk profile would include evaluating political risks, mine operational risks (flooding, strikes, etc.) and financial risks. The U3O8 contained in the finished fuel inventory should be evaluated as a component to mitigate future supply risk.
- Maintaining a "layered" approach to the expiration of individual uranium contracts, i.e. avoiding concurrent expiration dates, as OPG does, mitigates the risk of adverse impact of a default by any one supplier. Importantly, it also keeps OPG in the market on a regular basis to evaluate potential suppliers.

In summary, while we believe that in a stable uranium supply situation OPG's inventory levels could be reduced, in light of uncertainty as to uranium availability due to possible delays in mine development by AREVA, or the ramping up of production at Cameco's Cigar Lake, and the ending of the Megatons-to-Megawatts program in 2013, we suggest that OPG evaluate on an ongoing basis whether inventories should be retained at current levels.

Assessment: We find OPG's Target Inventory consistent with other utilities' inventory policies.

Recommendation: We recommend an ongoing evaluation of uranium concentrate inventory levels based on an assessment of potential risks of physical supply disruption. The evaluation should consider all of the uranium available to mitigate a supply disruption including uranium to be delivered from other sources, inventory on hand, inventory in process, and fresh fuel ready to be inserted into the reactors. We recommend OPG evaluate its inventory situation on an ongoing basis to optimize assurance of supply while seeking to reduce OPG's overall inventory carrying cost.

12.2. OPG's Procurement Strategy

We believe that OPG's procurement strategy is prudent in today's market. Maintaining a layered series of long term contracts, as OPG does, provides assured supplies. Spot purchases can provide economically attractive opportunities. Continued presence in the uranium market is essential for an

organization with uranium requirements as large as OPG's. OPG's contract portfolio and procurement strategy achieve a mix of market related and fixed price contracts that allows OPG the flexibility to manage the economics of the uranium supply equally well in up or down markets.

We also believe that OPG's procurement strategy will remain appropriate in the context of foreseeable future market conditions. Situations such as the ultimate impact of the Fukushima accident on new reactor construction and the operating status of reactors in countries such as Germany and Japan, are uncertain. Financial decisions on new uranium mine projects also are not yet defined. There is supply uncertainty regarding the ramp-up of new production to replace the 24 million lbs U3O8e per year of uranium derived from the Megatons-to-Megawatts program which ends in 2013. These are significant risks involved in assuring future supplies, and OPG's balanced approach is appropriate.

However, as pointed out above, the supply demand balance for the world wide uranium market has not been permanently disrupted and the prior balance points of supply and demand will shift further out in the future. L&A regards OPG's strategy as appropriate for the market conditions prior to the events at Fukushima, and with ongoing review, we believe it will remain so in the foreseeable future market conditions.

We believe OPG's procurement strategy is consistent with many other utilities, with a mix of spot and long term contracting. OPG has not undertaken the risky approach of relying totally on spot market purchases as did two large US utilities. At the same time, OPG is not overly reliant on fixed price contracts.

OPG's evaluation criteria, proposal evaluations, and supplier diversity have been well founded and appropriate. We see these as strengths of OPG's uranium procurement program.

In reviewing OPG's contracts we find their terms and conditions appropriate and consistent with those in other contracts.

We offer the following suggestions on contract terms and conditions for future contracting to the extent they can be achieved given market conditions. We recognize, however, that it is not always possible for OPG to get its preferred outcome on each and every item, particularly in a seller's market.

- Term contracts should generally be limited to 3-5 years in order to avoid potentially significant price dislocations. Long-term contracts extending beyond this time frame should have price reopeners.
- *Force Majeure* clauses can present a significant risk to the utility. They tend to provide all-inclusive protection for the seller.
- Flexibility in supply volumes should be taken advantage of when market conditions allow.
- Price ceilings should be included in the contract terms. This will normally require the *quid pro quo* of price floors to share the financial risk. The floors and ceilings can be arrived at in many ways, but they are often tied to price indices.
- Price escalation should not be applied to the entire contract price. Some of the uranium supplier's costs are fixed and, therefore, should not be escalated. A coefficient less than one should be incorporated into any price escalation calculation.
- There should be a termination clause in the contract. It may never be used, but it is prudent to have it in place.
- In our view, frequent spot market and midterm market purchases provide simpler contracting formats, although we recognize that some base level of long term contracting is necessary to stimulate new uranium mine production and mitigate supply risk.
- When market conditions allow, pricing mechanisms in term contracts should be based on a slight discount from an average of multi-month spot postings rather than the then-current long term price postings.

In a term contract, the buyer is providing an assured long-term sales opportunity as an incentive for the producer to extend mine production. In contrast, the future Long Term Price Indicator essentially represents the cost structure for a subsequent increment of production.

In addition, currently there are insufficient data points to provide a valid price assessment using today's Long Term Price Indicators.

Finally, accessing and evaluating comprehensive market information on a constant basis is vital to sustain an effective uranium procurement program, especially for a nuclear organization with requirements as large as those of OPG.

13. Summary Conclusions and Recommendations

Longenecker & Associates provides the following summary conclusions and recommendations:

Conclusions:

- We find OPG's procurement objectives appropriate and fully inclusive of the various factors which should be considered.
- OPG's uranium procurements have been undertaken in a professional manner, using evaluation criteria which give appropriate consideration as to diversity of supply, relative capabilities and performance risk of suppliers, and an appropriate mix of contracts (spot versus long-term, fixed price versus market-related, etc).
- We find OPG's uranium purchasing activities consistent with those of other utilities surveyed.
- We find OPG's forward uranium contract coverage consistent with the aggregated contract coverage of US utilities as published by the US Energy Information Administration (EIA).
- We find OPG's target inventory policy consistent with other utilities' inventory policies, while opportunity exists for an ongoing evaluation of inventory levels based on an assessment of potential physical risks.

Recommendations:

- ***We recommend that OPG maintain, consistent with the physical coverage limits, a continuing presence in the uranium market by frequent market contracting in order to maximize opportunities to achieve attractive contract terms and encourage potential suppliers to solicit OPG's business.***
- ***We recommend that OPG re-assess its Physical and Financial Coverage Limits on a more regular basis.***
- ***Recommendation: We recommend that OPG ensure that its Financial Coverage Limits continue to enable effective monitoring of the degree of price certainty as new pricing determinants emerge.***
- ***We recommend an ongoing evaluation of uranium concentrate inventory levels based on an assessment of potential physical supply disruption risks.***
- ***We recommend that OPG explore "off-market" negotiated transactions that may provide value by lowering its costs and providing terms and conditions that are not offered in open market transactions.***

14. Longenecker & Associates Qualifications

James P. Malone

Mr. Malone is the CEO of International Nuclear Energy Public Private Partners and also serves as Chief Nuclear Fuel Development Officer at Lightbridge Corp, and Vice President Nuclear Fuels at IBC Advanced Alloys. Mr. Malone was Chairman of Hathor Exploration Limited until its purchase by Rio Tinto in December, 2011.

Mr. Malone retired as Vice President, Nuclear Fuels at Exelon Generation Company, LLC at the end of October 2009. As Vice President, Nuclear Fuels Mr. Malone provided the strategic direction and tactical guidance for Exelon's nuclear fuel cycle activities. These activities including procurement of fuel for 17 operating reactors, both PWRs and BWRs. Procurement included uranium, conversion, enrichment and fuel fabrication. Mr. Malone was also responsible for establishing and maintaining an Inventory Policy for Exelon that addressed risks related to security of supply and price. Mr. Malone was also relied upon for guidance for managing used fuel. Mr. Malone's responsibilities also included special nuclear material accounting and safeguards, economics, and fuel cycle cost.

In addition to fuel procurement, Nuclear Fuels also provides reload bundle and core design, safety analysis and plant technical support including fuel reliability, component procurement strategy, and decommissioning strategy. Mr. Malone also guided the interactions of the Nuclear Fuels staff in the regulatory, political and public acceptance areas.

Prior to joining Exelon Mr. Malone served as Vice President and Senior Consultant at NAC International from October 1989 until October 1999. He participated in fuel cycle consulting including the front and backends of the fuel cycle and fuel reliability via NAC's Stoller Nuclear Fuel Division. Mr. Malone gained extensive international and spent fuel cask engineering experience while at NAC. One of his last projects at NAC was the international safeguards system for the Rokkasho Mura reprocessing plant in Japan. This was an IAEA project.

From July 1981 until October 1989 Mr. Malone was at SWUCO, Inc. beginning as a nuclear fuel broker. He was manager, Technical Services and became Vice President in 1986. He also served as Executive Vice President of GRP Consulting providing software Quality Assurance to EPRI and sophisticated software to utilities.

Mr. Malone joined Yankee in 1972 in the fuel procurement group and became Manager of Economic Analysis in 1978. Yankee's fuel procurement group was responsible for Yankee's Inventory Management Policy and Mr. Malone made extensive contributions to establishing and maintaining the Inventory Policy.

Yankee's nuclear fuel inventory policy became very important when the price of uranium began its rapid increase in the mid-1970s. Yankee and the operating companies were able to avoid most of the impact of the price increase as a result of the inventory policy.

In 1968, Mr. Malone began his career in nuclear power as an engineer in the utility reactor core analysis section of the nuclear engineering department of United Nuclear Corporation (UNC). His duties included bundle and core design for Dresden and Yankee Rowe. Mr. Malone also trained in thermal hydraulic analysis while at UNC.

Mr. Malone received a B.S. in chemical engineering (nuclear) at Manhattan College, Bronx, New York in 1968. In 1972 Jim completed an MBA at Iona College, New Rochelle, New York where he was awarded the Graduate School of Business Award for Academic Excellence.

Professional Affiliations

American Nuclear Society:

Past Chairman, Fuel Cycle Waste Management Division

Ronald B. Witzel

Ron Witzel is an independent consultant specializing in utility nuclear fuel procurement and uranium and enrichment marketing. He has over thirty years experience in the nuclear fuel industry and understands both the electric utility and fuel supplier perspective in the nuclear fuel cycle. He has also served as an expert witness, an independent arbitrator, and a uranium marketing agent.

Since March 1993, Mr. Witzel has been consulting for utilities and earlier acted as a marketing agent for uranium producers. After successfully operating as a sole proprietor for three years, Witzel Consulting, Inc. was incorporated in March, 1996.

Mr. Witzel currently provides ongoing procurement consultation to utility fuel managers on uranium and enrichment supply, and has prepared reports for other consulting organizations.

During the 1993-96 period Mr. Witzel served as an expert witness on international uranium trading for a uranium producer involved in a protracted litigation, which was settled in favor of the uranium producer.

In 1995, he provided marketing consultation and facilitated the liquidation of a large uranium inventory held by a former U.S. uranium producer.

During 1996-97 Mr. Witzel acted as marketing agent for a U.S. company developing uranium production in Mongolia, resulting in the successful negotiation of long-term uranium supply contracts with U.S. utilities.

Mr. Witzel is a Principal in Longenecker & Associates, providing expertise in uranium enrichment marketing. In 1998, Mr. Witzel was part of a team seeking to acquire the U.S. enrichment enterprise through a merger or acquisition. The enterprise was subsequently sold through an IPO.

From 1990 through early 1993, Mr. Witzel was employed by NUEXCO Trading Corporation. Initially, his role was to manage NUEXCO's fuel cycle services projects. In August 1991, Mr. Witzel began spending about half of his time working with Global Nuclear Services and Supply (GNSS), NUEXCO's Russian joint venture located in Washington, D.C. In October 1991, Mr. Witzel visited the Urals ElectroChemical Enrichment Plant in Yetkateringburg escorting utility customers.

Prior to 1990, Mr. Witzel was employed by Pacific Gas and Electric (PG&E) for 23 years where his responsibilities included management of out-of-core nuclear fuel. As Director of Nuclear Fuel Management, Mr. Witzel had responsibility for numerous activities including

supply/demand forecasting, fuel cost forecasting, contract negotiations, administration, fuel cost and lease accounting.

During his career at PG&E, Mr. Witzel was also involved in the negotiation of two separate nuclear fuel leases for the Diablo Canyon fuel with a line of credit totaling $450 million. His group had full responsibility for the administration and accounting for these financial instruments.

In addition, Mr. Witzel advised PG&E's Washington, D.C. representatives on pending legislation affecting nuclear fuel. In 1989, Mr. Witzel was elected Chairman of the Edison Electric Institute's Nuclear Fuel Committee.

Mr. Witzel has delivered numerous papers and chaired sessions at NEI and WNA nuclear fuel industry forums, frequently gave testimony before the California Public Utilities Commission during his years with PG&E, and early in his career participated in Congressional Subcommittee hearings on international uranium supply and demand.

In November 2010 Mr. Witzel co-authored with Jim Malone an article in FuelCycleWeek on the difficulties in reliance on price reporting for Long Term Contracts. In June 2011, Mr. Witzel authored an article for FuelCycleWeek on the uranium supply impact of the USEC – TENEX Long Term SWU Contract. He has also participated in Energy Daily Enrichment Webinars in the last several years.

Mr. Witzel received his Bachelor of Science degree in Business and Industrial Management in 1967 from San Jose State University and his Masters of Business Administration degree from Golden Gate University in 1971.