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MISSOURI PUBLIC SERVICE COMMISSION

FILE NO. ER-2014-0258

REBUTTAL TESTIMONY

OF

DAVID HUMPHREYS

ON

BEHALF OF

UNION ELECTRIC COMPANY
d/b/a Ameren Missouri

London, United Kingdom
January, 2015

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Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS

A. David Humphreys. My business address is 18 St Michael's Street, London W2 1QT, United Kingdom.

Q. WHAT IS YOUR OCCUPATION?

A I am principal of my own consulting company, DaiEcon Advisors.

Q. PLEASE DESCRIBE YOUR BUSINESS AND EDUCATIONAL BACKGROUND

A I have worked on mining and mineral-related issues for over 37 years. Between 1997 and 2008, I served as chief economist to two of the world's largest mining companies, Rio Tinto and Norilsk Nickel. In both these companies I had group-wide responsibility for economic and industry analysis and commodity price forecasting. These responsibilities extended across all commodities, including aluminium. I have served on the statistics committees of both the International Aluminium Institute and the European Aluminium Association, including a period as chairman of the latter. For ten years I authored the annual review of the aluminium industry for the trade publication *Mining Journal*.

Since 2009, I have worked as a consultant and as a mining company non-executive director. I have lectured and published widely on the economics of the mining industry. I have been a visiting scholar at the Colorado School of Mines and the Catholic University of Chile in Santiago, a Bosch Fellow at the Transatlantic Academy in Washington DC, and an honorary lecturer at the University of Dundee.

I have a bachelor's degree and PhD from the University of Wales.

Q. PLEASE DESCRIBE THE BUSINESS OF DAIECON ADVISORS

A. DaiEcon Advisors provides strategic consulting services to mining companies, financial institutions and international agencies.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to respond to the direct testimony given by Mr. Dale W. Boyles on behalf of Noranda Aluminum, Inc. Specifically, my testimony evaluates the approach employed by Noranda Aluminum to forecast aluminium prices used in the assessment of future sales revenues for the New Madrid smelter.

Q. YOU MENTIONED THAT YOU HAVE EXPERIENCE IN THE ALUMINIUM INDUSTRY. DOES THIS EXPERIENCE INCLUDE WORK FOR COMPANIES THAT OWN AND OPERATE ALUMINIUM SMELTERS?

A. Yes. As mentioned, I was Rio Tinto's chief economist between 1997 and 2004. Rio Tinto is one of the largest aluminium producers in the world. Like Noranda

Aluminum, Rio Tinto has bauxite mining and alumina refining operations, and operates aluminium smelters around the world.

Q. HOW WOULD YOU CHARACTERISE THE APPROACH ADOPTED BY NORANDA ALUMINUM IN FORECASTING ALUMINIUM PRICES?

A. Noranda Aluminum takes as its starting point the forecast of the average aluminium price[1] for the period 2016-2025 made by consultants CRU in December 2014,[2] expressed in 2013 dollar terms. CRU is a reputable commodity sector consultancy, based in London. Noranda Aluminum has engaged Mr. Colin Pratt of CRU as an expert witness.

Mr. Pratt explains that, in the early years of the forecast period (up to 5 years), CRU forecasts are based on modelling the fundamentals of supply and demand. For this period, the price cycle forecast by CRU is clear and explicit. Out beyond this period, CRU provides its price forecast in the form of a multi-year average. Cycles reflecting variations in economic growth, metal output and inventory levels are implicit in the forecasts. For this second period, Mr. Pratt explains that "CRU forecasts are based on the idea of mean reversion towards a value that is based on the long run costs of production (long run marginal cost or LRMC)."[3] From the standpoint of statistical probability, I (and I believe aluminium industry professionals generally) interpret

[1] Unless otherwise specified, the aluminium price in this testimony refers to the London Metal Exchange (LME) three-month price plus the Midwest Premium.
[2] CRU, *Aluminium Market Outlook*. December 2014. My understanding is that Noranda has relied upon CRU forecasts for various purposes in the past, for example in its presentation to the credit rating agency Moody's on 31 January 2014.
[3] Pratt testimony, page 10.

forecasts like those of CRU to represent an "expected" or "central" case, with equal likelihood of actual prices turning out to be higher or lower.

Mr. Boyles's testimony claims that forecasts such as CRU's do not constitute a realistic basis for projecting expected revenues for a smelter producing and selling primary aluminium since the price forecasts beyond the first few years do not show explicit year-to-year cyclical variation. To overcome this perceived limitation, Noranda Aluminum imposes on the CRU forecast a specified path of price reductions and increases to be assumed for the period 2016-2025 based on select historic patterns of price volatility. Specifically, Mr. Boyles adopts the actual performance of aluminium prices in the 10-year periods commencing 1998, 1999 and 2000 as the "model" for this future cycle. For each period, Mr. Boyles calculates the average level of primary aluminium pricing in the US.[4] Mr. Boyles then calculates the historic variation from the average for each year in the whole 10-year period, in percentage terms.[5] The resulting series of percentage variations from average for the selected historic periods is then applied to CRU's forecast average for 2016-2025.[6] The calculation is detailed in Exhibits A1, A2 and A3 of Mr. Boyles's testimony, corresponding to each of the three-year periods. Mr. Boyles explains the methodology further, as follows:

> By using the ten year period beginning in 1999 for example, to determine projected price for 2016, we applied the variation of 1999 to the real ten year average (16% below average) to the **[redacted]** per pound long-term average [forecast by CRU], to determine a projected real price (in 2013 dollars) of

[4] This consists of the LME three-month price plus the Midwest Premium.
[5] Note that historic price data are converted into 2013 dollar terms in order to assess volatility independently of general inflationary effects.
[6] Note that CRU's price forecasts are also converted into 2013 dollar terms in order to derive historical deviations independent of general inflationary effects. The average CRU forecast for 2016-2025 in 2013 dollar terms is **[redacted]** per pound.

[redacted]. We repeated this step, applying the variation for 2000 as a basis for forecasting the average price for 2017.[7]

I have closely examined Mr. Boyles's exhibits. The calculation corresponding to the period starting in 1999 (Exhibit A2) can be represented in graphical terms, as shown below in Figure 1:

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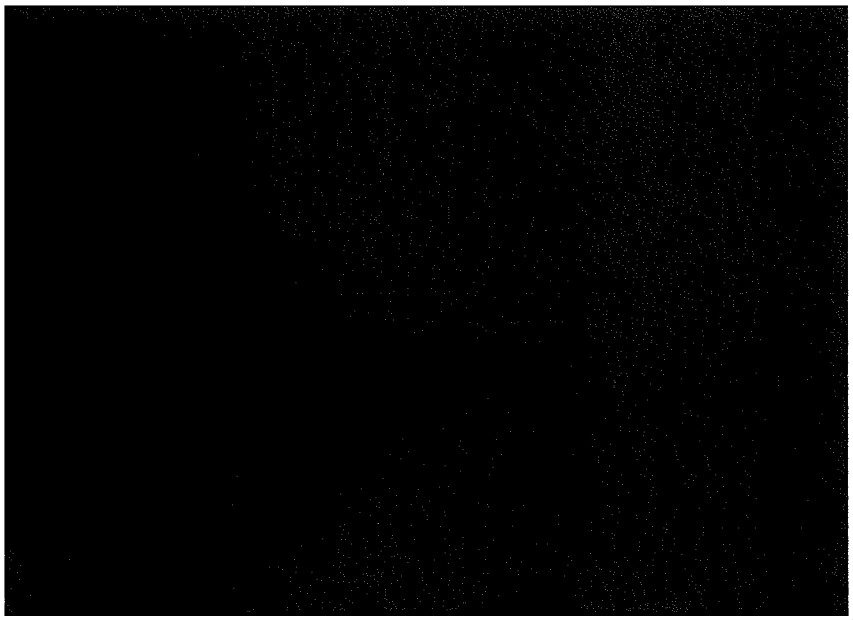

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Figure 1. Graphical representation of Noranda Aluminum's Exhibit A2 volatility analysis[8]

Q. CAN YOU EXPLAIN THE USE THAT HAS BEEN MADE OF THE ALUMINIUM PRICES DERIVED IN EXHIBITS A1, A2 AND A3 IN MR. BOYLES'S TESTIMONY?

A. Mr. Boyles takes the aluminium prices for the period 2016-2025 in 2013 dollar terms derived from his methodology and coverts them into nominal (money-of-the-day) terms using a general inflation factor. He uses the resulting nominal aluminium prices to

[7] Boyles testimony, page 16.

[8] The data for this figure are taken directly from spreadsheets supplied by Mr. Boyles and Mr. Pratt in support of their testimonies. Similar patterns exist for Mr. Boyles's 1998 and 2000 cases, which I have depicted in Schedule DH-R1 to this testimony.

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drive expected revenue assumptions in Noranda Aluminum's cash flow forecasts for the period 2016-2021.[9]

Q. DO YOU SEE ANY PROBLEMS WITH NORANDA ALUMINUM'S APPROACH?

A. Yes, I do. But first I should like to isolate the points where I do not have a problem with Noranda Aluminum's testimony. I wholly accept that aluminium prices are volatile year to year and endorse much of the analysis in the testimony supplied by CRU. I also accept that over time the aluminium price tends to reflect broad cyclical patterns, albeit that the precise length and amplitude of these cycles vary widely. For both these reasons, I am drawn to the conclusion that the future course of the aluminium price cannot be known with any certainty.

Q. SO WHERE DO YOU SEE THE PROBLEMS?

A. First, I see a basic conceptual problem with adjusting the CRU forecast using price volatility experienced over selectively chosen historic 10-year periods to represent an "expected" or "central" case. This is in part rooted in the particular historical time periods Mr. Boyles has chosen to serve as "models" for his future price projections. The time periods cannot fairly be considered representative of market conditions relevant to the period 2016-2025 and are therefore arbitrary predictors for that period. Additionally, I see a problem with the assumptions made about the length of the price cycle. Most fundamentally, however, I believe it is invalid to select any particular prior period of price volatility (or tightly grouped range) to impose upon a forecast such as CRU's for purposes of generating an expected case.

[9] These calculations and the resulting cash flows are detailed in Exhibits A1, A2 and A3 attached to Mr. Boyles's testimony.

Q. PLEASE EXPLAIN YOUR CASE IN MORE DETAIL.

A. I have a general problem with the implication of the approach adopted by Noranda Aluminum that the CRU forecasts do not take any account of price volatility. As already noted, price volatility may not be explicit in CRU's longer-term forecasts but it is clearly implicit. If it is the case, as Mr. Boyles claims (and I am not particularly challenging this), that prices spend more time in cyclical troughs than they do at cyclical peaks, then this will be reflected in the average price forecasts arrived at. In other words, some downside price risk is already built into the CRU forecasts.

A more specific problem I have concerns the particular past cycles which Noranda Aluminum has chosen as the "models" for its forward price projections, namely those commencing 1998, 1999 and 2000. Noranda Aluminum's testimony states that these periods were selected "because they are representative of average conditions" although no explanation is offered as to the sense in which these are "average conditions" or how this conclusion has been arrived at.[10] CRU's statement that "[t]he patterns chosen are a reasonable sample of the potential cyclical patterns that may be faced in the coming 10 years"[11] would appear to stop some way short of fully endorsing Noranda Aluminum's selection of "model" time periods.[12]

In point of fact, the periods chosen appear to be far from average. Despite Mr. Boyles's acknowledgement of the need to avoid "assuming either near term occurrence of

[10] Boyles testimony, page 15.
[11] Pratt testimony, page 22.
[12] The words "potential" and "may be faced" hardly sound like an endorsement of Mr. Boyles's analysis.

unusually positive or negative events like the commodities boom of 2006, 2007, and 2008, or the Global Financial Crisis of 2009,"[13] the 10-year period starting 1998, 1999 and 2000 inevitably capture towards their end the boom years of 2006-2008, a circumstance which has the effect of ensuring that, in the early years of the 10-year periods selected, prices are well are below the 10 years period average. Thus, in the period 1998-2007, the aluminium price was below the period average for the first seven years of the 10-year period, the most successive such "down" years at the beginning of any 10-year period since 1982 when the data set begins. For the period 1999-2008, the price was below the period average for the first six years of the 10-year period, and for the period 2000-2009, it was below the period average for the first five years of the 10-year period. Prior to 1998, the most successive "down" years at the start of any 10-year period since 1982 was three years. This occurred in the period starting 1991. (See Figure 2).

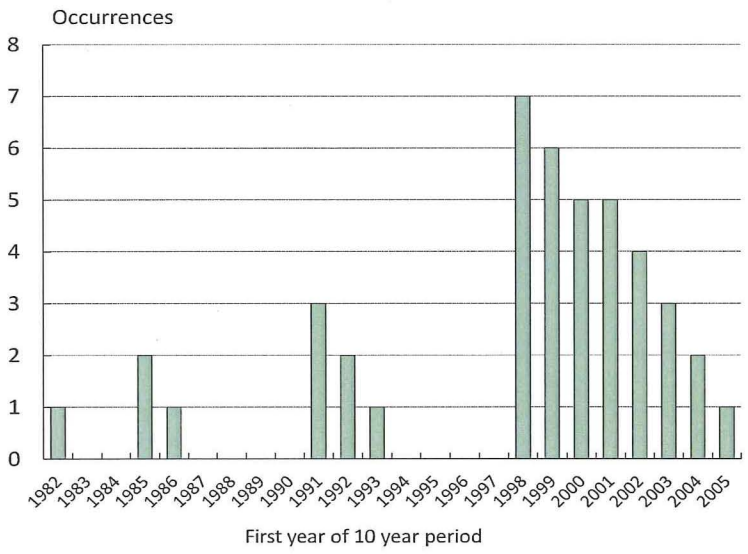

Figure 2. Number of successive "down" years at the beginning of specified 10 year period

[13] Boyles testimony, page 15.

Note: A "down" year is defined as any year in which the average aluminium price for the year is below the average price for the whole 10-year period

Far from representing "average conditions", the projections used by Noranda Aluminum imply an unusually prolonged cyclical downswing in projected aluminium prices in all three scenarios tested (A1, A2 and A3). For the approach to have any validity, more diverse patterns of cyclical behaviour, drawn from a wider range of past experience, would need to be employed.[14] However, the reality is that we really don't – and can't – know where we are in the price cycle at any particular moment. Noranda Aluminum, by choosing the past periods which it has to serve as models for its future price projections, is implicitly making a rather strong statement about where it claims we currently stand in the price cycle and the direction in which it claims aluminium prices are headed. Put another way, the historic periods chosen by Noranda Aluminum, and the assumption that we are now at the very beginning of a period that would repeat the conditions that were seen in those historic periods, reflect what can fairly be described as a worst-case scenario, appropriate to a sensitivity analysis, not a central case or reasonable expected case.

Q. DO YOU HAVE OTHER CONCERNS ABOUT THE HISTORIC "MODEL" PERIODS CHOSEN BY NORANDA TO DRIVE THEIR PRICE PROJECTIONS?

[14] If any one 10-year period qualifies, there may be a case for arguing that the period selected as the "model" for the future cycle should be the period ending 2014, since this will be the 10-year period which most closely approximates the conditions of the present day. This point is given additional emphasis by recent changes in the world economy, notably the effects of globalisation and the emergence of China as a major economic and industrial power, which make conditions over the past few years considerably different from those which prevailed in the earlier years covered by the historical data set. While for the reasons discussed in my testimony I do not believe any 10-year period qualifies as such a "model," if one were to pick the most recent 10-year period the picture would be much different than that painted by the periods chosen by Mr. Boyles, as shown on Schedule DH-R2 to my testimony.

A. I do. Noranda Aluminum employs a 10-year cycle for its price projections on the grounds that aluminium prices follow the general business cycle which is "commonly accepted to be approximately 10 years in length."[15] There is vast literature on cycles in economics and it is true that historically the so-called investment cycle, or Juglar cycle, was deemed to be 7-11 years in length. However, in recent years, globalisation has enormously complicated the form and nature of economic cycles. Recent price behaviours have been highly erratic as the analysis by CRU makes clear, a condition it puts down in part to a series of wholly unanticipated "shocks." The adoption of a 10-year cycle thus implies a degree of mechanical predictability which is not warranted. The figure on page 9 of the CRU testimony shows price peaks since 1973 occurring in 1974, 1980, 1983, 1988, 1995, 2006/08 and 2011. This implies peak-to-peak cycles of 6, 3, 5, 7, 9 and 3 years respectively. In short, the reality is that we have very little idea how long any forthcoming price cycle is likely to be, nor do we have any real idea about where we might be in a given cycle, whatever the length the cycle may turn out to be.

Q. IS IT YOUR VIEW THAT NORANDA HAS ASSUMED THAT IT KNOWS WHERE IT IS IN THE CYCLE AND THE LENGTH OF THE CYCLE?

A. I believe it has. As explained, the modelling in the Boyles testimony makes a clear assumption that aluminium is at the beginning of a sustained period of price weakness. I consider such an assumption to be unwarranted. We can never know for sure where we are in the cycle or how long the cycle will persist. The assumption of the Boyles testimony also appears to be at odds with what Noranda Aluminum has said previously on this matter. In evidence given before the Commission in an earlier

[15] Boyles testimony, page 15.

hearing, the CEO of Noranda Aluminum was asked where in the cycle aluminium currently was. He said "it's really hard to know."[16] It is. I agree with him.

Q. WHAT ARE THE IMPLICATIONS OF THE ABOVE FOR ESTABLISHING A REALISTIC EXPECTED CASE FORECAST OF ALUMINIUM PRICES?

A. CRU observes that "[w]hile we may know that the future is likely to be more volatile than is forecast, we cannot accurately predict the timing, *and to do so could be very misleading*" (my italics).[17] Detailed analysis of consumption, production and stock movements for aluminium provides some visibility on the likely direction of the market and of prices in the near term. CRU has produced a price forecast reflecting these near term cyclical factors. Mr. Pratt's testimony claims no more than that "it is unlikely that the aluminium market will experience tight market conditions in the next two years."[18] Beyond this time period, we have precious little information available to us to guide a judgment on what will occur. In this setting, I agree with the approach to price forecasting described by Mr. Pratt in his expert testimony.

Q. HOW DO OTHER MINING AND METALS COMPANIES, INCLUDING OTHER COMPANIES PRODUCING ALUMINIUM LIKE RIO TINTO, NORMALLY APPOACH THESE MATTERS?

A. Obviously I can only speak from the perspective of those companies I have worked for or consulted for. But generally I would say that companies make their price forecasts for two to three years out using fundamental analysis of supply and demand.

[16] Hearing Transcript, Testimony of Layle (Kip) Smith, p.304, l. 14 to p. 305, l. 7 (Case No. EC-2014-0224).
[17] Pratt testimony, page 11.
[18] Pratt testimony, page 11

They may do this themselves or else employ consultants like CRU to advise them. Some may opt to use a consensus of several market forecasts rather than just one forecast. Other companies may elect to make use of forward market price quotations as the basis for their price forecasts for the next year or two.

Out beyond this two to three year period, I would say that the most common practice would be to use broader price averages without any imposed cycle, and to deal with price risk through sensitivity analysis. Most economists, I think, would subscribe to the view – as Mr. Pratt does in his testimony, noted above – that prices have a tendency to revert to trend (or to the mean) over time. Of course, there is scope to debate exactly what the trend actually is and how it is calculated. The analysis of historical prices will likely play a part in the assessment, as will the analysis of contemporary industry costs. However, the important point is that companies adopt this approach because they have no idea of the timing of future cycles or when prices will revert to trend. They recognise that there is simply no rational basis for forecasting price cycles out beyond three years or so and that they could not therefore have any confidence in the outcomes of such forecasting. Put bluntly, anticipating cyclical patterns beyond this period is no more than guesswork.

Q. FOR PURPOSES OF MODELING PROBABILISTICALLY EXPECTED ALUMINIUM PRICES, IS THERE ANY RATIONALE FOR DEVIATING FROM CRU'S FORECAST METHODOLOGY: FUNDAMENTAL SUPPLY AND DEMAND ANALYSIS IN THE NEAR TERM AND MARGINAL COSTS OF PRODUCTION IN THE LONG TERM?

A. No. I do not believe so.

Q. FOR PURPOSES OF ASSESSING POTENTIAL CONTINGENT EVENTS, INCLUDING PRICING DOWNSIDES, ARE THERE NOT TECHNIQUES FOR EVALUATING THE LIKELIHOOD OF DIFFERENT CYCLICAL PATTERNS OCCURRING IN THE FUTURE?

A. There are. Using the history of prices and their volatility, it is possible to estimate the statistical probability of a price in any particular year – or particular series of years – falling within a given price range. It is also possible to run multiple simulations of possible price outcomes using statistical techniques such as the Monte Carlo method. These techniques are not bound by static assumptions such as a 10-year price cycle. Such techniques are sometimes of assistance in testing the likelihood of divergences from a central estimate of future prices. Importantly, however, as stated above, these techniques do not address the problem of determining what the central estimate of future prices should be.

Q. WHAT IF MANAGEMENT HAS A STRONG CONVICTION THAT THE ALUMINIUM IS GOING TO GO INTO A MAJOR CYCLICAL DOWNTURN AS YOU SUGGEST IS IMPLICIT IN THE NORANDA ALUMINUM PRICE PROJECTIONS? WHAT CAN THEY DO ABOUT IT?

A. As I have said, I don't believe there is much visibility in how the market will develop more than two to three years out. However, if it is the view of Noranda Aluminum management that prices are going to trend downwards over the next few years, then there is always the possibility to hedge their price exposure using forward sales or options to lock in future sales prices.

It would appear from their published financial statements that Noranda Aluminum already uses hedging routinely to protect itself on its fixed price contracts from adverse price movements during the time between when the contract is struck and the metal is delivered. However, it has the possibility to go beyond this and to take a '"strategic hedge"; that is to say, to sell forward metal which has not yet been contracted for sale in order to protect itself against a fall in market prices. Noranda Aluminum's 10k report for 2013 makes clear that the company has made use of such strategic hedging in the past. Although the company says that the last of these strategic hedges were closed out in 2010, it would appear from the document supplied in response to question 2.71 (although undated) that the company is fully aware of the potential of hedging to protect downside price risk and that the matter of hedging remains under active consideration. If it is the company's genuine belief that market prices are headed down over the next few years, then the adoption of strategic hedges would be a rational way to mitigate the effects of this.[19]

Q. ARE YOU AWARE OF ANY REASON WHY NORANDA COULD NOT ENTER INTO MEDIUM TERM STRATEGIC HEDGING TRANSACTIONS IF NORANDA MANAGEMENT EXPECTED FUTURE ALUMINIUM PRICES TO BE LOWER THAN HAS BEEN FORECAST BY CRU?

A. No.

Q. HOW WOULD HEDGING HELP TO INSULATE NORANDA FROM MEDIUM TERM ALUMINIUM PRICE VOLATILITY?

[19] See Noranda's Responses to Data Requests 2.70 and 2.71.

A. Using strategic hedging, a metal producer can fix in advance the price received for its metal. The London Metal Exchange offers producers the ability to sell aluminium up to 10 years ahead. Obviously there are costs to doing this – like any other form of insurance – and there is the risk that the producer's judgment will be wrong and prices will not fall as expected. But where a company genuinely believes that prices are set to fall, or else is not commercially in a position to risk the possibility that they will fall, this is clearly an option.

Q. BASED ON YOUR EXPERIENCE, IF YOU WERE ADVISING NORANDA ALUMINUM WOULD IT BE YOUR ADVICE TO ADOPT STRATEGIC HEDGES?

A. The decision of whether to hedge or not needs to be taken in the context of a company's specific situation; its level of costs (and thus its commercial vulnerability to price declines), its loan book and the conditions attached to it, the attitude of its shareholders (some investors buy a company's shares to gain exposure to the underlying commodity and do not want that exposure hedged away), as well as its perspective on the likely direction of the market. I do not have all this information. However, in light of what appears to be Noranda Aluminum's perspective on where the market is headed, as suggested in the testimony I have seen, it would be a logical thing to consider. A gold company of which I am currently a non-executive director has been operating a hedging programme since early 2013 out of concern for the effects of the falling gold price on its operating margins and loan covenants.

Q. IN VIEW OF WHAT YOU HAVE SAID ABOUT NORANDA ALUMINUM'S APPROACH TO FORECASTING ALUMINIUM PRICES, IS IT YOUR OPINION THAT THE

ALUMINIUM PRICES RESULTING FROM THE APPLICATION OF THE APPROACH NORANDA ALUMINUM HAS USED ARE LIKELY TO PROVIDE A SOUND BASIS FOR THE EVALUATION OF FUTURE SMELTER REVENUES?

A. It is not.

Q. SO YOU DISAGREE WITH MR. PRATT'S VIEW THAT THE RANGE AND PATTERN OF ALUMINIUM PRICES REFLECTED IN [NORANDA ALUMINUM'S] ANALYSES ARE REASONABLE?

A. I do. Mr. Pratt says that "The cyclical variations are based on overlaying a ten year cyclical pattern based on historical prices over a sample of ten year time periods."[20] While this may be true, the "sample" periods selected for the analysis are, as noted, neither typical nor random ones and to that extent the approach cannot to my mind be considered "reasonable."

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. It does.

[20] Pratt testimony, page 22.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Union Electric Company d/b/a Ameren Missouri's Tariffs to Increase Its Revenues for Electric Service.	)))	Case No. ER-2014-0258

AFFIDAVIT OF DAVID HUMPHREYS

David Humphreys being first duly sworn on his oath, states:

1. My name is David Humphreys. I work in the City of London, United Kingdom, and am principal of my own consulting company, DaiEcon Advisors.

2. Attached hereto and made a part hereof for all purposes is my Rebuttal Testimony on behalf of Union Electric Company d/b/a Ameren Missouri consisting of 16 pages, and Schedules DH-R1 and DH-R2, all of which have been prepared in written form for introduction into evidence in the above-referenced docket.

3. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded are true and correct.

David Humphreys

Subscribed and sworn to before me this 15 day of January, 2015.

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A. S. Said Ahmed
Notary

My Commission Expires on Death

SCHEDULE DH-R1

HAS BEEN DEEMED

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SCHEDULE DH-R2

HAS BEEN DEEMED

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