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Witness: Steven M. Wills
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MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. ER-2012-0166

SURREBUTTAL TESTIMONY

OF

STEVEN M. WILLS

ON

BEHALF OF

UNION ELECTRIC COMPANY
d/b/a Ameren Missouri

St. Louis, Missouri
September, 2012

TABLE OF CONTENTS

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OF

STEVEN M. WILLS

CASE NO. ER-2012-0166

I. INTRODUCTION

Q. Please state your name and business address.

A. Steven M. Wills, Ameren Services Company ("Ameren Services"), One Ameren Plaza, 1901 Chouteau Avenue, St. Louis, Missouri 63103.

Q. What is your position with Ameren Services?

A. I am the Managing Supervisor of Quantitative Analytics in the Corporate Planning Department.

Q. Are you the same Steven M. Wills who filed direct and rebuttal testimony in this case?

A. Yes, I am.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your surrebuttal testimony in this proceeding?

A. To respond to the rebuttal testimony of Missouri Public Service Commission Staff ("Staff") witness Dr. Seoung Joun Won regarding the appropriate adjustments to be applied to the historical temperature readings taken at the weather station at St. Louis Lambert Airport ("Lambert Field").

Q. Do you have any overall observations regarding the positions put forward by Dr. Won in his rebuttal testimony?

A. Yes. I have two. First, I am both surprised and troubled by Dr. Won's repeated assertions that temperature adjustments relied upon by both Ameren Missouri ("Company") and Staff in over a decade of rate cases are not based on adequate, appropriate, and sound scientific analysis. Mr. Allen Dutcher, the State Climatologist of Nebraska, is one of the climatologists that developed the original adjustment values in concert with another climatologist hired by Staff. Mr. Dutcher will respond to the specific methodological concerns raised by Dr. Won. However, the claims made by Dr. Won are particularly troubling given the fact that Dr. Won himself utilized the very same adjustments in his analysis for the Company's last rate case just over a year ago, Case No. ER-2011-0028. If he has such serious reservations about the calculation of the adjustments in question, surely he would not have found it appropriate to incorporate them into his own analysis so recently.

Secondly, Dr. Won repeatedly voices his concerns with the assumptions and methodologies that he specifically attributes to me in this case. I would point out that assumptions I made in this case regarding the appropriate weather adjustments **are exactly the same** as the assumptions made by each Company and Staff witness in every Ameren Missouri rate case over the past decade. So to the extent that his criticisms are valid (which I believe they are not, as I will point out below), they are just as applicable to all of the work on this topic that has been accepted by the Commission – and recommended by Staff -- for a very long time.

Q. Dr. Won indicates in his testimony that:

> **The DMA adjustments are not appropriate because Mr. Wills is relying on analysis performed approximately 13 years ago, and they are not adequate because DMA is a subjective methodology that can easily introduce bias. (Won rebuttal, p. 2, l. 19-21).**

How do you respond?

A. Mr. Dutcher clearly explains in his rebuttal testimony the objective criteria he uses in calculating the adjustments in order to refute Dr. Won's assertion of subjectivity in the methodology. The concern over the age of the analysis is simply absurd. The methodology outlined by Mr. Dutcher for performing Double Mass Analysis is very transparent, clear and robust. It doesn't become invalid simply because a few years pass by. I would point out that Staff's own weather normalization procedure is based on a manual developed by Dr. Michael Proctor in 1990,[1] more than twenty years ago. By Dr. Won's logic, it seems that the Commission also should question the appropriateness of Staff's weather calculations due to the age of their methodology. Let me be clear; I am not suggesting that the weather normalization manual written by Dr. Proctor in 1990 is invalid. But it does illustrate the irrelevance of pointing out the age of the analytic approach as a means to criticize it.

Q. In an attempt to criticize the calculation of the original temperature adjustments from Case No. EM-96-149, Dr. Won states regarding the reference temperature stations[2] used in the analysis:

[1] See n.72 on p. 97 of the Staff Cost of Service Report.
[2] A reference station is a weather station whose data is used to make comparisons with the data from the weather station that is the target of the double mass analysis study.

…even though there were no documented changes, the relationship between the two temperature data series was still inconsistent because of undocumented changes to the land use or land cover surrounding of the reference station. (Won rebuttal, p. 3, l. 5-7).

Does Dr. Won provide any evidence to support his claim?

A. He cites a source in a footnote. However, the source he cites does not have any information that is in any way pertinent to the temperature series used in Mr. Dutcher's analysis. The paper referenced only raises this issue generally as a *potential* concern with *some* methodologies for detecting and correcting biases with no specific reference to any particular weather stations. Mr. Dutcher will explain more fully how he addresses the issue of undocumented station changes so that it does not and cannot negatively impact his analysis. Dr. Won seemed to simply find a paper that identified a potential weakness in an analytical approach with some similarities to the analysis undertaken by Mr. Dutcher, and then asserted that that weakness was in fact a flaw of Mr. Dutcher's analysis with no evidence whatsoever to support the allegation.

Q. Is there evidence that the concern about undocumented station changes cited in Dr. Won's paper is not even applicable to Mr. Dutcher's methodology?

A. Yes. Mr. Dutcher will also respond to this point, but it bears repeating in my testimony as it is a serious flaw in Dr. Won's criticism of the Company's adjustment. The paper by Menne and Williams that Dr. Won draws his argument from states specifically in the very first sentence of the abstract that it discusses a method for developing an **automated algorithm** for calculating adjustments. This means that the process developed by the National Oceanic and Atmospheric Association ("NOAA") is a computer program that has data dumped into it, which spits out results that are considered

properly adjusted with no direct review of the calculations by any human. This is in stark contrast to the many man hours of direct inspection by a trained climatologist that were spent to come up with the calculation of the Company's (and Staff's in prior cases) adjustment. It makes perfect sense that the computer program would have an easier time dealing with documented station changes, where the date of the change event can be input into the program, than undocumented events. Mr. Dutcher, however, can identify undocumented changes due to his expertise and the time he invests in the process. Dr. Won seems to believe that NOAA's process is a superior process. However, he ignores the very real and significant constraint that NOAA is faced with. That is the fact that, because of the huge number of stations that NOAA must run this process on, they simply don't have the resources for manual inspection of the data. Given that constraint, NOAA's process makes sense. However, we are fortunate to have the option of choosing an adjustment that was calculated without the necessity of relying solely on a computer algorithm. This fact, coupled with the other evidence Mr. Dutcher has provided on the strengths of his approach and his concerns with NOAA's approach, are compelling reasons to adopt the Company's proposed adjustments.

Q. Dr. Won points out that the Company was unable to provide electronic copies of the analysis from Case No. EM-96-149. Should this be a concern when it comes to using the analysis from that case?

A. No. In fact, the Company did provide the data requested by Dr. Won. The only thing the Company was unable to do is provide it in the format Dr. Won would have liked. The data request cited by Dr. Won, in which the Company is quoted as saying the requested data is not available, was a follow-up data request asking for the

same data that had already been provided in hard copy graphical format in a response to a previous data request. It is not surprising that a particular electronic file might be difficult to locate after many years. The hard copies of the analysis provided in response to the original data request should be sufficient to demonstrate the basis of the calculation. Also, it is clear that Staff fully participated in and vetted the adjustments at the time of the original analysis, especially given the fact that the climatologist hired by Staff participated in and concurred with the analysis. This fact alone suggests that Staff should have had its own access to whatever electronic files existed. As stated earlier, Staff has consistently used this adjustment in over a decade of rate cases. Presumably this would not have been the case if Staff had not been sufficiently comfortable that the original calculation was valid. Producing an electronic version of a 13-year-old spreadsheet versus a hard copy of the same analysis should not be a pre-condition for continued reliance on the collaborative work that resulted in the adjustments that have been deemed to be just and reasonable for more than a decade.

Q. Dr. Won attempted to replicate the analysis that resulted in the original adjustments. Should this effort be a basis for now re-writing weather history at Lambert Field from what has been used in the last several rate cases?

A. No. Mr. Dutcher will outline specific concerns with Dr. Won's analysis in his surrebuttal testimony. Mr. Dutcher also provided his own re-analysis of the 1996 event in rebuttal testimony using the Staff's data. However, it should be pointed out that there was nothing precluding Staff from re-doing the Double Mass analysis at any time in the past decade. The change in the Lambert Field readings in question occurred in 1996, and the raw temperature data has been unaltered for all of these years. In addition,

NOAA has had its own analysis available for nearly a decade. Nothing has changed in this case that would cause a need for a re-analysis of the 1996 weather adjustment. Again, it is troubling that Dr. Won raises all of these concerns in this case when Staff, including Dr. Won himself for part of the time, used the Case No. EM-96-149 adjustment for over a decade without questioning it.

Q. Are there any other observations that you would make regarding Dr. Won's attempt to recreate the Double Mass analysis?

A. Yes. It is clear that despite the shortcomings in Dr. Won's analysis pointed out by Mr. Dutcher, the concept of Double Mass analysis is transparent enough that he was able to put together a reasonable attempt at replicating the analysis from Case No. EM-96-149 on his own. The same cannot be said of NOAA's calculations. In a data request response in which the Company requested copies of correspondence between NOAA and Staff, there was an exchange in which Dr. Won expressed to NOAA his need to replicate their analysis for purposes of this case. In an email sent to NCDC on January 5, 2012, Dr. Won states:

> To justify using your serially-complete monthly temperature, we respectfully ask the detail information of the comprehensive procedure of your homogenization with a full data set including temperature data of reference weather stations of St. Louis Lambert International Airport (Station Number: 72434). The information will be used for replicating your serially-complete monthly temperature and for producing the MPSC staff testimony.

Dr. Won renewed his request on January 12, 2012, in an email to the same NCDC personnel:

> For our analysis of normal utility usage in the area, we need to be able to replicate the 30-year-normals from the observations. We have found papers with verbal descriptions of the process used by NOAA in computing the new 30-year-normals but not the exact mathematical

formulas for making the calculations. Previously, NOAA always published its methodologies for calculating and making adjustments to the 30-year normals time series.

Despite the urgency of his requests, Dr. Won was not able to determine the exact mathematical formulas used by NCDC. In fact, during his deposition, Dr. Won acknowledged that he was unable to replicate NOAA's analysis, and in fact stated that it was impossible for him to do so.

> Q. Okay. Did you attempt to duplicate NOAA's analysis where they took the 40 stations and did the correlation?
>
> A. The first time, I attempt. And after communication with NCDC climatologists, we understand it is impossible.[3]

Clearly there is a lack of transparency into NOAA's methodology when it was literally impossible for Dr. Won, someone with a doctoral degree in mathematics, to replicate. Double Mass analysis is a far more transparent and understandable process.

Q. Dr. Won points out in his rebuttal testimony that, in response to his data request, you provided methodology documentation that included analysis of six weather stations, but you only used two stations. He criticizes the choice of two stations you used and indicates there is no justification for using them. How do you respond?

A. Hopefully at this point it is crystal clear that I did not do my own analysis of the weather stations, but used the *exact same adjustment values that have been used by both the Company and Staff for over a decade*. The reason that there were six stations in the methodology document is that the Company's original analysis in Case No. EM-96-149 was based on the use of six stations. The final adjustment agreed to in that

[3] Won deposition, August 6, 2012, p. 55, l. 5-10.

case (and every case since) by both Staff and the Company relied on the two stations Dr. Won mentions. That is the analysis that I used for this case as well. Dr. Won's search for justification of the stations used in my analysis needs to go no further than to look at the large amount of evidence compiled over time by both parties in numerous Company rate cases. It is his adjustments that in fact remain unjustified and unexplained.

Q. Dr. Won criticizes your work because it did not include consideration of a 2002 elevation change at Lambert Field. Please respond.

A. The 2002 change occurred after the Case No. EM-96-149 agreement and therefore had not been considered by either party until this case. Upon hearing of this change, the Company asked Mr. Dutcher to perform an analysis of Lambert Field temperature readings from that time period. My rebuttal testimony recommends adoption of Mr. Dutcher's analysis of the 2002 change and, therefore, Dr. Won's concern regarding the 2002 change should be alleviated. It should be noted that in his rebuttal testimony Mr. Dutcher reported preliminary results for the 2002 change due to time constraints in developing the full analysis. In his surrebuttal testimony he gives his final recommended adjustment for 2002, and I similarly recommend adoption of this final calculation. Weather normalized sales based upon the calculation are attached as Schedule SMW-ES9.

Q. Dr. Won suggests that use of NOAA's normals will help ensure consistency across utilities that the Missouri Public Service Commission regulates. What is your response to this contention?

A. The desire for *consistency* should not trump the desire for *accuracy*. The Commission should first seek to "get it right." Using the adjustments from the Case No.

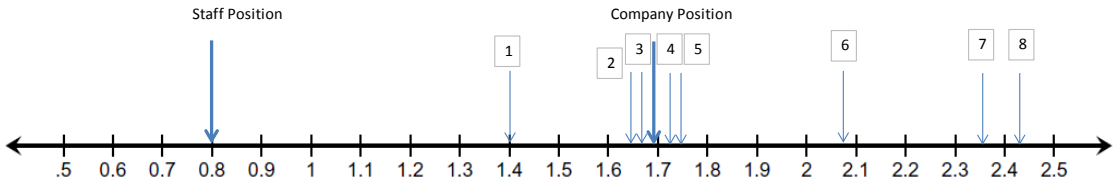
EM-96-149 agreement would in fact promote both accuracy and consistency across time in Ameren Missouri's rate cases, as they have been used for over a decade of rate cases. An appropriate Commission standard would be to consistently use the best available weather data. In some cases, where a robust analysis of the specific station in question is not available, using NOAA's numbers may be a reasonable approach. In a case such as this where a demonstrably superior analysis is available, the Commission should use that analysis.

Q. Dr. Won presents Schedule SJW-R1 at the end of his testimony, which summarizes the results of all of his Double Mass analyses, along with the analysis from the Case No. EM-96-149 agreement. What conclusions can you draw from this schedule?

A. I would start by pointing out that, for the reasons highlighted by Mr. Dutcher throughout his testimony in this case, Mr. Dutcher's analysis is the most appropriate to determine the most accurate temperature adjustments. However, considering all of the work that went into this analysis by both parties, there is one very clear conclusion - the adjustment Staff is proposing to use for the 1996 Lambert Field change is a clear outlier. See Figure 1 below to see a graphical representation of the various Double Mass analyses presented in this case by Staff (including the original double mass analysis from Case No. EM-96-149). It is clear from this graphic that the Company's position is squarely in the middle of the various estimates of the impact of the Lambert Field ASOS temperature sensor change that have been calculated by the parties. Staff's position is that the adjustment should be a full 0.6 degrees less than the lowest

estimate presented in this case based on any analysis in this docket that has been fully replicated and clearly explained (i.e. double mass analysis).

Figure 1: Staff and Company Analysis of Magnitude of 1996 Lambert Field ASOS Temperature Sensor Change



1	1.4	Staff Double Mass - Science Center 4 Year Analysis
2	1.65	EM-96-149 Double Mass - Science Center 4 Year Analysis
3	1.67	Staff Double Mass - St. Charles 4 Year Analysis
4	1.73	EM-96-149 Double Mass - St. Charles 4 Year Analysis
5	1.74	Staff Double Mass - St. Charles 6 Month Analysis
6	2.08	Staff Double Mass - St. Charles 7 SSW 6 Month Analysis
7	2.36	Staff Double Mass - Science Center 6 Month Analysis
8	2.43	Staff Double Mass - St. Charles 7 SSW 4 Year Analysis
Average	1.88	
Company Position	1.69	
Staff Position	0.8	

Although Dr. Won has presented concerns regarding Double Mass analysis relating to the potential for impacts on the analysis from undocumented station changes and the time period selected for the analysis, those concerns should be fully addressed by the range of estimates in Figure 1, which are based on comparisons with three different reference stations and two different time periods of analysis. If any one of the stations has an undocumented change, then the other two stations can still provide reliable estimates of the change. And for each station, Staff ran the analysis on a six month and four year window so that any biases due to time period selection will not impact both sets of analyses. At the end of the day, NOAA's adjustment is fully 0.6 degrees below the lowest adjustment suggested by the various combinations of stations and analysis periods. While Mr. Dutcher's expert opinion should be given the greatest weight in determining

the appropriate analysis to rely on, the range established by the various iterations of Staff's analysis supports the reasonableness of the adjustment adopted by the Company.

This graphic also serves to clearly illustrate just how far removed the NOAA analysis is from that reasonable range. It is interesting to note that NOAA's adjustment is very close to the Company's for minimum temperature and would fit squarely within the range established by Double Mass analysis. However, NOAA includes no adjustment for maximum temperature. The lack of adjustment to the maximum temperature (which is illogical) likely causes NOAA's calculation to be a significant outlier when compared to a range of estimates from double mass analysis.

Q. Is there any evidence from outside the regulated utility world that you can provide to demonstrate the accuracy of Mr. Dutcher's methodology relative to NOAA's?

A. Yes. The methodology used by Mr. Dutcher is advocated in a book used in the financial industry for valuing weather derivatives. Weather derivatives, as the name implies, are financial instruments that derive their value from underlying weather events. Valuation of these instruments relies on analysis of historical weather data. The book "Weather Derivative Valuation: The Meteorological, Statistical, Financial, and Mathematical Foundations"[4] discusses the issue of adjusting historical temperature data used in this valuation for station changes. The issue is exactly the same as what we are faced with in a rate case. Future outcomes with financial ramifications for multiple parties are based on analysis using historical weather data. That data must be adjusted so that it appropriately represents the weather conditions that will be experienced when the

[4] Weather Derivative Valuation: The Meteorological, Statistical, Finanical, and Mathematical Foundations, Jewson, Brix, and Ziehman, 2005, Cambridge University Press.

contract is settled. The parties to these contracts are sophisticated financial institutions that have a powerful financial incentive to make sure that these adjustments are as accurate as possible. The book describes the appropriate methodology to use in making such adjustments as follows:

> The testing and estimation procedures used for estimating the size of jumps are usually based on an analysis of the linear dependences between the target station and surrounding stations. Data from the surrounding stations can then be used to replicate the target station using regression, and a difference time series produced by subtracting the replica time series from the actual. Any jumps in the original time series show up clearly in this difference time series, and can be identified visually or using statistical tests.[5]

This description is remarkably similar to the methodology used by Mr. Dutcher. Notably, the text never suggests checking with NOAA to see if they have adjusted the data for discontinuities (or "jumps" as the text describes them). The reliance on this methodology by sophisticated financial institutions that have significant resources devoted to protecting their investments by accurately valuing them is another strong indicator that this methodology is credible and robust.

Q. Can you please summarize the Company's position on the appropriate adjustment that the Commission should adopt for historical Lambert Field temperatures in this case?

A. Yes. The Commission should adopt the adjustments to the Lambert Field temperatures in 1988, 1996, and 2002 sponsored by the Company in this case. There are at least four key reasons for this:

1. The adjustments proposed by the Company are consistent with adjustments recommended by the Company, Staff, and adopted by the Commission to set

[5] Id., p.41.

Ameren Missouri's rates for over a decade. Nothing has changed over that time that would render the temperature data relied upon for this entire time as suddenly unreliable.

2. NOAA clearly developed its methodology constrained by the need to automate this calculation for thousands of weather stations, which compromised the accuracy of the adjustments for the Lambert Field station. That constraint was not present for the Company's analysis, and the full attention of an experienced climatologist renders this analysis superior.

3. NOAA's adjustment has the illogical and highly improbable result of identifying a change in minimum temperature for three separate station changes, but no change in maximum temperature. Given the physical changes in equipment and location of the station, this just isn't realistic. The Company's analysis shows reasonable adjustments for both minimum and maximum temperatures for all three events.

4. Staff's own Double Mass analysis clearly demonstrates that their own position (using NOAA's 1996 adjustment) is outside of a reasonable range based on analysis against various reference stations and over various periods of time.

Based on the large amount of evidence supporting the Company's calculations, there is absolutely no compelling reason to change from the long-standing practice for adjusting Lambert Field temperatures that have been used in Ameren Missouri rate cases for years.

Q. Does this conclude your surrebuttal testimony?

A. Yes, it does.

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-2012-0166

AFFIDAVIT OF STEVEN M. WILLS

STATE OF MISSOURI)
) **ss**
CITY OF ST. LOUIS)

Steven M. Wills, being first duly sworn on his oath, states:

1. My name is Steven M. Wills. I work in the City of St. Louis, Missouri, and I am employed by Ameren Services Company as a Managing Supervisor of the Quantitative Analytics group.

2. Attached hereto and made a part hereof for all purposes is my surrebuttal testimony on behalf of Union Electric Company d/b/a Ameren Missouri consisting of 15 pages, and Schedule(s) SMW-ES9, 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.

Steven M. Wills

Subscribed and sworn to before me this 7th day of September, 2012.

Julie Donohue
Notary Public

My commission expires:

Julie Donohue - Notary Public
Notary Seal, State of
Missouri - St. Louis City
Commission #09753418
My Commission Expires 2/17/2013

Ameren Missouri - Residential Test Year Sales (kWh) - Revenue Month			
Month	Actual	Normal	Ratio
2	1,433,678,742	1,404,933,014	98.0%
3	1,095,005,472	1,118,038,066	102.1%
4	908,611,572	935,026,499	102.9%
5	798,778,804	792,435,343	99.2%
6	1,121,930,188	997,145,467	88.9%
7	1,443,119,939	1,243,148,347	86.1%
8	1,650,096,035	1,417,192,620	85.9%
9	1,262,058,762	1,148,551,169	91.0%
10	746,942,356	779,363,740	104.3%
11	798,752,905	837,322,810	104.8%
12	1,132,554,290	1,260,027,270	111.3%
1	1,362,948,524	1,532,295,072	112.4%
Total	13,754,477,589	13,465,479,417	97.9%

Ameren Missouri - Small General Service Test Year Sales (kWh) - Revenue Month			
Month	Actual	Normal	Ratio
2	322,070,100	317,660,632	98.6%
3	276,605,259	279,387,061	101.0%
4	254,519,563	258,531,905	101.6%
5	248,352,183	247,965,646	99.8%
6	294,263,195	280,546,543	95.3%
7	339,720,267	315,689,801	92.9%
8	367,179,686	337,341,340	91.9%
9	321,045,214	306,661,466	95.5%
10	249,520,215	253,761,300	101.7%
11	245,614,791	248,122,592	101.0%
12	280,975,109	297,930,059	106.0%
1	314,959,856	339,603,750	107.8%
Total	3,514,825,438	3,483,202,095	99.1%

Ameren Missouri - Large General Service Test Year Sales (kWh) - Revenue Month			
Month	Actual	Normal	Ratio
2	669,510,963	662,301,512	98.9%
3	620,435,085	625,646,813	100.8%
4	608,734,172	611,197,825	100.4%
5	628,768,136	625,960,410	99.6%
6	713,769,140	691,380,552	96.9%
7	773,570,461	731,387,108	94.5%
8	829,566,664	779,622,663	94.0%
9	765,754,461	740,894,895	96.8%
10	636,212,028	643,689,791	101.2%
11	611,906,142	613,283,994	100.2%
12	643,026,618	668,464,154	104.0%
1	683,361,872	728,363,368	106.6%
Total	8,184,615,742	8,122,193,085	99.2%

Ameren Missouri - Small Primary Service Test Year Sales (kWh) - Revenue Month			
Month	Actual	Normal	Ratio
2	297,825,183	297,749,560	100.0%
3	275,780,910	275,611,403	99.9%
4	273,433,501	272,615,620	99.7%
5	304,245,771	302,653,575	99.5%
6	320,453,711	314,662,927	98.2%
7	336,386,565	324,587,492	96.5%
8	353,230,426	337,678,378	95.6%
9	355,784,727	347,915,401	97.8%
10	298,968,027	300,115,618	100.4%
11	277,237,740	275,584,717	99.4%
12	288,224,875	288,706,540	100.2%
1	304,961,923	308,684,057	101.2%
Total	3,686,533,359	3,646,565,288	98.9%

Ameren Missouri - Large Primary Service Test Year Sales (kWh) - Revenue Month			
Month	Actual	Normal	Ratio
2	275,721,397	276,466,766	100.3%
3	270,852,633	269,782,255	99.6%
4	321,365,937	319,782,899	99.5%
5	298,464,920	296,131,342	99.2%
6	339,330,297	336,189,489	99.1%
7	347,904,912	340,793,873	98.0%
8	352,165,433	341,983,665	97.1%
9	376,752,043	371,056,703	98.5%
10	327,247,832	329,143,330	100.6%
11	307,257,946	305,460,042	99.4%
12	309,530,619	307,913,792	99.5%
1	297,321,806	296,985,299	99.9%
Total	3,823,915,775	3,791,689,456	99.2%